9th Balkan Region Conference on Engineering and Business Education (BRCEBE)
&
12th International Conference on Engineering and Business Education (ICEBE)

"Unique opportunity to share, learn and network"

16 - 19 October 2019

Lucian Blaga University of Sibiu, România

CONFERENCE PROCEEDINGS

Editors:
Claudiu Vasile KIFOR
Norbert GRÜNWALD
Lucian LOBONŢ

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FOREWORD

It gives us great pleasure to welcome you to 9th Balkan Region Conference on Engineering and Business Education (BRCEBE) and 12th International Conference on Engineering and Business Education (ICEBE).
This year BRCEBE & ICEBE is being held as a joint conference in beautiful Sibiu, Romania, from 16th –19th October 2019 and brings together a wide range of engineering, technology and business education stakeholders from around the globe to explore the building of new capacities that are essential in creating environmentally and socially sustainable 21st century economies. This joint conference aims to identify and explore the latest trends and developments that will shape the future worlds of engineering and business education. Situated in the heart of Transylvania, at the foothills of the Carpathians, Sibiu is one of the most important cultural centres of Romania and one of the most beautiful medieval towns in Transylvania.
With a theme: *Unique opportunity to share, learn and network*, Conference's mission is to disseminate recent research findings and development outcomes in engineering and business education as well as capacity building, with a focus on interdisciplinary and cross-cultural collaboration. This conference offers a unique opportunity for academics, practitioners and students from around the globe to share their knowledge, concerns and perspectives on educational environment and mindset, suitable for the development of innovative tech-products, tech-apps, business-processes, business-models and personal development with a global and local impact.

The coverage of this special issue includes, but is not limited to, the following subjects:

- Entrepreneurship education and research
- Innovative new methods for engineering and business education
- Cooperation between academia and business
- Knowledge management in engineering and business education
- Sustainability in engineering and business education
- New curricula development
- Quality management in engineering and business education
- Lifelong learning
- Dual study program
- Multimedia in engineering and business education
- Social and philosophical aspects of engineering and business education
- Management of engineering and business institutions
- HCI (Human Computer Interaction) applications for educational purposes
- The heritage and the development of national culture under economic globalization
- National culture innovation and education development

It is anticipated that the conference will enhance the links and the networks that have already been created during previous meetings, and will set the stage for more innovative and collaborative undertakings.

Claudiu Vasile Kifor and Norbert Gruenwald

General chairs of the conference

CONTENTS

NEW CURRICULA DEVELOPMENT

The Relevance of the Master's in Engineering Education at a University of Technology in South Africa

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ABSTRACT

The purpose of this theoretical paper is to explain the relevance of the Master of Engineering Education (M Eng. in Education) at one university of technology in South Africa, that comprises four distinct faculties. The paper is based on relevant literature review. The M Eng in Education creates the nexus between Engineering Sciences and Education as specific fields of study and research to enhance cross-boundary knowledge, skills, pedagogy and application. This is in line with the South African National Development Plan, Vision 2030, that accentuates the need for Science, Technology, Engineering and Mathematics (STEM) education in the country to address the economy, develop skills, create jobs, eradicate poverty and unemployment towards a capable developmental state. Using a social constructivist lens, the researchers draw from their experiences while working with Engineering lecturers who enrolled for the Postgraduate Diploma in Higher Education (PGDHE) programme, offered within the institution. From the interaction with the Engineers through the PGDHE programme, the researchers found that the teaching and research skills of these engineers fundamentally improved because they had to submit long essay-type assessments. The researchers conclude that the M Eng in Education will enable engineers to teach better and improve student learning within their classrooms.

Keywords: *Master's in engineering education, social constructivism, pedagogical content knowledge, student learning*

INTRODUCTION

Jesiek, Newswander and Borrego (2009:39) suggest that an impressive expansion of engineering education research has been underway since the early 2000s. The authors indicate that at the inaugural 2007 International Conference on Research in Engineering Education (ICREE), the first plenary talk was intended to present a picture of the emerging discipline, and probe questions such as: "is engineering education a recognised discipline?" and "what are the indicators with which a community recognises an established discipline?" These questions as well as changes in thinking about higher education offerings, the imperatives of the Fourth Industrial Revolution, disruptive technology, globalisation, internationalisation and the knowledge society, have prompted the development of the Master of Engineering Education (M Eng. in Education) at our university.

Although the development of M Eng Education in the faculty of engineering within the university is new, programmes of this nature have been offered at various universities nationally, regionally and internationally. With emphasis on the significance of inter, intra, multi and trans-disciplinary curriculum programmes that integrate student-centered learning with a curriculum orientated to the pressing challenges of revolutionary and disruptive technologies (New MIT School of Engineering, 2018:1), the interface of engineering and education as a field of study can never be overemphasised. Thursby (2014:2) for example, argues that US universities face a major challenge: the need to design curricula to attract and prepare students for the current and future workplace, where the need for multidisciplinary skills is increasingly the norm.

The University College London (2019:1), for example, suggests that “engineers will address the complex societal challenges of the 21st century by building a new generation of machines, materials and systems; and to achieve this vision three important issues: (i) engineering educational leadership, student centered learning, and capacity to deliver student-centered curricula, are crucial. Thursby (2014:2) suggests that the employment pattern in the USA shows that engineers contribute well beyond their technical skills and engineering holds great potential for continued US innovation in the future. However, to realise this potential, it will be necessary for US universities to extend the “integrative” expertise of engineers into areas well beyond the technical core (p.4). Palmer, Tolson, Young and Campbell (2015:103) assert that internationally the importance of science, technology, engineering and mathematics (STEM) for innovation and competition drives concerns about the adequacy of national STEM workforces. It has, for example, been observed that in the USA and UK there are now more STEM graduates than there are STEM jobs available. Yet those and other countries report perceived shortages of STEM-skilled graduates.

South Africa's socio-economic development is affected by what happens in the region and the world. Consequently, success in engineering education will depend on the country's understanding and response to five notable trends: global economic shifts, technology, globalisation, climate change and African economic growth (National Development Plan Vision 2030, 2011:19). To respond to these shifts and demands, the M Eng Education is developed in such a way that the graduate attributes and exit level outcomes include: (i) the ability to integrate multiple sources of knowledge in STEM education; (ii) evaluate current processes of knowledge production and to choose an appropriate process of enquiry for engineering education; and (iii) understand the consequences of solutions or insights generated within the specialised context of engineering education. This professional engineering approach, according to Fasano (2011:2), will address the present unmet professional education needs of the engineering industry.

CONTEXT

The Higher Education and Training sector in South Africa is intended to perform the following three functions as outlined in the National Development Plan, Vision 2030 (2011): (i) educate and equip people with high-level skills to meet the employment needs of the public and private sectors; (ii) produce new knowledge and find new applications for existing knowledge; and (iii) provide opportunities for social mobility while strengthening equity, social justice and democracy to deal with the injustices brought about by the apartheid (segregationist) system of the past regime. Presently, the sector consists of 26 universities, differentiated into eleven general academic universities; nine comprehensive universities and six universities of technology (Statistics on Post-School Education and Training in South Africa, 2016:14). Our university is one of the six universities of technology. The engineering faculty enrolls 60% of the student cohort within the university. This faculty operates in a context that is surrounded by various and diverse industries: three Technical Education Vocational and Training (TVET) colleges and four technical schools. A structured Master of Engineering Education degree (M Eng Education), in our schema will benefit trained engineers, enhance their professionalisation, and expose them to the social constructivist approach to teaching and learning which holds that knowledge is co-created by facilitators and students through social interaction.

THE CONFIGURATION OF THE M ENG EDUCATION

The M Eng Education is pitched at National Qualification Framework (NQF) Level 9, with 180 credits. Five main areas of the curriculum are: (i) artificial intelligence; (ii) informatics; (iii) education technology; (iv) education management and leadership; and (v) the research project. Content delivery covers 20% for lectures (face to face, consultations, supervisory support, simulations, presentations, feedback, limited interaction or technologically mediated); 40% is allocated to independent self-study of standard texts and references (study guides, books, journal articles); and 40% is allocated for independent self-study of specially prepared materials (case studies, multi-media, etc.).
The exit level outcomes are:

- The ability to apply specialist knowledge to enable engagement with and critique current research or practices; and an advanced scholarship or research in a discipline of engineering education and leadership, understanding of the theories, research methodologies, methods and techniques relevant to STEM education.
- The ability to design, select and apply appropriate and creative methods, techniques, processes or technologies to complex practical and theoretical problems related to engineering education.
- The ability to utilise resources to identify, analyse, communicate and address complex problems, as well as substantial ideas that are the products of research or development into engineering education.
- The ability to determine interventions within a system, based on an understanding of hierarchical relations within the engineering education system.
- The ability to make autonomous ethical decisions which affect knowledge production.

The graduates will contribute to local and global knowledge because the qualification is aligned to the European Universities via the Personalized Engineering Education in the South African (PEESA) project. Students will also learn how to manage, analyse problems and determine different scenario outcomes and gain experience in engineering education. These skills will prepare them to contribute meaningfully as engaged citizens within the context of the South African engineering industry, nationally, regionally and internationally.

SOCIAL CONSTRUCTIVISM LEARNING IN ENGINEERING

Social constructivism is adopted as a theoretical grounding to explain the relevance of the M Eng Education at our university. For Sario (2014), social constructivism is closely associated with contemporary theories, notably developmental theories of Vygotsky and Bruner and Bandura's social cognitive theory. These education theories, according to Machanick (2007:1), explore learning beyond the cognitive domain to provide additional insights into matters such as teaching style, curriculum design and assessment practices. Kitto (2010:1) suggests that social constructivism is based on specific assumptions about reality (ontology), knowledge (epistemology) and learning. Thus, to understand and apply models of instruction that are rooted in the perspectives of social constructivism, it is important to know the premises that underlie them. For example, Sario (2014:2) contends that the social context for learning builds on historical developments inherited by the learner as a member of a specific culture. Consequently, symbols, such as language, logic, mathematical systems, are learned throughout the learner's life. It is thus crucial to know the learner, to know the curriculum and to know how learning occurs in engineering education. This knowledge enables a learner-centered approach to learning facilitation and student learning. The social constructivist approach in engineering education means a paradigm shift from *instruction* to *learning*, emphasis based on an active self-constructed acquisition of knowledge, skills and competence (Briede, 2013:584).

The study of and application of learning theories is central in the field of education. Thus, the involvement of educationists in the M Eng Education brings about the balance or inter-link between technical expertise and the soft skills. Bay, Bagceci and Cetin (2012:43) suggest that constructivism stresses the social context, culture and collaborative side of learning. Considering this, Bruner (1971) asserts that learning is an active, social process in which students construct new ideas or concepts based on current knowledge. Consequently, for Kitto (2010:1) research studies in engineering education indicate that students build scaffolds from existing cognitive structures to new information when they can make connections to their existing knowledge base. In a social constructivist classroom therefore, knowledge is co-created by both the facilitator and students because students bring into the classroom cultural capital. In this sense, social constructivism has been heralded as a technique that is suitable for promoting effective student learning.

The M Eng Education programme is a structured masters that is intended to promote the social constructivist approach to teaching, learning, assessment and research, embedded within VUT's philosophy of teaching and learning. Constructivist principles of engineering education comprise learning, students, learning facilitators, innovative learning strategies, relations, motivation, evaluation, context and learning skills that privilege the humanistic modes of interaction for sustainable development within society (Briede, 2013:584). Professional competence, student centered learning, capacity to deliver student-centered curricula, critical thinking, problem solving, and co-operative skills are pivotal towards achieving the intended learning outcomes of the M Eng Education.

LITERATURE REVIEW

A new report from New MIT (2018) puts a spotlight on worldwide trends in the changing landscape of engineering education, pinpoints the current and emerging leaders in the field, and describes some of its future directions (New MIT School of Engineering, 2018:1-2). It further identifies some key challenges facing engineering education, and in some cases higher education. These include aligning the goals of national governments and higher education, delivering student-centered learning to large student cohorts, and setting up faculty appointments and promotion systems that better reward high-quality teaching.

Mindful of the assertions above, the M Eng in Education at our university creates the interplay between engineering and education as specific fields of study and research. In our schema, the nexus enhances cross-boundary knowledge, skills transfer, capability acquisition and application. For example, the University College London, in its rationale for engineering and education MSc, found the qualification to be unique because it is designed for engineers, teachers of engineering and engineering policy makers (University College London, 2019:1). For example, in their study, Carnevale, Smith, and Melton (2011) concluded that three factors driving the US STEM graduates away from STEM occupations were identified:

(i) the core knowledge, skills and abilities associated with STEM also exist in an increasing share of highly paid and prestigious non-STEM occupations;
(ii) many potential STEM workers never work in, or leave STEM occupations because they have interests and values more compatible with other careers; and
(iii) while STEM earnings are high relative to many occupations, STEM competencies provide access to superior earnings and alternative career paths in management, professional and health care occupation (Palmer *et al.* 2015:104).

University College London (2019:1) engineering and education MSc aims to develop the skills and knowledge required to lead change, lead teams, enhance the performance of engineers in industry, improve the quality of engineering education in universities, and influence engineering education policy: whereas the M Eng Education in South Africa with an urbanising, youthful population, presents an opportunity to boost economic growth, increase employment and reduce poverty

(National Development Plan Vision 2030, 2011:20). In South Africa, the education sector is challenged to improve the school system, including increasing the number of students achieving above 50 percent in literacy and mathematics, increase learner retention rates to 90 percent and bolster teacher training; strengthen youth service programmes and introduce new, community-based programmes to offer young people life-skills training, entrepreneurship training and opportunities to participate in community development programmes. The sector is also required to strengthen and expand the number of FET colleges to increase the participation rate to 25 percent; and increase the graduation rate of FET colleges to 75 percent (National Development Plan Vision 2030, 2011:20). The M Eng Education can play a pivotal in contributing to the solution of these identified challenges.

OUR EXPERIENCES WITH ENGINEERING LECTURERS IN THE PGDHE PROGRAMME

The Education department is one of the five departments that comprise the faculty of Human Sciences within our university. This department presently offers two qualifications: the PGDHE and the Bachelor of Education (Senior Phase & Further Education and Training Teaching), abbreviated B Ed (SP & FET Teaching). The PGDHE can be completed in one-year full time and two years part time. Eight modules are offered: Transformation of the South African Higher Education; Professional Development as Researcher; Innovative Student Learning in Context; Learning Facilitation in Higher Education; Assessment in Higher Education; Module Planning and Materials Development; eLearning in Higher Education; Leadership and Management in Higher Education. The entry requirement is an undergraduate degree or a diploma with five years teaching experience at a school, college or university.

Since the implementation of the PGDHE in 2013, many of our university employees coming from diverse academic fields have enrolled and graduated from the programme. From the initial cohort of 80 students in 2013, the enrollment has grown to 220 in 2019. The assessment methods used in the programme are based on continuous assessments (CASS) with submission of a summative portfolio towards graduation. We have had numerous engineers admitted to the PGDHE programme. From their assessment tasks, we identified that they would struggle with (i) the grasp of education concepts; (ii) searching for education related articles; (iii) using the Harvard referencing technique; (iv) the construction of paragraph; (v) the logical organisation of ideas to form coherence; and (vi) the presentation of ideas in long paragraphs with citations;(vi) there is a tendency to resort to bullets in the whole assignment, for example. To ensure pedagogical access we would encourage them to contextualise their assignments within engineering. However, it was not always an easy process. During discussions in class, the engineers would indicate that they just want to identify a problem and fix it, rather than having to write, for example, a problem statement, literature review, method of research and explanation of the philosophy behind the chosen research method! Though most of the work we were doing in the programme did not make much sense to them, they gradually began to appreciate the need and value for studying in some area of education.

For instance, one of the assignments was on the discussion of the impact of transformation in South African higher education - how would you go about initiating change in your department? In another module, the assignment was on the discussion of Piaget's (1971) cognitive development theory and students were requested to show how they would apply the theory in their own classrooms to improve student learning. These kinds of assessment tasks are inherent to education fields of study and not compatible to the technical orientation of engineering. Concepts such as scaffolding, interiorisation, constructivism are not commonly used in the domain of engineering. As we progressed with classes, the engineers indicated that they, for example, have begun to assess their own students differently after being exposed to education strategies of teaching, learning and assessment.

THE NEED FOR THE M ENG EDUCATION IN THE FACULTY OF ENGINEERING

Earlier in this paper we mentioned that one of the intended learning outcomes of the M Eng Education, is the ability to conduct independent research and lifelong learning through specialised developed skills. Artificial Intelligence is one of the modules to be offered in the programme. This is in line with the Fourth Industrial Revolution, which according to Schwab (2016:1) is on the brink of a technological revolution that will fundamentally alter the way we live, work and relate to one another. The statement by Schwab points to the much-needed interplay between technology and the human element (relation) in engineering education. Schwab advocates that the Fourth Industrial Revolution is within the control of all of us if we can collaborate across geographies, sectors and disciplines to grasp the opportunities it presents. The implication is that there is wisdom in blending engineering and education in the institution. Palmer *et al.*'s (2015:103) study concludes that engineering students would be better informed about, and equipped for, the world of post-graduate work if they were exposed to the likely options for their career trajectory. Likewise, these scholars maintain that secondary school students and others considering engineering undergraduate study would be more honestly advised if they were informed about the full range of career possibilities for engineering graduates and the probability that they are just as likely to work out of engineering as in it (p. 103). There is a growing trend of many engineering graduates being absorbed in banks as project managers, insurance companies and other multidisciplinary organisations in positions such as CEOs.
Considering the above, Fasano (2011:1) suggests that many engineers believe that the “raise the bar” effort for engineering education should include significantly more professional preparation, especially in leadership, management, business, communication and public policy. This is in line with the present M Eng in Education structure, because one of the modules is on Education Leadership and Management. In this module, planning educational facilities, moral dimension and leadership, higher education personnel, planning and change in educational organisations are accentuated. Many engineering education researchers are starting to recognise some of the disadvantages of ambiguity, including a marked lack of visibility, recognition, and respect in the wider academic landscape, as well as increasing anxiety about the challenges that come with scaling up their work, building capacity, and making larger impacts. Jesiek, Newswander and Borrego (2009:41) claim that there remain many open questions about whether the engineering education's formative infrastructure provides suitable foundations for continuing to expand engineering education research as a discipline, community of practice, and/or field.
In order to cope with the changing educational environment and the latest technology, the M Eng Education programme focuses on equipping students with the necessary skills to educate others within their applicable Scientific, Technological, Engineering or Mathematical (STEM) environment within a higher education institution. Our view is solidified by MIT’s engineering faculty that had to rethink how they were approaching their own offerings on campus and the decision to launch the New Engineering Education Transformation (NEET). The MIT proposes that they are targeting MIT education at the industries of the future rather than industries of the past (MIT School of Engineering, 2018:1). The study attributes this contrast to a range of sources. For one, they believe, many political leaders outside of the US are making major investments in engineering education as an incubator for the technology-based entrepreneurial talent that will drive national economic growth (p.1). It is prudent to notice the high growth rate in China during the last 15 years which has been achieved due to their leaders having been graduates of engineering disciplines.
The M Eng Education prepares students to become educators and scientific developers within any of the STEM fields and beyond. Through benchmarking with national and international higher education institutions as well as consultation with relevant stakeholders it became clear that a research component should be included in the qualification to prepare students for further studies. According to the New MIT (2018:2), three trends are likely to define the future of engineering education. The

first is a tilting of the global axis of engineering education leadership so it is less focused on US and northern European institutions. The second is a shift toward programmes that integrate student-centered learning with a curriculum oriented to the pressing challenges of the 21st century's societal, environmental, and technological learning. The third is the emergence of a new generation of leaders with the capacity to deliver student-centered curricula at scale. In South Africa we have very many TVET colleges expected to produce the many needed technicians and technologists whose primary aim is to complement engineering designs, translating them into processes that end up producing the relevant end products needed by society. We need these M Eng Education graduates to properly train the trainers for our TVET colleges.

IMPLICATIONS FOR POLICY AND PRACTICE

The M Eng Education is imperative because the focus is growing scarce skills areas, including SET, public accountability vs institutional autonomy, expanded access, improved quality and increased diversity of provision; a stronger and more cooperative relationship between education and training institutions and the workplace. Improving research and innovation in the system includes better alignment of Department of Higher Education targets, collaborative projects, national digital library access and other initiatives (Policy Overview of the Post-School Education and Training System, 2016:1). The M Eng Education would contribute towards the realisation of these initiatives if we integrate scientific principles with practically oriented research, provide systems and processes that create ways of acquisition of new knowledge. This integration makes engineering critical to successful industrial innovation and improves the quality of education (Thursby, 2014:1).

CONCLUSION

The M Eng Education option is likely to be popular within our institution because a great number of students know intuitively that they need professional skills to be successful learning facilitators. The use of a social constructivist approach to learning facilitation would yield better pass and success rates with the engineering faculty. The concepts of leadership, communication, management, student-centered learning, constructivism, culture, social relations and team building apply to all levels of engineering, not just to those who have a management designation. We believe that the M Eng Education would create value and meaning teacher-student interactions in the spirit of co-creators of the knowledge shared in vibrant classrooms of engagement.

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Conducting a Graduate Tracer Study at a University of Technology: a Quest to Enhance the Learning Experience

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ABSTRACT

The university is a complex open system with a range of stakeholders each with a variety of (different) expectations. It is important for universities to be aware of these expectations and to ensure that they are achievable (Ulewicz 2017:93). Universities are key role players in improving employability and to enhance economic growth. They are preparing students with the knowledge and skills required for the contemporary labour market (Tran 2016, 58-59) and should respond to governments' neoliberal pressures in finding ways to address the requirements of the labour market and to apply mechanisms to safeguard their graduates from unemployment. Vaal University of Technology (VUT) in South Africa, conducted a Tracer Study to gather information on graduate's experience and to evaluate their abilities and skills as employees. This is important as knowledge of the outcomes of the educational experience forms the basis for quality enhancement.
This presentation focuses on tracer studies as mechanisms to enhance programme quality and will reflect on the methodology that VUT followed, how the results inform the development of institutional remedial action plans and lessons learnt. This study may contribute to the dearth of research available on tracer studies in the sector.

Keywords: *Tracer Studies, employability, graduateness, quality enhancement.*

INTRODUCTION

Lidice *et al* 2013 emphasise the notion of 'added value' and the importance to compare what a graduate receives at his or her 'exit' with what he or she had at the 'entrance'. VUT's quality assurance system is based on the principles of Total Quality Management and therefore 'stakeholder focused'. It is therefore important for the institution to know the needs and expectations of its internal (students and staff) and external stakeholders (employers, industry, government, and so forth)stakeholder are. According to Ulewicz (2017:93), "quality is assessed by the external environment" by means of two 'steps'. The first step is an assessment of graduates own personal experiences and skills that that they acquired while studying in relation to the requirements imposed to them by an employer or the job market. The second step is the evaluation of the employer after confronting the graduates' abilities or skills.
The purpose of the Graduate Tracer Study was to trace VUT graduates' progress after graduation from the institution. This was done to determine the employability of VUT graduates, and to

retrospectively assess graduates' satisfaction with the services and tuition offered by VUT. In so doing, the study presents a means for VUT to evaluate whether the institution is meeting its primary objective, namely, to produce top quality, employable graduates. In addition, assessing graduates' satisfaction with the services and tuition offered by the university provides a means to highlight areas where the institution is performing well, as well as areas in need of improvement. The rationale for this study was to collect information that can inform the alignment of the curricula with the needs and expectations of the "world of work". The satisfaction survey questionnaire that was used was an effective tool to measure not only the satisfaction rate of alumni with their experience as students of VUT but also what level of importance they placed on each question. This allowed for an analysis of the high priority issues as this instrument was specifically designed so that issues with high satisfaction and low importance could be identified as low priority issues, while those issues that indicated low satisfaction and high importance rates, were indicative of high priority issues and hence could inform improvement plans.

Universities in South Africa are allowed within the Higher Education Quality Sub-Framework (HEQSF 2013) to change 30% of a curriculum, provided that the changes made support the exist level outcomes of the respective accredited programme. The research emphasizes not only the importance of Work Integrated Learning to enhance students' soft skills which contributes to academic success but also the significance of continuously aligning curricula with the changing needs of the labour market. The term curricula will be used in this article to refer to all "planned learning outcomes and the desired consequences of instruction" (Popham & Baker: 48). In this article it will also refer to the students' learning experiences to attain the VUT's academic goals, which concurs with the views of Tyler (1957:79).

SKILLS SHORTAGE

Pressure is increasingly placed on the higher education sector to promote socio-economic stimulation and growth by ensuring that the national workforce is highly skilled and internationally competitive. Chetty (2012, 19) states that 'it has been widely acknowledged that higher education plays a significant role in human capital development and economic growth.'. Of concern is the world-wide trend, also evident in South Africa, that the unemployment rate is higher amongst the youth than older members of society (Levinsohn et al. 2014; Oluwajodu et al. 2015).

There is wide consensus that the unemployment problem in South Africa is 'structural', resulting from a mismatch between the types of highly (educated), skilled and semi-skilled worker force available and those needed in the labour market. This mismatch mainly came about due to the increasing demand for highly skilled workers, in ever more technology driven, skills- and capital-intensive industries in the country. As would be expected under these circumstances, post-school education presents a crucial buffer against unemployment, where the majority of people that are able to work but poorly educated with limited skills find themselves unemployable most of the unemployed are poorly educated with limited skills), (DHET, 2013). Student throughput is generally low due to the lack of basic skills including conceptual skills. That said, a worrying trend has started to emerge where the unemployment rate for graduates has seen a steady increase since 1995 (Pauw, Oosthuizen, and Van der Westhuizen 2008; Baldry 2016).

Given the prevailing skills shortage in the South African economy (DHET 2014), a factor might be that graduates are not suitably qualified for the demands of the labour market. Graduates should be prepared to enter the world of work by 'hitting the deck running' (Harvey 2000, 4). This demands university-enterprise collaboration (Tran 2016, 61) to ensure that the skills needed are not developed solely in the higher education context, which places emphasis on the accountability of stakeholders such as industry and employers. Tran (2016, 61) observes that although an institution of higher learning can be viewed as the place where employability skills are developed, the results 'of that development can only be seen in enterprises'. Enterprise learning, therefore, is imperative to ensure that graduates develop in the working place as innovative, adaptable, resilient employees with flexible enterprise skills (Tran 2016, 61). Universities of technology in South Africa offer many programmes that have a compulsory work integrated learning component, which is imperative to the development of graduates with the desired skills, knowledge and applied competencies.

GRADUATENESS

According to Chetty (2012, 9), 'the interface between higher education and the world of work includes defining and understanding employability in relation to graduateness, the argument against the notion of skills being associated with labour market requirements, and employer needs and expectations'. The concept graduateness can be viewed as attributes, which graduates of an institution of higher learning own, as employable individuals that can contribute to a knowledge-driven society. Institutions of higher learning, therefore, should prepare students to become competent to compete within a shrinking global workplace (Griesel and Parker 2009). Concerns that institutions increasingly are pressured to produce graduates that are fit for the workplace are common (Chetty, 2012, 5), but the relationship between academia and employment should not erode academic freedom. Harvey (2000, 3) warns that if the focus of institutions of higher learning is on the training of students to become more employable, it might lead to a situation where the enhancement of their minds could be disregarded. Responsiveness, rather than the lowering of teaching and learning standards, is the new reality in a rapidly ever-changing world.
It is imperative that higher education institutions ensure that they provide quality education that will produce highly skilled graduates who will be directly employable in the labour market (Awere et al. 2016, 125). This implies not only furnishing graduates with specialist academic knowledge, but also ensuring that academic programmes equip graduates with experiential knowledge, high-level skills and attitudes required by the labour market (Kruss, 2002; Coetzee 2012, 120). This demands a close partnership between the higher education sector, Industry, professional bodies and stakeholders (Tran 2016, 65). While institutions claim that they prepare students with multiple of skills combined with discipline specific content knowledge, Dumford and Miller (2017, 160) assert that not all skills learned in higher education 'may transfer directly to the workplace'. To assess whether institutions are meeting the demands of the labour market, they need to use mechanisms such as evaluations and surveys. The tendency within the higher education sector is that institutions 'accept the neoliberal pressure and looking for ways to make their educational practices more aligned with the needs of the labour market' (Tran 2016, 58).

TRACER STUDIES

Quality higher education that is 'relevant to the workplace' is essential in counteracting the above-mentioned high unemployment rates and to address the concerns of Harvey (2000, 3). A main claim of institutions is that their entitlement for success comprises of the employability of their graduates (Dumford and Miller 2017, 16). One way institutions can get a glimpse into the success of their graduates is to conduct graduate tracer studies. Burke (2005, 314) states that tracer studies evaluate the perceptions of graduates on their learning experience during their student years. These studies will improve an institution's understanding of student preparedness and graduate success. Although tracer studies have been used since the late 1980s and early 1990s (Melchiori 1988, Pettit 1991 and Pike 1994), there is, unfortunately, a dearth of research available for a variety of reasons, including fear that these studies may reflect negatively on the quality of a respective institution's provision of teaching and learning. This aligns with the observation of Zemsky (2005, 282-283) that the publication of these studies may reveal institutional deficiencies. Graduate tracer studies gather information on the professional success of the graduates (i.e. are they employed or not), as well as on the relevance of knowledge and skills gained at the institution to fulfil their current roles in their places of employment. In addition, graduate tracer studies provide a means for graduates to assess their satisfaction retrospectively with an institution's curriculum and services (Schomburg

2003).
According to Saunders-Smits and De Graaf (2012, 134), ‘knowledge of the professional success of alumni and their opinion on the curriculum, adds the benefit of hindsight to the indicators used to determine curriculum quality’. Therefore, tracer studies can be used as a valuable indicator of an institution’s curriculum quality. Alumni are in a unique position to assess how effective their studies were, they could also indicate the shortcomings that they experienced in the workplace and suggest what current skills and knowledge will be needed to succeed in their careers (Saunders- Smits and De Graaf 2010, 133). According to Hsu, Wang, Cheng, and Chen (2016, 994), ‘alumni can better evaluate the curricular relevance to job requirements’. Universities can use theinformation to inform the revision of programmes offered. Universities in South Africa are allowed within the context of the Higher Education Quality Sub-Framework (HEQSF) to change 30% of a curriculum, provided that the changes made support the exist level outcomes of the respective accredited programme.

METHODOLOGY

Vaal University of Technology (VUT) is based in Gauteng, South Africa in an industrial area. Amongst others, there are two large industries, namely Sasol Chemical Industries and ArcelorMittal steel industry. The institution has the following faculties:

- Faculty of Applied and Computer Sciences
- Faculty of Engineering and Technology
- Faculty of Human Sciences
- Faculty of Management Sciences.

The purpose of the graduate tracer study was to trace VUT graduates’ progress after graduation from the institution. The target population was students that graduated the past five years. This was done to collect baseline information for future tracer studies, to determine the employability of VUT graduates and to assess graduates’ satisfaction retrospectively with the services and tuition offered by VUT. Assessing graduates’ satisfaction with the services and tuition offered by the university provides a means to highlight areas where the institution is performing well, as well as areas in need of improvement. This aligns with the generic purpose of tracer studies, namely ‘to improve the educational experience of …undergraduate and graduate students’ (Bosshart, Wentz, and Heller 2009, 411).

Development of data collection instruments

A questionnaire consisting of quantitative questions was developed after scrutinising the literature on graduate tracer studies. To ensure that all the objectives of the study were met, the following sections were included in the questionnaire:

- Graduates’ education and qualifications
- First position of employment
- Current employment status
- Current position of employment
- Graduates’ experience of VUT

The sample of the study was restricted to individuals who graduated from VUT within the past five years. The study targeted graduates from all four faculties of the institution. A convenience sampling method was used because alumni studies have, in general, low response rates. An online survey was conducted by using Google Forms survey platform. After being thoroughly tested to ensure accuracy, alumni that graduated received emails with a link to the survey. The exercise was also advertised on social media platforms (Facebook and LinkedIn). As a marketing tool to encourage participation, incentives in the form of technological devices were sponsored and could be won by respondents by means of a ‘Lucky draw’. Alumni had the opportunity to respond to the questionnaire that was active online for three months.

Gender was the only biographical characteristic that was asked of respondents in order to keep the completion of the questionnaire short and to encourage participation. The respondents were evenly representative between males and females, with 47.8 percent (N=1072) male, and 50 percent (N=1075) female respondents. The majority respondents (71.4%) held qualifications only obtained from VUT. The institution offers a variety of qualifications that include National Diplomas, B Tech, M Tech-, and D Tech degrees. Representatives of the post-graduate degrees (M Tech and D Tech) were significantly lower (8.8% and 1.4% respectively). The four faculties were well represented in the study, with the highest number of respondents that obtained their qualifications from the Faculty of Management Sciences (34.7%), followed by the Faculty of Engineering and Technology (24.5%), the Faculty of Applied and Computer Sciences (21.1%) and the Faculty of Human Sciences (19.0%).

Data collection

Raw data were collected from the Google Forms online survey platform and fed into the Microsoft Excel software programme. The quantitative data were checked, cleaned and then uploaded for the purpose of statistical analysis. Descriptive statistics (Coldwell and Herbst 2004,
92) were used in the study and were run in SPSS for all quantitative questions and graphs were created to represent the data from the frequency tables visually.

RESULTS

The following sections reflects on the most important results of the study:

Employment

It is plausible to note that more than one third of the respondents (43.5%) were employed while busy with their studies or they already received a proposition that they would be employed when they graduated. A total of 22.4 percent graduates found employment within six months after graduation, whilst 7.5 percent of the respondents were still unemployed by the time that this study was conducted. The respondents that were employed indicated that they found their jobs by means of newspaper or online advertisements (26%), by means of personal contacts (16%), or through the help of the University (13%). VUT could investigate ways to support graduates more in finding job opportunities. 55.8 percent of the respondents were employed in the private sector while 62.5 percent held contract positions. The respondents were asked to reflect on factors that helped them to secure employment for the first time. More than three quarters of participants who had found first-time employment (82%) agreed to some extent that having a tertiary qualification helped them to secure employment, with 73 percent specifically highlighting the role that the course they studied through VUT played in this regard. This is on par with the observation of Pauw, Oosthuizen, and Van der Westhuizen (2008) that post-school education safeguards against unemployment. Universities of technology like VUT offer courses with a compulsory work integrated learning component. This practical experience of the workplace develops the students' personal soft skill qualities and academic success. The above-mentioned teaching and learning experience at VUT could be deemed a supportive factor in securing employment by more than 60 percent of the respondents.

The majority of the respondents (78.7%) were employed in a field related to their field of study at VUT. As high as 95 percent of respondents indicated that the skills obtained during their qualification were relevant to their jobs (Figure 4). This finding, to a certain extent, contradicts the view that there is a mismatch between what is taught to employees and what is needed in the labour market (Pauw, Oosthuizen, and Van der Westhuizen 2008), or the observation of Moleke (2010) that there is a misalliance between graduate output and the employers' expectations and needs. This finding may also indicate that VUT succeeds, to a certain extent, in addressing what Shah and Nair (2011) regard as the changing needs and expectations of the labour market.

Learning experience

The respondents reported less positive satisfaction with student counselling and student guidance (57%). Less than half of participants were satisfied with the accommodation provided (45%), food services provided (46%), the degree of community engagement (47%), and the effectiveness of campus security and safety (48%). In conclusion, the satisfaction levels of the respondents with regard to teaching and learning activities are relatively high in comparison with the result of the satisfaction survey results for VUTs support services, especially student counselling and guidance, campus security and safety as well as accommodation and food services.
The respondents (more than three quarters of participants) rated the teaching staff's knowledge of content, student-teaching-staff interaction, respect shown towards students,
instructional materials provided and teaching methodologies with high satisfaction. Although the participants were somewhat less positive about staff members' accessibility outside of lecturing times, a considerable percentage (72%) is a good indication that the respondents were to some degree satisfied with this aspect. An aspect that was rated with a lower satisfaction was the atmosphere of political and cultural understandings (69%). This finding perhaps is reflective of the difficult transition to democracy and cultural and political tolerance faced by not only South Africa at large, but also its tertiary institutions specifically. VUT has a majority (90%) black student population (from different black cultural groupings), it, therefore, is not clear if this tension occurs mainly amongst the student population (variety of ethnic groups) or between students and staff members.

Satisfaction with VUT's facilities

The library and online digital library services, as well as the availability of online resources, computer laboratories, lecture rooms and the general condition of the buildings and grounds received relatively high satisfaction values. The respondents rated lower satisfaction for science laboratories, ICT facilities and services, equipment, medical services and recreational facilities. The provision of parking space received a significant low satisfaction value of 52 percent, which should be viewed against the fact that 15 percent of the participants noted parking facilities as 'not applicable' to them.

Satisfaction with the curriculum

As already mentioned, this tracer study measured the respondents' opinion on the relevancy of several aspects of their course curriculum and how it is on par with the requirements for the world of work. The results were very positive with high satisfaction values. Every aspect evaluated was rated at a satisfaction level of more than 80 percent. The following aspects were evaluated by the respondents: the suitability of the overall study programme, the suitability of the subjects students can choose from, the sequence of the subjects, compulsory courses that had to be taken, the theoretical instruction received, the practical instruction received, and the overall impact of the curriculum on graduates' knowledge/skills/competencies in their subject area. The overall impact of the curriculum received the highest ratings of relevance, namely 86 percent.

CONCLUSION

Although the findings from the survey, specifically with regard to teaching and learning aspects, were predominantly positive, there are other aspects detected as deficiencies, which need attention. From a quality enhancement point of view, remedial action is required for those areas that were rated with relatively low satisfaction values in order to improve 'the educational experience of undergraduate and graduate students' (Bosshart, Wentz, and Heller 2009, 411). This information should be disseminated to the key stakeholders and responsible portfolios of the institution. The findings can be triangulated by the data collected through other institutional studies such as student satisfaction surveys and focus group interviews. The deficiencies of the survey should feed into the quality risk register for remedial action planning purposes and for the monitoring of progress made. The following can be regarded as limitations of the study:

- The database of VUT's alumni should be updated for similar studies in future. This is important not only for administering the survey but also for feedback to the respondents on the results and the impact of the study.
- The survey should be active for longer than 3 months in order to allow for a higher participation rate.
- The alumni of all three sites of delivery should take part in the study and not only the main campus in Vanderbijlpark.
- The length of the survey should be short enough in order to be completed by the respondents between 15 – 20 minutes.

The findings on the teaching and learning aspects emphasise that the graduates are convinced that the skills learned at the institution are relevant to their working environment and, therefore, to the current labour market.

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Did the four-year extended programme make a difference towards the success rate of the engineering faculty?

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ABSTRACT

The four-year extended programme was offered from 2016 to 2018 at the Vaal University of Technology and statistically never been proved to be successful. Oral feedback from the faculty always portrait the programme to be successful, as students moved fluently through their years of study. The purpose of the extended programme was to improve the academic performance of students who are at risk due to their educational backgrounds. The key role of the extended qualification is therefore, to support educationally disadvantaged students who are underprepared despite meeting minimum admission criteria, by enabling them to be placed on an extended curriculum that will give them the academic foundations for successfully completing their studies. The purpose of this paper will be to statistically prove that the students who received the extended curriculum, based on the specific model followed, will perform well and they made a positive difference towards the success rate of the engineering faculty.

Keywords: *Foundation; extended programmes; gender equality; engineering*

INTRODUCTION

The Vaal University of Technology (VUT) has been experimenting with uplifting programmes in the Faculty of Engineering and Technology since 2002. The first programme, the introduction to engineering programme started in 2002 and was phased out during 2015. During 2016 the extended programme was implemented to replace the introduction programme. The main advantage for the students was that they were now registered for a four-year extended diploma programme and not only for a one-year short academic learning programme. The conditions were still the same, in other words the students still needed to pass all their foundational subjects before they could enrol for the following year. The students completed a foundational curriculum developed for one year which was then divided into five modules. Each module had to be successfully completed before commencing with the following module.
The modules were divided into the two semesters. During semester one, modules one and two had to be completed, while modules three, four and five had to be completed during semester two. The logical reasoning behind the curriculum development was to prepare the students for access as well as for success in the entire diploma programme (Govender, 2017). Semester one was utilised to get the students acclimated into a higher education environment, while the academic pace was limited to ensure students can cope with the change from the secondary school environment to a higher education environment. During semester two the academic pace was picked up and the workload completed was similar as what other students experienced in the mainstream, three-year diploma course (Calcagno, Crosta, Bailey, & Jenkins, 2007; Complete College America, 2016).

The engineering foundational year was developed as a generic programme and all students had to take the core subjects consisting out of Mathematics, Science, Language Literacy, Computer Literacy and Entrepreneurial Skills (Guy, Cornick, Holt, & Russell, 2015). The study material included some information of each discipline offered in the Faculty of Engineering and Technology at the VUT. Therefore, the student completed the foundational year by repeating what has been done in high school, without them realising it, as the curriculum was based on academic problem solving, as well as real world applications. It was essential for the curriculum developer that the students would start realising why it is necessary for them to do the specific subjects.
At the end of the foundational academic year, the students would participate in a colloquium where they then showcased their work. These work pieces ranged from prototypes to computer applications developed for a specific purpose. Students were confronted with problems that the community experienced and asked to find a solution in order to assist the community. In order to complete the task, they had to apply all the academic knowledge gained throughout the year (and sometimes investigate new concepts) to find a sustainable solution to the problem. Therefore, the application of the extended programme curriculum was presented in the form of a prototype or a computer application (project-based learning) that proved that the problem could be solved (Swart, & Sutherland, 2007).

THE EXTENDED PROGRAMME CURRICULUM DEVELOPMENT

From the background study completed by the curriculum developer, it seemed that the students attempted their higher education academic studies under-prepared (Hillman, 2005; Hayward, & Willett, 2014). This was mainly due to the lack of life, communication, numeric and literacy skills (Vygotsky, 1986; Yusof, Sadikin, & Phang, 2013; Mohd-Yusof, Phang, Sadikin, and Helmi, 2014; Bailey &Jaggars, 2016; Norodien-Fataar, 2016). Consequently, the introduction programme and extended programme lead to participation within the higher education sector and eventually assisted in providing quality graduates. This in turn assisted in retaining more students, as they became better prepared for the first year (Jaggars, Hodara, Cho, & Xu, 2015). It has been statistically proven that the introduction programme had a positive effect on the diploma programme subjects (Sutherland, 2009; May, & David, 2011; Vandal, 2016). Therefore, the students who completed the introduction programme had a higher graduation rate than the students not completing the introduction programme (Cho, Kopko, Jenkins, & Jaggars, 2012; Scott-Clayton, Crosta, & Belfield, 2014; Sutherland, 2014; Mohd-Yusof, Sadikin, Phang, & Abdul Aziz, 2016). Also proven was the fact that fewer students dropped out of the programme, therefor the decision to use this programme to retain not only female, but all participating students (Sutherland, 2014; Jones, 2015; Samsuri, Mohd-Yusof, & Abdul Aziz, 2017).
The curriculum development framework model, depicted in Figure 1, has been developed and implemented to broaden access through alternative admission to accommodate under-prepared engineering students. The main recommendation from the findings of the above-mentioned study is the formulation of the curriculum framework (Sutherland, 2009; Mohd-Yusof, Helmi, Phang, & Mohammad, 2015). A framework that aims at providing structured guidance, in the form of a skeleton profile, that provides strength to the inner sub-structures of curriculum development, institutional development and programme development (Svinicki, 2010). Hence the curriculum framework can be described as a sustainable practice that comprised a methodology, technique and innovative used resources that has a proven record of success in providing continuous improvements in academic performance, quality performance or other measureable factors (Calcagno, Crosta, Bailey, & Jenkins, 2007; Jenkins, Speroni, Belfield, Jaggars, & Edgecombe, 2010; Clarke & Braun, 2013). Although this programme was implemented to enhance engineering students throughout their studies, it was also used to study gender equality. Female students may

have experienced extra problems during their study period that their male counterparts were not experiencing, which may have affected their dropout rate negatively. By enhancing the students to perform better after completing the foundational year, it was hoped to find that more female students stayed in the engineering programmes.

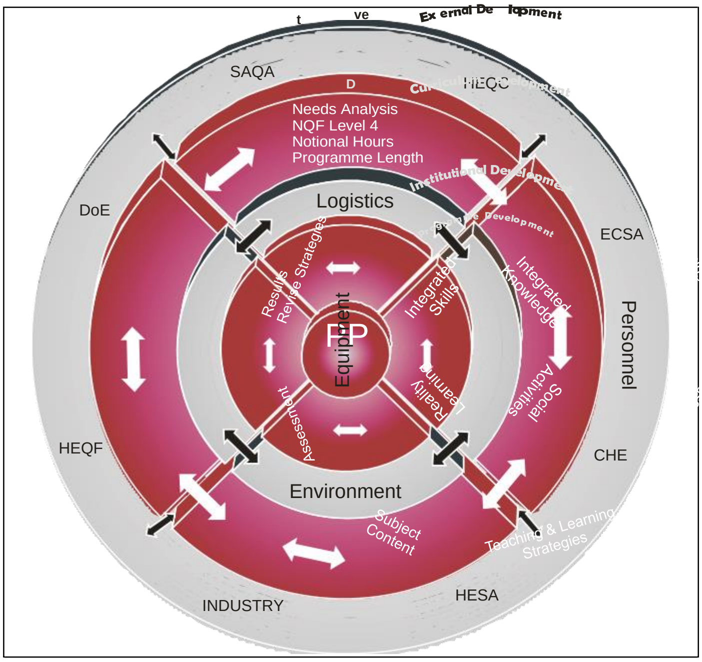

Figure 1: Curriculum Development Framework (Source: Sutherland, 2009)

GENDER EQUALITY

Gender bias should be considered as important, both for social or ethical reasons but also from a realistic engineering viewpoint. Throughout the year's universities have tried to increase the intake of female engineering students and ensure that they complete the undergraduate studies (Jordan, 2014). However, it is a timeously task and continuous research needs to be undertaken to ensure that female students retain in the study programmes (Camacho, & Lord, 2011). The VUT used the extended programme to ensure that female students receive the best foundation within the engineering undergraduate studies, so that they can graduate successfully.
However, it is not only the higher education institutions that need to sustain the females they have enrolled in their study programmes. Female students should be aware what they will encounter in the discipline they want to study. Therefore, they need to prepare themselves for what will come as soon as they have picked a specific discipline (Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; National Science Foundation. 2017). It would have been wise to have completed an aptitude test first before picking a discipline. Engineering is not a glamorous career; on the contrary, it involves hard work, long hours and dedication towards each project undertaken. It has to be a conscious choice to follow this career as a female, because it might interfere with social as well as family responsibilities (Cech, & Blair-Loy, 2010). Due to the long hours involved at work, family responsibilities will have to be balanced very delicately. It is possible, as many female engineers are

doing just this on a daily basis, but it is not easy, and an understanding spouse or life partner can make it work (Hatmaker, 2013).
The foundational programme introduces the students to the different disciplines on offer at the VUT. After they have completed the first year of study successfully, they might decide to change disciple due to the information gathered during the foundational year. Academically it should not be problematic to change disciplines, as a generic programme was offered for all. Now it is possible to see if this programme assisted students with their undergraduate studies and if the VUT indeed retained more students and also if the female student's dropout rate was lower than for those students doing a three-year undergraduate diploma.

RESULTS

The overall success rate of the students in the foundational year is depicted in Figure 2. The statistics shows how the students succeeded during 2016 and 2017.
The foundational students of 2018 were not taken into consideration, as they have not yet completed any mainstream subjects. They are currently enrolled for them.

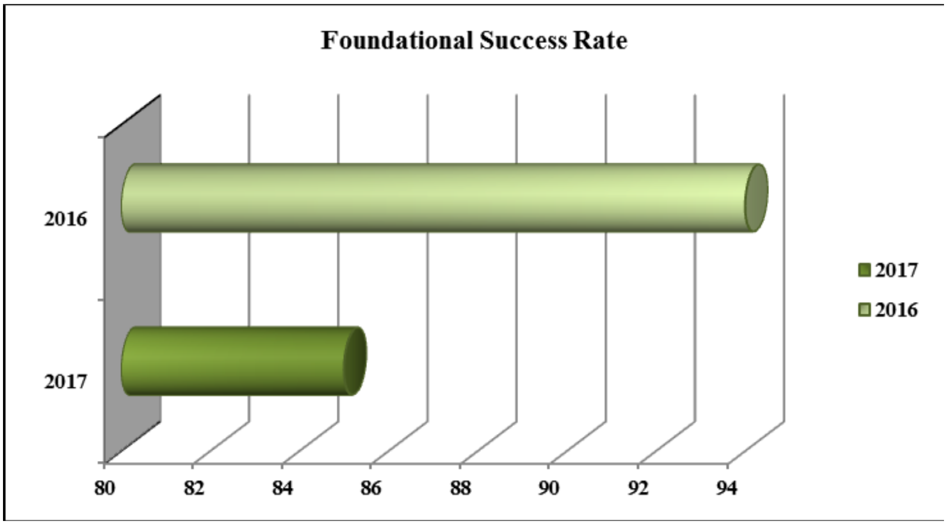

Figure 2: Students success rate during their foundational year

Figure 3 represent the total percentage of female students registered in the different disciplines on offer for the foundational year 2016.
The majority of the disciplines do not reach the 50% mark for female students registered. The chemical department is the only department with a high female representation.
Figure 4 represent the total percentage of female students registered in the different disciplines on offer for the foundational year 2017.
The majority of the disciplines do not reach the 50% mark for female students registered. The chemical department dropped while the metallurgy department picked up the amount of female students registered for 217.

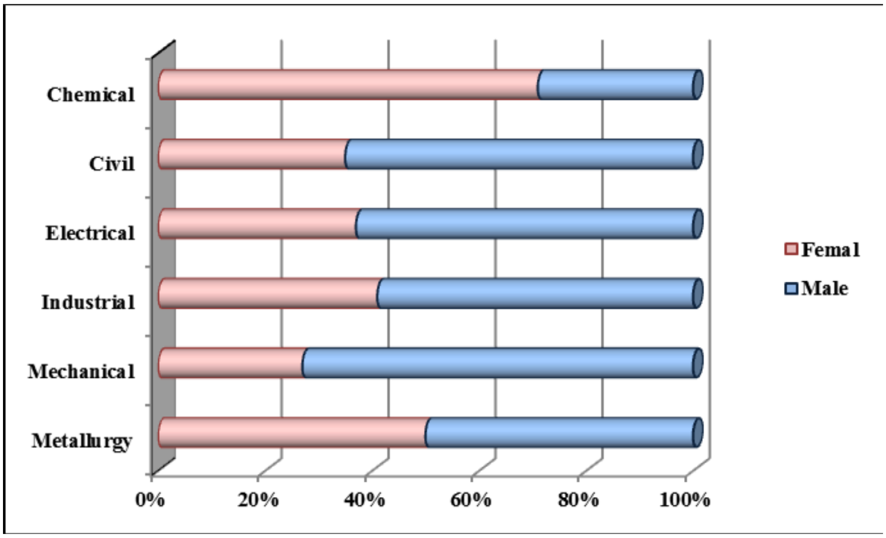

Figure 3: Female student registered during 2016 foundational year

The aim is to retain the students and in particular the female students. During the years 2016 and 2017 the female retention rate was high for each department that had female students registered.

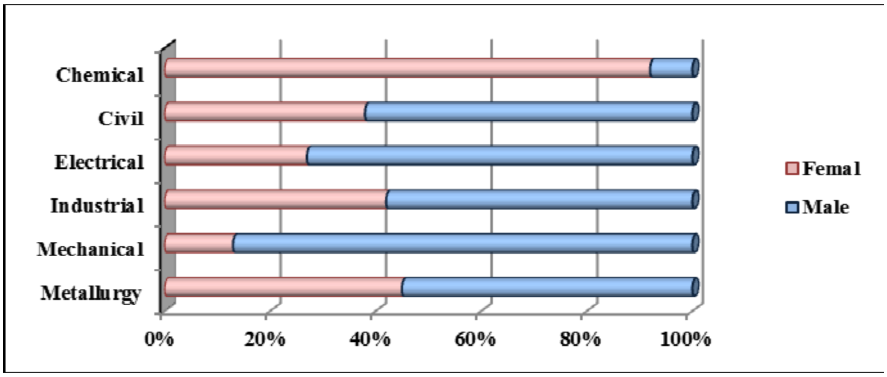

Figure 4: Female student registered during 2017 foundational year

Figure 5 depicts the percentage of female students that were retained from each discipline. This implied that even though the registration rate of female students in the departments are low, retention of these students is high, and, in the end, more female students will graduate and placed into the world of work.

From Figure 5 it is clearly visible that the female students are performing well in their academic careers. This proofs that the dropout rate becomes lower as the retention rate becomes higher.

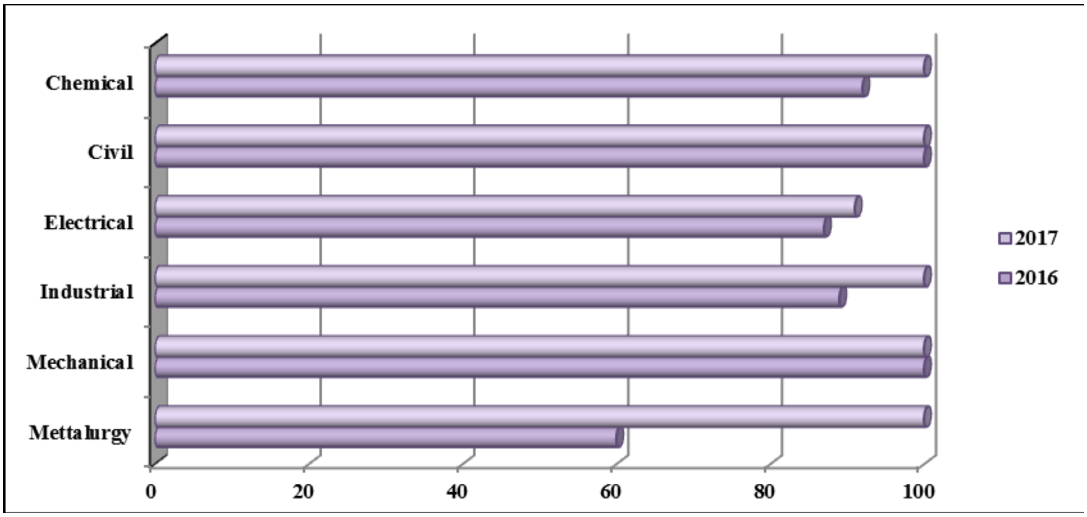

Figure 5: Female student retention from 2016 and 2017 foundational year

CONCLUSIONS

Even though the majority of higher education institutions try to retain their students within the engineering study field, the VUTs foundational programme had a positive outcome. Students complete the undergraduate qualification in the appropriate time span. No bottle-necking, or in other words, students failing repeatedly in one specific year of their study. The results show a good flow of students throughout each year.

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Effective strategies in new curricula development at Higher Education Institutions in South Africa

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ABSTRACT

Re-curriculation is currently the most talked about topic in Higher Education in South Africa because of the new Higher Education Qualification Sub-Framework alignment process required by all Higher Education Institutions. However, the lecturer in the classroom, especially new lecturers, are also faced with the task of designing the actual curricula of a subject once the new qualification is to be implemented, in terms of achieving the aims and objectives of the subject area. In other words, ensuring that the outcomes of the subject are achieved by the student. Ideally all lecturers at institutions of higher learning should develop strategies for their "own" curricula. Developing the aforementioned strategies might be challenging to first time lecturers. The methodologies of developing a new qualification and strategies for building curricula is discussed in this paper are different curriculum planning methods and strategies. The aforementioned strategies are focusing on students, mentoring, supportive tools such as software programmes, feedback and assessments. The findings of this paper are proper curricula development to enhance the ability to understand, recall and apply information. The main objective is to use proper curricula development to empower students with a diversity of cultures to understand the material presented by the lecturer. This paper concludes that curricula planning should allow students to be given space to grow and interact and ultimately attain deep life-long learning.

Keywords: *Re-curriculation, curricula planning, mentoring, curricula development*

INTRODUCTION

Re-curriculation in Higher Education in South Africa is very topical because of the new Higher Education Qualification Sub-Framework alignment process. This process is required by all Higher Education Institutions (HEIs). In addition to curriculation in Higher Education, lecturers should also design the actual curricula of their subjects in the classroom along with its implementation, to ensure the aims and objectives of the subject area are realized. This is to ensure that the outcomes of the subject are achieved by the student. It is good practice that each lecturer at institutions of higher learning develop strategies for their own curricula content.

RE-CURRICULATION IN HIGHER EDUCATION IN SOUTH AFRICA

The primary objective of the HEQF (CHE, 2007) and HEQSF (CHE, 2013) "was to enable the articulation of programmes and the transfer of students between programmes and higher education institutions" (CHE, 2013: 9) within a single coordinated higher education system. The shift from the National Qualifications Framework (NQF) as indicated in Section 4 of the NQF Act, 2008 (Act No 67 of 2008) as a single integrated system consisting of three coordinated sub-frameworks of which the higher education band included qualifications at NQF level 5-8 (SAQA, 2000) to the Higher Education Qualifications Framework (HEQF) (CHE, 2007) and the Higher Education Qualifications Sub-Framework (HEQSF) (CHE, 2013) both consisting of qualifications at NQF level 5-10, signaled a trend in re-curriculation and renewal with concomitant articulation possibilities. However, articulation between qualifications requires careful planning given the differences in levels from the NQF (2000) 8-Level framework to the HEQF (2007) and the current HEQSF (2013) 10-Level framework.

Steps in developing a new Higher Education Qualification Sub-Framework aligned qualification

Before embarking on developing a subject-specific curriculum, a qualification must be developed and approved by the relevant stakeholders, internally at a HEI and by the external agencies in Higher Education. The different stakeholders in the new qualification approval process is depicted in Figure 1.

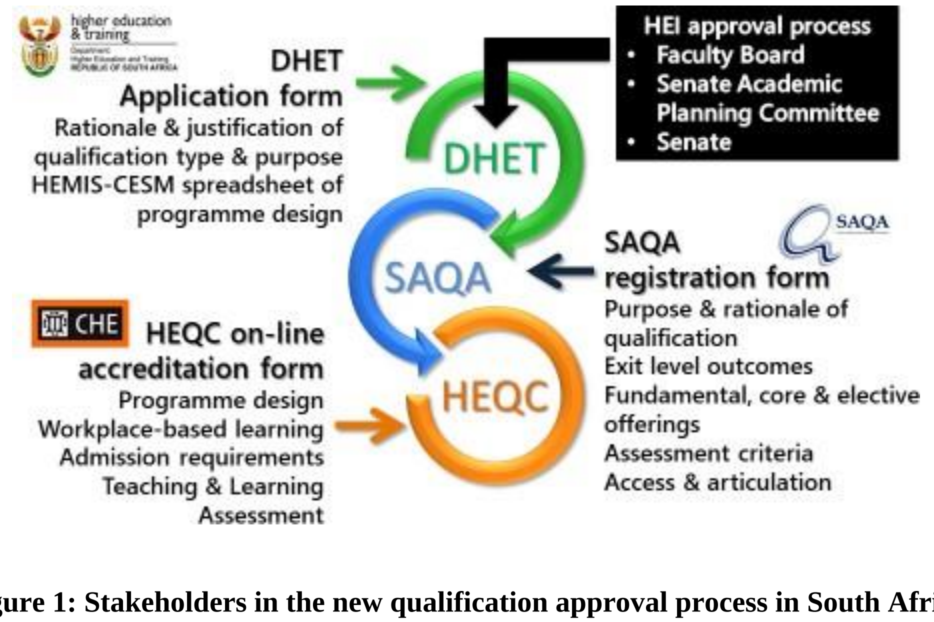

Figure 1: Stakeholders in the new qualification approval process in South Africa

The steps taken in developing a new qualification are listed below:

- Study the HEQSF description of the new qualification.

- Conceptualise the type of qualification to be offered based on the need for a particular qualification.
- Consider the strategic position of the new qualification on the new HEQSF.
- Consider the progression route from an NQF level 5 qualification to a Doctoral qualification, and how the knowledge and focus areas relate to the progression through the levels.
- Develop a purpose statement based on a discussion of the points above.
- Develop a rationale for the new qualification based on a discussion of points above.
- Complete the benchmarking exercise for the new qualification.
- Complete the situational analysis for the new qualification.
- Revisit the purpose statement as developed previously to determine whether the benchmarking and situational analysis activities might have influenced amendments to the purpose statement.
- Develop a qualification title with the appropriate qualifiers based on the purpose statement, benchmarking and the situational analysis.
- Develop Exit Level outcomes for the qualification.
- Develop assessment criteria to align with the exit level outcomes.
- Develop a basic programme design for the new qualification, outlining the possible core, fundamental and elective subjects.
- Outline the conceptual and contextual focus areas and approach to the subjects and the programme as a whole.
- Consider the knowledge areas, their relevance to the programme as well as their relevance for progression.
- Determine the CESM (Classification of Education Subject Matter) categories for each subject, which is the standard classification of subject matter embedded in a qualification as required by the Department of Higher Education and Training (DHET).
- Determine whether the ratio of the 50% specialisation aligns with the qualification title and its qualifiers.
- Confirm the qualification title and qualifiers.
- Determine credits and CESM categories.
- Consider the scope of knowledge areas for each subject.
- Develop teaching, learning and assessment outlines.
- Determine admission requirements to access this qualification.
- Decide on sites of delivery.
- Decide on mode of delivery.

The timeframes of the different stages up to the implementation of a new HEQSF aligned qualification is shown in Figure 2. It is clear or shows or depicts that the timeframe from start to implementation of a new HEQSF aligned qualification is between 24 and 36 months.

Re-curriculation

Once the new HEQSF-aligned qualification is approved by all the relevant stakeholders, subject lecturers must prepare to implement the new qualification by re-curriculating individual subjects. In many respects, re-curriculation requires lecturers to focus on what learners are able to do as opposed to what learners should know. Therefore, re-curriculation within the new Higher Education Qualifications Sub-Framework (HEQSF) should encourage lecturers to develop curricula that respond to the demands of regional, national and global industry priorities in education. Coupled with the above rationale for change, added pressure is brought to bear from the international community which strongly supports the enabling and empowering of people through the medium of education.

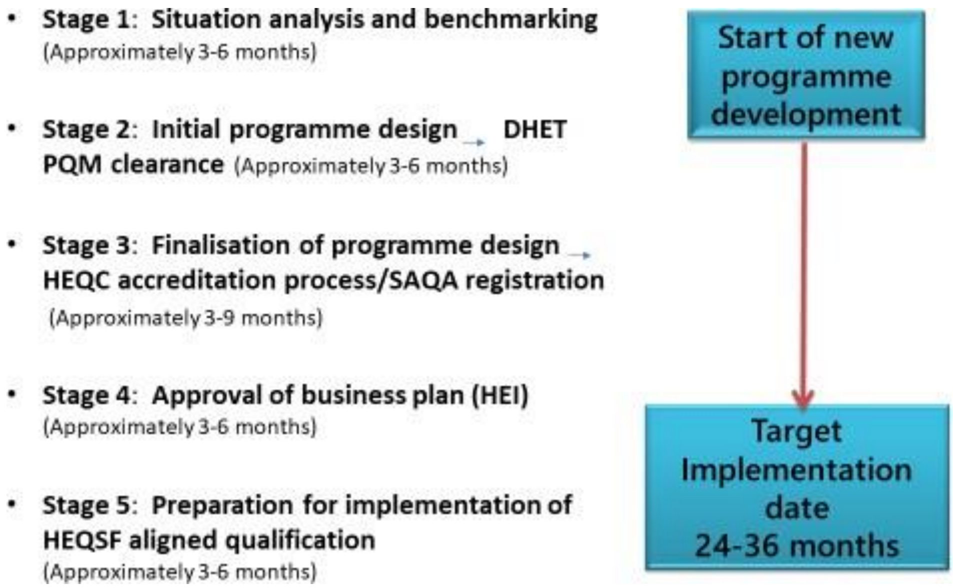

Figure 2: Preparation, development and approval process of HEQSF aligned qualifications

For the individual lecturer faced with curriculating a new subject, this should be seen as an experience rather than a product or plan (Luckett, 2001). Therefore, the lecturer should see the curriculum as 'a contextualized social practice' which is shaped by an ongoing social process comprised of the interactions of students, staff and knowledge. In addition, re-curriculation provides the opportunity to ensure that qualifications may be described in terms of what qualification holders can actually do. This is one way of ensuring that the registration of qualifications on the new HEQSF is systematic and that issues such as equivalence and progression from one level to the next may be addressed. This link between re-curriculation and the new HEQSF is often overlooked in speculation about the desirability of the new HEQSF.

Furthermore, one of the main requirements of the new HEQSF aligned qualifications is the associated assessment criteria for each exit level outcome. This requires a different approach to teaching than traditional approaches. The development of exit level outcomes requires teachers to focus on what they need to do in the classroom to allow the learners to attain these outcomes. Invariably, this involves lecturers developing and using facilitation skills that will allow students to explore and apply knowledge.

The new Higher Education Qualification Sub-Framework alignment process

A detailed situation analysis is conducted with the new Higher Education Qualification Sub-Framework alignment process, by engaging with stakeholders to determine if a proposed new qualification is viable. The initial design is submitted to the DHET for PQM clearance to obtain permission for the qualification to be included in the Programme and Qualification Mix (PQM) of the institution. After PQM clearance, the final programme design is submitted to Council on Higher Education (CHE) for accreditation approval and registration with the South African Qualifications Authority (SAQA). Thereafter, the HEI must internally approve a business plan and prepare for implementation of the HEQSF aligned qualification.

EFFECTIVE STRATEGIES IN NEW CURRICULA DEVELOPMENT AT HIGHER EDUCATION INSTITUTIONS

According to Deng there are three levels of curriculum planning, viz. Institutional Curriculum Planning, Programmatic Curriculum Planning and Classroom Curriculum Planning. The decision-making process of school content has a different degree of influence on teaching and learning in school (Deng, 2010).

Institutional Curriculum Planning

The institutional curriculum sets out the concept or paradigm of public education in relation to society. Curriculum planning at this level is characterized by education, culture and society. Critical thinking and creativity should be the main goal of education. A curriculum should combine what is taught with social and cultural systems outside the institute of higher learning and should always be undergoing change. The reason being the fact that social and cultural contexts often undergo rapid change. An institutional curriculum should also be a tool to empower communities. Curriculum planning at institutional level is normally a national or regional undertaking influenced at a political level, represented by advisory bodies on policy, educational specialists, heads of departments and civic and community engagement groups (Johnson, 2017) (Deng, 2010).

Programmatic Curriculum Planning

Programmatic curriculum planning is planning that takes place at the intermediate levels. These levels are between institutional curriculum planning and classroom curriculum planning. The emphasis is on compiling curriculum documents and materials. It forms the operational frameworks for institutions of higher learning and schools, with instructional guidance. According to Tyler the following questions addresses “purpose, content, organization and evaluation:

- What educational purposes should the university seek to attain?
- What educational experiences can be provided that are likely to attain these purposes?
- How can these educational experiences be effectively organized?
- How can we determine whether these purposes are being attained?” (Johnson, 2017) (Deng, 2010)

Classroom Curriculum Planning

Classroom curriculum is also known as enacted curriculum. It can be the development of a cluster of events by a lecturer(s) and\or a group of students, through an evolving process. There is interaction between the lecturer and students. Institutional curriculum and Programmatic curriculum are transformed in curriculum documents and materials for classroom curriculum purposes. This will be influenced by a lecturer’s own perspectives, students’ interests and experiences and university requirements and expectations. (Johnson, 2017) (Deng, 2010).

Modern supportive tools

Students today are constantly appreciating the use and value of the internet technology, messaging, digital information to enhance different learning styles. Academics should create a demand driven approach based on the Web, as well as various social media as interactive tools. Social networking media development such as Weblogs, audioblogs, iPods, Podcasts, Wiki, RSS / XML, Instagram, Facebook, Flickr, WhatsApp and Blackboard should be used as supportive tools in new learning methods. Student learning by means of social networking, strategy design, and technical support courses are “enjoyable” user experiences for the new generation. The use of social networks and novel digital platforms and technologies is applicable for the development of modern teaching and curriculum design. (Baird & Fisher, 2005). This will eventually enhance learning as a proper curriculum strategy.

Assessments

Assessments after instruction play an imperative role in curriculum design. It is also essential in professional development. A good combination of formative as well as summative assessments should be applied in a curriculum. Formative assessments are part of the instructional process and can be used to estimate important educational measurements of students' abilities. Summative assessments are used to determine what students know, and even more important to determine what students do not know. The outcome is important for both academic and student for feedback, credibility, reliability and evaluation purposes. According to Gullop & Berthenthal there are three key concepts related to assessments to draw proper inferences, viz. reliability, validity, and fairness (Gullop & Berthenthal, 2002). The key differences and similarities in Formative and Summative Assessment are shown in the comparison chart in Figure 3.

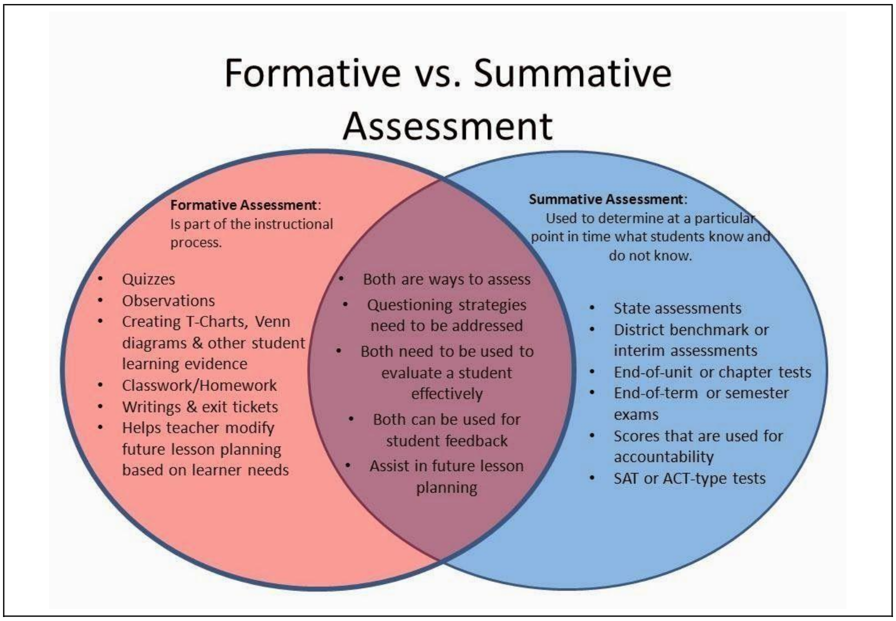

Figure 3: Formative and Summative Assessment: formative vs summative assessment comparison chart.

(https://keydifferences.com/difference-between-formative-and-summative-assessment.html)

The curriculum design should apply formative assessment to improve the ability of students, to check the understanding of a specific topic, to assist academics in planning instruction, and to provide students with feedback. Formative assessment happens during instruction. On the other hand, summative assessment happens after instruction, the goal is to prove that learning took place, evaluate learning at the end of a unit, show a level of mastery of a specific skill, and enable marks or grades to be assigned.

Mentoring

Although academic guidelines differ, mentoring is a recognized and studied teaching method and is considered an effective strategy in new curricula development at higher education institutions. Teaching methods require assessment and analysis by mentors. Qualitative information through mentoring promotes professional development, communication skills, leadership roles, troubleshooting, capacity building and academic knowledge (Hudson, 2013). New staff members should be assigned to experienced ones in order to enhance new curricula development.

Reflection and feedback on learning as a strategy

Reflection and Feedback on Learning is an important strategy for undergraduate curricula development and project work. Work integrated learning (WIL) modalities also play a significant role in the learning attributes of the new South African qualifications.

This is particularly the case in engineering programmes at Universities of Technology in South Africa where WIL is a compulsory component of the curriculum. Most engineering students are required to spend six months to a year in industry undertaking work-place based learning. In addition, there is a strong emphasis on project work which provides significant benefits from a student learning perspective. Project based learning can be used to encourage students to work in teams and especially in the South African context provide students with an opportunity to work in a multicultural environment. It can play an important role in promoting a student-centered approach to learning, and can be effectively used to develop the “soft-skills” required by engineers to succeed in the twenty first century. It is invariably multidisciplinary and can help students make connections across disciplines.

Project based learning provides an excellent opportunity for students to reflect on the extent to which the desired learning attributes and learning outcomes have been achieved. Project based learning is most beneficial if the project is grounded in industry or the community, hence students, lecturers and collaborators from industry or the community should work together to ensure that changes in curricula are realized through teacher development activities taking student contributions and student input into account. Activities based on a sound curriculation system in university subjects and projects should: a) support students through an active learning project, b) formalize formative and summative feedback, c) introduce opportunities for students to reflect and develop their abilities and skills.

The basic elements of a reflection and feedback on learning plan are: (a) providing students with reports on progress through written and oral feedback; (b) requiring students to keep proper records of their projects and (c) self-assessment for students to teach them about their own learning and to encourage reflection. Student focus groups should be created to ease the process of integration of different cultures of lecturers, students and employees (Heylings & Tariq, 2010).

CONCLUSIONS

Curricula planning should allow students to be given space to grow and interact and ultimately attain deep life-long learning. The importance of programmatic curriculum planning cannot be over emphasized because it is bridging the gap between abstract institutional curricula and ratified classroom curricula, by transforming content into subjects. A combination of the three levels of curriculum planning is dependent on decision-making activities across institutional to classroom hierarchy. Lecturers should develop their own teaching goals and curriculum materials, by taking the institutional curriculum goals and national instructional guidelines into consideration.

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Virtual Engagement: A Nexus Between Internationalisation and Decolonisation of the Curriculum in the PEESA III Project?

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ABSTRACT

Internationalisation and decolonisation are both prominent issues currently being discussed in South African Higher Education institutions. There is a strong impetus for decolonisation of curriculum design, development and delivery. Experience with the implementation of Collaborative Online International Learning at Durban University of Technology (DUT) has demonstrated that this approach to has immense potential for transformation of learning and teaching. The broader concepts of e-internationalisation and Virtual Engagement allow for even greater flexibility in fostering international collaboration, and opportunities for decolonisation of the curriculum. This paper briefly discusses internationalisation and decolonisation in general and at DUT specifically, and explores the opportunities that VE offers to address these imperatives in the implementation of the Personalised Engineering Education (PEESA) III Project.

Keywords: internationalisation, decolonisation, Virtual Engagement, PEESA III.

INTRODUCTION

Internationalisation and decolonisation are both prominent issues currently being discussed in South African Higher Education institutions. One focal area in the debates is the transformation of curriculum design, delivery, and learning and teaching methodologies. This is occurring against a backdrop that includes the increasing integration of technology into higher education with a proliferation of online, blended and flexible approaches to learning.
Since 2015 the Durban University of Technology (DUT) has been a pioneer as the first university, in Africa to be extensively involved in an initiative that is led and managed by the State University of New York (SUNY). This initiative is called Collaborative Online International Learning (COIL) which is grounded in an extensive network of partners, and programmes for capacity building academic staff, that have been established by SUNY. COIL promotes the development of a partnership with two academic staff from different geographical regions of the world (drawn from the SUNY partners). The academic partners co-create a short (4 – 6 week) learning project to be implemented with their respective groups of students. The two academics do not have to be in the same field or discipline, but they agree on clearly defined learning outcomes that jointly align with an area of the curriculum for which they are responsible. When the learning project is implemented

the students use technology to engage with each other virtually. COIL therefore provides innovative international learning experiences and virtual mobility for both groups of students.

As a result of the four year involvement in COIL at DUT there has been an exponential growth in the interest shown by the academic staff. Thus, the more comprehensive concept of *E-Internationalisation* has recently been adopted which is grounded in the adoption of a broader approach that DUT is calling ‘Virtual Engagement’ (VE). VE embraces COIL activities with existing SUNY partners, and expands the scope of internationalisation through promoting the establishment of partnerships outside the scope of the SUNY network. This approach also enables DUT to develop and implement its own ‘in-house’ VE capacity building initiatives for academic staff.

DUT is a partner in the European Union funded Personalised Engineering Education South Africa (PEESA) III Project. The purpose of this paper is to consider the opportunities to interconnect internationalisation and decolonisation of the curriculum for engineering education through the application of VE in the PEESA III Project. The following sections set out brief discussions of: the concepts of internationalisation and decolonisation respectively; the manner in which they are understood at DUT specifically; COIL, *e-internationalisation* and VE at DUT; and the implications for the PEESA III Project of the use of VE as a nexus between internationalisation and decolonisation.

INTERNATIONALISATION OF HIGHER EDUCATION

Internationalisation has emerged as one of the defining issues of higher education globally. There is a vast body of literature and engagement in conceptual debates, often without reaching agreement on the meaning of internationalisation (Zeleza, 2012). There is no doubt that over the past 25 years internationalisation has evolved from a marginal and minor element to a global, strategic, and mainstream factor in higher education. It has become a very broad and varied concept and now includes many new rationales, approaches and strategies in different and constantly changing contexts (Knight and De Wit, 2018).

Concomitantly the terminology used to describe international practices has also evolved; internationalisation is a term which has different meanings to individuals and varied interpretations in individual higher education institutions. In 2004 Jane Knight cited her own definition of internationalsiation as being “the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of post-secondary education” (Knight 2003 cited in Knight 2004).

Notably, more recently Stein (2017) cites Knight (2014) as suggesting that internationalsiation is losing its way and requires a reframing of the guiding principles and values. Over time the focus of internationalisation has shifted from scholarships for foreign students to developments such as branding, international programmes, provider mobility, global citizenship, internationalisation at home, MOOC’s, franchising, and joint degrees. Internationalisation has come of age and is addressed in, for example, university strategic plans, national policy statements, international declarations and academic publications. In this shift in focus, there has been a tendency for a transformation from values such as mutual cooperation, partnership exchange and mutual benefits to approaches that are grounded in competition, commercialization, self-interest and status building (Knight and De Wit, 2018).

INTERNATIONALISATION AT DUT

Durban University of Technology (DUT) strongly supports internationalisation as an essential element in the delivery of quality higher education. Internationalisation is firmly embedded in the current university strategic plan and goals (2015 – 2019) and will become more deeply entrenched in the DUT Strategic Plan 2020 - 2030 which is currently a work-in-progress. In support of the internationalisation initiative, over 10 years ago, DUT established the International Education and Partnerships Directorate. DUT adopts a very broad set of principles around internationalisation that resonate with the broad concept of internationaliation described by Knight and De Wit (2018) above, these DUT principles include:

- Excellence and mutual benefit – establishing partnerships that foster mutual benefit and that promote excellence as a benchmark of internationalisation;
- Equity and institutional culture - internationalisation activities will promote the University's equity and transformation objectives and will contribute to an institutional culture which values diversity;
- Positioning in Africa - increasing linkages and engagement within the SADC region and other African countries;
- Research and academic autonomy – encouraging academic staff to develop international links and collaborations;
- Curriculum – that is relevant to local, regional and international contexts;
- International students – actively promoting registration of international students.

Grounded in the above principles the IEP Directorate activities that support the DUT community in internationalisation include: partnership development; multilateral collaboration; ambassadorial and consular engagements; staff and student mobility programmes; liaison with international education organisations and consular relations; promoting internationalisation of the curriculum; and promoting *e-internationalisation.*

DECOLONISATION OF HIGHER EDUCATION IN SOUTH AFRICA

Before exploring the concept of decolonisation it is useful to briefly explore colonisation. Le Grange (2018) explains that first generation colonialism was the conquering of the physical spaces and bodies of the colonized. Second generation colonialism was the colonization of peoples' minds through disciplines such as education, science, economics and law. Neo-colonialism relates to the achievement of technical independence of a country that is still under the influence of the ex-colonial or newly developed superpowers. Put simply decolonisation is the "undoing of colonization" (Le Grange, 2018: 8).

Decolonisation is not a new discourse in higher education, but now and again events bring about a new-found energy into the conversations. In the case of South African universities, it was during the 2015/16 #Feesmustfall and #Rhodesmustfall movements that the decolonisation debates were oiled and 'wheels got spinning'. The calls for decolonisation during these movements were often characterized by violence as student protesters questioned the Eurocentric nature of the curriculum (Fomunyam & Teferra, 2017; Du Preez, 2018; Le Grange, 2018). As a result the need for higher education institutions to foster and engage in debate around transformation and decolonisation of the curriculum has been reignited.

Furthermore, in the debates there has been a re-emergence of the complex and varied concepts and definitions of decolonisation. It is well recognized that decolonisation is a broad term that different meanings for different people (Mheta, Lungu & Govender, 2018). In the context of this paper it is not possible to explore the various definitions in depth; extensive analyses of the concept of decolonisation are offered by, for example, Le Grange 2018; Fomunyam & Teferra, 2017; Du Preez, 2018; Mheta, Lungu & Govender, 2018). However, it is generally understood that decolonisation is about making efforts to challenge the process of colonisation and racialisation, and the historical and continued effects it has on maintaining colonial knowledge (Le Grange 2016; Heleta 2016; Higgs 2016). Furthermore, decolonisation is a process of creating and keeping alive ways of knowing, being and relating that eradicate the strong hold that the process of colonialty created (Stein and Andreotti, 2017).

DECOLONISATION AT DUT

DUT was not exempt from the decolonisation debate and initiated its own conversations about the issues at hand, in particular the curriculum at the university. Reaching a common understanding of decolonisation is a particular challenge especially at an institution that is so diverse, and with stakeholders who have roots deeply etched in different conceptualisations of colonization. Consequently, the way in which decolonisation was seen as a whole was very fragmented and quite difficult to grasp at DUT.

In response to the need for action a Decolonisation Task Team was formed 2017, and immediately tasked with developing a Position Paper for DUT. The resulting Position Paper discusses the need to explore for example, how the nature of knowledge can be changed, and about finding ways to make a shift from the strong hold of Eurocentric forms of knowledge to knowledge that is more contextual, relevant, and responsive for students at DUT. The paper also suggests that knowledge in the Global South has always centered on Eurocentric and Western (predominantly American) content, contexts, perception and understanding in the curriculum irrespective of whether the focus was about Africa or about the Global North. The aim of decolonisation at DUT is to disrupt this knowledge and begin to find ways to engage previously marginalized knowledge as well as create new knowledge from the South African contexts and realities (Mheta, Kehdinga, Govender, Hemson, Govender, Lungu & Manjeya 2018).

This shift in the use of knowledge as power (away from a West and North hegemony) resonates with what Knight and De Wit term knowledge diplomacy. Knowledge diplomacy involves the contribution that education and knowledge creation, sharing and use make to international relations and engagement. It is seen as a reciprocal process with knowledge sharing and mutual benefits through a two-way exchange being essential for all involved (Knight and De Wit, 2018).

The stance around decolonisation at DUT and the concomitant participation in the world of knowledge is consciously driven by both its location on the continent and by the realities of South African and African history. Thus the needs of this context, the resources of this environment, and the ways in which African people have developed knowledge to address those needs, and drawn on the resources, inform the ongoing development of knowledge. Secondly, the DUT participates in knowledge production with others around the world as peers, recognizing that their perspective is likewise influenced by their context and location (Mheta, Lungu & Govender, 2018).

THE RELATIONSHIP BETWEEN INTERNATIONALISATION AND DECOLONISATION AT DUT

At the outset the caveat that internationalisation initiatives, especially those pertaining to the curriculum, have the potential to become another form of colonisation must be heeded (Pinar, 2010; Du Preez, 2018; & Majee & Rees, 2018). A critique of internationalisation in higher education from the departure point of its colonial history to its conceptualisation in the last decade is presented by Stein (2017). In her analysis she interweaves consideration and critique of colonial influences on internationalisation and sets up a framework to provide a summary of critical approaches in higher education. Three approaches are identified: soft, radical and liminal. For each approach the summary includes a view of colonialism together with the desired changes to be brought about. Part of the rationale for the critique offered by Stein is to promote (re)thinking around the ethics and politics of how internationalisation in higher education is studied and practiced. This is particularly pertinent for South Africa given the nature of the current debates in higher education, in particular those around internationalisation and decolonisation.

Whilst many may believe that the constructs of decolonisation and internationalisation are mutually exclusive, it is the view of the authors that decolonisation of the curriculum is in fact a call for greater deepening and broadening of internationalsiation. It can be argued that the approach to internationalisation is dominated by a small number of paradigms and a few countries, and that such dominance has strong congruence with the colonial powers. In contrast, a broad approach to internationalsiation would include paradigms and countries that have previously been excluded, or are at the fringes of academic discourse, and allow them to be brought into the centre of the debate; and thus 'given a place at the table'. It is arguable that these additional voices would contribute significantly to the decolonisation debate such that decolonisation would not be seen as a narrow, parochial issue but as a broader challenge that needs an international response.

Some examples of the way in which international engagement could enhance decolonisation comprise: inclusion of indigenous knowledge; a focus on African knowledge; and bringing to the fore excellence in countries that are often marginalized. Examples of the latter include the Health Care System in Cuba, the Happiness Index in Bhutan, and excellence in various spheres in Eastern Europe that are not as prominent as cited exemplars in Western Europe. There are also Western countries that have not been colonial powers, whose education, social and economic systems are worthy of study, such as Ireland and the Nordic countries. Emerging giants such as India and China, together with some of the other Asian Tigers have deep and rich histories, economic and knowledge systems that could enrich a decolonized curriculum.

A colonialised curriculum is, by its very nature, one that is shackled by a narrow, parochial approach, and the dominance of a few over many. A decolonised curriculum should therefore, attempt to break those shackles and to espouse diversity, plurality, and a deep appreciation of 'other'. Internationalisation provides a potent and energizing opportunity to be part of a decolonised curriculum. It must be acknowledged that internationalisation would not be the only approach to a decolonised curriculum but could play an important role in informing a multi-perspective approach towards an enriched, decolonised curriculum.

Arguably, failure to embody internationalisation in the decolonisation debate would be a missed opportunity that could result in a curriculum that is deficient on a number of levels. The inclusion of internationalisation can be part of a dynamic and evolving process (rather than an event) to achieve the ultimate outcome. Internationalisation, has much to offer towards the challenges of an increasingly complex world. Likewise, a decolonised curriculum can be seen as a dynamic construct that continues to evolve in contributing to the challenges of the modern world; not a world that resides totally in, and is dominated by history. A decolonised and internationalised approach would promote the development of a curriculum that is futuristic, alive, vibrant and inspiring.

E-INTERNATIONALISATION AT DUT

As explained in the introduction above DUT has actively participated in the SUNY COIL initiative for the last four years. The SUNY Centre for COIL is one of the leading international organsiations focused on the emerging field of Globally Networked Learning – a teaching and learning methodology which provides innovative, cost effective internationalsiation strategies. COIL programmes foster staff and student interaction with peers abroad through co-taught multicultural online and blended learning environments which emphasise experiential student collaboration. The COIL model advocates creation of co-equal learning environments where academic staff work together to generate a shared curriculum based on well-designed coursework that emphasizes experiential and collaborative student learning (SUNY COIL Website http://coil.suny.edu).
According to Louw and Michau (2018) technology in an online teaching environment has the potential to transform learning, widen participation by students and increase learning opportunities. They caution, however, that the focus in such initiatives should be on the teaching and learning rather than the technology. The need for such a focus on pedagogy is reflected in the approach adopted in capacity building initiatives offered by SUNY which are deeply grounded in innovative pedagogy and practice, hearing student voices, appropriate use of the tools and technologies and assessing the impact of the joint projects (http://coil.suny.edu).
At DUT the implementation of the COIL concept is grounded in the integration of technology into pedagogy to facilitate international experiences for students whilst they are at 'home', through short assignments (optimally 4-6 weeks) which are implemented in collaboration with an international SUNY network partner. The focus at DUT has been on internationalisation, and transformation of the curriculum and not on e-learning (using a Learning Management System - LMS) *per se*. The technology is used as a platform to enhance the classroom experience and encourage students to become independent learners, thus promoting curriculum development and delivery initiatives. Aligned with the SUNY model a key aspect of COIL at DUT has been on the integration of knowledge from South Africa that is shared freely and uncensored with the academic partner and their students. The expansion of COIL projects to partners from, for example, Mexico, Brazil and India, has made major contributions to this shift in knowledge as power towards knowledge diplomacy. Currently the main focus of COIL activities at DUT have centred on undergraduate programmes.
A critical aspect of COIL is building in reflection at every level for the staff and the students involved. Feedback gathered from students who have been involved in these projects demonstrates strongly that their voices have been heard in equal partnerships with their peers, and that the learning experience has been deeper than the achievement of the pre-determined learning outcomes for the project. Students reported that, for example they: became much more aware of their strengths and weaknesses; overcame their fears of communicating with people from other countries; gained confidence in expressing themselves; took more responsibility for responding to comments timeously; acknowledged the intercultural differences and commonalities; appreciated the innovative teaching strategy and felt the learning opportunity was improved because of the collaboration; and were enriching their Curriculum Vitae
Drawing on the COIL experiences, a VE learning experience is designed by two academics one from DUT and one from a different institution (non-SUNY partner) in a different geographical location. The support and capacity building for staff is provided by DUT. The two academics agree on the learning outcomes for the project and the topics to be discussed collectively by the students. Interestingly the academics do not have to be from the same, or related disciplines. Some of the most innovative projects are multi-disciplinary, involving for example, nurses and engineers working on the design of a hospital, or health professional students and law students collaborating on an ethical issue. Once the project has been designed it is implemented with minimal input from the academic staff, whose role now becomes that of overseeing that the student groups are engaging with each other. The principles underpinning VE projects are that they are, by their very nature,

crafted with mindful attention to ensure that the two groups of students engage in a way that will enhance their intercultural awareness and will promote them to work in international, intercultural teams. Another vital aspect is that the academic staff are free to agree on a platform for communication that can be selected from the range of social media and apps available. The communication platform does not have to be pre-prescribed by the software available to support e-learning at the university. Students are also free to come to an agreement to the platform that they will use to communicate synchronously or asynchronously, outside of the platform chosen by the academic staff. Thus, in the implementation of the VE project there are opportunities for different levels of engagement within the student groups using a variety of technologies that transcends the level of the institutional LMS and enable the students to come together collaboratively.
In a nutshell the power of VE projects is that they are low-cost solutions to the internationalisation of the curriculum. The virtual mobility that the students experience through the implementation of the project allows them to exist in a place that they could otherwise not afford, and thus contributes tremendously to the achievement of internationalisation at home. They are provided with an opportunity to engage with their peers in a different country to exchange knowledge and create new knowledge that is both synergistic and shared.

THE PEESA III PROJECT AT DUT

DUT is one of the eight partner universities in the European Union Funded PEESA III Project. There are three other partners from South Africa together with two from Germany, and one each from Poland and Romania. The inclusion of Poland and Romania in the project is inspiring. Even within a well-resourced system of European countries, Poland and Romania have remained less involved than their Western European counterparts. The mix of partners in the PEESA III project opens up opportunities for the development of curricula that balances the African perspective as well as those from Western and Eastern Europe. The opportunity for DUT staff to work with staff and students from Germany, Poland and Romania adds a diversity that will contribute to new perspectives and plurality that are essential tenets of a decolonised curriculum
According to the PEESA III Project Proposal (2017) one of the key aims is to design three Master degree qualifications in engineering, based on flexible learning paths (blended, distance, on-line learning), that are mutually recognised by the Project partner universities. The associated activities are: curriculum development; the development of learning and teaching tools including those that embed ICT practices; the development of flexible learning paths with the integration of blended, distance and online modes of learning that enable access to the programme for students in full-time employment; and research into innovative practices including student-driven flexible learning paths. Consequently, each of the partner universities has identified the development of one online module as one of their key outcomes for the project. Other aims of the project include: capacity development for curriculum design and development; enhanced digital teaching; enriched intercultural capability; and promotion of real and virtual mobility for staff and students (PEESA III Project Proposal, 2017). The aims of the Project thus align well with the concept of VE as a driver for innovation in learning and teaching, development of intercultural competence, integration of technology and promoting virtual mobility.

VE AS A NEXUS IN THE CONTEXT OF THE PEESA III PROJECT

VE has been identified as having the powerful potential to be the nexus between internationalisation and decolonisation in curriculum design, development and delivery. As explained earlier, a VE project affords opportunities for students to exchange their own knowledge, from the context of their own location with peers in another country, and vice versa. This thus achieves one of the key

principles of decolonisation – that knowledge is shared and that African knowledge and perspectives has equal status with those from other contexts.
A counter-argument to VE could be that the development of blended, online, distance learning material will also promote these attributes. However, it is to be expected that the learning materials for the flexible pathway will be available on a selected LMS. At DUT the LMS (currently Blackboard), is used in online (e-learning) to share content, encourage collaboration amongst a student group, and for assessment of learning. Honest reflection reveals that it has had a very slow uptake, and that many staff use the LMS space merely as a repository for notes. Furthermore, online learning at DUT is confined solely to the university with no other partner institutions involved. VE projects offer a different perspective because there is a partner institution and there is greater freedom and flexibility in the choice and application of technology. The experience of COIL at DUT has demonstrated that academic staff respond innovatively to the opportunities the collaborative approach offers.
It is proposed that the stakeholders in the PEESA III Project be given the space and time to deliberate on the concepts of internationalisation, and decolonisation of the curriculum, and the implications for curriculum design in the PEESA III project. It is strongly recommended that projects that resonate with the VE principles are designed and implemented collaboratively by the partner universities to promote international, intercultural and multidisciplinary competences in the Master's degree students.

CONCLUSIONS

The discussion presented above has sought to briefly explore the concepts of internationalisation and decolonisation generally, and their interpretations at DUT specifically. Innovative approaches to learning and teaching using COIL and VE methodologies have also been discussed. A key purpose for this exploration of the potential of VE to be the nexus between internationalisation and decolonisation is to stimulate discussion with the stakeholders of the PEESA III Project. It is strongly recommended by DUT that the VE principles of curriculum design and implementation of are implemented in the Project.

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New Curriculum Development in Operations Management

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ABSTRACT

Operations management is growing in importance as an advanced studies discipline in Business and Management Schools and Departments. The structured masters program has particular appeal to working professionals with a business or engineering background. Structured masters programs in different areas of Management will serve as vital training for a young South African population preparing to engage in the 4th industrial revolution. Communication advances, particularly in information technology, have escalated the use of online and blended approaches to curriculum delivery. This research focuses on the design and implementation plan of a structured operations management program at the Masters level. It draws on an analysis of existing taught Masters programs at Tshwane University of Technology as well as an examination of best practices on an international level. This study also considers how the 4th industrial revolution should be addressed through curriculum content and delivery. Alternatives are presented regarding the best approach, considering time and resource restrictions.

Keywords: *curriculum development, operations management, blended learning.*

BACKGROUND

South Africa is concerned with preparing its workforce for the 4th industrial revolution. This is a natural response to globalization and technological advances that are impacting industry, consumption patterns, job creation, culture and communication. Every university wants to improve the employability and job advancement of its graduates. The expansion of postgraduate studies addressing operations management addresses these concerns.
A postgraduate program designed to produce Masters graduates with added skills in operations management in this era of the 4th industrial revolution is in the best position to expand the management workforce responsible for enhancing industry productivity. This is the milieu where advanced courses are developed and taught and where students engage with academic staff to conduct research. Postgraduate studies are increasing in proportion at universities across South Africa. Globally, universities are being rated based on their research production. The Department of Higher Education and Training (DHET) in South Africa recognizes the importance of postgraduate education allocating funding to Masters and Doctoral students directly and through

various additional sources including the National Research Foundation (NRF), Department of Trade and Industry (DTI), and the Sector Education and Training Authorities (SETAs). Postgraduate outputs provide universities with additional funds for each graduate and each recognized publication. The intent of these incentives is to provide much needed advanced skills. The added incentive for each university is the potential to improve their international ranking and rating. This in turn will make the university more attractive to top students, lecturers and researchers. The higher quality postgraduate students, lecturers and researchers will be more productive contributing toward further increased quality.

Tshwane University of Technology (TUT) is the largest university of technology in Southern Africa. TUT realizes to advance its status as a highly rated university it must expand its postgraduate opportunities. TUT's Faculty of Management Science has requested that the Department of Operations Management explore the development of a structured masters program in Operations Management.

In 2018, Tshwane University of Technology offered twenty structured Masters degrees. Each of the seven Faculties offers as least one structured Masters degree. The Faculty of Management Sciences currently offers more than any other Faculty, two in the School of Business, two in the Department of People Management and Development and one in the Department of Management and Entrepreneurship. Most of these masters programs are in the process of transforming from Masters of Technology to Masters of Engineering Technology. The university anticipates expanding is postgraduate offerings to several other structured Masters.

All the TUT structured masters programs, with the exception of the Masters in comparative local development and the MBA have a 90 credit research project /Mini-dissertation. To stay in line with other structured masters at TUT, this new program will have a 90 credit mini-dissertation. TUT has mandated every Faculty to develop online taught courses. However, the operations management program will start as an on campus taught program. The department will take advantage of the latest advances in educational technology, make full use of instructional support software and engage in blended learning.

The new program in Operations Management is based largely on examining comparable programs at highly rated universities, the undergraduate programs in Operations Management at TUT and related Masters programs at TUT such as the Engineering Management and MBA programs.

Several internationally rated programs in Operations and Production Management were examined. These include programs from Stanford University, Purdue University and Massachusetts Institute of Technology (MIT) in the USA and Rotterdam School of Management and HEC Paris in Europe. These programs share a strong emphasis in supply chain management, quantitative skills and a variety of taught electives open to students. In all cases the research project was 25% or less of the credits.

Before investigating different options, a number of questions were raised.

1. Should the Masters program address all three programs in the department: project management, management services and operations management?
2. What prerequisites should be established for entry into the program? 65 or 60 minimum on Honours or Postgraduate diploma. Should certain B Tech courses be required?
3. What should be the balance between taught modules and the research component? Should it be 50% taught modules and 50% mini-dissertation? Or 75% -25% split.
4. Should the program draw on modules from other departments and faculties? Enrol students in modules or take all or part of the content of select modules in other departments?
5. Should the presentation of the taught modules be totally classroom based? Or should blended learning modules or full online modules be considered?
6. Should there be one track of Operations Management for all students? Or should we have multiple tracks, such as a track devoted to operational research?

7. Should students be given options to choose between electives? If so what should be the core material required of all students? What and how many electives should be offered?
8. Who is the primary audience for this program? What is the primary pool for potential students? Is the focus fulltime day students or working students?
9. What is the geographic base of our students? Are we focusing on local students, or will we primarily look to draw from across the country, or across Africa or internationally?
10. How will the class be scheduled? Evenings, Friday evening only, Friday and Saturday, Saturday and Sunday, Saturday only, complete a block in 2-3 weeks, modules to go 6-15 weeks meeting one or two days a week, or other options?
11. What resources should be allocated to implement this structured masters? This would greatly impact the scope and timing of the development of the structured masters.
12. How and at what point should the research component be linked to taught modules? Should the research component meet as a class on a regular basis with fixed assignments?

Defining the context for development

The twelve question above were addressed by considering similar programs at leading universities, as well as a careful examination of the TUT trajectory in developing postgraduate studies. The Operations management department is small and one of the youngest in the University.

Table 1: Terms of Engagement

Pre-requisites	Admission to the program requires Honours or Postgraduate diploma in Operations Management or a closely related field. A student must have an average of 60% or higher overall, with 60% or higher in Operations Management, Research Methods and Operations Research modules.
Student Recruitment	The pipeline within TUT will be a primary source of recruitment. A plan to focus on recruitment across all UoTs is key to attracting quality students. However, the recruitment pool for this operations management program is international.
Admission Process	Student must submit all document standard to the university postgraduate admissions process. Students will submit an abstract of a minimum of 120 words indicating their research interest. After the abstract is approved, the student can register.
Collaboration with other programs	This program is only for students pursuing a Masters in Operations Management. However, the synergy with programs Project Management and Engineering Management must be considered.
Format of taught modules	The focus will be on direct contact taught instruction and will rely on the use of computer-based educational technology, as well as blended learning. In anticipation that most students will be working fulltime and attending TUT on a part time basis, taught modules will meet on Friday afternoon/evening and Saturday. 4-6 taught modules will be required.
Scope of core modules	Core modules will cover the fundamentals of operations and supply chain management and prepare students will quantitative methods for conducting research and managing production and service operations. Content will be mindful of the demands of the 4th Industrial Revolution.
Scope of elective modules	The selection of initial electives will take into account the current human resources in the department, university and country. The structure of certain electives will have a flexibility to adjust to demands of the 4th Industrial

	Revolution.
Research component	The research component will consist of a mini-dissertation worth half of the credits to complete the degree. At what stage in the Masters program should a student start the research component?

With the merger of the Technikon Pretoria, Technikon North-West and Technikon Northern Gauteng in 2004 a new entity came about that then became known as the Tshwane University of Technology (TUT). The Department of Industrial Engineering and Operations Management resided in the Faculty of Management Sciences and was also restructured in 2004. The B Tech: Technology Management and all the Industrial Engineering courses were transferred to the Faculty of Engineering and Built Environment (FEBE) in June 2004. The Operations Management department still presented Engineering subjects as a service to the Industrial Engineering department until the end of 2014. The subjects were officially transferred to the Industrial Engineering department because of the Operations Management department's lack of resources. The Operations Management department still has a lack of resources and this was taken into consideration in the development of the structured masters. The results in Table 1 above define the context for developing the new structured masters in operations management.

PRE-REQUISITES, RECRUITMENT AND ADMISSION

Admission to the program requires Honours or Postgraduate diploma in Operations Management or a closely related field. Working students with a B Tech in Operations Management pay be admitted with the requirement that the complete 40 credits of postgraduate coursework in operations management as approved by the department. A student must have an average of 60% or higher overall, with 60% or higher in Operations Management, Research Methods and Operations Research modules. However, a limited number of students will be admitted. Students with the highest averages will be considered first. However, a balance in student enrolment is important so gender will be considered and students coming from a disadvantaged community will be given special consideration.

A plan to focus on recruitment across all UoTs is key to attracting quality students. The preparation and intent of students in other UoT programs is most similar to that of TUT students. However, the recruitment pool for this operations management program is international. DHET (2017) has developed guidelines for the South Africa curriculum to align with international standards. The plan to recruit top students from outside South Africa will be multi-phased. As the program advances recruitment outside of the country will expand based on results of the programs and resources devoted to this effort. Success in recruitment is directly linked to funding available to support top students.

Student will be required to submit all documents standard to the university postgraduate admissions process. Students will submit an abstract of 200-400 words indicating their research interest with their application. The abstract should clearly indicate the planned methodology. This methodology should be based on material in one of the three core taught modules. They are encouraged to develop their abstract based on a topic from the list provided by the department. When the abstract is approved by the Departmental Committee for Research and Innovation (DCRI), the new student will be allowed to register. There are three registration time frames (start dates) each year. They correspond to the start date of the three core taught modules. The student should start the program with the core taught module that covers the methodological basis for their research. This allows the earliest collaboration with lecturers teaching the methodology the student has chosen to employ. This arrangement will provide the engagement on methodology at the earliest point of study and facilitate faster development of the student's proposal.

The Operations Management department has three tracks – operations management, management services and project management. The Diploma in Management Services teaches students how to advise all levels of management on solving their problems in a service environment to achieve their organisational goals, in particular regarding profit, cost-effectiveness, quality, efficiency and productivity. The Diploma in Operations Management, on the other hand, deals with the management of the process of providing the market place with products. It covers the tasks, issues and decisions facing an operations manager responsible for providing essential products to the market effectively and efficiently. The current project management qualification offered in the department, focuses on producing well-rounded project management graduates that are capable of applying project management knowledge, skills, tools and techniques to project activities in projects environments of varying complexities.

In developing this new program the synergy with programs in the School of Business and Project Management in the Faculty of Management Science (FMS) and Engineering Management in the Faculty of Engineering and Built Environment (FEBE) must be considered.

COURSE DELIVERY TAUGHT MODULES

The planned delivery of the taught modules for the structured Masters of Operations management follows the terms of engagement listed above. The core modules will cover the fundamentals of operations and supply chain management and prepare students will quantitative methods for conducting research and managing production and service operations. The plan for developing and selecting content of the core modules will be mindful of the demands of the 4th Industrial Revolution. The core modules will build on fundamentals taught in the Bachelor's, Honours and post-graduate diploma level in Operations management in South Africa.

The selection of core modules also takes into consideration core subject matter at leading universities internationally. The trend is to focus more on quantitative techniques. This is consistent with developments of the 4th Industrial Revolution where IoT, Cloud computing and Knowledge management are combining to generate massive amounts of information on both manufacturing and service operations.

Big data and information analysis is becoming pervasive. To better prepare management, the emphasis on quantitative methods such as mathematical programming, regression analysis and forecasting techniques will only increase (Hillier & Lieberman 2015). Big data and analytics also facilitate the use of simulation and other decision support techniques. Operational Research is a core course at both the diploma and advanced postgraduate diploma level. The core module on advanced operations research and quantitative methods builds on these pre-requisites. This module will provide a range of methodologies for students to engage in quantitative research (Wilson et al 2016).

Supply chain management continues to be a core aspect of operations management (Sarkar 2017). The globalisation process makes supply chain and value chain study even more important. Consumer goods and machinery manufacturing involve suppliers from multiple countries increasing the complexity of their supply chains (Chopra and Meindl 2018). The Africa Free Trade agreement offers opportunities to examine the supply chain and value chain from the primacy of Africa. Small and medium enterprises (SMEs) play and important role in the economy of South Africa. It is important to understand SMEs' role in the supply chain and to assure their fair share of the value chain. These are considerations that must be addressed in this module to best prepare students to engage in management operations. This core module is the pre-requisite for more in depth study in the service, government and manufacturing sectors.

System dynamics (SD) is a methodology that originated at MIT Sloan School of Business (Forrester 1975, 2013). They have one of the internationally top ranked management programs and offer a

Masters and Doctoral degree in system dynamics. Along with system thinking, SD has emerged as a major approach to addressing a wide range of business problems. The approach taken is to train students in the methodology and the programming tools such as Stella or Vensim (Sterman 2000). Peter Senge, trained at MIT in SD, developed a systems approach, for building learning organisations, that is widely used by business and governments (Senge 2006). Both SD and learning organisations are covered in the Business Dynamics taught module for the Engineering Management structured masters at TUT. It has been well received and a number of students use SD as their methodology for their thesis research. The proposed module for operations management will extend the system thinking content (Jackson, 2019). There is a South Africa SD Society that hosted a national conference offering the opportunity for students and staff to present their research.
The decision to provide elective modules is in line with the operation of the most successful and highly rated operations management masters programs internationally. This is designed to assure the program keeps pace with evolving sub-disciplines in operations management, as well as the technological demands on industry and government operations. Giving students options through taught electives makes the program more attractive to students that have distinct interests. The selection of initial electives takes into account the current human resources in the department, university and country. The structure of the electives will have a level of flexibility to adjust to demands of the 4th Industrial Revolution (Xing & Marwala 2017; Canals & Heukamp 2019; Odame & Jubi 2018). Financial management and Project management overlap with operations management (Block, Hirt, & Danielsen, 2019; Kerzner, 2018; Turner, 2019). The core taught material provides the basis for advanced studies in financial, project and service management. The elective module on Special Topic: Advances in operations management is designed to adjust the content based on current developments in operations management.
The range of credits varies indicating the potential range in depth of each of the taught modules. The minimum number of taught modules would be four with three core modules of 30, 20 and 20 credits and one elective of 20 credits. The option detailed below is with three core modules of 20 credits each and two electives of 15 credits each. This provides more time for the core modules that focus on alternative methodologies that the students can select from. The elective modules will be provided based on resource availabilities and may be offered only once every two years.

Table 2: Taught modules: Core and Elective.

CORE TAUGHT MODULES (20 credits each)	
Advanced Operations Research & Quantitative Methods Supply Chain Design & Management with Value Chain analysis System Dynamics and System Thinking	
ELECTIVE TAUGHT MODULES (15 credits each)	
Advanced Operations Management: Engaging the 4th Industrial Revolution	Project Management
International & Environmental Management	Service Management
Special Topic: Advances in Operations Management	Financial Management

COURSE DELIVERY RESEARCH COMPONENT

In keeping with most structured masters programs at TUT, the research component will consist of a mini-dissertation worth 90 credits, half of the 180 credits required to complete the degree. Every effort will be made in organising this component to assure timely proposal development and dissertation completion. This will require a careful examination of the successes and failures in how current structured masters programs are handling their research component.

The critical question is - At what stage in the Masters program should a student start the research component? Some programs require completion of all the taught modules before beginning the research component. NRF will only fund Masters students that complete their research proposal within six month of the start of the program. Students in the current structured masters for Engineering Management submit their proposal during the 2^{nd} year. This makes them ineligible for NRF funding. The current Policy on Postgraduate Studies states "the student prepares and submits a research proposal preferably within six months (but not later than eight months) to the relevant DCRI, for approval by the FCPS." The organisation of the research component must take these realities into consideration.

The Policy document on Postgraduate Studies must be revised to clearly indicate the distinction between mini-dissertation and full research dissertation. This may require indicating a recommended page limit or required number of references. It may also address changes to the external review process. External reviewers of mini-dissertations must be advised on the unique nature of the mini-dissertation so their review will be consistent with the intent of the structured masters program.

The recommendation is that all students develop their proposal during the first six months of study. The Faculty Committee of Postgraduate Studies (FCPS) must approve a student's proposal within this time period. This requires that students have a strong idea of what they will research and the methodology they will employ when they start the program. Students should build on the abstract they submitted as part of the admissions requirement. Students should draw their methodology from one of the three core taught modules. This will allow a student to complete a significant portion of the methodology development while completing these core modules.

Most Masters programs at TUT and other competing universities in South Africa, require a journal publication, conference presentation or journal ready paper. This is not a standard requirement for most mini-dissertations. All of the students in this program should submit a journal ready paper that must first be approved by the student's supervisor and then must go through an internal department review coordinated by the DCRI.

Given the current timeline for developing the Operations Management Masters program, aspects of the research component may have to be developed as the program approval process progresses. The university is currently considering recommendations for additions or changes to the Policy on Postgraduate Studies. The process for developing this new masters program should consider submissions to the revised policy document that will benefit the proposed structured Masters in Operations Management.

RESULTS: SELECTION OF APPROACH

The approach addresses both course delivery issues and curricula content development, and will be determined by the time and financial constraints and the program goals. Table 3 examines alternatives for different timelines for full-funded program implementation, while Table 4 corresponds to limited funds for the new program. In both cases, a short-range 1-2 year time constraint is compared to a 3-5 year full term program.

Table 3: Full Funded Curriculum Development Options

Time Constraint	Program goal	Recommended approach
1-2 years	Limited New program	This requires the addition of one full time senior lecturer or professor fully devoted to the postgraduate program to teaching and supervising students. Core modules taught by Operations management staff. Number of students limited to 20 so department staff can handle

		research projects. Only four elective modules – project management (handled in department); financial management (handled by Business school); service management (handled by department) and Special Topic: Advances in operations management. Each core and elective module will be taught once a year
3-5 years	Full New Program	This requires the addition of two full time senior lecturers or professors fully devoted to the postgraduate program to teaching and supervising students. The additional two electives will be added. All electives and core modules will be taught once a year. With limited staff the enrolment will be maintained at 30 students per year

Table 4: Limited Funds Curriculum Development Options

Time Constraint	Program goal	Recommended approach
1-2 years	Limited New program	Core modules taught by current staff. Number of students limited to 20 so current staff can handle research projects. Only three elective modules – project management (handled in department); financial management (handled by Business school) and Special Topic: Advances in operations management (this allows possibly teaching any of the other listed modules such as service management; this may be handled by department or outside partner). Each core and elective module will be taught once a year
3-5 years	Full New program	This requires the addition of one full time senior lecturer or professor fully devoted to the postgraduate program to teaching and supervising students. The additional three electives will be added. The most popular 2 electives will be taught each year and the other four will be taught every other year. For example: project management and special topics every year; financial management and International & Environmental Management even years; and service management & Advanced Operations Management: Engaging the 4th Industrial Revolution the odd years. With limited staff the enrolment will be maintained at 25 students per year

Stanford University, Purdue University, Georgia Institute of Technology and MIT were selected as benchmark institutions for related structured masters in operations management because they are ranked as top postgraduate programs in operations and production management in the USA (US News, 2018).

Module development of both core and elective modules should be organized as a collaborative effort between the project management and operations management programs in the Management Faculty and the Industrial Engineering department in the Engineering and Built Environment Faculty. This will involve an exchange of course materials used by instructors. Discussions on lecture material; student group and individual exercises and assignments; testing regiments; tutorials and audio and video supplements will lead to the development of enhanced modules. This collaboration must identify new materials relevant to the module and new developments in instructional technology that can be used.

CONCLUSIONS

Learning from best practices of the leading examples in essential to this process. “Operations Management (OM) is the functional area of business primarily devoted to the creation, planning, and management of the resource capabilities used by a firm to create products or services” (Scheller, 2019). The concept of the firm can be extended to address public organisations. This definition of operations management by Scheller College of Business is similar to that expressed by competing top universities. The common ground operations management have with engineering management was considered and they also were examined as a source of best practices (GaTech 2019; Gupta 2018). This is the foundation for developing the new program for TUT. The authors also draw on previous experience in curriculum development. In particular the work on developing an engineering management postgraduate program at TUT (Trimble et al. 2018), as well as work on appropriate technology (Trimble 2013) and socially relevant curriculum development (Trimble & Keeling 2014).

A three-step systems approach was used in developing the recommended program. The first step was to identify questions of concern when developing a postgraduate program in operations management. The second step was to address these questions and craft the ‘terms of engagement’. The final step was to address these terms to flesh out the proposed program. Recognising the uncertainties in support and with time, four scenarios were developed for implementing the new program: 1) short range limited funding; 2) mid-range limited funding; 3) short range full funding and 4) mid-range full funding.

Module descriptors for core and elective taught modules are developed. These descriptors address: syllabus overview; pre-requisites; competencies; method of delivery; assessment activities; credits; anticipated contact and student hours and possible textbooks. Detailed descriptors for all core and elective modules can be found in Appendix B. These descriptors are the basis for comprehensive development of course material. This is a major next step in the process of implementing this new postgraduate program on operations management. The other major need is to develop a set of research topics that students can draw from. This is a key element in the recruitment process as well as assuring the timely completion of the program.

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Appendix A: Structured Masters Programs Offered at TUT

Faculty & Department	Program	Taught Modules Required	Electives
Economics and Finance /Economics	Comparative Local Development	9	None
FEBE / Architecture	Architecture in Architectural Technology	5	None
FEBE / Building Sciences	Building Science	4	2
FEBE / Industrial Engineering	Engineering Management	7	4
Humanities / Applied Languages	Language Practice	2	None
Humanities / Public Management	Public Affairs	5	7
Humanities / Safety & Security Management	Policing	6	9
ICT / Computer Science	Information Networks	5	8
ICT / Computer Science	Professional Practices in Info Technology	6	3
ICT / Informatics	Business Information Systems	6	None
Management Sciences /Business School	MBA	12	6
Management Sciences /Business School	Organisational Leadership	6	None
Management Sciences /Management and Entrepreneurship	Entrepreneurship	6	None
Management Science /People Management and Development	Human Resource Development	4	None
Management Science /People Management and Development	Labour Relations Management	4	None
Science / Environmental, Water and Earth Sciences	Environmental Management	4	4
Science / Mathematics and Statistics	Mathematical Technology	12	None
Science / Pharmaceutical Sciences	Pharmaceutical Sciences	4	5
Arts / Drama and Film	Drama	1	None

Note: the four Masters programs (not counting the MBA) in the Faculty of Management Sciences each require either 4 or 6 taught modules and offer no electives.

Appendix B: Taught modules – Core and Electives

B.1 Core Taught Module Descriptors

Module Name	**NQF-Level**	**Overview of Syllabus**
Advanced Operations Research & Quantitative Methods	9	Review of linear, non-linear, dynamic and stochastic programming and discrete simulation; extensive applications of mathematical programming, linear and non-linear regression, forecasting, cost-benefit analysis and advanced statistical analysis applications.
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, lab sessions for software instruction and tutorial sessions	40 hours over 10 weeks	Demonstrate the ability to construct and solve a range of mathematical programming models for business situations; And to set up and perform regression models, alternative cost-benefit analysis and statistical models.
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	20	Operations Research at Honours or Postgraduate diploma level
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	300	Homework problems using Excel solver and Lindo (or other LP/NLP software) to solve mathematical programming and regression models; In class / group assignments formulating mathematical programs and statistical models; 3 Tests and End of term team project or individual research pre-proposal

Textbooks	**Reference books**	**Related websites and videos**
Regression Analysis: Understanding and Building Business and Economic Models using Excel: JH Wilson et al Introduction to Operations Research: FS Hillier et al	Non Linear Programming: D Bertsekas	www.informs.org http://www.orssa.org.za

Module Name	**NQF-L**	**Overview of Syllabus**
Supply Chain Design & Management with Value Chain analysis	9	Supply Chain Performance: Achieving Strategic Fit and Scope; Supply Chain Drivers and Metrics; Designing Distribution Networks; Network Design in the Supply Chain; Designing Global Supply Chain Networks; Demand Forecasting in a Supply Chain; Aggregate Planning in a Supply Chain; Sales and Operations Planning; Coordination in a Supply Chain; Global Value Chain; Impact of 4th Industrial revolution
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, blended learning with online tutorials, lectures and tests with asynchronous access	20 hours over 8 weeks	Use of software such as Excel solver to construct and solve supply chain problems at strategic, planning and operational levels, Ability to conduct value chain analysis for global problems.
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	20	Operations Management at Honours or Postgraduate diploma level
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	200	Problems using Excel solver to locate facilities, design distribution, forecast demand and calculate other supply chain measures; Group activities (in class and online) to evaluate case studies on supply chain design and operation 2 Tests End of term project (team or individual) or individual research pre-proposal

Textbooks	**Reference books**	**Related websites and videos**
Supply Chain Management Strategy, Planning and Operation: S. Chopra & P. Meindl	Global Supply Chains: Evaluating Regions on an EPIC Framework – Economy, Politics, Infrastructure, and Competence: “EPIC” Structure – Economy, Politics, Infrastructure, and Competence – M. Srinivasan	www.pearsonglobaleditions.com/chopra

Module Name	NQF-Level	Overview of Syllabus
System Dynamics and System Thinking	9	Major concepts of system dynamics including feedback, delay and generic behaviour; Causal loop diagrams; stock & flow diagrams; bulls-eye diagram; constructing aging chains and using co-flows; modelling using Stella, Vensim or similar software; critical thinking, system thinking, mental models and conceptual models as related to business problems
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	20	Operations Management at Honours or Postgraduate diploma level
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, lab sessions for software instruction and tutorial sessions. Some online content, including key videos from noted system dynamic practitioners out of MIT	32 hours over 8 weeks	Application of system dynamics methodology including identification of problems, reference mode, time horizon and construction of stock & flow diagrams, causal loop diagram, time horizon and bulls eye diagram. Ability to conduct validity checks on system dynamics models
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	200	Problems using system dynamics software; Construct stock & flow diagrams. Group activities addressing team learning, shared vision, mental models system thinking and critical thinking 2 Tests End of term project (team or individual) or individual research pre-proposal

Textbooks	Reference books	Related websites and videos
Business Dynamics: J. Sterman Learn to Think in Systems: A. Rutherford	The Fifth Discipline: P. Senge Strategic Modelling and Business Dynamics, A feedback systems approach: J Morecroft	www.systemdynamics.org systemdynamics.org.za

B.2. Elective Taught Module Descriptors

Module Name	NQF-Level	Overview of Syllabus
Project Management	9	Organisation structures, staffing, communication and conflict management; Planning & scheduling techniques; Pricing & cost control; Metric, risk and quality management; project specification, review and life cycle; Master PERT/CPM; Risk analysis; Project management maturity models.
Method of delivery	**Contact hours**	**Competencies**
lectures, lab sessions for software instruction and tutorial sessions	30 hours over 6 weeks	Demonstrate knowledge of and engagement in the area of project management techniques, methods and methodologies including competencies in application of tools and techniques relevant to the field of project management.
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	15	Advanced Operations Research & Quantitative Methods; Supply Chain Design & Management with Value Chain analysis
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	Homework problems; In class assignments formulating mathematical and statistical models; 2 Tests and End of term team project

Textbooks	Reference books	Related websites and videos
Project Management: A Systems Approach to Planning, Scheduling, and Controlling: H Kerzner	A Guide to the Project Management Body of Knowledge (PMBOK(R) Guide-Sixth Edition)	www.projectmanagement.org.za www.ipma.world

Module Name	NQF-Level	Overview of Syllabus
Financial Management	9	Investment decision criteria; project cash flows; Risk analysis and project evaluation; Financial forecasting & planning; Working capital management; Corporate risk management; International business finance
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, and tutorial sessions	30 hours in 6 weeks	Display an understanding of risk-return trade-off and ability to conduct financial forecasting
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management or Business School	15	Supply Chain Design & Management with Value Chain analysis and System Dynamics and System Thinking
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	Homework problems ; 2 Tests and End of term team project

Textbooks	Reference books	Related websites and videos
Financial Management: Principles and Applications: S Titman, A Keown, and J Martin	Financial analysis, Planning & Forecasting: theory and Application: JC Lee & CF Lee	www.fma.org

Module Name	NQF-Level	Overview of Syllabus
Service Management	9	The service concept; customer and supplier relationships; service processes and service people; resource utilisation, information, networks and technology; performance management; service strategy & culture
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, and tutorial sessions	30 hours over 6 weeks	Understand 1) technology options in service industries; 2) service strategy formulation and 3) service performance measures
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	15	Advanced Operations Research & Quantitative Methods; and Supply Chain Design & Management with Value Chain analysis
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	Homework problems; Case studies of service industries; In class / group assignments; 2 Tests and End of term team project

Textbooks	Reference books
SERVICE MANAGEMENT An Integrated Approach to Supply Chain Management and Operations Haksever & Render	Service Management: Operations, Strategy, Information Technology: J Fitzsimmons Service Operations Management: Johnson & Clark

Module Name	NQF-Level	Overview of Syllabus
Advanced Operations Management: Engaging 4th Industrial Revolution	9	Using AI to eliminate waste; the four manufacturing revolutions; data mining and product flow; introduction to deep learning and neural nets with applications in manufacturing; AI lean six sigma, project management/ development
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, Tutorial sessions, Online videos	30 hours over 6 weeks	Understanding how 4th Industrial revolution is different from earlier industrial revolutions; applying AI lean six sigma
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	15	Advanced Operations Research & Quantitative Methods
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	Homework problems; 2 Tests and End of term team project

Textbooks	Reference books
Lean Six sigma in the age of AI: M George and	Strategy is Digital: How Companies Can Use Big Data in the Value Chain: C. Gordon et al; Handbook of Research on Supply Chain

D Blackwell	Management for Sustainable Development: U Akkucuk

Module Name	NQF-Level	Overview of Syllabus
Special Topic: Advances in operations management	9	Focus on recent developments in operations management. Knowledge transfer in special topics of operations management. This allows for international guest lecturers to provide online sessions.
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, online, blended and/or tutorials	20-30 hours in 4-8 weeks	To be determined by the particular subject matter and lecturers.
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	15	Advanced Operations Research & Quantitative Methods; Supply Chain Design & Management with Value Chain analysis; and System Dynamics and System Thinking; and permission of supervisor
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	To be determined by the particular subject matter and lecturers.
Textbooks	**Reference books**	**Related websites and videos**
TBA	TBA	TBA

Module Name	NQF-Level	Overview of Syllabus
International & Environmental Management	9	The role of different global environmental institutions; Issues with maintaining ocean, atmospheric and fresh water commons; Species and biodiversity conservation; Emerging issues and future scenarios.
Method of delivery	**Contact hours**	**Competencies**
Classroom lectures, tutorial sessions	30 hours in 6 weeks	Apply System dynamics to environmental and global problems.
Module Custodian	**Credits**	**Module pre-requisites**
Operations Management	15	Supply Chain Design & Management with Value Chain analysis; and System Dynamics and System Thinking
Method of assessment	**Student hours**	**Assessment activities**
Continuous assessment	150	In class / group assignments; Case studies; 2 Tests and End of term team project
Textbooks	**Reference books**	
Global Environmental Institutions: E Desombre	Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems: A Ford	

DUAL STUDY PROGRAMMES & NEW CURRICULA DEVELOPMENT

New role model for teachers in Higher Education?

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ABSTRACT

The traditional university was for decades not called into question as a place for R&D and higher education.
At the one hand this enabled successful independent research, at the other hand there was few need to reflect traditional structures of knowledge transfer.
The nowadays omnipresent decrease in financial resources has caused universities to compete for financial support from the business sector; additionally universities have to justify their existence for their duties in education for providing the society with academic skilled working forces. This leads to a competion between the universities and to attract applicants they have to boost the attractivity of the offered study programs. Education became a market.
The traditional methods of ex-cathedra teaching have been the standard mean of knowledge transfer for a long time. The pedagogical concepts at the tertiary level were neglected; in many institutions the teaching duties were seen more as a burden than mission.
The paper will show that the values of our great philosophers are still valid and how the new teaching approach of Dual Education can fullfil requirements of industry for young academics at the entrance to business life.
The development of dual study programs and a new pedagogical approach in teaching methods may be one mean to face the challenges for the successful education especially in the technical sciences.

Keywords: *teaching, dual study program, cooperative education, knowledge transfer*

INTRODUCTION

The presented exposition will deal and highlight the following questions: What does the economy/industry expect from students after graduation? What does business expect from universities and schools?
What do great philosophers say about educational goals?
What does it mean for the role model of a cooperative teacher? What is a teacher? What is the teacher's role and what are his/her traditional duties and expectations?
How can the teaching model of Dual Education be supportive in the learning processes?

EXPOSITION

The Dual Study program of "Production, Technology and Organization" at the University of Applied Sciences FH Joanneum in Graz was the first dual study program in Austria. This so called Dual Education roots in the traditional secondary education of apprenticeship as it is known in the German speaking countries (Austria, Germany and Switzerland).
"Dual Education", in the English speaking world called "Cooperative Education", transfers the idea of having two learning environments (university and company) in the tertiary level - academic -

education.
The requirements of industry concerning the education of academic employees are rising, but it is not only the subject related specific educational content which has to be improved more over there are values of the Humboldt's ideal of "studium generale" and personal developement which become more and more requested.
The working environment is changing rapidly and the buzz-phrase "industrial internet of things" (in German speaking countries called: "Industry 4.0") has become omnipresent in all production branches. There is no question about the fact that our society needs reseachers and scientists; nevertheless, because of the industrial internet, there is a rising demand in industry for highly qualified academics even besides R&D.

The German Chamber of Industry and Trade showed already in their survey in 2014 what the main expectations of business are concerning graduates from bachelor programs (see Fig. 1).

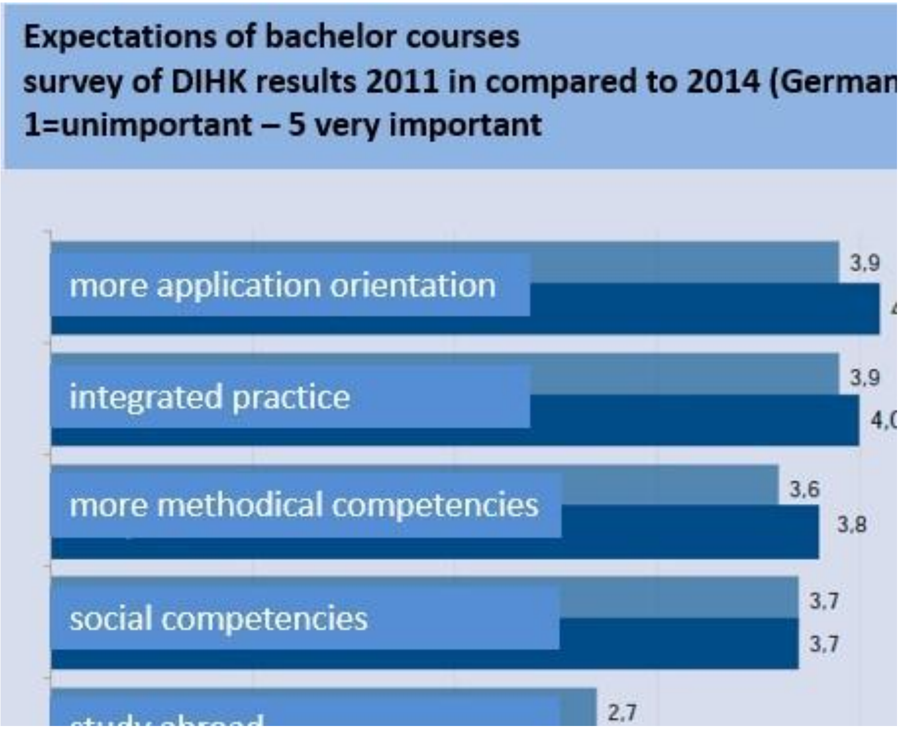

Figure 1: "Expectations of bachelor programs" (Heikaus and Flasdick, 2015)

Fig. 1 shows clearly that the needs of business in Germany do not lie squarely in specific scientific knowledge. Most companies need well-educated engineers who are employable in the field of application.

Most students at traditional universities have maximum one semester internship experience. Often it is the case that the internship does not support the content of the study program. Social competencies should also be developed. Mostly, students are educated as "lone warriors" as they get used to being in permanent competition with their colleagues.
Fig. 2 und Fig. 3 show that competency in R&D is really not the main target and demand.
Competency in R&D is expected anyway but there are also softskills which are vital.

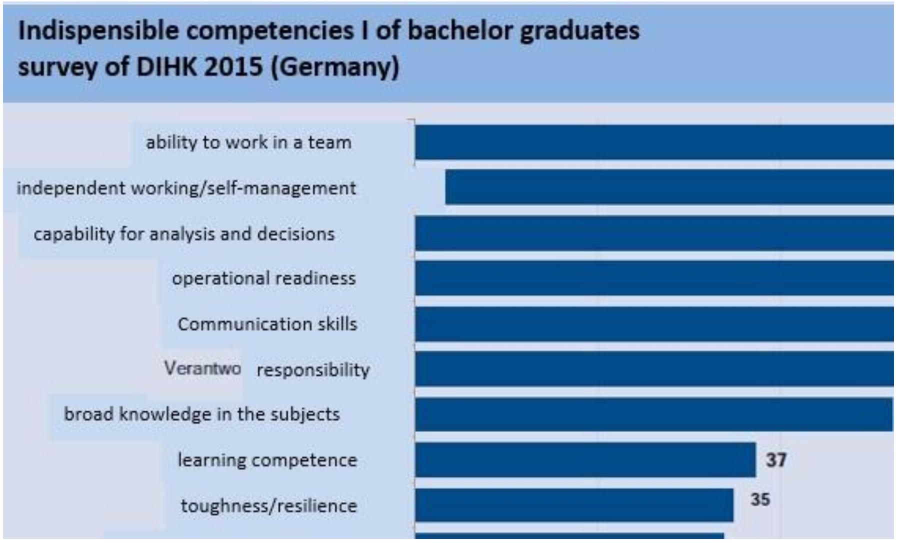

Figure 2: "Indispensible competencies I" (Heikaus and Flasdick, 2015)

A look at the Fig. 2 and Fig. 3 show the "Indispensible compentencies" which are expected by German industry to be the educational result of a bachelor graduate. It is quite interesting that the top 11 expectations are more or less in accordance with the great European philosophers and their ideals.

Figure 3: "Indispensible competencies II" (Heikaus and Flasdick, 2015)

For example autonomous individual, according to Alexander v. Humboldt, is said to be an individual who gains self-determination (autonomy) and maturity through his use of reason. To quote Humboldt: "To transform as much world as possible into one's own person is life, in the

higher sense of the word“.
“The endeavor is to work to the fullest extent possible in/at the world and thereby develop as a subject.
To become a world citizen is to deal with the great questions of humanity: to look for peace, justice, exchange of cultures, other gender relations or a different relationship with nature to strive"(Hofmann, 2010).
Immanuel Kant describes the concept of maturity as the inner and outer faculties of self-determination and self-responsibility.
He describes maturity is as state of independence. It says that you can speak and care for yourself. “Maturity is often associated with the concept of emancipation” (Berlinische Monatsschrift, 1784).
Furthermore in his famous text, in answer to the question "What is Enlightenment?" Kant wrote in 1784: "Enlightenment is the outcome of man's self-imposed immaturity.
Immaturity is the inability to use one's mind without the guidance of another. This self- immaturity is self-inflicted if its cause is not due to lack of understanding but to resolution and courage to use it without the guidance of another. ‘Sapere aude! Have the courage to use your own understanding!’ This is the motto of the Enlightenment“ (Berlinische Monatsschrift, 1784).
While the educational understanding of the last decades is usually based on a person's ability to be conditioned and therefore presupposes the "meaning" or has to presuppose unreflectively, new education leads to move independently on the level of the senses and to gain the starting point for everything else.
Originality replaces tradition.
In addition to the knowledge, in the future, this will be a self-reliant orientation knowledge, which in turn determine one’s knowledge and competencies. Traditionally, "learning" meant to pick up certain ideas or methods. In the future, it will be more a matter of developing knowledge and the ability to autonomously organize the processes of knowledge acquisition. Informal learning is increasingly replacing learning that can be organized in institutions (Dietz, 2013).
The short excursion to the thoughts and ideals of the great European philosophers that just took place shows that aims of education have not changed during the last 300 years.
Our pupils and students still need

- Maturity
  - Resolution
  - Courage
    - Self-determination
      - Self-responsibility

ans businesses of the Western World expect alumnies/graduates with these traits.
The role of the teacher is to fullfill the demands of education and of business in cooperation with enterprises. This means that students should have the chance to apply the theoretical knowledge at internships after each semester at university.
“A teacher is a person who, through higher competence in certain areas, teaches something to others. Since it is not a protected term, everyone can basically refer to a phase of the imparting of knowledge, skills, lifestyles or education” (Pfeifer, 1993).
This definition shows that everybody can be a teacher. The new way of teaching makes professors and teachers to “knowledge-facilitators“ and “knowledge-coaches“. On the one hand, they have to impart traditional values according to great philosophers; on the other hand, they have to orientate the teaching content to meet demands of the industry.
The aim and method in teaching must be not ex-cathedra teaching but to motivate and escort students in a cooperative way together with industry.
Both teachers, student‘s mentors in industry and the student himself take responsibilty for the career and sucess of the student.
There are good experiences with dual education especially in technical study programs. There is a good balance of theory and practice with the added value of accessing the knowledge of the degree program.

According to the Austrian definition of Dual Education there are two learning environments for the student – the university for the theoretical background and the company for applying the theoretical knowledge in practice.
At University fundaments of the subjects are taught in a (peer-)coaching process. The student is given a certain input and has further to elaborate the teaching material. The Professor is assisting in the process nevertheless the student takes responsibility for his success.
In the company the project works for the students are in accordance with the curriculum. The company challenges the students in projects to show that he is well-educated concerning the theoretical background and also able to apply his knowledge practically. The student is integrated in the working process and also has to show (or develop) the softskills and responsibilities which he will need as a full employee after graduation.
Due to this combination there is much more sustainability in the process of learning as the student is able to recognize the meaning- and usefullness of the subjects.
With the graduation of the student practically a full-fledged employee who requires no further training is available for the industry.
The curriculum is constantly adapted and by this at the state of the art and needs of industry.

Figure 4: "Theory and practical training" (Mahler, 2015)

CONCLUSION

The traditional values which are introduced by the old philosophers are more up to date than ever. The new demands for Universities are not only to teach theoretical knowledge to the students but to teach them personal values which are nowadays called "softskills". The so called Dual or Cooperative Education in higher education is the new approach in fulfilling the demands of industry.
The system of Dual Education not only rises the value of the alumnies on the labour market it alsooffers professors/teachers the chance to be in touch with real life and permanently increase their expertise and knowlegde.
Dual education develops a new role for the professor/teacher as "science-manager" by using the state-of-the-art teaching according to the industry's demands.
The role of the teachers changes from a frontal ex-cathedra teacher to a coach.
The means mentioned above will also raise the reputation and competiveness of universities implementing these practices.

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Flexible Pathways for Modernisation of Undergraduate Engineering Programmes by Country-Adapted Implementation of the Practice- Integrated Dual Study Model in Bulgaria and Romania

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ABSTRACT

The paper addresses the need for more flexible routes for acquiring current industry-related skills necessary to boost and sustain innovation in the sectors identified by the national strategies of Smart Specialisation and regional innovation in Bulgaria and Romania. For this purpose, regular practical phases in enterprises were integrated in the ongoing engineering curricula to accelerate the update of knowledge traditionally provided by higher education institutions. The paper presents a summary of the feasibility study conducted to identify the transferability of a county-adapted model of dual higher education in Bulgaria and Romania. Consequently, the approaches of curriculum adaptation followed by the implementing universities in both countries are briefly described. Finally, the paper discusses the outcomes and provides an outlook for future development of the dual study model in Bulgaria and Romania.

Keywords: *dual higher education, responsive engineering curricula, industry-related skills*

INTRODUCTION

The need for flexible and responsive engineering curricula is a challenge in order to keep pace with the rapid technological advancement and increasing innovation pressure. In EU aspect, the need for modernising the ongoing engineering curricula is particularly acute in the new Member States Bulgaria, Romania and Croatia, which were ranked as the modest innovators in the EU scoring the last three places in the 2018 European Innovation Scoreboard. This leads to missed economic opportunities for both the states and EU investors since industrial sectors such as manufacturing represent one of the main sectors of opportunity in the region. However, the shortage of skills has been widely recognized as a key obstacle for innovation in the sectors.

Problem Definition

Advanced technologies are changing manufacturing industries transforming traditional business models and supply chains into dynamic and interconnected systems. Thus, there is an urgent need to create a flexible, adaptable and active learning workforce [Marr, B., 2019]. Education providers are challenged to regularly update engineering curricula in order to respond to the rapidly changing business and technological environment. However, the modernisation of the ongoing curriculum is often obstructed by long process of design, approval and accreditation phases within the laggard legal framework (university perspective). On the other hand, there is a lack of methodology how to involve industry stakeholders in the design and delivery of curriculum content and practical in-company training (business perspective). To tackle these problems, the project “DYNAMIC” established a knowledge alliance between academic organisations, industrial enterprises and chambers of industry and commerce to ensure better labour market intelligence and improve innovation capacities of the academic and industrial stakeholders. The alignment of objectives can be materialised through a practice-integrated dual study education programme, which strengthens the supply-demand feedback chain between business and academia.

METHODOLOGY

The implementation of the dual study model in Bulgaria and Romania was examined in the scope of a feasibility study under the name “EUDURE – European Dual Research and Education”. Objective of the feasibility study was to identify the potentials and experiences of the countries in order to find adaptive elements for transfer that can best be harmonized and adapted to the regional structures and conditions. The EUDURE project examined the framework conditions and transfer options of the German dual study principles in Bulgaria and Romania and formulated specific recommendations for implementation. Subject of the study were two of the main forms of dual study programmes in Germany – programmes with integrated vocational training and practice-integrated dual programmes as defined by the German Council of Science.
The study was conducted in cooperation with stakeholders from Bulgaria and Romania, represented by higher education institutions and social partners. The EUDURE feasibility study has adopted for the country-specific investigation the transfer factors formulated by the German Academic Exchange Services (DAAD) for measuring the adaptation potential in other countries. Based on the DAAD methodology, country-specific data was collected in order to answer the following questions:

- What type and quality of binational exchange already exists?
- Does the educational governance structure promote transfer initiatives?
- Is there already an understanding of dual education models in the target countries?
- Are the economic conditions in the target country conducive?
- Legal framework and country specifics related to university internal rules
- Are there German companies in the target country who are interested in cooperations?

A further important condition for the transfer of the dual study form is the fundamental interest of social, economic and political decision-makers in the target country, e.g. through reforms and initiatives to promote dual training models. Results of the feasibility study will be exposed in the following section.

SUMMARISED RESULTS OF THE FEASIBILITY STUDY

Both Bulgaria and Romania offer study programs at the level of the German Bachelor's degree programs as part of the Bologna Process. In both countries, especially at universities, the focus is on practical and job-oriented university degrees. Both countries have comparable quality standards in

teaching, a uniform higher education system with ECTS and a similar semester schedule, divided into winter and summer semesters. Furthermore, the framework conditions (both political and economic) are set up so that a fundamental transfer potential exists. In both countries, the efforts to upgrade vocational training are prominently located with the adaptation of the German dual vocational training system in the implementation stage. Extensive networks and cooperation between national and international economic and institutional partners already exist in both countries. Many companies with German participation are located in Bulgaria as well as in Romania. Based on the evaluation factors of the DAAD study on the transfer potential, both in Bulgaria and in Romania very good starting points for the initiation of pilot projects on dual study are a further step within the readiness to reform and the paradigm change in the education sector.
In Bulgaria and Romania, there is a significant shortage of skilled workers in the forecasted economic upswing. This increases the demand for more practical orientation in highly qualified occupations and higher education. Therefore, the dual degree program is an attractive model for both countries. In both countries, a strong initiative of the economy is currently restructuring and rebuilding the vocational training structures, based on the German vocational training system.

APPROACHES FOR CURRICULUM ADAPTATION FOR DUAL IMPLEMENTATION IN COUNTRY-SPECIFIC CONTEXT

This section focuses on the adaptation of curricula of two of the university-partners in project Dynamic to curricula with dual education elements.

Context of curriculum adaptation

Higher education across Europe is strongly characterised by the Bologna Process, which reforms aim at more coherence to higher education systems across Europe. The implementation of education reforms based of Bologna objectives in the countries Bulgaria and Romania, in particular the three-cycle system, as well as use of ECTS and Diploma Supplement tools, are fundamental for the introduction of dual studies at higher education level. The tools of EHEA establish comparability between programmes at the same graduation level throughout Europe. In this context, similarities in the operational environment of the partner higher education institutions could be drawn in order to justify the transferability of the dual education model across Europe. These were used to identify common parts in the degree structures between Germany and Austria, where dual studies at under-graduate level are well established, with those in the transfer target countries Bulgaria and Romania.

Constrains and limitations of the curriculum adaptation process

Despite the similarities in higher education structures across the partnering countries in project Dynamic, different approaches, explained by the country specifics of the single national higher education systems, were followed by the academic partner institutions during the curricula adaptation process. Beside the constrains in curriculum adaptation imposed by the national regulations in higher education, certain domains are subject to additional control and standard implications that must be taken into account. A practical example is provided by Technical University Varna, Bulgaria during the curriculum evaluation and realignment of undergraduate programmes, which underlay the regulation of the Executive Agency “Maritime Administration”.

Practice-integrated dual higher education in Romanian context Practical example "Mechatronics" in Lucian Blaga University Sibiu

The selected approach to tailor the educational process in order to comply with the requirements of the industrial partners was to adapt/change the syllabuses of specialty subjects. The adaptation of the curriculum for the dual study specialization were made by adapting/changing the syllabuses of specialty subjects. Certain specialty subjects were selected for this change (Computers programming, Digital Electronics, Power Electronics, Microcontrollers Hydraulic and pneumatic driving systems and Programmable Logic Controllers). For the dual-study Mechatronics study program, supplementary hours of practical activities were added. A supplementary amount of 810 hours of practical activities were added to the existing 240, which will lead to a total amount of 1050 hour for the dual study option. Nine weeks of supplementary hours were added at the end of the 2nd, 4th and 6th semesters (a period which now is allocated to the summer holidays). Another difference between the regular and dual study forms is that students from dual study program must attend the extracurricular courses organized by the companies (mandatory requirement), while for the students from the regular study program the attendance is optional. A new syllabus for practical activities was designed for the dual-study program. Also new rules for assessing the students for the practical activities were established by LBUS and agreed with the industrial partners. All diploma works/graduation papers for the graduates of dual study program must be unfolded in companies (mandatory requirement).

The implementation of the practical phases for dual study specialization were formalized by contractual agreements beween the university and the industrial partner (contract on practical work) as well as between the industrial partner and the student (contract of internship).

The differences between the regular and the dual study form were also formalized by designing a modified curriculum for the dual-study option of Mechatronics study program, which was approved by the Council of the Faculty of Engineering and by the University Senate of "Lucian Blaga" University of Sibiu.

Practice-integrated dual higher education in Bulgarian context Practical example from Technical University Varna

The Innovation Strategy for Smart Specialization of Bulgaria as one of the thematic area includes "Mechatronics and clean technology". At the end of 2018 the strategy was updated including new priority directions "Blue economy – development technologies". Currently, there is an urgent need for personnel in the shipbuilding and ship repair industry in Bulgaria. For this reasons, the Bulgarian academic partner Technical University of Varna has selected the programmes "Naval Architecture and Marine Technology", "Marine Engineering" and "Design of Marine Power Plants and Systems" for update of ongoing curricula and alignment with industry needs.

The specific of the selected engineering domains is characterized by the strong regulation of the ongoing curricula and syllabus by the Executive Agency "Maritime Administration" and the International Maritime Organization – for the specialty of "Marine Engineering" only. In addition all specialties follow the rules and legislations provided by the Law on Higher Education and the rules of activity of the Technical University Varna. For this reason, the curricula could be only partly adapted for dual implementation by integrating of practical components in the existing plans.

The approach for curricula update and integration of practical phases can be described with the following principles:

- all practical trainings (practices) included in the students' curriculum should not be conducted in the laboratories of TU-Varna, but on the territory of an industrial and design enterprises;
- laboratory exercises in specialized subjects (if possible) - to be conducted in the territory of an industrial and design enterprises.
- in the specialty of "Naval Architecture and Marine Technology" and "Marine Engineering" there

are planned hours (respectively credits) for independent work, which were also incorporated into the industrial enterprise training.

Integrating practical components in the programme “Marine engineering”

Students from the specialty of "Marine machinery" (“Marine engineering”), in the fourth year of their study, from the Bachelor's Degree program, have subject "Repair of Ship Machinery" in the winter semester. The programme was rescheduled in order to free two weeks at the beginning of December in which students were accepted for training at the industrial partner MTG Dolphin. During this period of two weeks, the students could pass their practical training directly involved in the repairs of marine machines and mechanisms. Classes were full-time for two weeks. All students signed a contract with MTG Dolphin, as well as they were asked to fill-in every day their diary with explanation of provided and solved tasks. A contract between TU-Varna and MTG Dolphin was also signed in advance before the training. Students who have already completed their practical training in the subject of “Repair of marine machinery” and have passed successfully their state exams in “Marine engineering” and English language for mariners, at the end of June, are currently employed on board of marine ships, part of the World Maritime Merchant Fleet.

Integrating practical components in the programme "Design of marine power plants and systems"

According to the increasing demand for marine engineers and designers of marine power plants and systems, in 2018 the Department of “Naval Architecture and Marine Engineering” has accepted the four students to study at the Master's Degree Program of "Design of marine power plants and systems". These four students, enrolled to the Master's degree program are part-time students. They currently work at Industrial Holding Bulgaria - “Ship Design”. Due to the small number of students and higher degree of flexibility, the programme was selected for test in dual mode. During the first two semesters of their study, students passed practical training at the Industrial Holding Bulgaria - "Ship Design" in the following subjects:

- „Computer systems for design of ships and marine equipment“- 1 part - 15 hours of lectures / 45 hours of exercises
- „Design of systems and devices for ships and marine equipment“- 30 hours of lectures / 15 hours of exercises
- „Computer systems for design of ships and marine equipment“- 2 part - 60 hours of exercises

The specialty of "Design of marine power plants and systems" is not under the specific regulations of Maritime Administration Executive Agency. This means that changes in the curriculum content are allowable and changes can be acceptable in accordance with the Law on Higher Education, the regulations, the rules of activity of the Technical University - Varna and the requirements of the industry.

Integrating practical components in the programme “Naval Architecture and Marine Technology”

According to the actual curriculum three are two practical activities. After second semester there is so-called “Introduction Practice” (30 hours) and after 6-th semester “Specialized practice” (60 academic hours - 2 ECTS). There are other subjects like Marine Piping Systems, Electrical Equipment of Ships and Marine Structures, Technical Safety, Structural Mechanics of Ships and Marine Structures, Welding of Marine Structures, Strength and Structure of Ships that include more than 500 extracurricular activities. Based on this the structure of the dual –study is organized in two phases: During semesters in TUV and in partner company – in summer vacation after 6th semester. The practical training is held in the summer months after the 6th semester in BULNAS (Bulgarian National Association of Shipbuilding and Shiprepair) companies with which TU-Varna has concluded partnership agreements.

The practice starts with the student application followed by approval by the company. In summer vacation after 6-th semester there are total 640 academic hours (480 astronomical hours). This is equal to 60 working days (eight hours working day). The practice will be paid according to the company conditions. This and all other conditions will be described in the corresponding agreement. Special training logbooks will be elaborated for the needs of pilot implementation. All the necessary documentation - contracts, logbooks, reports etc. will be developed taking into account local conditions, based on good practices in partner countries involved in the project. Pilot implementation of dual study will be based on a voluntary choice by the students of the 3-year course.

OUTLOOK

The described activities of curricula adaptation and implementation in form of dual practice-integrated programmes aim to demonstrate the need of closer cooperation between education providers and business actors in the countries Bulgaria and Romania. Although the dual model itself is known from the past in both countries, the connection between the stakeholders needs to be re-established and strengthened. The developed programmes described in this paper are understood as a pilot introduction of the dual study model at higher education level. At this stage, only flexibilisation of ongoing curricula within the frame of the existing legislation could be achieved by integrating practical phases in the pilot programmes. The additional efforts of the dual students in comparison with those enrolled in the regular form of study could be demonstrated by using EU recognised tools such as the Diploma Supplement. However, for the future development of the dual study model in Bulgaria and Romania, there is a need for political action and adjustment of the higher education legislation that officially recognises the dual form of study. Within the scope of the project Dynamic, examples of dual higher education solutions were created and shall be serve to facilitate the dialog with policy makers.

CONCLUSIONS

Skills shortage and rapid workplace change create the need for agile workforce. To achieve this goal, higher education curricula should be more flexible and adaptive to the current industrial needs. The close business-academia cooperation is expected to strengthen the employability of the graduates by providing them with improved knowledge, skills and motivation. The dual higher education model provides a solution for more responsive education and talent growing for the benefit of all stakeholders.

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The Emerging Role of New Technologies in Vocational Education

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ABSTRACT

The paper presents some essential tools in the field of 3D modelling for vocational education. The purpose of vocational training is to adequately prepare students for the needs of the industry. Over the last decade, the appearance of low-cost virtual reality (VR) technology has enabled it to be deployed across a broad range of educational institutions. VR as a system allows intuitive human-computer interaction and offers great benefits in many application areas important for educational process. In this paper, two VR studies in educational field were compared.

Keywords: *3D modelling, virtual reality, vocational studies, education.*

INTRODUCTION

Ever since the first industrial revolution impacted a world on a big scale, science and technology are rapidly evolving year after year. With the introduction of the steam engine, new business ideas and opportunities are created. By its evolution, improvements in speed, productivity and transport speeds were significantly improved. The steam engine allowed and brought many advantages. Big factories were opened, new transportation means were presented. The creation of the steam engine shows the result of many years of research and technology development. When the scale of the possibilities brought by that innovation was understood, people started to realise the importance of science. With the continuous work and improvements in technology and science, the world was introduced with many new solutions, inventions and things that made such a drastic and significant impact on it. Today it is almost impossible to even think about not travelling by buses, ships, planes, electric cars, etc. It is practically impossible to imagine humans lives without computers, playing consoles, mobile phones, TVs. All of those things are the result of technology evolution, research and innovation. Some of the tools that are at the basis of teaching in the field of 3D modelling for vocational education are *Virtual reality (VR), Augmented reality (AR), 3D modelling and 3D printing* (Radolovic, 2019).

EDUCATION LEVEL AS A VARIABLE IN PROCESS

The application of different technological devices in the educational process accelerates the teaching process and makes it more exciting and more acceptable. The knowledge that students need to have at the end of schooling is rapidly changing.

3D MODELING

The 3D modelling process has become more and more used in broad industry range to improve and to speed up the planning as well as the working process. Virtual models of various products, machines and facilities can help to increase efficiency while reducing costs like the ones that occur when having defect parts and components. Building a 3d product component before starting to manufacture it can help with the estimation of material costs and manufacturing process. If the product is part of an assembly we can see how will that component interact with other components of the assembly in a virtual space, and make changes if needed before the component is even made.
All the virtual 3d components are made in programs that are called Computer Aided Design (CAD). There are several different CAD programs, some of them require a licence that must be purchased in order to be able to use the program, but there are also some free CAD programs or the ones that offer free licence for educational use or for small businesses that are just getting started. One of the free CAD programs that are recently starting to be used more and more is the FUSION 360 from the company Autodesk. It is a user-friendly easy to use and cloud-based program that offers the user an interactive and multifunctional all in one service. CAD programs are most commonly used to better visualize the end product, to increase its functionality and to make assembly and work drawings of the components to be used in the workshop. In cooperation with CAM (eng. Computer Aided Manufacture) software it can be used to create the manufacturing process for the part to be made and then creating a G-code that is compatible with the CNC machine. CAD models can also be used to create analysis of the model under different loads (statically, dynamical, vibrating…), and to test and see how the product will behave under different temperature (thermal analysis). This type of virtual 3D model analysis is called Finite Element Method (FEM). Today we have one major field that is expanding at high speed every day, and it’s the field of 3D printing. Combined with 3D modeling it goes hand to hand as 3D printing represents the fastest way to get from a virtual 3D model to a functional prototype at your desk.
Virtual 3D models can be used in a very versatile way, and are therefore compelling to be used if not even necessary in the education. Specially important application can be for students in technical fields of study to be able to adapt to the high demands of today's market and industrial requirements.

Industrial design has become crucial to the products innovation and value-added process in current highly competitive marketplace. To provide designers nature and natural means to express their ideas freely and overcome the technical gap in the iterative design process, virtual and augmented reality technologies are employed to supplement the traditional Computer Aided Design – Rapid Prototyping (CAD-RP) iterative design process *(Yang Ran & Zhenbiao Wang, 2011).*

VIRTUAL REALITY

Virtual reality or popularly called just VR, is becoming a field of intense interest in the modern days. Today VR is used for different things, from presentation and marketing up to making video

games that allow the players to experience the feeling like they are part of the game they ar eplaying. VR helps us better envisage a specific product or a particular area. The recent appearance of low cost virtual reality (VR) technologies – like the Oculus Rift, the HTC Vive and the Sony PlayStation VR – and Mixed Reality Interfaces (MRITF) – like the Hololens – is attracting the attention of users and researchers suggesting it may be the next most massive stepping stone in technological innovation *(Pietro Cipresso etc 2018)*. Today we have two fields that can at first seem as very similar, but in reality they are different. One is virtual reality or VR as we mentioned before, and the other is augmented reality or AR. The big difference is that augmented reality allows us to visualise a virtual component in the real world that surrounds us, while the virtual reality enables us to create a fictional virtual world that doesn`t have to be similar to the real one. For example with virtual reality we can stay at our office desk while simultaneously virtually visit the factory in London. That's why this is so tempting for usage in educational purposes. With the help of virtual reality students can visit the factories, production lines from all around the Globe while being at their Universities. They can inspect the motors, turbines and all the different machines up close and see how they work instead of just reading about them in the books. Virtual reality is a tempting tool to be used for better visualisation and better understanding, and needless to say it is fun to use. Although working to create a virtual reality program requires a little programming experience, the usage of it results does not. Today, there are few different programs that allows the creation of the virtual reality, and like the CAD programs, some require a paid licence while others give free educational licences like for example Unity.
Virtual reality aids many types of industries such as construction companies, automobile industry, military designers, research and education developers and hospitals. It has been most helpful in improving the design and reducing prototype costs, which lowers manufacturing costs *(D.C. Sherrard & M. Narayanan).*
Some experimental virtual reality usage in education has already been made and it was found that students become self-motivated learners and mentors for their peers (Rex Kozak & Robert Berggren, 2013).

THE RADOLOVIĆ AND ALLCOAT & VON MUHLENEN RESULTS COMPARATION

This paper is focused on our previous work Radolović et al. (2019), and the work of Allcoat & Von Mühlenen (2018) results comparison. In mentioned previous study, (*Radolović et al., 2019.)* 58 students were interviewed with different previous educational background.

A survey was based on the following questions:

1. Do you think that the design and implementation of 3D print models should be introduced into regular teaching at a vocational training?
2. How satisfied are you with the quality of the virtual model?
3. Do you think that the implementation of 3D models would contribute to a significant improvement of vocational training?
4. How informed are you about the application of new technologies in educational activities in the process industry?
5. Do you think that the implementation of 3D models would contribute to a significant improvement in the quality of teaching?

Students were given access to the virtual model and got explanations for use. A link to the virtual model on which education was provided was attached. After that, they followed instructions to get hands-on through the 3D model preview software. The survey was bilingual in Croatian and English to cover as many different students as possible. Poll questions were closed type. The answers offered the option of choosing between answers yes/no or they are given on a five-degree Likert-type scale (gradually from 1- I am not at all, 5- I am extremely/fully) Radolović et al. (2019).

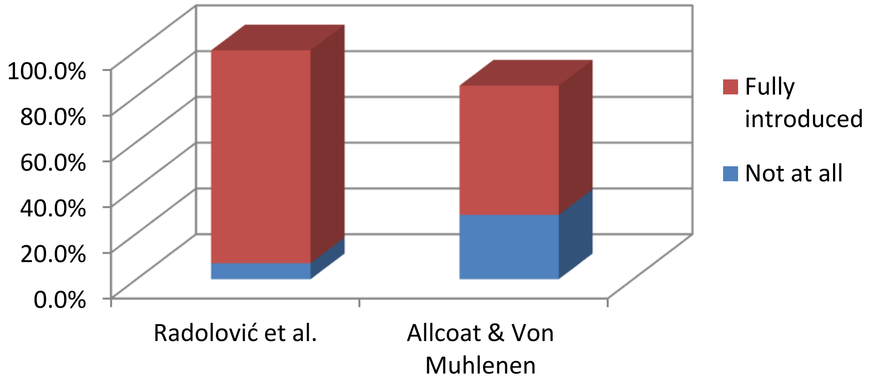
Answers on the questions:

1.) 96.4% of respondents believed that the design and implementation of 3D models should be introduced into regular teaching at the vocational training. 3.6% of respondents believed that they should not be introduced.
2.) 59.6% of respondents are very or very satisfied with the quality of the virtual model, 29.8% are not sure, neither satisfied nor dissatisfied, while 3.5% of respondents stated that they are not satisfied.
3.) 94.7% of respondents considered that the 3D model application would contribute to a significant improvement in vocational training, while 5.3% of the respondents believe that the application of the 3D model would not contribute to a significant improvement in vocational training.
4.) Most respondents (43.9%) replied that they are medium introduced, 24.6% are fully introduced while 29.8% of respondents are not introduced at all.
5.) 93% of students considered that the application of 3D models contributed to a significant improvement in teaching. Only 7% of them think that applying 3D models would not bring significant improvement in teaching.

In their investigation, Allcoat and Von Mühlenen (2018) explored recent advances in virtual reality (VR) technology for potential learning and education applications. They assigned 99 participants to one of three learning conditions: traditional (textbook style), VR and video (a passive control). The learning materials used the same text and 3D model for all conditions. Each participant was given a knowledge test before and after learning. Participants in the traditional and VR conditions had improved overall performance (i.e. learning, including knowledge acquisition and understanding) compared to those in the video condition. Participants in the VR condition also showed better performance for ‘remembering’ than those in the traditional and video conditions.
The 17 focused questions were marked as correct or incorrect and used in the calculation of an overall percentage correct, separately for each participant. Allcoat and Von Mühlenen (2018) marked the average knowledge and confidence scores ratings in the pretest and the post-test, together with the difference scores, as an indicator for learning.

Table 1. The VR models learning impact in Radolović et al. and Allcoat and Von Mühlenen study

The application of VR models contributed to a significant improvement in teaching.			What was the difference in approving the knowldge scores in pre and post-test in using virtual model		
Radolović et al.	Not at all	7,0%	28,1%	Pretest	Allcoat & Von Muhlenen
	Fully introduced	93,0%	56,5%	Post-test	
	Difference	86,0%	28,4%	Difference	



Graph.1. The VR models learning impact in Radolović et al. and Allcoat and Von Mühlenen study

Table 1. shows VR models learning impact in Radolović and Allcoat and Von Mühlenen study. VR models impact was, in both cases, tested by enabling students to learn from VR model. In Radolović et al. (2019) study 93% of students who learned by using VR model considered that the application of 3D models contributed to a significant improvement in teaching, in sense of a better remembering and understading the presented material, while Allcoat and Von Mühlenen study (2018) showed the 28,4% difference in approving the knowledge scores in pre and post-test, as shown in graph 1.

CONCLUSIONS

In order to follow the high industrial and marketing demands, students and future engineers need to embrace the new technologies that are today implemented in modern factories. These technologies serve not only to prepare them for the future market and workplaces but also as a tool for better and faster learning as it helps students to better visualize new content. Young engineers and students seem to adapt the changes of the modern industry as shown by the results of both Radolović as well as the Allcoat &Von Muhlenen studies. Both studies showed students considered that the application of 3D models, as well as VR, contributed to a significant improvement in teaching in a way of a better remembering and understading the presented material. Knowledge scores and confidence ratings are improved in VR learning vs traditional ones. Remembering and understanding increased more in VR learning, and in using 3D model, then in using textbook as a dominant learning tool. With these results we can suggest the implementation of 3D modelling and VR technologies as an addition to classic lecture in form of laboratory practice exercises.

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Internal Service Quality at our University - Centralizing vs. Decentralizing

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ABSTRACT

This article looks at interdisciplinary services such as a career service center and start-up counselling for students. Using the example of the Wismar University of Applied Sciences, the question is examined as to whether it makes more sense for the students of the university to bundle these services in a central unit or whether it would be better to allocate them to faculties or departments on a subject-specific basis. The advantages and disadvantages of both solutions are discussed. In the concrete case of the Wismar University of Applied Sciences, it is shown that based on almost a decade of experience with its approach, the centralisation of these interdisciplinary functions has indeed led to synergies. The article also identifies a set of critical success factors which the design of such a solution will need to meet.

Keywords: *interdisciplinary services, career service, start-up support, structural unit*

PROBLEM DEFINITION

At the interfaces between university education and professional practice or the economy (Vandekerckhove, W., & Dentchev, N.A., 2005), there is a need for advice for students, graduates and employees that is not necessarily subject-specific. This concerns advice in areas such as individual career planning (Niles, S.G., & Harris-Bowlsbey, J.A., 2005), the promotion and support for realisation of start-up ideas, as well as other areas involving issues that can only be dealt with on an interdisciplinary basis.
There is also a need on the part of external actors such as business enterprises or municipal institutions for information on the performance of the local university (Freemann, R.E., 1984). The respective questions or deficits are often not limited to a specific subject. For example, companies are simultaneously looking for either specialists from different specialisations for which a central contact person is preferred or seeking to promote innovative product development ventures in cooperation with local universities. Both these aspects are important competitive factors for German universities. Due to demographic trends causing a decline in the number of potential students per age

group, it is becoming more important for higher education institutions to distinguish themselves through the provision of an excellent service to students and the local economy that goes beyond pure specialist training in order to maintain one's own attractiveness. At the same time, universities can only fulfil their third role as a regional innovation engine if they succeed in networking effectively with regional players.
This raises the question as to how interdisciplinary services should best be organised to secure the desired outcomes. In particular, it is a question of whether centralisation, and thus the pooling of resources, is preferable to sharing capacities among faculties or departments. This question is currently a research topic at Wismar University of Applied Sciences in which, since 2011, interdisciplinary services have been bundled in a central unit, the Robert Schmidt Institute (RSI), and placed under the direct supervision of the university management. As part of a future ERASMUS+ project, researchers in Wismar are investigating whether the successful model that has been developed there can be sensibly transferred to higher education institutions in Ghana and South Africa and which specific local conditions can lead to modifications of the Wismar model.

CONTENT

This paper will firstly compare the advantages and disadvantages of centralising multidisciplinary services, before presenting the example of the Wismar University of Applied Sciences with the RSI as the central unit for interdisciplinary services. Finally, it outlines the critical success factors for a possible transfer of this solution to other universities while also explaining the success story of the RSI.
The pros and cons of a centralisation of interdisciplinary services can be summarised as follows:

Table 1: The pros and cons of a centralisation of interdisciplinary services

Pro	Con
• One precise contact for external partners (e.g. companies with job offers, internships, topics for theses, research questions, interest in research cooperations). • Resources can be bundled and jointly used for creating synergies (e.g. career service center + start-up counselling for interdisciplinary team building). • Creation of a "critical mass", e.g. for demanding projects, project management etc.	• A lack of subject-specific competence in order to be able to assess the corresponding offers appropriately or to place them in the portfolio of the university based on own current research focal points (not always known) and own resources (e.g. time resources of the staff/students, available laboratory equipment etc.). • Risk that offers are perceived as "remote".

• No "competitive situation", no over- riding subject-specific self-interest (i.e. it avoids the risk that if external offers are scarce, that competition for connections could lead to information being reserved for an insider circle that chooses not to share the opportunity for the benefit of the wider university). • Promotion of interdisciplinary cooperation. • Concentration by service employees on their core tasks (e.g. application training, start-up consulting) allowing a high level of competence to develop; in the case of decentralised service splitting, employees usually have further tasks (e.g. organisational and/or subject-specific tasks) that lead to work fragmentation. • Higher probability of reaching students with non-subject-specific group characteristics, e.g. migrants (whereby interdisciplinary information transfer can also be tailored to group characteristics). • Reduced barriers to use of services (e.g. by avoiding to embed start-up counselling within Business or Economics (via Entrepreneurship Chairs), access for students or staff from other disciplines with an interest in/ideas for self-employment/start-ups is enhanced).	• Departments with a small number of staff lose even more influence when these tasks are delegated. • Loss of control in the faculties or external institutes or units (including professors of other faculties) best able to determine the time burden on the respective students (interdisciplinary projects) • Greater distance to accurate curricula evaluation as it becomes more difficult to assign achievements of individual students in interdisciplinary projects/topics as study-relevant (creditable, examinable) performance - In the worst case, this can lead to overburdening and a drop in performance over the main study period.

ROBERT-SCHMIDT-INSTITUTE OF WISMAR UNIVERSITY OF APPLIED SCIENCES

The Robert Schmidt Institute (RSI) of the Wismar University of Applied Sciences was founded on June 8, 2011. As an administrative staff unit of the rector's office, it reports to the prorector for special tasks. This ensures the commitment of the university management and independence from subject-specific self-interests within the university. The RSI focuses on the three pillars of: Career service; Start-up support; and management for international educational projects. In particular, it promotes interdisciplinarity, the development of interdisciplinary competences and the networking of the university with the business environment. Its work is focused on the development of leadership and team skills, as well as entrepreneurial competencies. The goals of the RSI are the interdisciplinary networking of the faculties and students among themselves, the promotion of student engagement, the provision of comprehensive career planning for students and the support with the adaptation of technical and social competencies related to the complex requirements of the global job market as well as the establishment of contacts to enterprises. There are various offers available for the achievement of these goals within the three pillars of the RSI.

The Career Service Center supports students in their search for internships and jobs Hirsch, A., 2010). Over the past few years, the Center has established a network of contacts to around 600 companies for this purpose. It also organises the annual company contact exchange on campus (job fair). In 2019, almost 100 companies presented their offers for students and graduates. When selecting the exhibitors, special attention is paid to the fact that there should be companies and offers for students of all three university faculties (Business studies, engineering sciences and design). In

addition, the Career Service Center organises mentoring projects for female students with the help of third-party funds and advises student drop-outs on alternative paths open to them as well as facilitating their entry into the regional labour market (Niles, S.G., & Harris-Bowlsbey, J.A., 2005).
The start-up support service assists those contemplating self-employment and budding entrepreneurs. It begins with offering low-threshold counselling services and courses within the seminar "Entrepreneurial Thinking and Acting" for students of all three faculties, which is organised each semester with predominantly external experts and representatives from regional companies. To support development of innovative ideas, interdisciplinary student research and development teams are formed and supported. Inventors, innovators and potential founders are introduced to networks with regional companies involved in the construction of prototypes, their testing and subsequent marketing of their product ideas. Here the start-up support works closely together with the career service making use of its extensive database of enterprises. Last but not least, the RSI assists the most promising entrepreneurs by helping them to apply for the EXIST start-up scholarship awarded by the Federal Ministry of Economy, in which respect it has established a very strong track record of continuous successful applications.
The international project management service offered by the RSI is mainly addressed to the university staff and rests on the basis of two requirements. The first is the interdisciplinary cooperation with all three faculties and their departments, largely developed within the scope of the two aforementioned pillars. And secondly, it has been possible to promote and retain employees who have acquired many years of experience in researching relevant funding programmes with strong knowledge of the rules and procedures for the respective application and project management of different projects and grant funding bodies. Strategic-thinking and researching professors are thus motivated to participate in international projects or to initiate them themselves due to the involvement of the RSI as coordinating and management partner.

SUCCESS FACTORS

Based on the pros and cons of centralising the provision of multidisciplinary services, several success factors can be established that can be used to measure and assess the performance of such a central institutional entity.
The first factor is dependent on the scientific structure of the university. In particular, the pertinence of such a factor is determined by the answer to the question as to whether the innovative strength of the university depends to a large extent on interdisciplinary cooperation within the university. If this is the case, i.e. there is sufficient depth, breadth, complementarity and interdependencies between faculties, a central institution such as the RSI can support this. Wismar University of Applied Sciences has three faculties - Business Administration, Engineering and Architecture and Design. Thus, it is excellently equipped for the processing of business-related and interdisciplinary tasks.
A further important aspect is the spatial concentration or dispersion of the individual departments or structural units. The greater the geographical distances, the more likely interactions will lead to a loss of time and hesitation, which in turn represents a barrier to access to, and thus performance of, centralised services. The example of the Wismar University of Applied Sciences illustrates the beneficial characteristic of close proximity since it has only one campus and the RSI is easily accessible by every faculty.
The institutional structure of the central unit is also an important factor as it determines the organisational set-up and commitment of the university management to the provision of interdisciplinary services. Together with the issue of resource endowment and capabilities, see interaction with the factor of equipment or continuity, this factor affects the priority and accountability expected of this task. As previously mentioned, the RSI reports directly to the rector’s office and this link to the executive ensures the lasting commitment of the university management.
The equipment or continuity concerns the financing and filling of positions to carry out the tasks, i.e.

whether these are filled with a so-called "core troop" over the long term. If this is the case, it can also be anchored on campus in the long term, which leads to awareness and recognition. The current problem for the RSI is how to ensure personnel continuity. Several members of the core team are employed through so-called third-party funded projects on the basis of fixed-term employment contracts. Today, this circumstance still poses a threat to the continued maintenance of the Institute's performance over time.

The team spirit of staff members of the central unit, but also the collaborative inclination of key university staff generally, is a further factor of success. This concerns the question of to what extent the individual responsible persons are prepared to assume responsibility for team results beyond their own task boundaries, i.e. whether their motivation for the collective interest can enable the consequent realisation of synergies. At RSI, team spirit has been firmly anchored in the mentalities and values of the staff working there, and is attributable to the good leadership work of the unit head.

Related to the issue of resource availability, is the need to conduct public relations work with regard to the interdisciplinary services provided. This further factor, of having sufficient communication activities, raises the question of the quality of advertising and how effectively stakeholders can be reached.

This leads to the last factor, stakeholder involvement. Professors, for example, can act as so-called "pilots" for interdisciplinary offers, e.g. acting as instigators and multipliers for promotion of the start-up consulting services. Based on the experience of the RSI, the development of the acceptance of the centralised offers and the recruitment of the controllers is a process that can last several years before reputation and trust can bear its fruits.

CONCLUSION

As shown by the example of the RSI, a centralisation of interdisciplinary services can contribute to an increase in the attractiveness of the respective university location. In the case of Wismar University of Applied Sciences, the decisive success factors are the broadly diversified but complementary scientific structure with around 40 fields of study, the geographical proximity of the individual structural units to each other, the commitment of the university management and personnel continuity in key functions, working with a good team spirit.

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Development and Implementation of Master Programme in Smart Transport and Logistics for Cities

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ABSTRACT

The existing Master programs in Ukraine are based on separate branches of transport systems. The general approach used was to isolate and hence to study the single elements and to neglect the relationships between them within the whole analysis systems. Therefore, the developed educational modules, based on smart technology and environment (which exploit these neglected relationships) have not yet presented in the current curricula of Ukrainian Master programmes in transport systems. In this context, the paper presents the upgrading process of Master curriculum, designed and implemented in O.M. Beketov National University within the E+-KA2-CHBE Programme. In particular, how the local conditions and needs as well as the results of the international reviews on which the curricula were built are described. Finally, some indications for process transferability are provided.

Keywords: *SmaLog, smart transport, smart logistics, curriculum development, internationalization.*

INTRODUCTION

Europe needs more cohesive and inclusive societies which allow citizens to play an active role in democratic life. Education and youth work are key to promote common European values, foster social integration, enhance intercultural understanding and a sense of belonging to a community, and to prevent violent radicalisation. Therefore, the Programme Erasmus+ is an effective instrument to promote the inclusion of people with disadvantaged backgrounds, including newly arrived migrants (Erasmus+, 2016). In this context, some Ukrainian and Georgian universities worked together for developing an E+ proposal. The germinated proposal (Master in transport and logistics for cities – SmaLog) was positively evaluated by EU and was selected for funding within the

framework of the Erasmus+ Capacity Building in the Higher Education programme in 2017. The project started in October 2017 and will end in October 2020.
During the proposal stage, the joint analysis carried out in cooperation also with Ukrainian and Georgian stakeholders highlighted that there is a need to strengthen the role of research for improving educational programmes and to start managing transport and logistics exploiting the opportunities offered by telematics. For this reason, the SmaLog project aims at transferring to Ukraine and Georgia the most recent knowledge and good practices developed in the European Union in the field of smart transport and logistics for cities. Ukrainian and Georgian Universities are the key actors to start this process (Gruenwald et al., 2008 and 2010; Comi et al., 2018). The consortium is composed of four EU universities, four Ukraine and two Georgian universities, and one institute of advanced studies.
Starting from these concepts and knowledge developed by the European partners, the project aims to:

- develop and test in Ukraine and Georgia a 2-year University Master programme according to the Bologna process standards;
- “Train the Trainer” supporting Ukrainian and Georgian academics in defining and delivering the Masters;
- provide each Ukrainian and Georgian University with a laboratory dedicated to smart transport and logistics for cities;
- disseminate through newsletters, events, workshops and seminars the importance of research in the field of smart transport and logistics for cities;
- set up a national coordinated network of Universities, public bodies, private companies and NGOs on smart transport and logistics for cities involving Ukrainian and Georgian Universities in the wider European network of research centres.

With reference to the definition of effective and useful Master curricula on smart transport and logistics, two preconditions were identified as necessary for reaching the above aims: there is a need to clearly understand local conditions and needs both in terms of research and teaching on such a topic; on the other hand, the need to review and analyse the most relevant and recent experiences and tools in the field of smart transport and logistics for cities available at international level. This analysis, started at the beginning (from SmaLog proposal design), was deepened in the first months of project life and highlighted several important aspects.
Some gaps also emerged. For example, there is a problem of isolation from the international research world that leads:

- a need to update contents and methods of courses (and subsequent modules) for students;
- a need to update research topics in the field of smart transport and logistics for cities;
- a need to adequate technical equipment in the laboratories.

Finally, the preparatory analysis allowed user needs to be identified and to point out that, while Master on transport field are already available both in Ukraine and Georgia, there is not a specific Master that prepare technicians (or researchers) in exploiting the new opportunities offered by telematics. Besides, not almost all local partners are fully research experience in smart transport and logistics within cities.
Therefore, the main objective of paper germinates, i.e. to present the curriculum process development of Master in Smart Transport and Logistics for Cities in one of the partner institutions involved in SmaLog (O. M. Beketov National University of Urban Economy in Kharkiv – Ukraine) in order to point out how this experience can be useful for improving master curricula including more and updated challenges in other Ukrainian or Georgian universities.
The paper is structured as follows. Section 2 presents the structure of master programme, while Section 3 recalls the main opportunities offered to students. Finally, some conclusions and the road ahead are drawn in Section 4.

MASTER PROGRAMME STRUCTURE

Existing curricula of Master Programmes are based on separate branches of transport systems in O. M. Beketov National University of Urban Economy in Kharkiv (NUUE). European educational and scientific programmes consider city transport on a systemic way, pointing out that city transport systems concern many different stakeholders, which takes into account while developing sustainable transport system (NUUE, 2019). In particular, the existing curricula in NUUE have not presented such approach yet. Educational modules, based on smart technology, which pays attention to environment, have not yet presented in the current curricula of master's programmes. There is a shortage in the application of systematic modelling tools and decision making in transport systems that are widely used in EU and in the world. Simultaneously, the current curricula of master's programmes in EU partner-universities include modules addressed to meet the requests of operators and users, with the aim to build competences for future city needs. They are more devoted to the management and control of the current transport services with telematics. EU partners, which have significant experience in this field, hence help to create the methodological support, strengthen the internationalization of HEIs and the capacity to be network effectively in research, scientific and technological innovation. Existing Master programmes at NUUE are shown on the Figure 1.

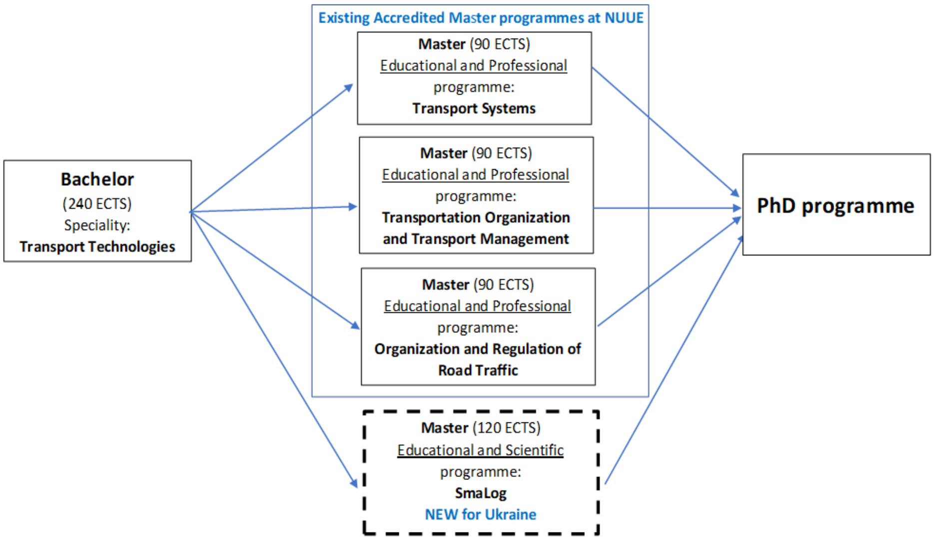

Figure 1: Educational path at Department of Transport Systems and Logistics of NUUE.

Programme Overview and Objectives

SmaLog meets the Standard of Higher education in Ukraine refers to Specialty 275 Transport Technologies and corresponds to: the National Qualifications Framework – Level 8; the Framework for Qualifications for the European Higher Education Area FQ-EHEA – Second cycle; the European Qualifications Framework for lifelong learning in the EQF-LLL – Level 7. The approach of curriculum development, based on requirements of the regulatory framework in higher education in Ukraine and requirements of SmaLog project and vision and opportunities of NUUE, is plotted in Figure 2.

The Master programme will be defined as 2-year and 120 ECTS with transparent quality assured contents in accordance with the Bologna process that will allows the course/programme to be recognised within the Lisbon Convention and on par with the European Area of Higher Education. The Master programme consists of:

- 10 ECTS for modules that characterize general competence;
- 48 ETCS for modules that characterize professional and practical training;
- 32 ECTS for elective professional modules (students' free choice);
- 6 ECTS for Specialized Pre-diploma Training;
- 24 ECTS for Master thesis.

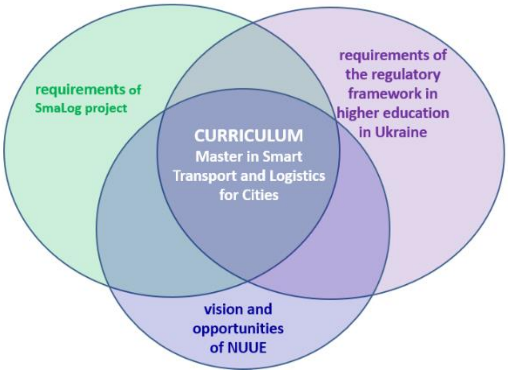

Figure 2: The approach of curriculum formation at O. M. Beketov National University of Urban Economy in Kharkiv (NUUE).

SmaLog programme includes modules of professional and practical, social and humanitarian, fundamental, natural science and general economic training, which are of an integrative nature, the content orientation of special courses and subjects of free choice of students. Professional modules are organized in four main study areas of transport, Table 1:

- passenger transportation: methods and models for supporting the assessment and the implementation of new actions for the improvement of urban passenger transport;
- freight transportation: methods and models for supporting the assessment and the implementation of new actions for the improvement of urban freight transport;
- traffic: methods and models for simulating city traffic and related impacts;
- smart: how telematics can drive and support improving city sustainability and liveability.

Table 1: Professional modules of Master programme SmaLog

Module	**Credits, ECTS**
1st and 2nd semesters, September 2018 – June 2019	
MODULE 1. Smart Transport and Logistics for Cities	5
MODULE 2. Traffic Flows Simulating and Management	5
MODULE 3. Traffic Control	5
MODULE 4. City Passenger Transport	4
MODULE 5. Freight Transportation Simulation	6
MODULE 6. Smart Transport	5
MODULE 7. Integrated Transport Systems in City Logistics	5
MODULE 8. Smart Transport and Logistics for Cities Project	3
3rd and 4th semesters, September 2019 – June 2020	
MODULE 9. Human and Environmental Impacts, Safety and Sustainability	5
MODULE 10. Traffic Flows Management in the City Center	5
MODULE 11. Efficiency of Cities Transport Systems	5
MODULE 12. Master Thesis	24

The educational objectives provide to obtain theoretical knowledge, skills and competencies sufficient to develop new ideas, solve complex problems in the field of transport technologies, which study the laws that determine the conditions for the rational organization of transport services and transport processes and encompass problems of building and ensuring the effective operation of transport components, development of its material and technical base.
Learner must satisfy the programme requirements in the programme specification, which includes: theoretical classroom instruction on subjects (lectures, seminars and practical studies), consultations and student independent work, including fulfilment of a course project and paper on speciality; pre-diploma training and defence thesis. Credits are awarded based on student's successful passing of written/oral tests and exams in subjects, defence of a course project, and defence of a report on the training, defence of Master's thesis.

Objectives

The aim of the educational program is to obtain competences sufficient to solve complex problems in the field of transport systems of urbanized territories based on best practices and technologies developed in European countries in the field of intelligent urban transport and logistics.
Based on results of the *user needs analysis* and on discussions with Ukrainian local experts and stakeholders a set of "core competencies" for technical SmaLog professionals has been identified. These competencies are intended to provide a broad framework for educating SmaLog professionals. They represent a fundamental set of knowledge, skills, and abilities needed to effectively function as a professional in smart transport and logistics for cities. Graduates will have the competencies:

- for increasing the efficiency of city logistics, traffic and passenger transportation within the city exploiting the opportunities of intelligent transport systems;
- for analysing city transport systems, in particular using smart transport systems and information communication technologies;
- for research, assessment and management of the operation of transport systems in the cities;
- for the management of freight, passenger transportation, traffic control within the city;
- for the implementation of Information Communication Technologies and Intelligent Transport Systems in urban contexts.

Learning Outcomes

Learning outcomes of SmaLog are defined with the five Dublin descriptors.
1) Knowledge and understanding:

- modelling of transport processes and systems in the cities with particular attention to smart technologies;
- planning, organization, control of transport processes in the cities taking into account environmental impact and sustainability;
- the economic, environmental substantiation of decisions on the organization of transportation in the cities, namely city logistics measures;
- conditions of efficient integration of international transport systems in the cities including intelligence transportation system;
- design of warehousing by cargo delivery, system planning of logistics transport systems;
- organization of professional safety management.

2) Applying knowledge and understanding:

- to be able to formalize and determine the parameters of the transport processes and to form a strategy for transport processes management with particular attention to ITS;

- to be able to choose models, types and the number of vehicles for technical support of transport process, form of transportation routes, schedule vehicle movements at cargo transportation, to develop the technology of transporting in main communication, to choose the forms and methods of control over the implementation process due to achieving sustainable transportation system in the cities;
- to be able to analyse the existing situation, to choose the strategic directions of the city passenger transport development based on transit-oriented methods and ICT;
- to be able to implement modern approaches to traffic management, to assess the effectiveness of the implementation of measures of improving road safety in the cities.
- to be able to justify and consult on the economic expediency of transport efficiency in the cities, city logistics applications;
- to perform design of warehousing system, city logistics systems;
- to assess, monitor and formulate a system of professional safety management.

3) Making judgments. Ability to perform scientific and research and design works dealing with the problems of traffic, passenger transportation and city logistics with particular attention to smart cities.
4) Communication skills. The ability to relate and work in groups, in a professional context both nationally and internationally, is taken into account throughout the course of study. Communication skills are first and foremost evaluated during the checks on both the final exam and the courses required by the curriculum. All the orientations promote activities such as curricular internships, internships and projects (including interdisciplinary) in companies of products and services, in which the student is placed in a position to measure himself with interlocutors at different levels of specialization and with different cultural backgrounds.
5) Learning skills. The structure of the teachings and of the other formative activities, foreseeing in most cases seminary components, of bibliographic research and planning, makes the master's degree able to: read, understand and use a scientific text (also not applicable to specific areas of mathematics, physics and industrial engineering) at university and post-university level; to use reference manuals for the practices in use in the different industrial realities concerning specific problems; autonomously to use manuals for the use of software of different types and applications; to proceed autonomously to professional and cultural updating; to undertake post-graduate studies.
The learning ability of the graduating student is verified through the specific tests.

Studying Process

In accordance with the Enrolment Conditions approved by Ministry of Education and Science of Ukraine (Entrance, 2019), to be admitted to a Master degree course, students must have at least a Bachelor degree. The procedure for admission to Master degree based on the students rating and examination. Rating includes average grade according to Bachelor diploma. Examination procedure includes two exams: professional entrance examination in a specialty and foreign language. The admission procedure is from July to August, each year. Department of Transport Systems and Logistics is owned Laboratory “Ergonomic and Transport Problems” and “Information Technologies”. Students can attend it during studying. The classes are also held in the laboratory of “Automated Control Systems on Transport” of NUUE.

The tutoring activity is one of the institutional tasks of professors and researchers, as an integral part of their teaching commitment aimed at guiding students' cultural education and studying support. The tutoring activities are scheduled by the Faculty at the beginning of each academic year. Each student has a tutor, who can be consulted for evaluations and general suggestions regarding the progress of the student's study activities. The achievement of the Master’s degree involves defence of the thesis. Students begin to write thesis and defend in 4th semester. Master thesis includes 24 ECTS. Before starting to develop a thesis, student has to pass all modules of Master programme and Specialised Pre-diploma Training. For defence of the thesis student develops thesis on a topic

proposed by a professor of Transport Systems and Logistics Department. The Master's degree sessions are set by Head of Educational and Methodological Department within the time intervals set in the curriculum. Examination Commission for thesis defence consists of 5 representatives – at least one external expert from industry, others are professors of Department. Examination Commission process are public and open for all stakeholders.
There are two options to finance students studying: government payment (budgetary) and own student payment (contract). For budgetary payment Ministry of Education and Science of Ukraine offers different number of places each year. Number of contracts for students are limited by number of licences from Ministry of Education and Science of Ukraine.
A unique opportunity of the project is the additional mobility within the framework of the project both for students and teachers, i.e. Special Mobility Strand. Students can study for one full semester in the four involved programme country universities. Thus, they will get acquainted with the peculiarities of the educational process in EU universities, attend the class and pass the exams in accordance with the agreed learning agreements as currently occurs for EU students. This will significantly increase the level of training of students and the professional knowledge of teachers.

EMPLOYMENT OPPORTUNITIES

Large cities of Ukraine are in the stage of rapid development of modern Intelligent Transportation Systems and their implementation, so the transport industry is in urgently need of qualified specialists. Working places for graduates could be universities or scientific organizations, scientific positions in communication, transportation, management, state institutions, private companies, consulting etc. Teachers' positions in the institutions of higher education could be a work opportunity, too. The detailed list of employment opportunities is presented in Table 2.

Table 2: Employment opportunities

Indicator	Description
Positions that can be held by a graduate	director of a transport company, head of the transport department, transportation manager, transport engineer, urban planning engineer, traffic service manager, inspector, design engineer, new equipment and technology introduction engineer other.
Possible place of work	public authority, department of infrastructure, transport enterprises, research and design institutes, etc.
Areas of activity	the implementation of organizational and management activities in the state transport administration, transport departments of local governments and in transport enterprises of various forms of ownership.
Tasks that can perform	city logistics measures of optimisation, road traffic measures of optimisation, passenger measures of optimisation, possession of the regulatory framework for the functioning of the transport management system, the economy and the principles of conducting commercial work in transport, organizing the interaction of different types of transport, the basics of foreign economic relations.

CONCLUSIONS

The paper presented the developing process implemented at O.M Beketov National University of Urban Economy in Kharkiv. The implementation of SmaLog program will allow to update topics and methods of courses for students with the most recent international experiences; to update research topics in the field of smart transport and logistics for cities with the most recent international experiences; to involve teachers in the international research networks.

Smalog curriculum will be based on Master program at Transport Systems and Logistics Department of O. M. Beketov National University of Urban Economy in Kharkiv, that will replace existing Master programme in Transport Systems.
Using the acquired knowledge, European and world experience in urban transport functioning, graduates of the programme can be employed for key places in transport for developing of sustainable transport system in Ukrainian cities.

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VET in the Marine Higher Education – Some Challenges and Outcomes

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ABSTRACT

Vocational Education Training (VET) programs offer much more than just training and a vision to the future career path of young people. It is a serious step to broaden professional horizons, competitiveness and personal development. VET systems in Europe are based on a well-developed network of various governmental structures, industrial employers and trade unions, supported by strong system of laws, rules and legislations. VET system was introduced in Bulgaria in 2016, pilot projects are being implemented in cooperation with Switzerland, Germany and Austria. Since October 2017 the Technical University of Varna (TUV) is a key partner in project DYNAMIC. It aims at development, implementation, test and validation of programs for VET for students from the TUV.

Keywords: *European Union, marine higher education, project DYNAMIC, VET*

INTRODUCTION

The Role of VET

Vocational education programs date back from the early 1900's, however, both the idea and principles of VET had been in a process of development in earlier years of the XX century, (http://mbit.org).
Principles and rules that lay down the foundations of contemporary vocational training are discussed in details in (Wollschläger, Guggenheim, 2004). Centuries ago, in many European countries after the establishment of the guilds, the work of artisans and their vocational education and training were very well structured and organized, see (Wollschläger, Guggenheim, 2004). Guilds were associations in which, from the 12th century, people who worked in the same trade or craft joined together and were led by their own laws and rules. How vocational education and training in the guild system were organized? The hierarchy in the guild system was apprentice, journeyman, master.
Nowadays, the labor market has changed a lot and goes in agreement with the progress in industry and education. It requires higher level of skills, strong scientific background and interdisciplinary.
What does it means VET? What is hidden behind?
As stated in (http://cedefop.europa.eu), VET is very important part of the so called "lifelong learning systems", it provides people with skills, knowledge and various competences, all needed on the labor market. In addition, VET contributes to enterprise performance, to strengthen competitiveness, to research and innovation practices and important to society. VET is organized in agreement with the economy of each country.
VET programs offer much more than just training and a vision to the future career path. It is a serious step to broaden professional horizons, competitiveness and personal development,

http://www.cedefop.europa.eu. VET contributes to research and innovation in many areas and is important to future's economy. Also, the vocational education training is of huge importance for students, especially from the universities. VET could set students on the right track to a profitable and enjoyable future, http://.mbit.org).

When a person could gain an exceptional background, practical experience and technical skills, when likes the chosen career path, this person is going to do a tremendous job, leading to more profit both for the company and for the person. Last mentioned means that benefits of VET could be economic and social – for individual persons, for industry and for the society, (http://cedefop.europa.eu).

VET systems in Europe are based on a well-developed network of VET providers - they are government structures, employers and trade unions and include the so called initial and continuing VET. Initial vocational education and training (I-VET) is related to the upper secondary level; it is organized and carried out in schools, training centres or companies, with apprenticeships schemes.

The other type of VET – the so called continuing VET (C-VET) aims young people to improve their knowledge and scientific background, also to acquire new skills and to continue their personal development. The continuing VET takes place after the initial education and training or after the person has started its career, (https://ec.europa.eu).

In the European Union, education and training are organized by the Member States. The EU is responsible to support the Member states via funding and policy cooperation. For instance, funding instruments are the European Structural and Investment Funds and Erasmus+ program. The Education and Training monitor ensures evaluation of education and training systems; it also aims to strengthen the mobility of young people for learning and their educational results. The EU Publications Office website provides information to many other useful EU resources, (https://ec.europa.eu).

The EU priorities for vocational education and training up to 2020 were discussed on various forums and described in two main and very important documents - Bruges Communiqué in 2010 and the Riga Conclusions 2015.

The main tasks of the European VET systems for the period 2015-2020 are as follows:

- to provide more flexible ways to enhance the access to VET;
- to provide more effective opportunities to development of key competences and skills through I-VET and C-VET;
- to promote work-based learning, to gather commercial chambers, partners, companies to contribute in the best way to development through innovation and entrepreneurship;
- to introduce and develop innovative approaches and opportunities for continuous professional development of VET trainers and mentors.

VET in Bulgaria

Bulgaria has strong educational traditions for many years. In last three decades, demographic changes have affected the educational system a lot, (Popova, 2018).

Instead of all problems, in last years, Bulgaria is implementing reforms at all levels of education. There is an increased focus on the problems such as early school leaving, teacher salaries, lack of introduced dual learning. There is a huge need to solve so mentioned problems and also to improve digital skills and strengthen learning system and the educational outcomes.

Bulgaria typically does not invest too much in the pre-primary and primary education, areas which are key areas for an equal start in life and for preventing income inequalities later in life. However, after a revision and changes in the funding models for education, additional resources to disadvantaged schools were allocated. Students' knowledge has increased. However, still the skills of graduates in higher education and vocational education and training, insufficiently match the labour market needs. Participation in adult learning remains very low.

Dual VET was introduced in Bulgaria in 2016, confirming apprenticeship as a form of practical training. Pilot projects are being implemented in cooperation with Switzerland, Germany and Austria. In 2017 around one per cent of all students were involved in the VET. Educational programs were updated in agreement with business partners as well as in agreement with actual government requirements and legislations.
Training institutions within the VET system are vocational schools and vocational gimnasiums – for students aged 14 and above; art schools and sport schools – for 4 years of study after completed basic education; vocational colleges – 2-3 years of study after secondary education; vocational training centers and vocational guidance centers – career guidance for people aged 16+, for students and adults, (http://slideplayer.com).
Responsible institutions for VET in Bulgaria are as follows, (http://slideplayer.com):
• Ministry of Labour and Social Policy – analyses trends in the labour market; provides and controls requirements for acquiring qualifications in professions; controls conditions for healthy and safety work; participates in the coordination of the List of Professions for VET;
• National Agency for Vocational Education and Training: responsible for licensing of activities in VET system; to issue and suspend permits for provision of vocational training and guidance services; controls the activities of licensed training centers; issues the List of Professions for VET and the State Educational Requirements for acquisition of qualification by professions, etc
• Ministry of Education and Science: provides and regulates national programs for secondary and higher education; provides communication and information technologies; controls and regulates qualification and career development of teachers in schools and academic staff in universities; regulates national education and examination programs, state educational requirements and programs with their supporting materials; assists, coordinates and inspects all activities, related to education.
The state educational standards that have been imposed, by professions regarding the VET education, include, (http://navet.government.bg):
- minimum entry level qualification and specific education requirements according to the profession;
- requirements for theoretical and practical training facilities, as well as requirements for trainers;
- description of needed learning objectives and learning outcomes – knowledge, skills, competences, etc.;
- description of the specific work responsibilities, personal specifics and qualities, characteristics of working conditions, equipment and tools;
- validation of professional knowledge, skills and competences;
- provided opportunities for professional development according to the National Classificator of Professions;
- provided various opportunities for continuing VET training.
State educational requirements to acquire needed qualifications provide the necessary information regarding: development of required curricula and syllabus in cooperation with business; individual career planning; human resources planning; training and competences assessment; selection of personnel and its employment.

PROJECT DYNAMIC

Project DYNAMIC aims at addressing the need for more flexible routes for acquiring current industry-related skills necessary to boost and sustain innovation in the sectors identified by the national strategies of Smart Specialization and regional innovation in the new member states, see (DYNAMIC Documentation). For this purpose, regular practical phases in enterprises will be integrated in the ongoing engineering curricula to accelerate the update of knowledge traditionally provided by higher education institutions.

The aim of the DYNAMIC project is to develop, implement, test and validate undergraduate programs in the specialties of “Naval Architecture and Marine Technology” and “Marine engineering” at the Technical university of Varna (TUV), as well as in the field of Mechatronics and Robotics at Lucian Blaga University in Sibiu, Romania and in the area of Mechanical Engineering and Production at Politechnica Pula, Croatia.

In order to ensure successful implementation of the dual programs, the project will develop/update syllabus and curricula for definite subjects. Also, a toolkit documentation and assessment of the practical training for academic supervisors are envisaged. To strengthen the training capacities of the enterprises, involved in the dual education for students in agreement with DYNAMIC, the project will develop materials for a presence training of industrial supervisors.

The main intellectual output of the project is “Methodological guidelines for design and implementation of practice-integrated dual higher education programs in Science & Technology Studies” in the context of Bulgaria, Romania and Croatia. The output will satisfy the need for strategic approach in updating engineering curricula implicating the dual education model. The knowledge and experience gained within the project will be synthesized in this methodological document that will describe the different sets of methods employed at the different stages of the process.

The full commitment of 16 partners from Bulgaria, Romania, Croatia, Germany and Austria and the active involvement of key stakeholders will ensure sustainable long-term exploitation of project results beyond the project life-time.

The main fields of Bulgarian maritime sector considering the turnover for 2015 are shown in Figure 1. The maritime industry is concentrated in Varna region (**Error! Reference source not found.**). These circumstances laid down in the core of the choice which specialties could be included in DYNAMIC project and its activities. Specifically, the specialties of Naval Architecture and Marine Technology and Marine engineering were chosen for the pilot implementation of VET in the area of marine higher education in Varna, Bulgaria. This is in a strong agreement with the project goals, see (DYNAMIC Documentation).

The involvement of TUV will be in all work packages and specifically in the following activities:

• Identification of the training needs and stipulation of the content of the practical phases of pilot undergraduate program to be implemented under the dual concept;

• Participation in the development of the toolkit to be used to facilitate and support the communication between the key stakeholders involved in the delivery of cooperative higher education programs.

• Pilot implementation of the program at TUV following a block-model structure for integrating the practical phases. The first two years are part of the regular engineering study program and will focus on theoretical courses. It also provides the students with the possibility to undergo a competitive selection process and find an industry partner. The students will undergo a selection process coordinated with the companies of the alliance and they can continue their studies from year two onwards as part of the dual study program. During the pilot implementation of the practical phases in Work Package 5 (WP5) an academic tutor from TUV will be in contact with the industrial mentors and will be responsible for the assessment of the students’ results.

• Participation in the regional working groups meetings, periodical regional workshops

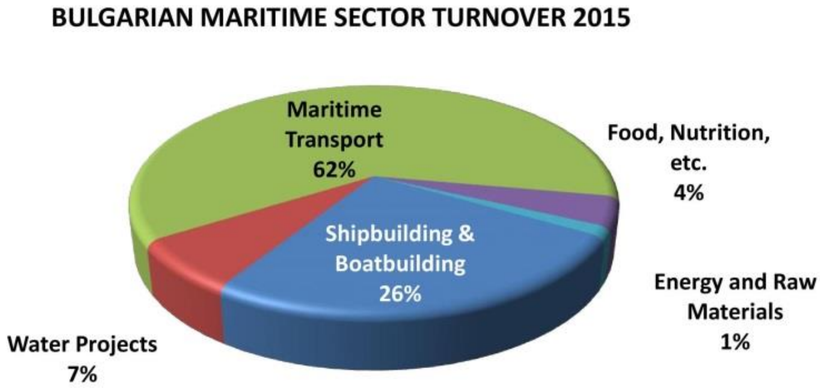

Figure 1. Bulgarian maritime sector turnover 2015, (Report Marine Cluster, 2017).

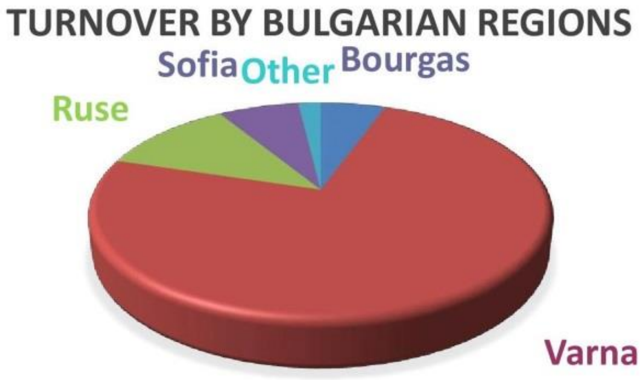

Figure 2. Regions of maritime industry, (Report Marine Cluster, 2017).

Active participation in all dissemination activities, writing articles for the local media, maintaining the project blog dedicated to student placements, organise/participate in targeted events.

The integration of the practical phases will follow a block model with periodical rotation of theoretical phases in the university and practical phases in the enterprise in terms of fixed and flexible practical hours. This model has been selected because it allows integration of the practical phases without major restructuring of the curricular plan. In this way the partner universities remain politically and legally autonomous in their decision-making and do not have to take any additional binding of teaching capacities. Another advantage of the selected block model is the compatibility with the semester plans and the block model used in Hochschule Wismar (HSW) and Joanneum University of Applied Sciences (FHJ), which allows mobility of staff and students. After the first 3-month practical phase, staff from HSW and FHJ will conduct a study trip at the partner universities to support the assessment process and evaluate the first implementation.

The partnership will test the dual approach and optimise the modules while providing various best practice examples of university-business cooperation for the region. Based on the evaluation results, the partners will improve and further develop the programmes. Know-how and experience gained in the implementation process of pilot actions will be disseminated, (Georgiev, Ilieva, 2018).

Project-based subject-related activities for each of the modules taught during the prior theoretical phase will take place in the enterprises as defined in WP2. All the activities during the pilot VET phase will be fully integrated into the curricula, mapped to the learning outcomes of the updated

programs and recognized with ECTS credits. For the assessment of the students' performance specifically developed tools will be applied. The assessment process will also reflect the generic capabilities of students acquired by applying problem-based learning in real work environment, see (Report Marine Cluster, 2017).
During the last practical phase, the students will write the final thesis on an industry-related problem assigned by the enterprise. Last mentioned is only relevant to those who have included a diploma thesis in their educational program. At the end of the pilot implementation students will have the opportunity to be employed, if the enterprises are satisfied with their performance during the practical phases.

PILOT IMPLEMENTATION AT THE TECHNICAL UNIVERSITY OF VARNA

In months March, April and May, three regional focus group meetings were organized among partners TUV, MTG "Dolphin" and Keppel FELS Baltech Ltd, Figure 3. Main tasks were as follows: to define needs of industry and training needs of our students; to find appropriate models, timetables and organization of VET; determination of syllabus contents; to arrive to agreement on contractual terms between the university and stakeholders; determine how to implement the programs: assessment methods, time schedule, expenses, confidentiality, property rights, labor protection, etc; development of a toolkit to facilitate and support the communication between industry and university; to define topics for training workshops; determination of templates for students' diary and contracts, etc.
The pilot implementation for students from Technical University of Varna has already started in October 2018 with students from the specialty of "Marine engineering". Six students from the specialty have passed their practical education and training in "Repair of marine machinery" in workshops of our industrial partner MTG "Dolphin"-Varna, see Figure 4 (a,b).
Next, students from the specialty of "Naval Architecture and Marine Technology" have attended a workshop for introduction to the VET specifics and they were involved in dual training during the summer vacation.

Figure 3. A moment from the first focus group meeting – 21.03.2018 at the Technical University of Varna

The considered and accepted structure of VET for students from the specialty of “Naval Architecture and Marine Technology” is organized in two phases: workshops during semesters at the University and in partner’s company – during the summer vacation. Students start their dual education after the 6th semester. Student application is approved by industrial companies. As it is related to the workshops – one is organized at the Technical University and one in each of the both industrial partners. Goals of workshops are to promote the VET among the students as well as presentation and discussion on requirements of the business partners.
Practical phase during the summer vacation is characterized by following: update of syllabus in agreement with needs of industrial partners and where possible; students work on practical tasks provided by the companies; contracts are being signed once between technical university and industrial partner and between company and students; it is mandatory for students to fill-in practical diaries for training periods.

(a) (b)

Figure 4 (a,b). Students from the specialty of “Marine engineering” at MTG “Dolphin” (a), students involved in repair operations with mentors, (b).

Since 2012 TU-Varna provides suitable for design work premises and hi-speed Internet, while Kepple FELS Baltech Ltd provides *thin clients set* as Remote Desktops to access Virtual Machines installed on KFB servers, see Figure 5 (a,b). In regards to the project DYNAMIC, students are able to work at the company KFB on design tasks or in those specially arranged premises at the University.
VET for students from the specialty of “Marine engineering”:
- practical training and gain knowledge in specific subjects, related to the processes of construction, montage, de-montage and repair of marine machinery in workshops of industrial partners;
- work on specific tasks provided by their industrial mentors and professors;
- update of syllabus where needed and possible;
- student’s application is approved again by the industrial companies followed by signed contracts by both parties;
- students filled-up logbooks (diaries for practical training) for their VET hours with detailed explanation of solved tasks.

Logbooks for all students from both specialties are under the control of professors and industrial mentors.
In addition to the project are involved four master students from our new specialty “Design of marine power plants and systems”.

(a) (b)

Figure 4 (a,b). Students working on design projects.

These four students within the first two semesters of their study were involved in VET in the following subjects: “Computer systems for design of ships and marine equipment“- 1st part (15 hours of lectures and 45 hours of exercises) and 2nd part (60 hours exercise) and “Design of systems and devices for ships and marine equipment“- 30 hours of lectures and 15 hours of exercises.
Project DYNAMIC is still running, we work on the development of new programs and explore the possibilities to broaden and implement project outcomes to VET in other specialties.

CONCLUSIONS

It is clear that VET programs offer much more than just training and a vision to the future career path. VET contributes to research and innovation in many areas and is important to future’s economy.
Instead of all problems, in last years, Bulgaria is implementing reforms at all levels of education. There is an increased focus on the problems such as early school leaving, teacher salaries, lack of introduced dual learning. There is a huge need to solve so mentioned problems and also to improve digital skills and strengthen learning system and the educational outcomes.
The project DYNAMIC is targeting young people and students to be introduced to the VET, this project is one the first ones in Bulgaria. It will help young people to do a serious step to broaden professional horizons, competitiveness and personal development.

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INNOVATIVE NEW METHODS FOR ENGINEERING AND BUSINESS EDUCATION – 1

Academic Staff in Engineering and the Built Environment at Durban University of Technology: A Baseline Study of Gender Equality

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ABSTRACT

The research reported in this paper is part of a large Personalised Engineering Education South Africa III Project that involves eight universities across Europe and South Africa. One of the foci of the project is around gender equality in engineering education. The literature on Women in Science, Engineering and Technology (STEM) in general is briefly reviewed. Attention then shifts to gender equality in STEM, academia, and engineering education more specifically. Management Information data from 2014 to 2018 were analysed to establish a baseline for the number and the rank of female staff in seven academic departments in the Faculty of Engineering and the Built Environment (EBE) at Durban University of Technology (DUT). The results show that there is low representation of female staff in the selected academic departments. Female staff are not represented in the higher academic ranks such as Associate or Full Professors. These findings resonate with other published research. This baseline study will be used to further investigate the experiences of women in EBE at DUT.

Keywords: Gender equality, Engineering Education, Universities of Technology, South Africa.

INTRODUCTION

The European Union funded Personalised Engineering Education in Southern Africa (PEESA) III project involves eight universities in Europe and South Africa. One of the foci of the project is around gender equality in engineering education. The specific goals are to increase both: the number of female academic staff members in the PEESA III project meetings; and the enrolment of female engineering students in the partner universities in Southern Africa.
In recent years significant changes have been made to equity legislation, accompanied by economic incentives for women to transfer into historically male-dominated occupations. However, women who defy conventional female career paths by choosing to pursue careers in male-dominated occupations, often return to careers that accommodate their roles as primary caregivers (Ashraf, 2007; Cha, 2013; Danziger & Eden, 2007; England, 2010; Frome, Alfeld, Eccles & Barber, 2006). The challenges experienced by women arise from traditional gender hierarchies prevalent in societies, which spill over into organisational policies and practices and ultimately become embedded in gender-biased

organisational culture, structure and management strategies. As a result organisations do not necessarily support the career paths of women and the efficient integration of work with family responsibilities (Bobbitt-Zeher, 2011; Cha, 2013; Frome et al., 2006).

In South Africa transformation has positively impacted women, with an increase in the number of women in the workforce due to improved access to education, the promulgation of equity legislation, and increased employment opportunities in previously male dominated environments (Finnemore & Cunningham, 1995; Franks, Schurink & Fourie, 2006; Mostert, 2009; Van den Berg & Van Zyl, 2008). However, progress with gender equality and transformation in academic sciences and the workplace is still deemed to be unsatisfactory (Anonymous, 2012; Du Plessis & Barkhuizen, 2012; Hicks, 2012; Lewis-Enright, Crafford & Crous, 2009).

Previous studies on gender based issues in organisations in South Africa have identified pre-defined phenomena that specifically affect woman in the workforce. These include, the life-role construction of career-orientated women; the work-home interaction; cross-cultural comparisons of stress in high-level career women; perceptions on gender differences in workplace progression; the barriers affecting women in their careers in engineering, and issues of gender and race for South African quantity surveyors in the workplace (Brink & De la Rey, 2001; Mostert, 2009; Van Aarde & Mostert, 2008; Franks et al., 2006; Van Den Berg & Van Zyl, 2008; Du Plessis & Barkhuizen, 2012).

The Women in Engineering Research Team at DUT has adopted a comprehensive approach to exploring the project goals for an increase in the number of both female academic staff and the enrolment of female students. The team developed a proposal for a case study, grounded in two baseline studies, followed by a qualitative study of the issues and challenges facing female staff and students in seven selected departments in the Faculty of Engineering and the Built Environment (EBE). The first baseline study, on gender equality among female students in either engineering or construction management at DUT, was conducted in 2018. This study revealed that whilst female students were underrepresented in these fields they consistently performed better than their male counterparts in terms of pass rate, attrition rate and throughput rate. When the data were disaggregated a spectrum of representation by enrolment in the seven engineering programmes was revealed which ranged from just over 10% of females for Mechanical Engineering to almost 50% for Chemical Engineering (Cooke, Jackson and Hefer, 2018).

This paper focuses on the representation of female staff in seven academic departments in EBE: Civil Engineering (Durban); Civil Engineering (Midlands); Chemical Engineering; Industrial Engineering; Mechanical Engineering, Electronic and Computer Engineering, and Construction Management and Quantity Surveying. The context is set through a brief literature review of: the global picture of women in science, technology, engineering and mathematics (STEM), gender equality in academia; and women in engineering education. The focus then moves to an analysis of the number of women in engineering, and construction management at DUT. The paper concludes by identifying some of the challenges facing women in engineering education and elucidates the next phase of the research project at DUT.

WOMEN IN STEM: THE GLOBAL PICTURE

The lack of public recognition for the work of brilliant female scientific minds can be traced back through over a hundred years of history. For example, Patricia Fara (2018) writes about the huge impact that women had in the First World War (1914 -1918). As men left to fight in the War women scientists took over their vacated positions and engaged in warfare related research When the War was over and the men returned, the women were forced to revert to the same low status positions that they had held prior to the War. So for female scientists, doctors and engineers the opportunities post-war were lost. Today the inequalities in the number of male and female scientists, especially at higher levels, still persist (Fara 2018).

STEM fields are broadly regarded as essential to the national economy of any country. However, as indicated above, globally, women continue to remain under-represented in professional occupations that are associated with STEM. The past two decades have seen policy makers and researchers focus on challenges to the recruitment, retention and social equity of women in STEM at higher education institutes (Blair-Loy, Rogers, Glaser, Wong, Abraham, and Cosman, 2017). Studies have reflected that inherent biases, in for example the assessment of professional competence, disadvantage women, while giving men credit for high levels of competence (Ridgeway, 2011; Williams and Dempsey, 2018). These assumptions that highlight women as being less competent, are often found in male-dominated STEM professions (Carli, 2001; Ridgeway and Smith-Lovin, 1999).
Likewise the field of engineering and construction has historically been seen as a male dominated profession due to the culture and attitude of the industry (Evetts, J. 1998; and Barnard, Bagilhole, Dainty and Hassan, 2012; and Powell, Bagilhole, and Dainty, 2009). In the Anglo world there is a lack of women in engineering and technology, for example 11% of the workforce in the US, 10.5% in Canada and 8.5% in the UK are women. Whilst the gender disparity in the engineering workforce in some European countries may be healthier (25% in Bulgaria, Croatia and Romania), less than 15% of the engineering workforce in Switzerland, Austria, Finland and Ireland are women (Hutchins & Kovach, 2019). In Australia women are underrepresented in STEM at school and engineering programmes at university. Women comprise less than 10% of the engineering workforce and this imbalance is mirrored in the workforce of academic engineers at universities (Dobson, 2012).

GENDER EQUALITY IN ACADEMIA, STEM, AND ENGINEERING EDUCATION

Gender equality in academia can be defined in several ways. The first is where equity is equated with equality through equal pay, equal access to opportunities to enter an occupation and advance in it, career advancement and freedom from harassment. However, equality is still not the same as equity – equating equity with equality makes an assumption that the workplace is completely separated from the rest of life. Through being gender-neutral this first definition ignores the different life experiences of men and women and makes the current ‘male’ model of the ideal academic normative. It makes assumptions that women can follow the model as easily as men and be seen as successful and as central as their male colleagues. This leads to a second definition that goes beyond equal opportunities, and that is based on practices that promote fairness and that take an academic’s life outside the academy into consideration. Whilst this second definition allows for practices such as parental leave it does not take into consideration the career consequences for women who take advantage of the leave (Bailyn, 2003).
Bailyn (2003) proposes that the ideal definition of gender equality is be based on the integration of the public sphere of work and the private sphere of family, community and other personal involvements. For true integration to occur organizational practices, culture and rules need to be scrutinized, modified accordingly and understood by everyone. Bailyn documented the experiences of female academics at Massachusetts Institute of Technology in 2003. Some nine years later Dobson (2012) indicated that whilst the proportion of female academics in general is rising, it is at a slow rate. He also indicated that women are more likely to be in junior positions (lecturer), younger than their male counterparts, and less likely to be tenured.
Over the past 25 years, the role and rank of women in the field of STEM has been a vital concern that is rooted in two essential sets of issues: the recruitment of females; and the social equity of professional female participation. Several authors have written about the status of women in STEM, and whilst some studies have suggested that the playing field of progression between men and women is level, however, others have presented opposing views. The only widely-agreed-upon conclusion is that women are underrepresented in professional fields such as geoscience, engineering, economics, mathematics, computer science, and the physical sciences (Ceci, Ginther, Kahn, and Williams, 2014).

In Europe for example, although there have been sustained efforts to promote engineering careers to young women, engineering is still the most male-dominated academic discipline (Barnard, Bagilhole, Dainty, and Hassan, 2012).
Hutchins and Kovach (2019) identify that the issue of the low representation of women (and women of colour) as academics in STEM constrains universities from being truly diverse and inclusive and that this limits the development and enhancement of women scientists. Furthermore, for women in engineering at higher education (HE) institutions, the challenge of breaking through the barrier of historically male dominated occupations, accompanied by the unwillingness to accommodate them in those occupations, provides for an unattractive workplace environment. A further lack of understanding of the challenges faced by women and the manner in which they cope in these environments may contribute to the poor integration and advancement of women in the field of engineering (Fox, 2001; Martin, & Barnard, 2013).
It is well-documented that women are underrepresented in advanced positions in HE in Europe. In most European countries there are more women undergraduates than men, and more women graduate than men. However, the unequal gender structure of higher positions (senior lecturers and professors) persists in that, in general, men hold more top positions in HE than women, especially at the level of professor (Silander, Haake and Lindberg, 2013). In HE in the UK, the lack of women in senior positions in STEM, in particular at the professorial level (12%), is well recognized (Howe-Walsh and Turnbull, 2016). Likewise in the USA although there are more female academics than ever before (40.5% of all fulltime positions), the gains in all fields has not been equal, such that engineering, with 11.5%, has the lowest proportion of female academics. Women academics in all disciplines are in the lowest ranked positions. Female engineering academics are concentrated at the rank of assistant professor and very few become full professors. Although 23.6% of all full professors are women, only 2.8% of all engineering full professors are women (Minerick, Wasburn and Young, 2009).
Furthermore, women in academia often engage in very different career paths in comparison to their male counterparts, have less continuity in their *Curriculum Vitae*, and experience more stress and greater isolation (Meschitti and Smith, 2017). Whilst the barriers to female leadership in academia broadly have been reported, less attention has been focused on the experiences of women in STEM with the consequence that less is known about the challenges for females assuming leadership roles within these fields (Howe-Walsh and Turnbull, 2016).

WOMEN IN ENGINEERING EDUCATION AT DUT

Management Information (MI) data were analysed in order to establish the number of staff by gender in the seven academic departments of Civil Engineering (Durban); Civil Engineering (Midlands); Chemical Engineering; Industrial Engineering; Mechanical Engineering, Electronic and Computer Engineering, and Construction Management and Quantity Surveying in EBE at DUT. Data were gathered on the headcount of permanent academic staff by gender, headcount of secretaries and laboratory staff by gender, and the gender distribution of academic staff by rank, in the seven academic departments. The data, across a five year time period from 2014 to 2018, are presented in Table 1 - 4, and Figures 1 - 3 below.

Table 1 presents the headcount of permanent academic staff by gender in the seven academic departments for 2014 to 2018. The data show that, in 2014 the number of female academic staff in each of the seven departments was low in general and very low in Civil Engineering and Geomatics, Electronic Engineering and Mechanical Engineering. The overall representation of females had shown little to no improvement by 2018. In the case of Mechanical Engineering there was negative growth (1 female in 17 staff in 2017 and 0 females in 14 staff in 2018).

Table 1: Headcount of Permanent Academic Staff by Gender for 2014 to 2018 in 7 departments in EBE

	2014		2015		2016		2017		2018	
Department	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Chemical Engineering	3	4	3	7	3	7	3	8	3	9
Civil Eng & Geomatics	1	17	1	17	1	18	2	17	2	17
Civil Eng (Midlands)	3	6	1	6	3	6	3	6	3	6
Const Mngt & Quant surveying	2	5	2	6	2	5	2	6	4	6
Electronic Engineering	1	20	1	20	1	19	1	18	2	19
Industrial Engineering	1	5	1	5	1	5	1	5	1	6
Mechanical Engineering	1	16	0	15	0	16	0	14	0	14
Total	**12**	**73**	**9**	**76**	**11**	**76**	**12**	**74**	**15**	**77**

The lack of representation of females in the total headcount of permanent academic staff is even more evident when the data are presented as a percentage in Table 2. The data clearly indicate that male staff dominate in each of the seven departments. The number of female academic staff has very marginally increased from 12 (14%) to 15 (16%) in the time period from 2014 to 2018.

Table 2: Percentage of Female Academic Staff: 2014 & 2018 in 7 departments in EBE

	2014			2018		
Department	**Female**	**Male**	**Female %**	**Female**	**Male**	**Female %**
Chemical Engineering	3	4	**43%**	3	9	**25%**
Civil Eng & Geomatics	1	17	**6%**	2	17	**11%**
Civil Engineering (Midlands)	3	6	**33%**	3	6	**33%**
Const Mngt & Quant Surveying	2	5	**29%**	4	6	**40%**
Electronic Engineering	1	20	**5%**	2	19	**10%**
Industrial Engineering	1	5	**17%**	1	6	**14%**
Mechanical Engineering	1	16	**6%**	0	14	**0%**
Total	**12**	**73**	**14%**	**15**	**77**	**16%**

The data on the headcount and percentages of total of secretaries and laboratory staff by gender in Tables 3 and 4 reveal a similar trend in terms of representation of females. The situation is comparable to that with female academic staff; a number of departments have only one female member of staff in the secretaries and laboratory staff sector. Notably each of the seven departments has a female secretary (in five of the departments this accounts for the '1' female captured in the table) and the number of female non-academic staff has decreased from 9 (24%) in 2014 to 8 (21%) in 2018.

Table 3: Headcount of Secretaries and Laboratory Staff by Gender: 2014 to 2018 in 7 departments in EBE

	2014		2015		2016		2017		2018	
Department	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Chemical Engineering	2	5	2	5	2	5	2	4	2	4
Civil Eng & Geomatics	1	5	1	5	1	4	1	5	1	5
Civil Engineering (Midlands)	1	3	1	4	1	4	1	4	1	4
Const Mngt & Q Surveying	1	1	1	1	1	1	1	1	1	1
Electronic Engineering	2	8	1	7	1	8	1	9	1	9
Industrial Engineering	1	1	1	1	1	1	1	1	1	1
Mechanical Engineering	1	5	1	6	1	6	1	6	1	6
Total	**9**	**28**	**8**	**29**	**8**	**29**	**8**	**30**	**8**	**30**

Table 4: Percentage of Female Secretaries and Laboratory Staff: 2014 to 2018 in 7 departments in EBE

Department	2014 Female	2014 Male	Female %	2018 Female	2018 Male	Female %
Chemical Engineering	2	5	29%	2	4	33%
Civil Eng & Geomatics	1	5	17%	1	5	17%
Civil Engineering (Midlands)	1	3	25%	1	4	20%
Const Mngt & Quant Surveying	1	1	50%	1	1	50%
Electronic Engineering	2	8	20%	1	9	10%
Industrial Engineering	1	1	50%	1	1	50%
Mechanical Engineering	1	5	17%	1	6	14%
Total	**9**	**28**	**24%**	**8**	**30**	**21%**

Figures 1 and 2 present the total number of female academic staff plus the total number of secretaries and laboratory staff as a percentage on the total staff for 2014 and 2018 respectively. The pie charts for both years illustrate at a glance the low representation of females across the five-year period and the lack of improvement during this time span in the seven departments.

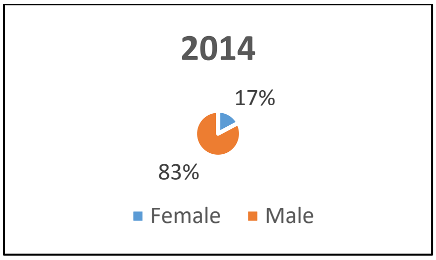

Figure 1: Total percentage of staff according to gender in 2014 in 7 departments in EBE

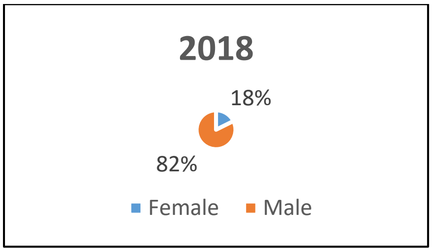

Figure 2: Total percentage of staff according to gender in 2018 in 7 departments in EBE

Figure 3 shows the stark picture regarding the distribution of female staff according to rank in the seven departments. In 2014 the majority of the small number of female staff held the rank of Lecturer. The females were clearly ranked in lower positions than their male counterparts. By 2018 the situation had barely changed with only a very marginal increase in the ranks of female Lecturers and Senior Lecturers. There are no female associate professors or full professors in the seven departments.

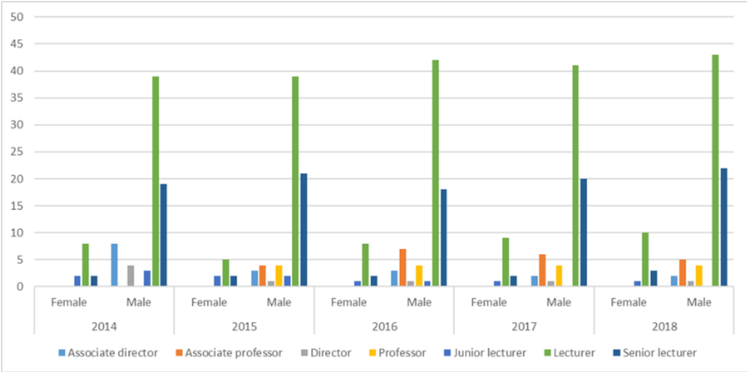

Figure 3: Gender distribution of academic staff according to rank in 7 departments in EBE

The data for the seven departments in EBE pertaining to the representation and rank of female staff resonates strongly with the findings in the literature presented earlier. Representation of female staff in general is low, and female academic staff are employed at the lower levels of rank than males. Furthermore, the situation has clearly not improved over a five year period. These findings resonate with the 2018 baseline study which revealed less than 30% of female students were registered in Civil, Electrical and Mechanical Engineering (Cooke, Jackson and Hefer, 2018).

CONCLUSIONS AND FURTHER RESEARCH

The baseline study data for the representation of female staff, and the ranks of female academic staff in EBE at DUT over a five-year period are presented. The findings are consistent with those presented in the relevant literature. Females are underrepresented in both academic and support staff; the rank of female academic staff is lower than their male counterparts; there are no female associate or full professors in the seven departments in EBE.

Women academics in STEM face many issues and challenges relating to their gender, including: institutional processes for recruitment and selection; discrimination of female candidates with a family; perceptions that females are less competent than, and have lower publication outputs and research funding than their male counterparts; lack of endorsement from peers for promotion to senior levels; and the absence of female role models in leadership positions (Howe-Walsh and Turnbull, 2016). At DUT these issues and challenges will be explored through further research in a qualitative study, conducted from a constructivist grounded theory perspective. Data will be gathered from a range of sources to investigate the research questions pertaining to engineering and built environment programmes. The questions include: factors influencing the choice of career; experiences of studying/working; the main challenges encountered; initiatives that DUT can implement; the main contributing factors to the students'/staff development; the overall differences between the experience of male and female students/staff ; the recommendations female students/staff would make to new female students/staff.

The overall findings (baseline and qualitative studies) will assist EBE with the development and implementation of policies, strategies and initiatives structured towards attracting, integrating, retaining, supporting and motivating women students and staff, in engineering and the built environment education. The study aims to contribute towards understanding the manner in which integration of women in academia may successfully occur. Furthermore, the study will inform the strategy that EBE will adopt to achieve gender equality.

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Adaptation of the Engineering Curriculum in the Age of Industry 4.0

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ABSTRACT

With the rapid proliferation of Industry 4.0 across the globe there is an immediate need for institutes of higher learning to adapt their curriculums, especially in the fields of engineering and IT, in order to ensure relevance to both industry and society. Industry 4.0 is synonymous with cyber-physical systems, AI and the internet of things and requires a knowledgeable workforce that are both inter- and multi-disciplinary skilled. This paper proposes a framework for a three- or four-year electronic engineering degree that aligns itself with the needs of Industry 4.0. The framework is comprised of three core pillars and provides a roadmap for the adaptations required in the curriculum, practical work and competency components of the qualification. In addition to knowledge attributes we also discuss the notion of graduate attributes as well the assessment of these outcomes. A three-year bachelor's degree in electronic engineering that applies this framework is currently being offered at the Durban University of Technology, South Africa.

Keywords: *Industry 4.0, Industrie 4.0, Fourth Industrial Revolution, Engineering Education, Education 4.0*

INTRODUCTION

The first industrial revolution began with the mechanisation of mass labour-intensive manufacturing processes. Subsequently, and arguably the more important leap, was the automation of one or more of the manual mechanisms that made up those machines; this was primarily owing to the invention and use of the steam engine. The second industrial revolution involved the improvement and upscaling or massification of manufacturing and production methods; this coincided with the invention of the combustion engine and electric generator. Contemporarily, industry and society were being transformed through a deeper understanding of the relationship between and use for electricity and magnetism. The third industrial revolution involved the integration of digital systems across all aspects of the manufacturing process; this was owing, in the main, to the invention of the transistor, integrated circuit and microprocessor as well as the subsequent proliferation of digital communication systems and computers. The integration of digital electronic and communication systems with automated mechanical systems is termed mechatronics. Mechatronic systems may be highly precise in their operation but are nevertheless methodical and non-decisive in nature. The fourth industrial revolution (4IR) refers to the 'independence' of the digitally automated manufacturing processes using cyber-physical systems (CPS). CPS may be described as systems that have integrated feedback sensors with intelligent decision-making capabilities; this may be considered as the transition from mechatronic to robotic. Incidentally, the term "fourth industrial revolution" was previously associated with the development of nanotechnology (Hung, Wang, & Chang, 2012); however, in recent times it has become associated with CPS and more synonymously with the terms "industrie 4.0", industry 4.0 (I4.0 or I4) and industrial internet of things (IIoT).

With the proliferation of I4.0 across the globe there is an immediate need for institutes of higher learning to swiftly adapt and implement the methodology and elements of these rapidly changing trends and evolving demands of the industry into their current syllabus (Kozák, Ružický, Štefanovič, & Schindler, 2018). The consequence of not doing so will result in cohorts of graduates finding themselves as part of the redundant workforce where their acquired knowledge might quickly become obsolete (Wermann, Kliesing, Walter, & Moraes, 2015).
With the changing landscape of I4.0 it is predicted that jobs, such as those in parts assembly, could be eradicated; however, there may be new jobs in R&D and engineering, such as 3-D printer designers, that could be invented (Lorenz, Rüßmann, Strack, Lueth, & Bolle, 2015). Similarly, according to a 2016 World Economic Forum white paper it is estimated that by 2030 anywhere from 2 million to 2 billion jobs will be in jeopardy because of these digital disruptor technologies associated with the machine age; however, it is estimated that 6 million new jobs will potentially be created by 2025 (Accenture, WEF-SC, & WEF-WG, 2016). Currently, there are jobs (and even words and descriptors for jobs) that didn't exist 10-years ago; these include mobile application designer and developer, *Uber* and *Taxify* driver, blogger and vlogger, big data analyst, tech ethicist, drone expert, 3D printer and printing designer, and driverless car engineer. These new type of jobs will primarily benefit those people in the fields of electronic and process engineering, information technology, mathematics and computer science (Benešová & Tupa, 2017). In Germany, for example, it is projected that there will be a shortfall of around 120,000 university graduates with degrees in computer engineering and IT by 2025 (Lorenz et al., 2015). Consequently, there is an immediate need for universities to adapt to these industrial and societal changes, especially in the fields of engineering and IT.

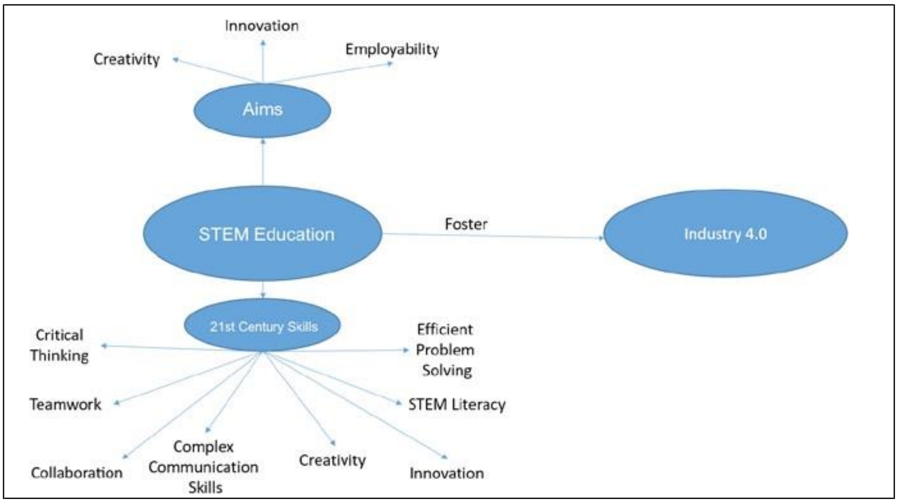

Figure 1: STEM Education and Industry 4.0 (Idin, 2018)

Although science, technology, engineering and mathematics (STEM) would appear to be related to I4.0 there is no coherent link between knowledge, skills and attributes of the higher education graduate and the associated requirements of industry in the machine age (Idin, 2018). Universities therefore are required to proactively adapt the curricula of their STEM qualifications in order to create this relationship. Figure 1 provides a model that shows the relationship between STEM, 21st century skills, aims and I4.0.
Both social as well as global economic development are intertwined with engineering education (Lucena & Schneider, 2008); consequently, in addition to knowledge of the engineering sciences, it is necessary for engineering students to have robust skills in human relations as well as

practical experiences in real contexts (Baena, Guarin, Mora, Sauza, & Retat, 2017; Litzinger, Latucca, Hadgraft, & Newtetter, 2011; Male, Bush, & Chapman, 2010).
The purpose of engineering cultivation at an institute of higher learning is to provide students with theoretical knowledge and enhanced practical ability to promote innovative thinking in order to meet the needs of society and industry while ensuring their employability (Jun & Jing, 2017). However, higher education, like industry, is just as susceptible to disruptions brought about by digital transformation; consequently, traditional education methods are no longer adequate in providing a foundation for employability (Ciolacu, Svasta, Berg, & Popp, 2017).
According to the European Commission (2016), I4.0 will require a greater focus on practical education and practical skills in order to develop, maintain and operate systems in smart factory environments where humans and machines will be working in collaboration. With the development of complex equipment there is a shift towards merging deep theoretical knowledge with practical emphasis and real world skills; this will undoubtedly put pressure on universities (Madsen, Bilberg, & Hansen, 2016). The curriculum must be industry-relevant, particularly in institutes that have a high emphasis on practical skills; students should be taught with stimulating learning experiences that promote the development of skills demanded by industrial markets (Hashim, Abdullah, Herman, Taib, & Alias, 2014; Ramirez-Mendoza, Morales-Menendez, Iqbal, & Parra-Saldivar, 2018).
The aim of this paper is to present a curriculum that incorporates a significant amount of the requirements of I4.0 for a three-year undergraduate bachelor’s degree, and a subsequent one-year postgraduate Honours degree, in electronic engineering. Complementary to the curriculum, the integration of the practical work components and competency outcomes of the programmes are also discussed. The bachelor’s degree discussed in this paper has been on offer at the Durban University of Technology, in South Africa, since January 2018.

METHODS

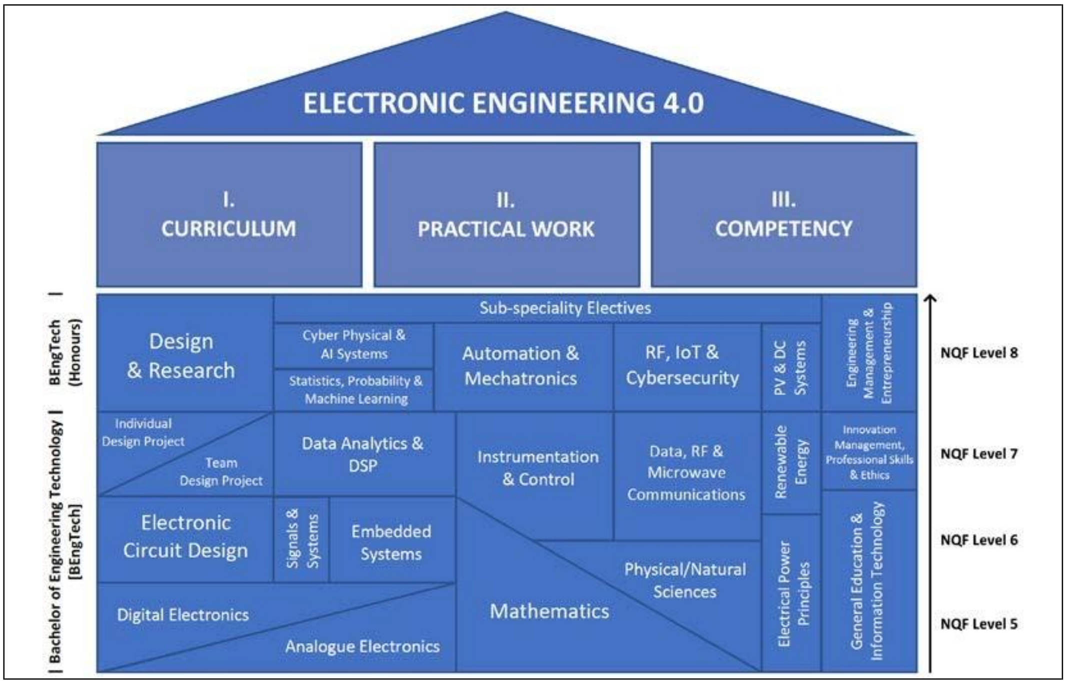

Figure 2: Industry 4.0-based Curriculum Framework for Electronic Engineering

The core objective of higher education is to arguably prepare graduates for work and life whereby content mastery, deeper learning, teamwork, communication skills, creative problem solving, higher order thinking and increased critical thinking abilities are integrated (Jeganathan, Khan, Raju, & Narayanasamy, 2018). Other attributes may also include practical ingenuity, business and management, creativity, strong analytical skills, global awareness, leadership, dynamism, ethical values, and social consciousness.
Since the technologies associated with I4.0 will have to be controlled by employees that are highly educated and qualified, basic engineering is seen as a tool that avoids obsolescence (Benešová & Tupa, 2017). A sensible point therefore in designing a new curriculum will be to find a balance between a strong scientific foundation, broad education and specialisation. In developing countries, such as South Africa, where there are often only limited job opportunities in all specialities, the graduate must be able to adapt to what is available (Venturino, Alberto, & Godfrid, 2007).
In this part, a framework for an electronic engineering qualification that incorporates the requirements of I4.0 is presented. As aforementioned, the qualification is currently being offered at our institute, the Durban University of Technology (DUT), and is referred to as the Bachelor of Engineering Technology in Electronic Engineering (BEngTech:EE)
The framework, which is illustrated in Figure 2, comprises three overarching core pillars that are interrelated and interdependent on each other; these include curriculum, practical work and competency. *Curriculum* refers to the modules, theoretical content, flow and structure of the course or qualification. *Practical work* implies the observation, practice, manipulation and/or application of the theory in various environments such as laboratories, industry, natural surroundings, homes and classrooms. *Competency*, according to the late former United Nations General Secretary, Kofi Annan, may be defined as *the combination of skills, attributes and behaviours that are directly related to successful performance on the job* (Irigoin, Whitacre, Faulkner, & Coe, 2002). The measure of the competency is achieved through the assessment of the relevant knowledge profile (theoretical and practical work) underpinning the *skills* as well as *attributes* associated with a qualification. *Attributes* in this context refers to the wholistic quality, attitude and disposition of the graduate; this commonly referred as graduate attributes (GAs).

Curriculum

In this sub-section we will discuss the curriculum framework that was developed for the BEngTech:EE at DUT. Engineering education finds itself in a quandary whereby graduates must be prepared for jobs that haven't been created, using technologies that haven't been invented, and solve problems that haven't become problems yet. It is therefore unrealistic to devise a curriculum that accounts for all real-time problems that currently exist and may exist in the future. Engineers are expected to be life-long learners and therefore be able to provide solutions to a myriad of realistic problems. The curriculum needs to be resilient, agile and dynamic that include technical, soft-skill and social components (Jeganathan et al., 2018).
Although specialisation is important it is also necessary for engineering students to have a solid general foundation in the physical, mathematical and engineering sciences as well as multi-disciplinary know-how and inter-disciplinary exposure (Kozák et al., 2018; Wermann et al., 2015). Albert Einstein's own pedagogical viewpoint was that *the development of general ability for independent thinking and judgement should always be placed foremost, not the acquisition of special knowledge.*
Moreover, with industrial processes becoming ever more complex, the creation of intelligent automated systems require elements of many different aspects of engineering, knowledge and skills across a variety of disciplines and an understanding of topics not related to one's area of

expertise (Jeganathan et al., 2018; Ramirez-Mendoza et al., 2018). Figure 3 provides an illustration of a multidisciplinary system design (Kozák et al., 2018).

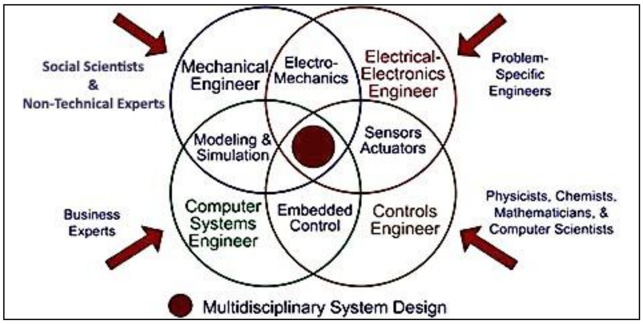

Figure 3: Multidisciplinary professional areas of education for Industry 4.0

The International Engineering Alliance (IEA) is an organisation that establishes and enforces internationally bench-marked standards for engineering education; it represents 27 countries, including South Africa, which are signatories to the Washington, Sydney and Dublin accords. The IEA refer to engineering content areas as a knowledge profile; this includes mathematical sciences, natural sciences, engineering sciences, engineering design and synthesis, computing and IT, and complementary studies (IEA, 2013).

Although at first glance there may not appear to be much flexibility within the IEA knowledge profile, however, both *engineering sciences* and *complementary studies* allow for the incorporation of inter-disciplinary, multi-disciplinary and humanities components.

Another factor that needs to be considered is the educational level at which the content is being presented and evaluated. In South Africa, the different levels of education from Grade 9 up to Doctorate are classified according to a national qualification framework (NQF), whereby Grade 9 to Grade 12 (matric or exit-level for high/vocational school) are defined as NQF levels 1 to 4, one-year post-matric vocational certificates are NQF level 5 (emphasis on remembering, understanding, applying and analysing content), two-year post-matric diplomas or advanced certificates are NQF level 6 (emphasis on evaluation of content), three-year post-matric degrees or advanced diplomas are NQF level 7 (emphasis on creation and application of content), four-year post-matric degrees or post-graduate diplomas are NQF level 8 (emphasis on research), Master's degrees are NQF level 9, and Doctoral degrees are NQF level 10.

The BEngTech:EE is a three-year (NQF level 7) 210 ECTS-credits bachelor's degree and the Honours is a further one-year (NQF level 8) 70 ECTS-credits degree. The fundamental difference between the BEngTech:EE and the Honours degrees, besides the different NQF levels, is that the former deals with the notion of *broadly defined* engineering problems while the latter involves the notion of *complex* engineering problems.

A graphical overview of the knowledge and content areas incorporated into the BEngTech:EE and Honours degrees as well as the associated NQF levels are provided in Figure 2. At the foundational level the core fundamentals of the mathematical and physical sciences, analogue, digital and power electronics, as well as general literacy, computing and IT skills are introduced and developed. Subsequently, the students are broadly exposed to four interdisciplinary electronic engineering subject areas; these include (i) telecommunications, (ii) instrumentation and control systems, (iii) embedded and intelligent systems, and (iv) renewable energy. These four subject areas are developed and assessed from the intermediate to the exit level. In addition, a fifth complementary core stream, which includes the principles and applications of engineering design, is incorporated. Finally, multidisciplinary topics such as data and statistical analytics, machine learning, economics, project management, innovation, entrepreneurship and ethics complete the knowledge profile. All modules in the BEngTech:EE are compulsory.

At the Honours level the gravitas of the knowledge profile will be further enhanced through a deeper understanding of the interdisciplinary and multidisciplinary subject areas together with their application to complex engineering problems as well as engineering research. At that stage, the broad subject areas covered in the BEngTech:EE will be amalgamated into some of the core topics associated with I4.0; these include, among others, cyber physical and AI systems, automation and mechatronics, embedded telecommunications as well as IoT and cybersecurity. It is proposed that a significant portion of the modules in the Honours programme be compulsory; however, a selection of elective modules will be provided for students desiring a modicum of sub-specialisation.

For a detailed breakdown of the BEngTech:EE curriculum, including modules, content and handbooks, refer to the department of electronic and computer engineering webpage at www.dut.ac.za.

Practical Work

In this sub-section we discuss the role and integration of practical work into the curriculum of the BEngTech:EE degree at DUT. Practical learning may be defined as the process whereby knowledge is created through the transformation of experience (Kolb, 1984). Kolb's experiential learning cycle is arguably the most frequently referenced model of practical, reflective learning (Ramsey, 2006); this is illustrated in Figure 4. Briefly, a *concrete experience* may be described as a sequence of events or some situation; *reflection* is the answering of the 'how' and 'why' did something occur; *generalisation* may be considered as the abstract conceptualism of how the experience may apply to other situations; and *action* is seen as the application of the learnt experience. At least one other institute is applying Kolb's model to the laboratory components of the curriculum in regard to I4.0 engineering education (Coşkun, Kayikci, & Gençay, 2019).

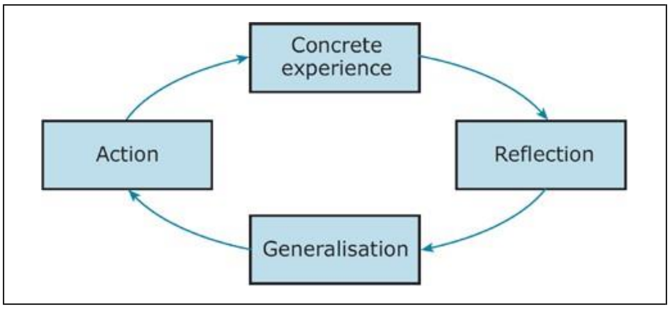

Figure 4: Kolb's Experiential Learning Cycle

Reflective learning, simply put, is *the idea of reflecting upon what you have done and thinking about how you could do better next time* (Ramsey, 2006). This is not about 'just trying harder' when faced with difficult problems, since real world experiences, unlike mathematical algorithms, are not repetitively identical. An apt comparison may be made with Churchill's (1948) paraphrased quote of Santayana: "Those who fail to learn from history are doomed to repeat it." Here the word "learn" may prudently imply *reflective learning*. Students must understand that for a different result there needs to be a different approach.

Ramsey (2006) proposes an amalgamation and minor expansion of Kolb's experiential learning model. In this case, experiential learning is understood to happen when you firstly, generate and evaluate new ideas from an experience or content; secondly, when you reflect on the experience by considering what has happened and what can be learnt from it; and thirdly, by considering your past experiences as well as feedback and the experiences learnt from others. An important component of learning is not just self-reflection but also reflection based on feedback or experiences of others; this factor is not explicitly considered in Kolb's model.

A common misconception, especially in relation to practical work, is that the ability to do and the ability to know why one is doing something are the same; however, these actually represent two different outcomes (Millar, Tiberghien, & Le Maréchal, 2002); this is illustrated in Figure 5. Practical work should not be designed like a 'recipe' since the result may be successfully achieved (effectiveness at level 1), however, the reason behind the result being achieved is not understood (effectiveness at level 2) (Millar, 2004). For example, if a modified version of the original 'recipe' is provided, however, with an incorrect 'ingredient' (step or component), then an error in the result may either not be realised nor understood. In the BEngTech:EE programme the practical work has been developed by considering an adaptation of Kolb's model, where external feedback is also considered, as well as taking into account both levels of effectiveness whereby students not only focus on the observables but also have to think about the explanatory ideas involved. The assessment of practical work is discussed in the next sub-section.

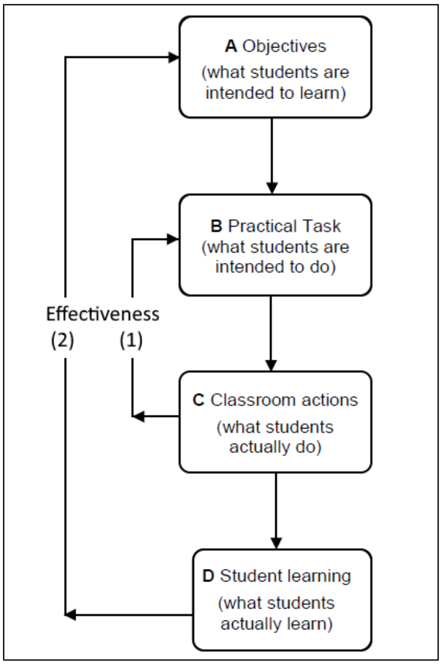

Figure 5: The process of developing and implementing a practical task

Competency

In this sub-section we discuss the outcomes and assessments of the curriculum of the BEngTech:EE degree at DUT. In addition to the knowledge profile, the IEA also emphasises the graduate attributes (GAs) of the student (IEA, 2013). According to the IEA, *GAs form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level*; these include engineering knowledge, problem analysis, design/development of solutions, investigation, modern tool usage, the engineer and society, environment and sustainability, ethics, individual and teamwork, communication, project management and finance, and lifelong learning.

The theory, practical work as well as the GAs must be assessed across the curriculum and throughout the qualification. In modules with practical work, we set a benchmark of 40% of the assessments to be based on these components; although not prescriptive, this is however in keeping with the ethos of I4.0 engineering education. Both the theory and practical work are continuously assessed throughout the semester in a series of formative and summative assessments. Formative assessments allow for students to get feedback from the lecturer and are intended to provide an opportunity to reflect on their results and/or shortfalls. The summative assessments are usually developed as a form of re-assessment, where the students are given the opportunity to improve on their previous shortfalls and/or solidify their knowledge and application of the content (effectiveness levels 1 and 2, as discussed in the previous sub-section).
In the BEngTech:EE, GAs are *developed* during the first two years and subsequently *assessed* at the third year exit level. In Honours, the GAs are only expected to be *assessed*. For the assessment of the GAs it is necessary to be innovative since these measurements are not as clearly defined as those for the theory and practical work components; for example, how does one assess ethics or even lifelong learning? It is not as simple as just providing a module on, for example, morals and ethics since effectiveness level 1 may be achievable in this manner, however, it doesn’t automatically address effectiveness level 2; in these cases, *reflective learning* is imperative, as discussed in the previous sub-section.
In South Africa, post-graduate degrees generally refer to Master’s and Doctorate degrees, while Honours degrees are associated with professional qualifications. At present the BEngTech:EE at DUT will allow for registration as a candidate professional engineering technologist. The international accreditation of the programme is dependent on both the requirements of the knowledge profile being adhered to as well as the graduate attributes being achieved.

CONCLUSIONS

In this work we proposed a generic framework for a three- or four-year electronic engineering degree which incorporates several factors associated with the demands of the burgeoning Industry 4.0. The framework consists of three overarching components viz. curriculum, practical work and competency. In the curriculum component, we incorporated inter-disciplinary, multi-disciplinary and humanities components into the recommended IEA knowledge profile. In the practical work component, we incorporated an adaptation of Kolb’s experiential learning model, where external feedback is also considered, and students not only focus on the observables but also must think about the explanatory ideas involved. In the competency component, we assess not only the theory and practical work aspects but also the graduate attributes. The practical work components of the modules represent 40% of the total assessment; this is in keeping with the ethos of Industry 4.0 engineering education. Finally, the recommended IEA graduate attributes are also developed and assessed throughout the curriculum. This framework is applied to a three-year bachelor’s degree in electronic engineering currently being offered at the Durban University of Technology, South Africa.
Although universities are urged to adapt their engineering curriculums to address the needs of Industry 4.0, there are two immediate factors that hinder this conceptual shift. The first is that there is no clear direction with regards to Industry 4.0 and the rapid changes in the requirements of the labour market (Lambrechts & Sinha, 2018). The second is that educators are having difficulties in being able to acquire new knowledge relating to these current trends and subsequently applying these principles to the teaching of their students (Chan, Chen, & Chou, 2006). These are not small concerns, however, in the coming years it is imperative that institutes of higher learning remain relevant and evolve with the rapidly changing needs of industry and society or they themselves might also become obsolescent.

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Open Educational Resources - in Engineering Education, Case Study at UC/AGH, UB and ULBS

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ABSTRACT

To change the educational scene in the epoch of the digital generation there is the possibility of using Open Education (OE) and Open Educational Resources (OER). The term "open educational resources" refers to resources with free access to use, adaptation and redistribution. The objectives of the research are to determine the degree of knowledge and use of OER in three Engineering Universities in three countries (Poland, Hungary and Romania) and to find out whether there is a relationship between the institutions in terms of knowledge and use of OER. The measurement is made by applying the survey method on a sample of n = 192. As a tool we use the questionnaire with 15 questions structured in three chapters: knowledge of OER; using OER; opinions about OER. In this analysis we summarize: the presentation of the degree of familiarity with some OER-related concepts, the use of special search engines, the use of free software sources, the frequency of use of OER and opinions on different types of OER that could be exploited in the future. For the description of relationship between nominal variable we use contingency tables and diagrams and compare the frequency data with the Pearson Chi-square test.

Keywords: *Open Educational Resources, special OER search engines, free software sources, digital generation.*

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1. INTRODUCTION

According to Harari (2018) we live in times of revolutionary changes of information and bio-technology, we deal with unseen technological challenges.

The technological and software changes defining our contemporary society imply the need to redefine the educational reality for all the participants to the educational scene, meaning that all the roles need to be updated and the training offers have to be integrated into the current context.

In the context of the digital era, Prensky proposed an interesting paradigm for the actors of education. Most of today’s learners belong to the digital native category (Prensky, 2001), meaning the ones born and raised in the era of digital technology, the others being mentioned as digital immigrants. The characteristics of these digital natives are: (1) The way the information is processed – they are used to take over and communicate with friends very quickly, text messages have become a form of primary communication, the information is analyzed very quickly; They were born with multitasking skills (both cognitive and sensory) and practiced them all their lives. (2) They prove a series of cognitive behaviors oriented towards efficiency and avoiding redundant information. (3) They have a personal identity in the virtual electronic environment and virtual social relationships are extensions of what they are and defines them. According to Prensky (2005), it is important for teachers to be willing to teach school students and university students: where and how to find important information; how to critically evaluate them; how to use them in appropriate contexts.

From an educational point of view, the social media acquires a special status. Digital native school students and university students are willing to talk and share what they know, they want to learn from each other within a wide learning community. There is a tendency to extend this learning desire from the social media context to the educational environment. Social media is defined as "a group of Internet-based applications, built on the ideological and technological foundation of Web 2.0 and enabling the creation and exchange of user-generated content" [6]. The most important forms of the social media are: (1) website blogs and formulas, (2) microblogging sites, (3) social networks (Facebook, Google+, Instagram, LinkedIn etc). Social networking sites that offer user-defined content: social bookmarking, social curating, (5) Wiki (Wikipedia, online galley and open encyclopedia). According to Artega Sánchez, Cortijo and Javed (2014 - in Ceobanu 2016), even if Facebook was not designed for educational purposes, it can promote the collaborative learning model, it increases the motivational level of learners. The study by Karvounidis, Chimos, Bersimis and Douligeris (2014) demonstrated a positive influence of the use of Web 2.0 tools (blogs, wikis and podcasts) in academia's academic context. Pawlowski (2013), in Open Education 2030, mentions the need for joint cross-border actions involving communities in different European countries in order to remain on the global education market. Dușe and Dușe (2015) talk about the need for European education systems to provide learning experiences offered to students closer to labor market requirements, the contribution of ICT to be more emphasized, inter alia in engineering education, both in teaching and learning, with an additional focus on the use of open educational resources.

The global dimension of engineering education pursues a high level of understanding and insight into the world. It positions the role of the engineer as a person who responds to the demands of society, they depend on solving those problems that require technical and innovative knowledge. Their field of expertise includes theoretical, practical, technical, strategic and conceptual capabilities. These knowledge and capabilities enable them to design solutions, identify different needs. However, society changes, changes in the environment, economic changes require more insistently the formation of broader skills that facilitates contextual performance both in organization and in society. In response to these demands, in engineering education, over the last decade, we have seen the development of a new type of engineering pedagogy with a holistic professional training. Among other things: problem-based learning, project-based learning, student-centered learning, education that includes the student as a consumer. According to Lappalainen (2017), as a new benchmark for the development of engineering education, recent studies propose that pedagogical objectives and activities include the development of personal attributes such as personality, socio-emotional skills and system intelligence. The latest refers to the ability to act intelligently as part of the whole, even when the whole is lacking. In this context, the whole represents an economic and social context on any scale, from small projects to large projects. This new type of education aims at developing a "life-philosophical" thinking that is based on the positivist paradigm in which the personal dimension (the growth of self) provides the foundation for system thinking.

Among the real opportunities to change the educational scene, in the epoch of the digital generation are the opportunity to capitalize on Open Education (OE) and Open Educational Resources (OER). Among the first, in 2002, the Massachusetts Institute of Technology (MIT) launches the OpenCourseWare project: materials and online courses with the possibility of free use and distribution; being followed by many other examples of OER projects in engineering education: (a) The Pennsylvania State University: Petroleum & Natural Gas Engineering, Course Author: Michael Adewumi; (b) University of Portsmouth: Scool of Engienering / Postgraduate Researsh Opportunities;) (c) UNSW Australia Enginiering: School of Petroleum Engineering, Open Learning Program; (d) Massachusetts Maritime Academies: Engineering etc.

The term "open educational resources" - used for the first time in 2002 by UNESCO - refers to educational resources (lesson plans, guides, training modules) with free access to use, adaptation and redistribution. The open source is a concept and a practice that allows user and developer access and redistribution, with the central principles of collaboration and circulation. According to Bucher (2011) and the Best practice guide of OER (2014) on www. acces-deschis.ro/ro/OER a complete list of all OER initiatives and databases is impossible to be issued due to their dynamic nature. The number of freely available materials increases every day, finding materials of interest remains the responsibility of the user. An important role in the future will be played by specialists who will facilitate access and whose efforts will lead to the development of automated or semi-automated tools to identify resources as closely as possible to needs. To reach the search results, the user is good at using a specialized search engine. Most of the large OER databases are institutional digital deposits, which focus on disseminating the materials developed by the organization. In addition to large databases, users also have a number of online catalogs, which, although they do not contain OERs themselves, link to various OER world warehouses, whose resources have passed a quality test, according to criteria search entered. OER types include: Open Courses, Open E-Books, Open Video, Open Audio, Open Photo / Open Photo, Open Social Community Forums.
On the 5th June 2019 an intergovernmental Expert Meeting adopts revised Draft Recommendation on Open Educațional Resources and that will be submitted to the UNESCO Conference in November 2019. The draft Recommendation text sets out a transformative vision of OER, one that contributes to the 2030 Sustenable Development Agenda.
The present research strategy applied in this work tries to describe and explain phenomena in the field of engineering education. The objectives are:

- Determining the level of knowledge and use of OER in three Engineering Universities from three countries: Poland, Hungary and Romania.
- Considering the involved population (students and teachers) in the education process of the three Technical universities (UC/AGH; UB; ULBS) we wish to find out if there is a significant association between the membership of one of the three universities and OER usage.

We have a research model with independent measurements. The variables are categorical, the measured cases are classified in one of the nominal cases, they can also be considered qualitative.

2. RESEARCH INSTRUMENTS AND DESCRIPTION OF POPULATION

As a tool we use the questionnaire with 15 questions structured in three chapters: Knowledge OER; Using OER; Needs/opinions about OER; In this analysis, we summarize the presentation of the degree of acquaintance with some concepts related to OER, the use of special OER search engines, the use of free software sources, the frequency of use of OER and opinions on different types of OER that could be capitalized in the future . Thus, we analyze questions no. 1, 2.b, 4, 7 and 11 with elements corresponding to the operationalized concepts: the category of belonging to one of the universities (UC/AGH, UB, ULBS) and OER (knowledge, use, opinions).Trying to describe relations between nominal variables we call them to be presented as contingency / association tables and bar/column diagrams. Comparison of the frequency data is done by using the Person Chi-square test. The form of the questionnaire is Word Document in Romanian for ULBS, English for UC/ AGH and Google Forms in Hungarian for UB (https://goo.gl/forms/BGjbMvfVUF18oEcl2).
The measurement is made using the survey method on a sample of 192 people (n=192). Professors, students, PhD or Ms students from the University Engineering Institutions were asked: CRACOW UNIVERSITY of Tehnology (UC/AGH), ÓBUDA UNIVERSITY ”Rejtő Sándor Faculty of Light Industry and Environmental Engineering” (UB) and UNIVERSITAEA ”LUCIAN BLAGA DIN SIBIU” Facultatea de Inginerie (ULBS), according to table no.1

Table 1. Participants in the survey

	ULBS n=92		UC/AGH n=34		UB n=66		Total n=192	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Respodents	92	47,92	34	17,71	66	34,38	192	100

3. RESULTS AND DISCUSSIONS

a. Are the subjects familiar with the following: free license, license terms, website: www.cretivecommons.org, copyright?

Familiarization with OER-related concepts: free license, licensing terms, copyright is for more than 50% respondents to each institution. The knowledge of www.cretivecommons.org is under 20% at each university. Figure no. 2 shows the percentage frequency of the extent to which those with OER concepts are familiar: free license, license terms, site: www.cretivecommons.org, copyright.
In the case of the acquaintances of those with a "free license", we wanted to find out if there are significant differences between one of the institutions and the "free license". After obtaining the Pearson Chi-square coefficient $X^2 = 13{,}897$; df = 2, p = 0,001 (p <0,05) we can state the significant difference between the frequencies observed and those expected when belonging to one of the universities (ULBS, UC/AGH, UB) . UC/AGH respondents tend to be the most familiar with free licenses, the least familiar with UB.

b. Knowledge and usage of RED search engines

Frequency of search engines OER for general search engines (Google, Bing) is higher than for special search engines in each institution. Table no. 2 shows the percentage of use of the OER search engines, and Figure no. 1 summarizes data on the use of special OER search engines by institutions.

Table 2. Use of special OER search engines

Institutions	***Google***	***Bing***	***Globe***	***Folk semantic***	***Discover ED***	***Creative Comon***	***Open Coursware***	***Other engines***
	F %	***F %***	***F %***	***F %***	***F %***	***F %***	***F %***	***F %***
ULBS	98,91	22,83	14,13	5,43	9,78	11,96	7,61	11,96
UC/AGH	100	8,82	2,94	-	-	-	-	26,47
UB	98,48	18,18	4,55	-	3,03	4,55	-	1,52
Total	98,96	18,75	8,85	2,60	5,73	7,29	3,65	10,94

The use of special search engines OER has the highest ULBS (34.78%) and lowest UB (12.12%). According to Pearson Chi-square analysis $X^2 = 10{,}491$; df = 2; p = 0,005 (p <0,05), the difference is significant.

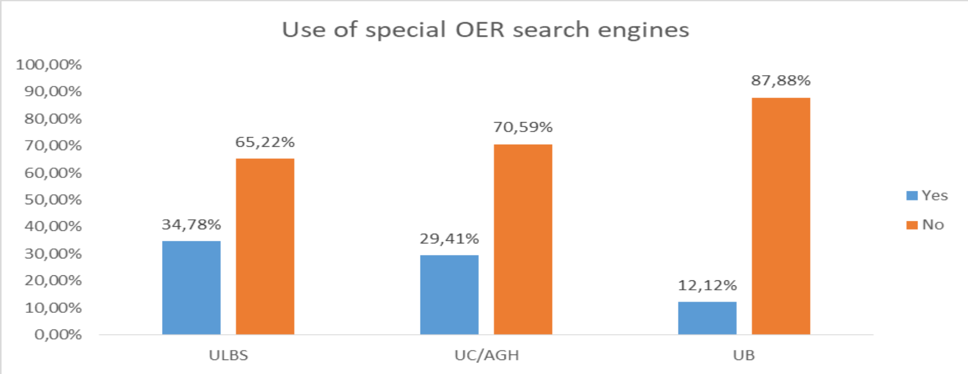

Figure 1. Use of special OER search engines

c. Which free software sources (Learning Systems / LMS Tools) are used?

Respondents from ULBS use each of the free software sources presented in Table 3. With the exception of *Dokeos* and *Atutor*, all other learning systems are used to a certain extent by respondents in UB. Respondents from UC/AGH uses: *Moodle*, *Bodington*, *Atutor*, *Olat* and others. It is understandable that the highest percentage (27,17%) of *Moodle Ro* belongs to ULBS.

Table 3. Use of free software sources (LMS Tools)

Free software sources	*Instituţions*			*Total*
	ULBS	*UC/AGH*	*UB*	
	Frequency %			
DidaTec	13,04	-	3,03	7,29
Moodle	10,87	38,24	84,85	41,15
Moodle Ro	27,17	-	3,03	14,06
Bodington	4,35	5,88	1,52	3,65
Caroline	3,26	-	1,52	2,08
Dokeos	2,17	-	-	1,56
LRN	3,26	-	1,52	2,08
Atutor	3,26	1,52	-	2,08
OLAT	2,17	11,76	3,03	4,17
Other sources	7,61	8,82	3,03	12,50

The differences between the membership of one of the university institutions participating in the research are greatest when using the *Moodle* system. The value of Pearson Chi-square is x^2 = 86,998; df = 2; p = 0,00 (p <0,05), UB's tend to use the most of the *Moodle* learning system.

d. How often do you use RED?

The answer to the question of the frequency of OER usage is *often*, *not so often* or *hardly any*. UC/AGH (47.06%), ULBS (33, 70%) and then UB (16.67%) are the most frequent use frequencies. As the frequency of use *not so often*, the highest percentage is UB (42.42%), followed by UC/AGH (23.53) and ULBS (19.57). *Nearly none* uses OER according to the answers: ULBS (46,74), UB (46,42) and UC/AGH (23,53), shown in Figure 2.

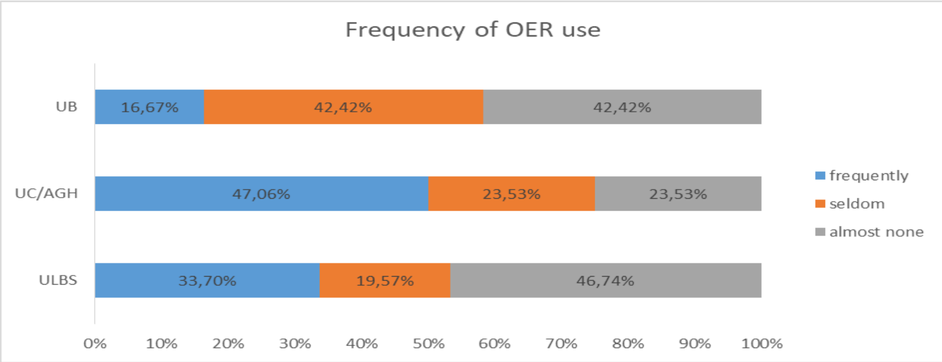

Figure 2. Frequency of OER use

e. Which types of RED could be used in the future?

In the opinion of the respondents, the types of OER mentioned in the question, also presented in Figure 3, could be used in the future very well/well: open courses (66,67%), open e-books (56,25%), open audio / photo / video (65.63%), open software (58.33%), open community forums (44.27). There are fewer people who believe that these types of OER can not or almost never make good use: open courses (12,50%), open e-books (19,79%), audio/ photo materials/ open video (0,42%), open software (20,83%), open community forums (23,96%).

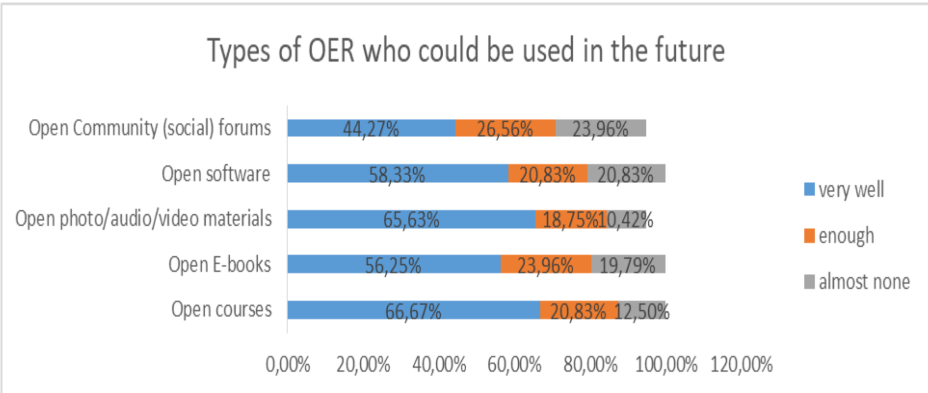

Figure 3. Types of OER who could be used in the future

If we analyze the answers given by respondents belonging to the three universities in the case of "open forums", presented in Figure 4, at each institution the highest percentage is given to the very good / good use (ULBS 43.48%, AGH 58, 82%; UB 37.88%). Pearson Chi-square coefficient X^2 = 7,195; df = 2; p = 0,126 (p> 0,05) shows that the differences between the frequencies observed and those expected when belonging to one of the universities (ULB, UC/AGH, UB) in relation to use "open forums" are not significant. Respondents of each institution are of the opinion that in the future the OER "open forums" could be use *very good/good*.

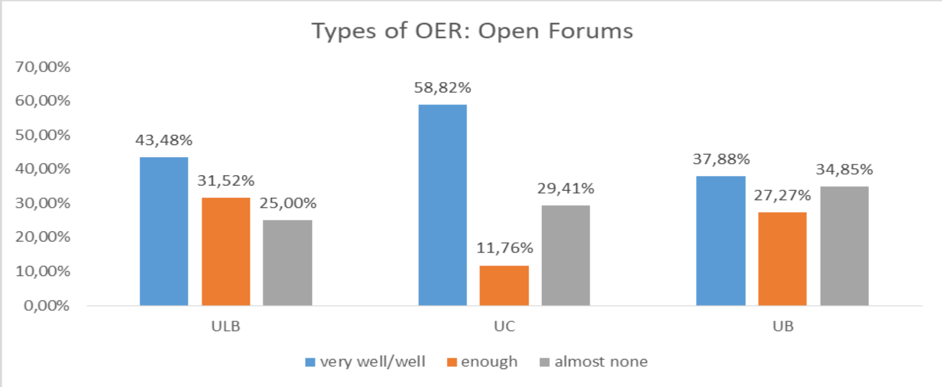

Figure 4. Types of OER: Open Forums

CONCLUSIONS

Different educational institutions or those in the economic sphere are trying to find new opportunities in online courses, platforms and portals in the field of courseware.
Among the benefits of open educational resources we can highlight: low costs, potential to improve access to different materials, performance through the use of data that can be accessed much easier and much faster, community development by offering a new model of collaboration and cooperation between teachers and between students. Developing open educational resources can fulfill the mission of making learning and knowledge available to everyone.
In the present paper we have attempted to present, according to the proposed objectives, the level of knowledge and use of OER in three Engineering Universities in three countries and the extent of the existence of relations between membership in one of the institutions regarding the knowledge and use of OER. Of the OER-related concepts, each institution is more familiar with the concepts of free license, license terms, and copyright. Less well known is the site www.cretivecommons.org. General Search Engines (Google and Bing) are more often used than special OER search engines: Globe, Folksemantic, DiscoverED, Creative Comon, Open Courswase. Of the special OER search engines only Globe is used by each institution. The special OER search mats are mostly used by ULBS (34.78%), followed by UC/AGH (29.41%) and UB (12.12%).
Of the free sources of mentioned software, three are used by the respondents of each institution: Moodle, Bodington and OLAT. Regarding the degree of use of the free source of Moodle software, there are significant differences between institutions, UB tend to make the most of this learning system (84.85%) then UC/AGH (38.24%) and ULBS (10.87%). Among the opinions on OER, we analyzed what types of OER could be used in the future. These could be open courses, open e-books, open audio/photo/video, open software and open community forums. Significant differences between institutions on the use of open social forums do not exist, the respondents of each institution tend to believe that open community forums can contribute to the valorisation of open educational resources.
To conclude, ULBS tends to use the OER search engines to the greatest extent, UB's are those who use significantly the free sources of Moodle software, and those at UC/AGH are those who are most familiar with the OER concept of "free licenses," the frequency of "often" use here is the largest. Also, UC/AGH tends to believe that the open forums might be "very good/good" use in the future, even if everyone believes this and the difference between universities at this point is not significant.
Given the benefits of Open Educational Resources (OERs) both from the point of view of institutions and learners, it would be desirable for these resources to be as widely used both in higher education institutions as in pre-university education .

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Entrepreneurial Learning and AI Literacy to Support Digital Entrepreneurship

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ABSTRACT

The formation of the entrepreneur as a person for digital transformation is important and considered, in a large part, to be due to learning. Entrepreneurship is "a process of new value creation" and digital entrepreneurship is understood as "a subcategory of entrepreneurship in which some or all of what would be physical in a traditional organization has been digitized". The integration of artificial intelligence - AI into business world can automatize some tasks and make entrepreneurs more "creative" and fulfilled, which would obviously benefit the companies that they work for." Entrepreneurial learning is a basis for education of entrepreneurs and should supports digital entrepreneurship within the process of designing, lunching and running a new business within digital transformation. It should include AI courses in the learning and teaching process to achieve AI Literacy competence.
The first part of the paper includes results of literature review and of interviews that the author has done with entrepreneurs within some European projects about different forms of entrepreneurship, particularly digital entrepreneurship and the use of AI. A review of literature about entrepreneurial learning and basis components, which characterizes it, is given in the next part including also experience of the author in teaching and training entrepreneurs
The last part of the paper presents some new approaches within education by using entrepreneurial learning including AI Literacy oriented to digital workplaces and digital entrepreneurship. Developments within European projects with the participation of the authors are also given.

Keywords: *Entrepreneurship, Digitalization, Digital entrepreneurship, AI, Entrepreneurial learning*

INTRODUCTION

Digitalization means many transformation processes and implications for entrepreneurs as well as for entrepreneurship; researchers and educators should identify new opportunities on business and new theoretical and practical methods in education and training for entrepreneurs.
The formation of the entrepreneur as an instigator for digital transformation is important and considered, in a large part, to be due to learning from experience (Deakins and Freel 1998, Rae and Carswell, 2001). Many entrepreneurs engage also in formal and informal learning activities,

individually—such as enrolling on university courses (Davidsson and Honig 2003)—or collectively—such as forming peer learning groups (Mäkinen 2002).
Entrepreneurship is “the process of designing, launching and running a new business” (Hsieh and Wu, 2018) with its distinct characteristic of “new value creation” (Hull et al., 2007). Scott A. Shane is the 2009 winner of the Global Award for Entrepreneurship Research. First,
Shane has influenced central aspects of entrepreneurship and has been a leading figure in redirecting the focus on entrepreneurship research itself. Shane’s research improve understanding of entrepreneurship (References). He has contributed to how entrepreneurship research should be conducted. Shane has been a forerunner in examining relevant units of analysis that are difficult to sample; research designs and databases specifically designed for studying entrepreneurial processes; and sophisticated analytical methods. This has contributed to advancing the methodological rigor of the field.

In connection with the developments of technology, other forms entrepreneurship are defined. Ferreira (Ferreira et al., 2016) opts for a broad conceptualization of technology entrepreneurship suggesting that it is a combination of entrepreneurship and technology-based innovation. Beckman (Beckman et al., 2012) wrote that it is a type of entrepreneurship that aims at exploiting opportunities related to advances in science and engineering.
Technology entrepreneurship is an established concept in academia. The digitalization of the “technology” not only changes its properties but also affects the overall technology entrepreneurship process. It also has an impact on entrepreneurial processes in general and on new forms of entrepreneurship.
“Digital entrepreneurship” is understood as “a subcategory of entrepreneurship in which some or all of what would be physical in a traditional organization has been digitized” (Hull et al., 2007).
The connection between entrepreneurial learning and entrepreneurship was presented first by Schumpeter (1950) and then developed within an evolutionary framework, such as the evolutionary theory of the firm, the competence perspective in the theory of the firm (Foss and Mahnke 2002) and theories of organizational routines (Feldman and Pentland 2003; Becker 2004).
Entrepreneurial learning as a theoretical concept has been studied by many researchers and educators and has played a crucial role in the development of government policies aimed at fostering the ‘knowledge-based economy
(http://eprints.bournemouth.ac.uk/15080/1/241_Erd%C3%A9lyi_Final%20Paper_313_The%20Matter%20of%20Entrepreneurial%20Learning.pdf).
It is a basis for education of entrepreneurs and supports digital entrepreneurship within the process of designing, lunching and running a new business in the digital era (Hull et al. 2007).
Artificial intelligence (AI) has been used for decades. But due to progress of key technologies like cloud computing and data analytics, AI impacts more the digital transformation. Google, Facebook and Microsoft have been investing in AI in the last years.
A good definition of AI is important because it “is quite a bit of buzz in the marketplace” and it seems that just about any tech company considers itself to be a big player in AI
(https://www.forbes.com/sites/tomtaulli/2018/05/05/what-entrepreneurs-need-to-know-about-ai-artificial-intelligence)
Andreas Roell, who is a managing partner at Analytics Ventures gives the following definition of technology: “The way to think about the general concept of Artificial Intelligence is the introduction of smart thinking into computers. Instead of providing them with specific formulas of how to process data and information, computers are fed algorithms to process data, which has general boundaries that lead to desired outcomes.”
(https://www.analyticsventures.com/managing-partner-andreas-roell-describes-ai-in-forbes/)
Machine learnings (ML) is a sub-component of AI referring to using computer systems to consistently improve the performance of the outcomes; it often involves image recognition and language translation.

For entrepreneurs AI is an enabler but also a new obstacle. Entrepreneurs however, do not have to get too deep into the details; for them it is important to understand the potential of the technology, how AI works and to focus on realistic results.
After this Introduction, the paper includes results of literature review and of interviews the authors have done with entrepreneurs within some European projects about different forms of entrepreneurship, particularly digital entrepreneurship,
A review of literature about entrepreneurial learning and basis components, which characterize it, are given in part 3.
It also includes the experience of the authors in teaching and training entrepreneurs. The last part of the paper presents some new approaches within education by using entrepreneurial learning oriented to digital workplaces and digital entrepreneurship. Developments within European projects with the participation of the authors are also given.

DIGITAL ENTREPRENEURSHIP

Schumpeter (1950) started the study of the entrepreneur and entrepreneurship education and underlined that these have a central place in the study of economic growth; entrepreneurs take the risk to introduce innovative products, services and new technology to the economy.
Landreth and Colander (1994, affirmed "...the real source of economic growth is fostered by the activities of the innovative entrepreneur not in the activities of the followers who are risk averse."
Schumpeter (1950) emphasized that an entrepreneur is an individual who is innovative in same time.
An entrepreneur has desire for achievement in any activity that one is engaged in (McClelland, 1961), being proactive instead of reactive (Miller, 1983) being innovative and creative (Drucker, 1985), being able to take risks (Brockhaus, 1980), being an opportunity identifier, moderate risk takers, and having an internal locus of control (Brockhaus, 1982).
Digitalization creates new opportunities for entrepreneurship (cf. Hull et al., 2007), a new business model uses digital potential and entrepreneurs needs to be aware of those opportunities in order to be ready for sustainable innovations. Some of these forms of entrepreneurship are:
Recent developments in the context of entrepreneurship, possible combinations of technology and entrepreneurship which have resulted with digital era.
The following table shows some topologies of entrepreneurship in connection to technology.

Table 1: Forms of technology and digital entrepreneurship Source Bailetti (2012), Gions (2017)

Typology	Technology Behind the Opportunity	Key Activities in the Process	Access to Resources and Funding
Technology Entrepreneurship	New products based on breakthroughs in research; science-based advances through specific knowledge in an academic field Example: Graphene	Technology proof of concept: first customer validation; activate a global but niche market (Clarysse et al., 2011)	Public research grants and other soft money sources Venture capital attracted by promising intellectual property (Audretsch et al., 2012; Giones & Miralles, 2015)
Digital Technology Entrepreneurship	New products based on ICT technologies only; making smart devices using the possibilities of Internet of Things Example: Smartphone	Use of existing technologies: market validation, traction, and growth, scalability	Business angels; seed and venture capital; stock market Crowdfunding: reward and equity (Gedda et al., 2016)
Digital Entrepreneurship	New products and services based on the Internet. Services running only in the cloud; using big data or artificial intelligence. Example: Snapchat	Technology as an input factor: high growth ambitions (Wallin et al., 2016); stay ahead of competitors; be the dominant player in the category	Business angels; seed and venture capital; stock market Equity crowdfunding (Tomczak & Brem, 2013)

Digital entrepreneurship can also be considered a reconciliation of traditional entrepreneurship (Le Dinh et al, 2018,) with the new way of creating and doing business in the digital era and also as a form of technology entrepreneurship but we used the classification of Bailetti.

Digital entrepreneurship is a phenomenon, which arose through technological assets like internet and information and communications technology (Le Dinh et al., 2018). Entrepreneurial activity that transfers an asset, service or major part of the business into digital can be characterized as digital entrepreneurship. Products, marketing activities and workplace mark the major differentiation criteria between digital and non-digital entrepreneurs.

The main advantage of digital entrepreneurship is that private business could be managed from anywhere in the world, provided by access to the internet.

Other advantages are:

- More flexible hours
- Cost savings
- Easiness of reaching many people
- Easily scalable business

Big companies recognize the value of AI within digital entrepreneurship i.e. in automating standardized tasks, motivated by cost, productivity and efficiency gains, or the increasing pressure of regulatory compliance rather than employee happiness (Link). They understand that in order to remain relevant and competitive, they must often engage in AI research, introduce AI-based products and services, and implement AI tools and applications.

Modern companies rely on faster, more affordable and more accurate modes of marketing because by using AI in digital marketing practices, entrepreneurs can benefit from higher response value from the target audience and ultimately achieve better results. AI based search engines are now doing a do far better serving searcher intents, using deep learning algorithms to grade relevancy, reader-friendliness, and authenticity before displaying content. Higher quality content should be created since its rankings predominantly depend on how well it addresses its intent to the target audience.

AI integrated search engines respond to user intent signals more authoritatively against predefined algorithms and machine-learning capabilities of search engines allow to gather information and predict, anticipate and influence trends in content marketing. By utilizing AI interventions, online marketers are now able to improve engagement, extend retention, personalize user experience and boost sales. One of the most successful yet underrated techniques is search engine optimization (https://www.entrepreneur.com/article/324586).

AI will also have an important role in improving the advertiser-customer relationship by facilitating interaction through deep learning.

Entrepreneurs can use cloud compute, storage as well as modern machine learning as a service on demand with pre-trained machine learning models. As companies continue to integrate machine learning into their businesses there will be inherent benefits to new startups. Smarter CRM tools like SalesForce and Hubspot help drive sales, marketing automation, and customer service. These and other platforms will continue to add value to historic and emerging data, help optimize business timing, maximize resources and minimize waste with well-informed decisions.
(https://medium.com/@vartoogian/artificial-intelligence-impact-on-entrepreneurship-and-the-ai-literacy-imperitive-7b5e0364509c).

Research in digital entrepreneurship particularly in integrating AI methods is still at the beginning particularly when talking about the required education to support it. Digital business models, digital entrepreneurship process, platform strategies, education and social digital entrepreneurship are topics to be further researched.

Wind (2008) underlines that digital businesses represent a “shift from traditional management approaches to network orchestration’” as networks and communities are crucial for digital entrepreneurs. Digital business models in terms of the appearance of goods and services,

digitalization of the distribution channel, digital communication with stakeholders and internal processes are carried out on a digital basis.
Huang and Cox (2016) conducted research with a case study and Taiwan and mention that the motivation for low-income people to engage in social digital opportunities is an interesting field for further research.
The importance of competences and skills of entrepreneurs required to define and describe entrepreneurship as a competence and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit". It was necessary to:

- develop the reference framework describing its components in terms of knowledge, skills and attitudes
- Provide European citizens with the appropriate tools to assess and effectively develop this key competence.

In this context, the JRC on behalf of the Directorate General launched the Entrepreneurship Competence study (EntreComp – European Commission, 2015) for Employment, Social Affairs and Inclusion (DG EMPL) in January 2015. One of the key objectives of EntreComp was to develop a common conceptual approach, which could support the development of entrepreneurship competence at European level.
The DigComp 2.0 framework (https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework) identifies the key components of digital competence necessary in digital entrepreneurship:

- Information and data literacy i.e. Articulating information needs, locating and retrieving digital data, information and content, judging the relevance of the source and its content, storing, managing, and organizing digital data, information and content.
- Communication and collaboration i.e. interacting, communicating and collaborating through digital technologies while being aware of cultural and generational diversity, participating in society through public and private digital services and participatory citizenship, managing one's digital identity and reputation.
- Digital content creation i.e. Creating and editing digital content, improving and integrating information and content into an existing body of knowledge while understanding how copyright and licenses are to be applied, knowing how to give understandable instructions for a computer system.
- Safety i.e. protecting devices, content, personal data and privacy in digital environments, protecting physical and psychological health, and being aware of digital technologies for social well-being and social inclusion and of the environmental impact of digital technologies and their use.
- Problem solving i.e. identifying needs and problems, resolving conceptual problems and problematic situations in digital environments, using digital tools to innovate processes and products, keeping up to date with the digital evolution.

ENTREPRENEURIAL LEARNING AND AI LITERACY

The European definition of entrepreneurial learning includes the development of entrepreneurial attitudes, skills and knowledge that enable the individual to turn creative ideas into action. Entrepreneurship is not only related to economic activities and business creation, but more widely to creating value in all areas of life and society, with or without a commercial objective (http://www.thelearninglab.nl/?dt_portfolio=36345).
Entrepreneurial learning:

- Creates conditions for job creation and a healthy economy
- Stimulates innovation and capacities to deal with exponential change and globalization
- Engages and motivates students through relevant learning experiences for education, life and work.

- Empowers people to create value for society and deal with societal challenges.

Peter Erdélyi underlines that entrepreneurial learning is

- An observable phenomenon, something entrepreneurs engage in or are associated with
- A concept that has started to receive increasingly explicit articulation in academic literature in the past decade and which has been implicit in the literature since Schumpeter (1950)
- A core policy objective in developed Western countries implemented through funded programs targeted at entrepreneurs

(https://www.researchgate.net/publication/228419882_The_Matter_of_Entrepreneurial_Learning_A_Literature_Review).

Entrepreneurial learning is still a relatively new area of study, presenting more interests since Becker and Knudsen (2009) associated it i.e. with globalization, the spread of new ICTs, and the revival of small business. The confrontation of entrepreneurship studies and organizational learning literature (Dierkes 2001; Easterby-Smith and Lyles 2003), which was done parallel during the past decade, raised the interest in entrepreneurial learning.

Entrepreneurial learning has emerged as an important area of inquiry in relation to both the academic studies of entrepreneurship and the practical development of new entrepreneurs. Theoretical approaches that focus on diverse aspects of entrepreneurial learning are divided into two main groups, depending on their analyzing object: those focusing on the individual entrepreneur and those focusing on the organizational context (https://www.researchgate.net/publication/228419882_The_Matter_of_Entrepreneurial_Learning_A_Literature_Review).

The first approach has as object the personal learning experience and the cognitive capabilities of the „entrepreneurial individuals „ the second sees entrepreneurship „as a collective activity and at various scales, from the single firm and its immediate network until the national system of innovation.

Deadkins and Feel consider entrepreneurial learning a type of management learning to build an entrepreneur and to set up new business; Kolb (1984) uses the theory of experiential learning to describe how entrepreneurs learn from experience; entrepreneurship is a behavior that is learned through experience. The second group defines entrepreneurial learning as a social or collective activity. Some authors (i.e. Gibb, 1997) try to use Learning organization in SME context.

In order to improve the practical character of education and training for entrepreneurs it is necessary to (Gibb, 1997):

- Support understanding of entrepreneurial learning
- Integrate it into teacher/trainer education
- Create strong cooperation between higher education - HE, research and business life,
- Develop a basic education in this context.

Concerning AT, it seems that there is a “mismatch” between the expected potential benefits of AI and its development and implementation due to a misunderstanding or due to the development of AI products, tools and applications which has slowed down through the lack of a “digital culture” and entrepreneurial spirit in the workplace.

Entrepreneurs should be encouraged to use training time on developments in digital technology, particularly in artificial intelligence.

In order to prepare the next generation, schools and universities, AI should has to become a mandatory topic in all of their programs which in other words means a development of AI Literacy.

For some classes, the fundamental technological principals like history, philosophy, economics, and ethics of artificial intelligence will be sufficient.

Concerning education and training of entrepreneurs, the lack of a basic agreement of who is an entrepreneur makes the attempt to defining education of entrepreneurship and particularly supporting entrepreneurship, a difficult task. Education to support entrepreneurship has an important role in social and economic developments: by encouraging society to look for opportunities and

taking initiative, result in creating jobs and economic prosperity, and providing social value to citizens.
Many educational and training curricula have been developed in this context but there is little focus on sustaining a business beyond its creation.
The importance of digital entrepreneurship increased but teaching and learning of digital entrepreneurship is not only a current hot topic, but should be better integrated in entrepreneurial learning programs.
In addition to the equipment, certain features are essential if someone is willing to learn to be a digital entrepreneur:

- Curiosity: in order to undertake on the internet, one needs to cultivate own curiosity, because only by researching a lot about the market and the behavior of consumers for future business that a solution that adds value to people’s lives is to be found.
- Willingness to study/become specialized: reading news about the daily market. Over time the need develops to specialize in one theme that affects your business the most.
- Wanting to help people: “Entrepreneurship is associated much more with identifying problems and opportunities to implement an idea that causes positive impacts than with being innovative and creating something never seen before.”
- Knowing the advantages of digital entrepreneurship.

Guthrie (2014) reports her own experiences with using student’s themed blogs in a learning project within an e-commerce major in a European business school and provides a set of digital entrepreneurship skills, which are grouped along the phases of digital product life cycle (production, distribution, promotion). Nichols et al. (2017), who described the supportive contribution of academic libraries to entrepreneurship and digital humanities on campus, showed a lack in providing further research opportunities. Le Dinh et al. (2018) suggests possible research opportunities regarding their living lab approach. Further empirical research is needed for the generalizability of the living lab approach, a better understanding of its various options and the inclusion of big data, though clear reference to education of entrepreneurs is missing.
Nowadays education and training of entrepreneurs and undergraduate curriculum do not cover the how and why AI technology can help. Talking to SIRI, Netflix recommendations, smartphones or hailing an Uber are all taken for granted yet there is hidden genius enabling it all. On the surface, it may seem overwhelmingly complex to even explain, yet AI should be viewed as a tool and a prerequisite skill (https://medium.com/@vartoogian/artificial-intelligence-impact-on-entrepreneurship-and-the-ai-literacy-imperitive-7b5e0364509c).
AI literacy should become a standard part of the curriculum to fuel the entrepreneurial minds of tomorrow.

EXAMPLES

The new economy brings with it many challenges for SMEs.
They more productive than larger organizations, they often remain stagnant (European Commission, 2015). In a recent project Archimedes, SMEs identified the burden of workload trying to sustain a business. They emphasized the need for staff to take initiative and use digital technologies. (O’Brien and Carroll, 2015). Digital technology can provide the capacity to assist SMEs to grow. If adopted correctly it can introduce process efficiencies and reduce costs, it can allow SME to access international customers without having to set up a physical presence but many SMEs struggle in the adoption of digital technology. To facilitate successful adoption of technology it is important that SMEs look for digital business opportunities and identify how technology can support them to afford these. In addition to this, finding skilled staff is a major barrier for SMEs (Muller et al, 2017).

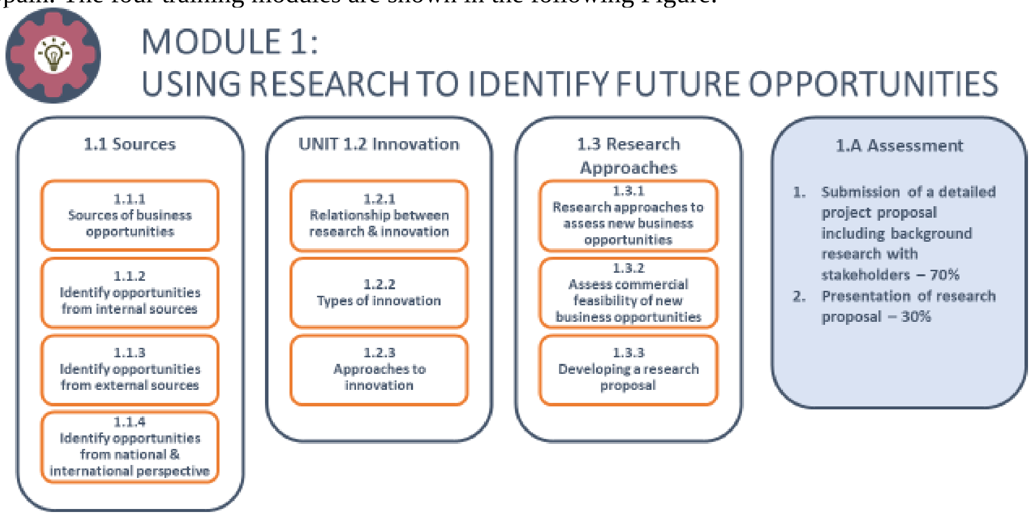
In 2018, the authors started the Erasmus + project REINNOVATE, aimed to translate policies to support digital entrepreneurship into practice by focusing on cultivating an entrepreneurial culture in small companies (Hamburg et al., 2018). Prior to the starting the project, the REINNOVATE consortium conducted a survey in Ireland, Germany, Lithuania, Portugal and Romania to determine the challenges and needs of 142 SMEs in Europe in order to be innovative, to grow and to cope with digital changes. It was found that 97% of asked companies want to become more innovative and use digital technology but corresponding competences are missing.

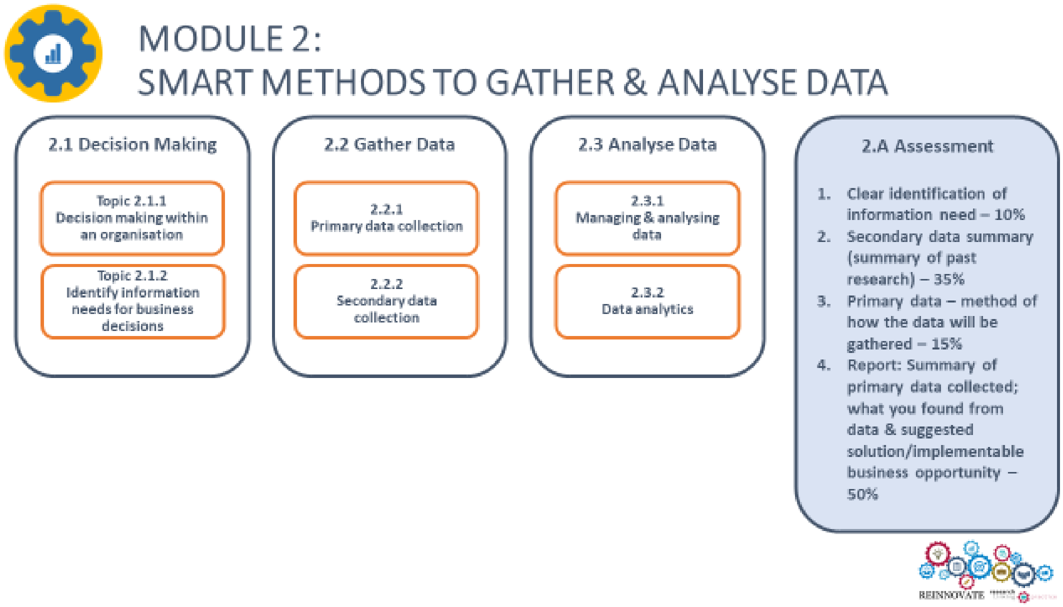
Other barriers to innovation are resources (60%) i.e. specialized equipment, staff. About 38% of SMEs answered that skills to use digital technologies to deliver new products and services or new digital business models are missing. The survey explored the potential of SME collaboration with Higher Education institutes in order to help them to be more innovative. The hypothesis was that leveraging from public research organizations would address the resourcing issues SMEs faced regarding innovation. One of the main concerns SMEs had was that higher education does not understand SMEs business needs or take too long to design and implement solution SMEs can use.

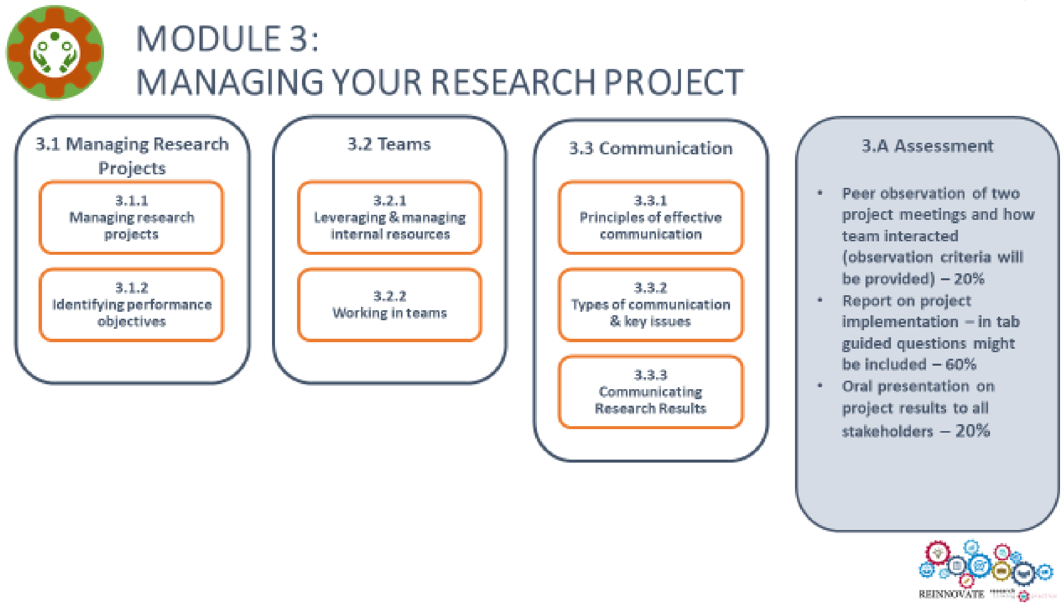
Research skills were seen as significantly important with, 87% of SME identifying research skills as important or very important to their organization, however there is a significant skills gap with 62% of SMEs having no research skills. To address such missing skills gaps the Reinnovate consortium with higher education institutes and research organizations, chamber of commerce and SME representative bodies will develop research skills to stimulate the employees' ability to systematically identify new digital opportunities and manage the implementation of these to improve the performance of the company. Four entrepreneurial learning modules have been developed. After improvements the modules will be offered in national languages to SME staff to help them

- to use workplace-oriented research to identify opportunities from national & international perspectives incorporating digital transformation.
- to gather and analyze the relevant data to allow them to implement a digital business opportunity or an innovative idea in connection with digital transformation.
- to manage an own research project about a digital business model including some AI facilities and evaluate it.

The training process will be mostly by using digital media supported by face-to-face sessions and a mentoring process in partner countries Ireland, Germany, Lithuania, Romania and Spain. The four training modules are shown in the following Figure:




MODULE 2:
SMART METHODS TO GATHER & ANALYSE DATA
2.1 Decision Making
Topic 2.1.1
Decision making within an organisation
Topic 2.1.2
Identify information needs for business decisions
2.2 Gather Data
2.2.1
Primary data collection
2.2.2
Secondary data collection
2.3 Analyse Data
2.3.1
Managing & analysing data
2.3.2
Data analytics
2.A Assessment
1. Clear identification of information need – 10%
2. Secondary data summary (summary of past research) – 35%
3. Primary data – method of how the data will be gathered – 15%
4. Report: Summary of primary data collected; what you found from data & suggested solution/implementable business opportunity – 50%
REINNOVATE


MODULE 3:
MANAGING YOUR RESEARCH PROJECT
3.1 Managing Research Projects
3.1.1
Managing research projects
3.1.2
Identifying performance objectives
3.2 Teams
3.2.1
Leveraging & managing internal resources
3.2.2
Working in teams
3.3 Communication
3.3.1
Principles of effective communication
3.3.2
Types of communication & key issues
3.3.3
Communicating Research Results
3.A Assessment
Peer observation of two project meetings and how team interacted (observation criteria will be provided) – 20%
Report on project implementation – in tab guided questions might be included – 60%
Oral presentation on project results to all stakeholders – 20%
REINNOVATE

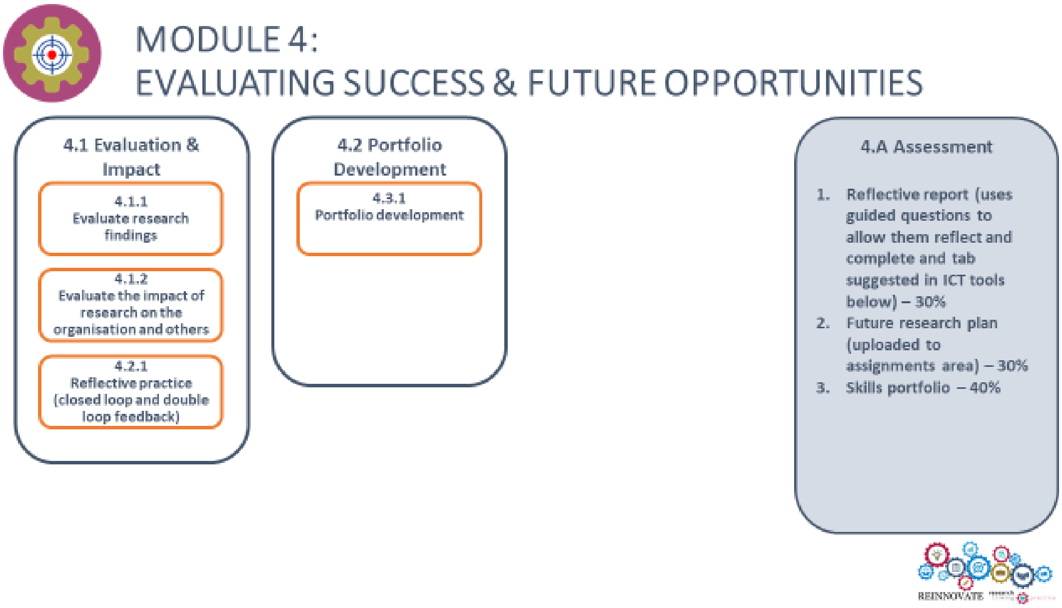


Figure 1: Reinnovate Modules.

CONCLUSIONS

This chapter provides an overview of entrepreneurship forms relevant to sustainable businesses and focuses on offering new products and services in response to digital developments (Hamburg, 2019).

Digital entrepreneurship means creating new ventures and transforming existing businesses by developing novel digital technologies and/or novel usage of such technologies, (European Commission, 2015). Digital entrepreneurship has been viewed as a critical pillar for economic growth, job creation and innovation by many countries including the Member States of the European Union.

However, digital entrepreneurial capacity depends largely on digital entrepreneurial behavior, culture, and strategies to use technologies like AI, as well educational approaches. These are all topics that are less researched. Entrepreneurial learning has emerged as a promising area of research in the interface between learning and the entrepreneurial context with the importance of the specific processes of learning to achieve knowledge i.e. AI literacy, that occur in this context.

In many literature, the focus is more on the many aspects of entrepreneurial learning and the role of learning in the entrepreneurial process, particularly within digital entrepreneurship; this is a future research topic of the authors together with aspects of new curricula, development of a digital culture and employee's behavior in this context.

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Emotional Intelligence as a Support for Professional Development in Engineering Education

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ABSTRACT

Engineering education is an expanding field due to the globalization of the engineering profession. Such globalization is driven by the evolution of both the engineering sciences by themselves as well as the evolution of technology and the professional environment.
Approaching emotional intelligence as a support for professional development in engineering education is analyzed as a potentiation of necessary competences and abilities for academic performance in the engineering education environment as well as for reaching a high level of engineering professional performance in a diverse social context.
The article includes an analysis of the current state in the field of theory and scientific investigation of emotional intelligence as it is relevant for engineering education. Such an analysis has been developed by using the morphological matrix of ideas by associating the conceptual dimensions of emotional intelligence with human factors that are relevant for engineering education.
Based on the conclusions developed by the use of this instrument there have been developed possible scientific investigation objectives that are in coordination with the proposed theme.

Keywords: *emotional intelligence, engineering education, academic achievement, professional development.*

EMOTIONAL INTELLIGENCE AND PROFESSIONAL DEVELOPMENT

The concept of emotional intelligence (EI) has generated numerous debates and research both related to the scientific substantiation of the construct as well as in the field of human aspiration (Matthews, G., Roberts, R.D., Zeidner, M., 2004). This interest that is manifesting itself simultaneously in the scientific and journalistic perspective has generated investigation on the construct itself as well as on the development of research instruments adapted to measuring the level of emotional intelligence. The theoretic models that were developed operationalize the emotional intelligence concept either as an ability or as a trait. (Nelis, D., Quoidbach, J., Mikolajczak, M., Hansenne, M., 2009).
The theoretic model of emotional intelligence seen as an ability defines emotions as organized answers which transcend the borders of various psychological sub-systems and appear as a typical response with a negative or positive value for an individual in relation to an internal or external event. (Salovey, P., Mayer, J.D., 1990). From this perspective, emotional intelligence represents the ability to monitor your own as well as the others emotions, to differentiate and to use this information in order to direct thought and action (Brackett, M.A., Salovey, P., 2006). This model defines the EI as a type of social intelligence that includes elements such as evaluation and the verbal and nonverbal expressing of emotions as well as using emotional content in solving problems. (Mayer, J.D., Salovey, P., 1993). In its first stage, this model included three categories of

abilities arranged in a hierarchical manner from the most simple to the complex: evaluating and expressing emotion, self-regulating emotions and using emotional intelligence. (Salovey, P., Mayer, J.D., 1990, Mayer, J.D., 2004). Later, based on extended research a theoretical revisions, the model of the EI ability has been developed as having four dimensions, similarly ordered in a hierarchy: perceiving emotions, using emotions to facilitate thought, understanding emotions and managing emotions (Mayer, J.D., Salovey, P., Caruso, D.R., 2008). As the theoretical perspective has developed its fundament and has been expanded, so has the measuring instrument that supported the scientific legitimacy of EI as a form of intelligence has been developed. This was initially the MEIS-The Multifactor Emotional Intelligence Scale (Mayer, J.D, Caruso, D.R., Salovey, P., 2000). Later on, this was followed by a new version – the MSCEIT- Mayer-Salovey-Caruso Emotional Intelligence Test (Mayer, J.D., Caruso, D.R., Salovey, P., Sitarenios, G., 2001).
The theoretical model of emotional intelligence as a trait was developed due to the expansion of popularizing the concept of emotional intelligence. This has led to the association of this concept with a number of different traits and concepts, leading to the development of mixed models of IE (Mayer, J.D., Salovey, P., Caruso, D.R., 2008). These EI conceptualizations include elements such as recognition, understanding and expressing feelings and emotions; understanding what others feel and interacting with others; managing and controlling emotions; managing change, adapting and solving problems of personal and interpersonal nature; generating positive and self-motivating effects. (Bar-On, R., 2006). From the perspective of the Bar-On model, emotional intelligence is defined as an arrangement of emotional and social competences and abilities that determines for each individual how effective they express and understands themselves and others, how to react when interacting with others, how to meet the demands and challenges of everyday life (Bar-On, R., 2010).
In the body of theories about EI, an important factor of propagating the term in the scientific and journalistic world was the publication of Daniel Goleman's Emotional Intelligence (1995). Describing the researches previously made by J.D. Mayer, P. Salovey, as well as R Bar-On, a new EI approach is proposed from the perspective of modeling competencies that separate top performers from mid-level individuals (Goleman, D., 2018). This theoretical model has been developed for application in theory, research and organizational practice. From this perspective, emotional intelligence is defined as a structure composed of four elements such as: the ability of the individual to understand their own emotions and emotional state, being able to manage and regulate the response to these emotions, recognizing the emotional state of others and reacting to them in order to interact effectively (Bradberry, T.R, Su, L.D., 2006).
The existence of many versions and approaches in the field of EI associated with different measurement methods and different outcomes can be interpreted as a sign of vitality, resulting in the emergence of increasingly sophisticated and evidence-based theories. (Cherniss, C., Extein, M., Goleman, D., Weissberg, R.P., 2006). Contrary to the assertions that EI test results can be a predictor for educational and professional fields more than intellectual skills, the EI construct needs clarification according to a set of criteria associated with scientific substantiation for intelligence in general: the definitions developed are not conceptually coherent , EI measurements do not fully meet psychometric criteria, EI distinction from other personality constructs is not clear, EI does not have all the elements in line with intellectual ability, EI is not for emotion what IQ is for thinking, EI measurement results are not a strong indicator for adaptation, there is not enough evidence for EI to be a decisive factor for success in life. (Matthews, G., Roberts, R. D., Zeidner, M., 2004).
In the body of research in the field of emotional intelligence, results of investigative steps that identify its "dark side" are highlighted and claim that a high level of IE can have negative effects both in relation to one's own person through the appearance of mental health problems and against others by manipulation and antisocial behavior. (Austin, E.J., Farrelly, D., Black, C., Moore, H., 2007; Côté, S., DeCelles, K.A., McCarty J.M., Van Kleef, G.A., Hideg, I., 2011; Monnier, M., 2015; Davis, S.K., Nichols, R., 2016)

Research results that established a relationship between emotional intelligence and education have led to the development of intervention and educational programs aimed at enhancing EI related abilities and traits. Developing, implementing, and evaluating training programs aimed at developing emotional intelligence can be argued for by the fact that general success and well-being in the maturity stage can also be determined by learning how to engage social and emotional abilities learned while facing daily challenges. (Humphrey, N., Curran, A., Morris, E., Farell, P., Woods, K., 2007).

The introduction of such programs is not without limitations, obstacles and criticism. The main obstacles concern the difference in scientific legitimacy of classical disciplines vs. the field of emotions (Mayer, JD, Caurso, DR, Salovey, P., Sitarenios, G., 2001), the necessity of scientific substantiation by clearly defining the fields of EI approached on studies and scientific results demonstrating improvement in socially and emotionally effective behavior (Bar-On, R., 2010) or arguing for the positive effect on healthy development and pupil performance, but, due to the fact that they were of a short duration and were not correlated with the academic mission of the school, they failed. (Bradberry, T. R., Su, L. D., 2006). The benefits of such programs are not supported by consensus and evidence, and this has led to a diverse range of offers that, for example, aim to increase the level of emotional knowledge of students in order to better prepare them for approaching professional realities.(Goroshit, M., Hen, M., 2012).

The multidimensionality of the relationship between emotional intelligence and professional development is determined by a complex set of elements of an epistemological nature, by research that indicate contradictory and diverse outcomes regarding the predictive value of EI for components of academic performance, professional performance, success in life and workplace.

INTEGRATING EMOTIONAL INTELLIGENCE IN ENGINEERING EDUCATION

Integrating emotional intelligence into engineering education and engineer training for effective insertion into the labor market is justified both by the growing awareness of engineering practice in the context of transcending cultural and national borders as well as by the challenge to teachers and educators in the engineering field to develop for students a package of knowledge and abilities associated with emotional competence (Chisholm, CU, 2010). The analysis of the relationship between academic performance and the level of emotional intelligence for students should take into account that they have specific / individualized levels of emotional and cognitive qualities practiced and developed during previous schooling periods, and the introduction of EI into the university curricula should not be interpreted as way to fundamentally change students' EI level. (Saibani, N., Muhamand, N, Wahab, D.A., Sahari, J., 2012).

The analysis of the opportunity of integrating emotional intelligence into engineering education was based on the study of specialized articles that followed the relationship between these concepts. This approach was achieved by using the morphological matrix of ideas and the following dimensions and associated characteristics have been set:

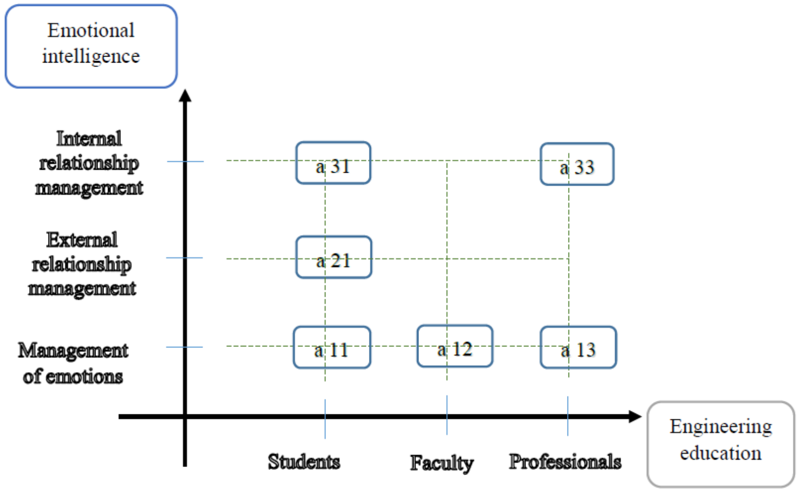

Figure 1: Morphological matrix of ideas

• Emotional intelligence:
The use of this dimension offers the various possibilities of identifying the analysis criteria within the morphology matrix of ideas: the theoretical origin of the construct (the Mayer-Salovey-Caruso model, the Bar-On model, the Goleman model), the operationalization of the concept (ability, skill, trait), measuring the concept (as performance or as self-evaluation). In view of these aspects, an option has been formulated by identifying the levels of IE ability measurement in the field of engineering education that indicates opportunities for development and intervention: management of emotions, external and internal relationship management (Dușe, C.S., Dușe, D.M., 2009, 2010). Variable levels of EI abilities may be associated with drop out of university studies and academic success, indicating a tendency for male EI students to drop out of university courses (Parker, J.D.A, Hogan, M.J., Eastabrook, A.O., Wood, L.M., 2006) whereas higher scores of EI dimensions (intrapersonal, adaptability, stress management) may be indicators of academic high-performing/ non-performing students (Parker, J.D.A., Summerfeldt, L.J., Hogan, M.J., Majescki, S.A., 2004).

• Engineering education
The university is a complex environment that facilitates both substantiation and development of specialized knowledge as well as the practice and development of abilities that are not expressly included in the university curriculum. The implementation of programs or courses focusing on these aspects of EI can be taught /learned in the university environment by using innovative pedagogical methods and by the experiential practice of emotion management. (Gillar-Corbi, R., Pozo-Rico, T., Sanchez, B., Castejon, J.L., 2018). The necessity to develop training programs within universities aimed at developing EI components can also be determined by the employers' perspectives that point to shortcomings in some social and emotional skills of graduates who are integrated into the labor market (Jameson, A., Carthy, A., McGuinness, C., McSweeney, F. (2016).
Considering the two dimensions of EI and engineering education from the morphological matrix of the ideas and following the analysis of the studies that regarded the investigation of the relationship between the two concepts, the following information was obtained:
a) a 11: Students in engineering show variable levels of scores obtained for distinct EI fields. Although they can achieve a high level of attention and self-control of emotions (as EI areas), interventions on the dimension of emotional knowledge / knowledge of emotions are needed (Chisholm, C.U., 2010).

b) a 12: In the absence of teaching methods and learning methods based on the development of EI, there is no stimulating climate for exercising emotional competences and abilities. Results indicating that classroom management implemented by science and engineering teachers is not in line with their EI level is a prerequisite for reconsidering EI as a relevant factor for the educational environment. (Hiso-Llego, J., 2017).
c) a 13: Managing emotions and expressing them in a predominantly male environment, such as engineering, can be perceived as inappropriate (Lindebaum, D., Casell, C., 2012). This dimension aims to efficiently use the perception of one's own emotions and others for managing interactions and conflicts (Bradberry, T., Greaves, J, 2016). An organizational culture based on power and masculinity may be an impediment to implementing programs and interventions designed to integrate EI into the professional activity.
d) a 21: Measuring the level of EI abilities in engineering students reveals the strong areas in which they can excel but also the areas in which students are deficient. Although abilities such as conflict management, interpersonal communication, and the development of public communication are not the main subjects of study in engineering specialties, they prove to be relevant in their professional activity (Saibani, N., Muhamand, N, Wahab, DA, Sahari, 2012). The introduction of EI into the academic route of students enrolled in engineering specialties indicates, in longitudinal studies, that EI develops both in relation to age as well as to the efficiency of teaching / learning (Saibani, N., Sabtu, MI, Harun, Z., Wan Mahmood, WMF, Muhamand, NI, Wahab, DA, Sahari, J., 2015).
e) a 22: Measuring the general level of EI and the specific dimensions of this construct in the case of engineering university teachers indicates variations that could substantiate the intervention for the development of EI skills and competences. Given that high scores for the emotional awareness dimension are identified, but just average levels for emotional management and relationship management are recorded, then the need to introduce EI into the training of teachers in engineering education can be concluded. (Dușe, D.M., Dușe, C.S., Deac, C., 2015). These results, when they are underlined by evidence showing that the EI level of engineering teachers is lower than colleagues from other specialties and correlating these results with organizational culture (which may be a facilitator / barrier), are all the more relevant to the argumentation for the need EI field development. (Dușe, C.S., Dușe, D.M., 2019, 2010).
f) a 23: Given the context of globalization, of industry and technology development, of the exercise of the profession in complex social contexts, the graduate and engineer's profile must include sets of abilities extended beyond the technical training (Riemer, MJ, Jansen, DE , 2003). These technical and social developments require engineer training in areas such as cross-cultural abilities (Del Vito, C., 2008), intercultural (Riemer, M.J., 2003), non-verbal communication (Riemer, M.J., 2004). The effectiveness of the engineer's professional work on the labor market as well as the sustainability of engineering disciplines can be achieved by introducing practical learning and combining specialized knowledge with the emotional intelligence abilities (Burns, GR, Chisholm, CU, 2003), introducing e-learning and e-guidance along with aspects of EI (Chisholm, CU, 2003).
g) a 31. This intersection of the morphological matrix of ideas represents the maximum desirability level: the association between high levels of internal EI management with components of engineering education. From this perspective, a high level of EI for students from engineering specialties appears to support the above-mentioned research on the positive correlations between EI and academic performance, but students with high academic performance and reduced EI appear to be those who are more focused on getting results rather than establishing social relationships and friendship with colleagues (Brandenbrug, S., Zhou, X, Bell, L., Skipper, C., 2011).
h) a 32. This dimension implies awareness of emotions and the targeting of this awareness towards the effectiveness and positive directing of behavior (Bradberry, T., Greaves, J., 2016). In the case of engineering teachers, a low score for this dimension affects the educational interaction with the students (Dușe, D.M., Dușe, C.S., Deac, C., 2015)
i) a 33. The development of this dimension of emotional intelligence can redefine and ensure the sustainability of engineering education from the point of view both of the social perception of the

engineering profession as well as of the reconfiguration of engineering disciplines (Chisholm, C.U., 2003)
Using the morphological matrix of ideas is a useful tool in analyzing the perspective of integrating emotional intelligence in engineering education. Going through the criteria of both dimensions indicates some areas where future investigations and research can be directed. If specialized studies addressed the relevance of emotional intelligence to engineering students and teachers, the impact of this type of intelligence in the field of engineering is a fertile field of scientific research.

RESULTED RESEARCH OBJECTIVES

Arguments and ideas generated by the morphological matrix of ideas have determined possible research objectives that can bring additional data into the study and /or the scientific investigation of the relevance of emotional intelligence as a support to professional development in engineering education. The possible proposed objectives are developed both in line with the theoretical milestones and the analysis of the current state of research in the EI field.
• Measuring the level of emotional intelligence of students, faculty members and engineering professionals in order to identify areas of intervention to increase academic performance and professional performance.
• Identification of the skills and emotional competences profile of the successfully integrated into the labor market engineer.
• Identifying and analyzing training /education programs based on emotional intelligence for students in engineering university environment.
• The scientific substantiation of a training program aimed at developing the abilities and attributes specific to the appropriate level of emotional intelligence which is correlated with the educational environment and the engineering professional environment. This program can also be developed taking into account the specific idiosyncrasies of the two backgrounds: educational and professional

CONCLUSIONS

Addressing emotional intelligence as a support to professional development in engineering education is a field of scientific research effervescence. The results of emotional intelligence scientific studies focused on EI area impacting on the academic performance of students from engineering specialties and the data obtained on the array of EI skills and competences of teachers from engineering universities offer a fundamental premise in the developing of curriculum programs focused on this theme.
The engineering profession tends to become a global profession, which is influenced by rapid changes in the field of science itself, the technology and the pursuit of the profession in increasingly diverse cultural environments. Emotional intelligence in relation to professional development in engineering education should not be interpreted as an aspect that could supplement certain professional and human skills and competences, but as a potentiation factor for enhancing the professional and educational effectiveness of the student engineer as well as the engineer.

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Investigation on the Possibility of Designing an Educational Dynamic Light Scattering Device for Sizing Particles Suspended in Air

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ABSTRACT

If a light beam meets a fluid that contains scattering centers randomly distributed in suspension, light is scattered by each of them. If the light source is coherent, the scattered waves will be also coherent, therefore they will interfere. The fluctuations of the far-field interference signal, once recorded and digitized, become a time series that can be later on analyzed to produce the average size of the suspended particles or the size distribution. The technique wears the name of Dynamic Light Scattering. We present the results of our investigation on the possibility of using an educational model, made of low-cost, conventional electronics, for recording the time signal of light scattered by particles suspended in the air as the carrier fluid. The device can be used in measuring the particle size in exhaust gases of conventional power plants or automobile engines.

Keywords: *Dynamic Light Scattering (DLS), Particle sizing, Exhaust gas, Educational Model.*

INTRODUCTION

When a light beam is targeted on particles suspended in a carrier solvent, each particle in the beam area scatters light, thus becoming a secondary light source. The particles act like scattering centers (hereafter SCs). If the incident light beam is coherent, so are the scattered waves, and, consequently, they will interfere. The consequence of the Brownian motion of the suspended particles that scatter light is the restless moving aspect of the interference field, having the aspect of “boiling speckles”. There have been published articles describing the variation of the moments of the digitized image, as the speckle contrast, average intensity and speckle with some parameters of the SCs as the diameter and the number per volume unit, and references (Piederriere & all, 2004a, Piederriere & all, 2004b, Chicea, 2007) are just some of them, but they are not optimal for particle sizing in dynamic processes where both the number of SCs and the SCs diameter can change in time (Chicea, 2007). The procedure that makes use of the dependence between the speckle dynamics and chaotic motion of the particles is called Dynamic Light Scattering (DLS) and the fundamental theory of the procedure is presented in many works, out of which we mention just a few (Clark & all, 1970, Goodman, 1984, Van de Hulst, 1981 and Xu, 2002).

DLS is widely used to analyze the size and dimension distributions of nano-particles, colloids, and proteins in the suspension of various solvents (Bhattacharjee, 2016). The DLS technique turned to be appealing (Stetefeld & all, 2016) as it has certain advantages over other experimental methods. The DLS technique can be used for investigating suspensions on a wide range of sample buffer, over a relatively big range of temperatures and of concentrations, as well. Moreover, DLS requires small amounts of sample. Above many other techniques, DLS has the advantage of providing absolute rather than relative results, therefore it does not require calibration.
The DLS technique has been established for quite some time (Clark & all, 1970). In the pioneering stage of DLS, photomultiplier tubes were the only choice for detectors, as they have a fast response with good amplification (Berne and Pecora, 2000). Later on, photomultiplier tubes were replaced with photo-diodes, which were replaced by the next stage in performance, which were the avalanche photo-diodes (Berne and Pecora, 2000). Better in performance were the P-I-N diodes, which replaced them (Berne and Pecora, 2000). Autocorrelator was the name of the hardware part used to compute the autocorrelation function of the DLS time series. As time passed Laser diodes proved that can replace the gas Lasers. A PC started to be used to record the DLS time series. It can also replace the autocorrelator in processing the DLS time series. All these technological improvements made possible a considerable simplification of the experimental setup, as can be found in many papers, (Chicea & all, 2012) and (Chicea, 2012) being just some of them.
This paper presents the results of the work carried on to investigate the possibility of performing DLS measurements on samples that have air as a carrier fluid, aiming to perform particle sizing in exhaust gases of industrial furnaces, as a power plant heating source, or the in exhaust gases of an automobile engine. Moreover, we investigated the possibility of designing an educational model of a DLS device, with low cost, conventional electronics, and a PC for both data acquisition and time series processing.

THE DLS DATA PROCESSING PROCEDURE

A schematic of a simple DLS setup is depicted in Fig. 1. The coherent light source can be either a He-Ne laser or a Laser diode. The wavelength is a typical 633 nm and the scattering angle θ is variable, as will be presented in the next section. The DLS experiment is intended to be carried on at 20 °C. The samples consist of particles with the size in the range 10 – 1510 nm, suspended in the air. The cuvette-detector distance D is assumed to be 0.1 m.

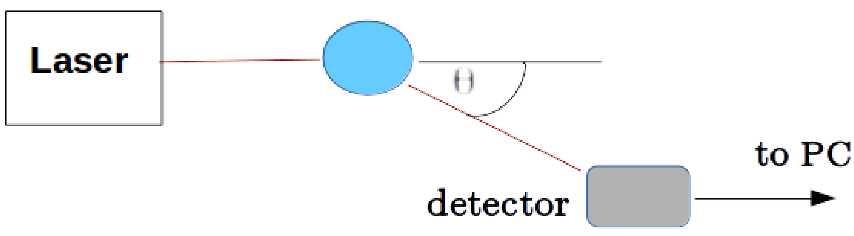

Figure 1: The experimental setup

If we use a detector at angle θ and if we digitize the signal with a data acquisition system (DAS hereafter), we record a DLS time series. It consists of a set of values recorded in a digital format at equally spaced time intervals Δt=1/f, where f is the DAS sampling rate. As stated in (Goodman, 1984, Tscharnuter, 2000 and Weiner, 1990) the width of the autocorrelation function of the time series is proportional to the diffusion coefficient. The diffusion coefficient is directly related to the

SC diameter. An alternative version, which allows us to perform a straight analysis of the possibility of performing DLS on suspensions in air, is described below.
The pioneering works (Clark & all, 1970, Dubin & all, 1967) and the following theoretical refinement (Berne and Pecora, 2000, Goodman, 2000, Hect, 2001), revealed that the frequency spectrum of the intensity is related to the probability density function (hereafter PDF). The frequency spectrum is linked to the autocorrelation of a process, as stated by the Wiener-Khintchine-Theorem. The Fourier transform of the intensity time series is the power spectrum, or the intensity frequency spectrum, FS hereafter. The spectrum calculated from the experimental data can be described using the Lorentzian line S(f) (1).

$$S(f) = a_0 \cdot \frac{a_1}{(2\pi f)^2 + a^2{}_1} \quad (1)$$

The Lorentzian line S(f) has two parameters a_0 and a_1. The optimum values of the parameters can be determined using a least squares fit minimization procedure to match S(f) to the frequency spectrum (Chicea & all, 2012 and Chicea, 2012) The radius can be calculated using equations (2) and (3):

$$R = \frac{2k_B T K^2}{6\pi\eta a_1} \quad (2)$$

where:

$$K = \frac{4\pi n}{\lambda} \sin\frac{\theta}{2} \quad (3)$$

In (2) and (3) R is the average radius of the suspended particles, η is the dynamic viscosity of the solvent, k_B is Boltzmann's constant, θ is the scattering angle, T is the suspension absolute temperature, n is the refractive index of the solvent and λ is the wavelength of the laser radiation (Chicea & all, 2012 and Chicea, 2012).

THE DLS FOR SCATTERING CENTERS IN AIR AS SOLVENT

Equation (1) with a_1 computed as in equation (2), with K replaced from equation (3) can be used to predict the shape of the FS of the DLS time series of the scattered light from particles in a certain solvent, at a certain temperature and a particular scattering angle.
If SCs are suspended in water at 20°C, n=1.33 and $\eta=1.02*10^{-3}$ daP. If the solvent the particles are suspended into is air, $\eta=1.81*10^{-05}$ daP, which is two orders of magnitude smaller, and this affects the a_1 parameter for the same radius of the particles. By reverting the first part of equation (2) we notice that for the same radius R of the particles, a_1 is inversely proportional to η, therefore a decrease in η will increase the a_1 parameter, therefore the turnover point in the plot of the frequency spectrum versus frequency, as in Figures starting with 2, will be shifted toward bigger frequencies. This feature requires higher data acquisition sampling rates f, therefore more expensive data acquisition systems, thus leaving the area of the intended device, which is a low cost using conventional rather than custom design electronics.
Firstly, a simulation of the frequency spectrum of a time series acquired using a sampling rate of 100 KHz was carried on, for diameters in the set: 10.00, 176.67, 343.33, 510.00, 676.67 843.33, 1010.00, 1176.67, 1343.33 , 1510.00 nm. The simulation for these diameters was carried on at each angle in this set: 10 20 30 40 50 60 70 80 90°.
The typical angle for DLS scattering is 90° and the simulated frequency spectrum for the diameters in the set mentioned above, hereafter the diameter set, are illustrated in Figure 2.
Examining Figure 2 we notice that the turnover point in the lowest curve is not within the frequency range in the plot, therefore a least square fit will not identify a_1 in equation (1), hence the correct

radius of the particles, but might work for bigger particles, like the second in the set, having a diameter of 176.67 nm.

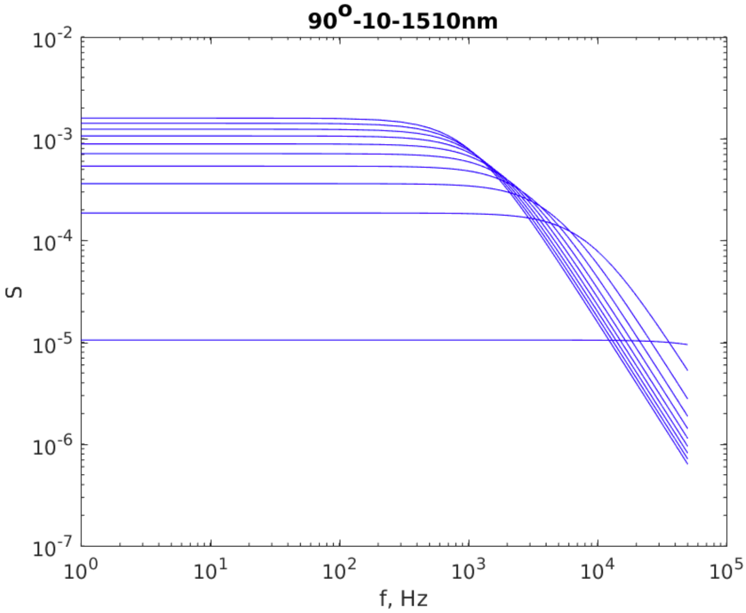

Figure 2: The simulated FS for the set of diameters at a scattering angle of 90°. The lower curve is the FS for the lowest diameter, 10 nm, while the upper curve is for the biggest diameter, 1510 nm.

Figure 3 depicts the simulated frequency spectrum for the diameters in the diameter set for the same sampling of 100 KHz, recorded at a scattering angle of 50°. We notice that the turnover point in the lowest curve is at the edge of the frequency range in the plot, therefore the least square fit will not be precise in identifying a_1 in equation (1), hence the correct radius of the particles.
If we run the simulation for smaller scattering angles, like 50°, we get the lines in Figure 4, for the same sampling rate, of 100 KHz. Figure 4 suggests that DLS is possible in the air, for such relatively low sampling rates. Even so, low as they might appear, such sampling rates are not easy to be achieved with relatively low-cost electronics. We include in this category the audio class of preamplifiers and amplifiers, which have a reasonably lower cost as they are produced in very big numbers.
If we move to the class of low cost electronics, we have in mind sampling rates of up to 44 KHz. Moreover, we can imagine using the sound card of the PC or laptop, which is a low cost and good quality DAS. It turned to be so as it has been constantly been improved for decades and keeps a low price as it is produced in very big numbers and can be found in any desktop or laptop. The sound cards can record data with 16 bits resolution, with a certain caution, provided that there is no spectral attenuation from the detector to the input.
The simulations were run again for the diameters in the same set and for the same scattering angles, aiming to find the conditions where DLS FSs can be processed by fitting the Lorentzian line to them, but for a sampling rate of 44 KHz. The first choice would be to use the FSs for time series recorded at 90°, as the turnover points for different diameters are maximally distanced from each other, and this increases the precision in assessing the diameter. The plot of the FS versus frequency

is not depicted in this paper, because it would simply present the curves in Figure 2, but for the frequency range 0 – 22 KHz, as the output of the fast Fourier algorithm is.

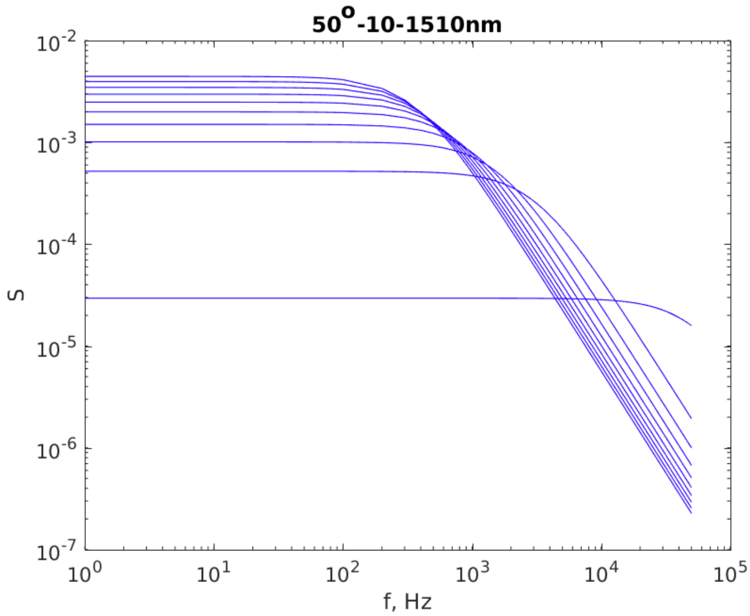

Figure 3: The simulated FS for the set of diameters at a scattering angle of 50º. The lower curve is the FS for the lowest diameter, 10 nm, while the upper curve is for the biggest diameter, 1510 nm

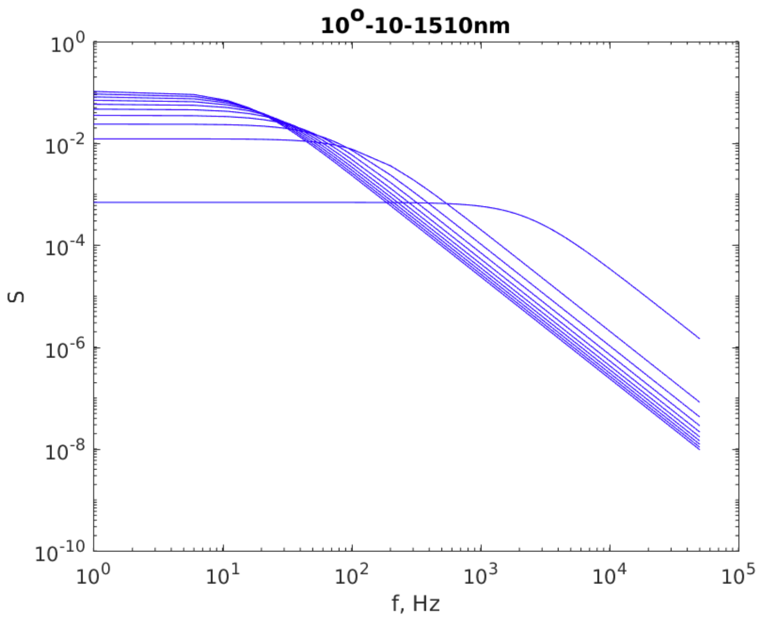

Figure 4: The simulated FS for the set of diameters at a scattering angle of 10º. The lower curve is the FS for the lowest diameter, 10 nm, while the upper curve is for the biggest diameter, 1510 nm

We notice that the conclusion is the same, which is that a least square fit will not identify a_1 in equation (1), hence the correct radius of the particles, but might work for bigger particles, like the second in the set, having a diameter of 176.67 nm. But particles of such a big diameter can hardly be considered to be nanoparticles. The purpose of this simulations, as stated in the introduction section, is to investigate the possibility to detect nanoparticles in air, therefore recording time series at 90^o with such a small sampling rate cannot work.
The plots were computed and examined for different angles, starting from 1^o, and we can conclude that the time series recorded at 10^o can possibly be processed by fitting the Lorentzian line to the computed FS and finding a1 and here from the diameter of the particles. Figure 5 depicts the simulated frequency spectrum for the diameters in the diameter set for the sampling rate of 44 KHz, recorded at a scattering angle of 10^o.

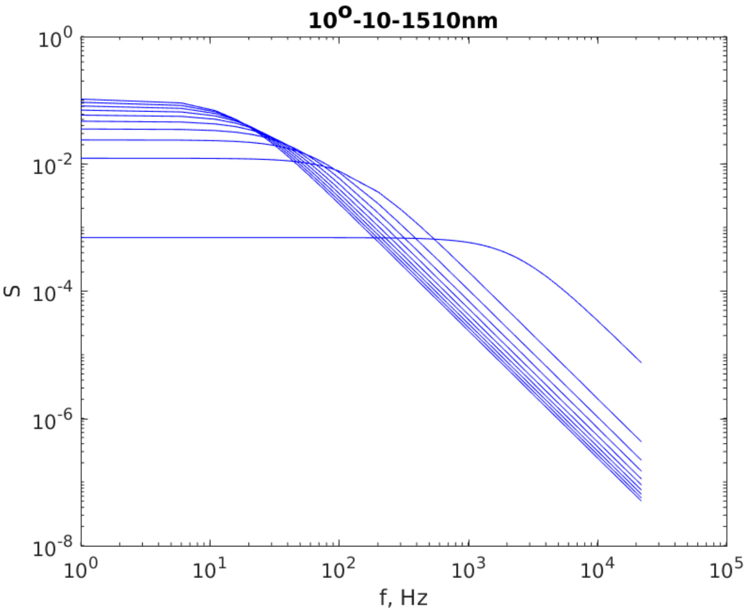

Figure 5: The simulated FS for the set of diameters at a scattering angle of 10^o. The lower curve is the FS for the lowest diameter, 10 nm, while the upper curve is for the biggest diameter, 1510 nm. The sampling rate was 44 KHz.

CONCLUSIONS

This manuscript presents briefly the DLS technique, with a very simple, educational experimental setup and one of the procedures that are currently used in processing the DLS time series, which consists of computing the FS and fitting an analytical function to it. The parameters determined from the fit are directly linked to the average diameter of the particle suspended in the solvent.
We performed a computer simulation of the FS produced by particles which have air as the solvent, which is a modeling of the particles in the exhaust gases of a power plant or of a Diesel or Otto engine. We maintained the goal of keeping the experimental setup at the educational level, with using a low-cost DAS, even the sound card of the PC or laptop and a low-cost audio preamplifier.

For this purpose, we investigated the possibility of using a sampling rate of 44 KHz, which is the upper limit of the sampling range for a conventional PC sound card.
The results of the computer simulation reveal that theoretically, DLS in the air as the solvent is possible for particles with the size in the range of 10 – 1500 nm, with a sampling rate as low as 44 KHz, if the recording is carried on at low scattering angles, as 10º. There does remain an experimental problem to be addressed, which is related to the minimum intensity that can be detected with a reasonably good signal to noise ratio. It is related firstly to the decreasing of the scattered light intensity with the scattering angle, as described in the Monte Carlo simulation reported in (Chicea & Turcu, 2007 and Chicea, 2008). The minimum intensity required for a precise output of the procedure is also related to the design of the preamplifier, but this is experimental work on this subject, in progress for the time being.
As the title of the paper suggests, this paper presents not the device but the results of the theoretical investigation on the possibility of designing and using a low cost, educational model for performing particle sizing in air. The theoretical investigations narrowed the range of the setup parameters to the region where DLS is possible in air, as pointed out above. Moreover, the model is educational, primarily because it can be assembled from low cost parts during a laboratory session by students. The setup parameters can be easily modified by desire and the parameters of the data acquisition can be adjusted to any values. The length of the time series can be decided according to the desired precision. Writing a simple code for processing the time series, as explained in this manuscript, by fitting an analytical function to the power spectrum, is again one of the goals to be achieved by students during a laboratory session and these steps will help them understand in detail the DLS technique.
With these particularities in mind, we can conclude that the model we propose can be functional and can be used for teaching students the DLS technique during one or more laboratory sessions at the master and doctoral levels.

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Innovative Method for the Transmission of Knowledge in Food Engineering

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ABSTRACT

Pedagogical research is a way of explaining the educational phenomenon. Through this, it develops optimal solutions to the problems raised by the instructive-educational process, by following the social exigencies. The experimental activity took place between October 2018 and February 2019 at the University "Lucian Blaga" of Sibiu, within the Faculty of Agricultural Sciences, Food Industry and Environmental Protection. The main objectives were reducing the percentage of students with weak exam results, developing the intrinsic motivation of students, using of teaching materials in increased efficiency, developing active, realistic, investigative thinking, synthetic and clear expression, encouraging teamwork, using of worksheets and self-evaluation tests.
The subjects included in the research were students from the 3rd year of specialization "Food Products Engineering". The methods of research used were direct observation, survey method, school document research method and test method. It concluded that students do not like the classical assessment, but prefer the evaluation with the help of working sheets or self-evaluation. They also preferred working methods such as worksheet discovery, conversation, problem-solving, and assaulting ideas.

Keywords: *pedagogical research, active learning, motivation, self-evaluation.*

INTRODUCTION

Pedagogical research is a way of explaining the educational phenomenon. It is a strategy that takes place to capture new relationships between the components of educational activities and to develop optimal solutions to the problems raised by the instructive-educational process by following the social exigencies. The pedagogical experiment involves the introduction of some changes in the educational activities, and finally the appreciation of the validity of these interventions (Tița & Calcan, 2014).
In recent years, there have been many studies that have shown the effectiveness of new methods of teaching and assimilation of knowledge, but also many studies illustrating the propitious behaviour of a teacher. In 2014, Horakova and Houska conducted a study by which they demonstrated that it is more productive for students before using an experiment or a practical application to present

traditional or previously used methods. Thus their degree of assimilation and understanding increased compared to those cases in which these examples are not presented (Horakova & Houska, 2014). In 2018, several studies have been carried out to improve teaching methods. The first one was done by Naumkin, Kondratieva, Grosheva and Kupryashkin, which concluded that it is more beneficial for students from technical faculties to use methodical systems (mathematical models, 3D models, cumulative and innovative technologies) during research and design laboratories (Naumkin, Grosheva, Kondratieva, & Kupryashkin, 2018). Cimermanova has conducted a study which showed that teaching online courses is effective, maybe even better than classical, face-to-face courses. Also, there has been a steady and rapid increase in student interest in virtual classes, using online teaching tools or videos (Cimermanová, 2018).

In 2011, Mâță carried out a research in which she concluded that the experience of the teacher, the place of teaching, and the structure of the lesson is very important. Teachers who teach in the urban environment have achieved far better results than those who teach in a rural environment, but in terms of structuring the lesson plan, rural school teachers have achieved far greater results than those teaching in urban environments (Mâţă, 2011). Bdiwi, Runz, Faiz, and Cherif (2019) have come to the conclusion that a teacher is more likely to capture the attention of students if they create a smart learning environment that includes new communication and computerization technologies and radio frequency identification based on the positioning system inside (Bdiwi, de Runz, Faiz, & Cherif, 2019).

To lead to the development of modern education methods, the teacher must have a professional and personal development centred on this. A teacher must be capable professionally and pedagogically to develop activities in favour of students (Gilmeeva et al., 2017). Therefore it is very important that from the future teachers' training schools there are courses with vocational subjects, pedagogy, psychology, modern technical teaching methods and educational teaching systems (Kamak, Rakhmetova, & Imankulova, 2016).

Performing scientific research in the field of pedagogy involves the passing of some stages that form the logic of the process of design, development and evaluation of the respective activity. The stages of a pedagogical experiment are:

1. Choice of formulation the research problem – takes place when we want to modernize the instructive-educational process.
2. The motivation of use of the research - presupposes the presentation of the reasons that led to the choice of the respective theme.
3. Documentation - represents the consultation of the specialized literature on the subject.
4. Formulation of the research hypothesis - is an assumption about the results we want, and practice will confirm or refute it.
5. The elaboration of the experimental plan includes the establishment of the sample, the establishment of the procedures and the elaboration of the measuring instruments.
6. Apply the experimental plan - consists in implementing the plan and collecting data.
7. Data analysis and interpretation of experimental results - which specifies the research hypothesis is confirmed or not in practice (Tița & Calcan, 2014)

MATERIALS AND METHODS

Research objectives

The main objectives were reducing the percentage of students with weak exam results, developing the intrinsic motivation of students, using of teaching materials in increased efficiency, developing active, realistic, investigative thinking, synthetic and clear expression, encouraging teamwork, using of worksheets and self-evaluation tests.

Working hypotheses

Depending on the proposed objectives, we have set some working hypotheses:

- Can traditional training be transformed into an autonomous process?
- Can students be able to use their full learning potential?
- Can a pleasant atmosphere be created to develop active, realistic, investigative thinking by creating problem situations?
- Is it possible to develop teamwork with positive effects on communication skills, critical thinking and social skills?
- Is it more effective to evaluate the progress of training if worksheets, assessment and self-evaluation tests are used instead of traditional methods, whose items will be centred on the specific skills of each course?

Methods of research

The research methods used were active methods. At the moment in the courses and labs, lectures and face-to-face dialogue are practised. The use of innovative methods of teaching at the university level can generate much better student results. The research methods used were direct observation, survey method (interviewing and questioning), school document research method and test method. The active observation identified the action of the learning mechanisms, the process of motivation development, the degree of assimilation of some models, norms, values, according to the requirements of the program. The survey method aimed at gathering data (opinions, interests, desires, aspirations) in relation to the motivation of learning, dialogue between teacher and student in the course or laboratory, the information volume and the time needed to assimilate knowledge, the role of general culture and the formation of professional culture, the role and importance of practical training in formatting skills specific to the work in milk processing. The method of the research of the school documents has identified the connection between the students' personality traits and their portrayal in the written works or the portfolios. The test method was aimed at the formative and summative assessment of the progress of the students.

Sample setting

The experimental activity took place between October 2018 and February 2019 at the University "Lucian Blaga" of Sibiu, within the Faculty of Agricultural Sciences, Food Industry and Environmental Protection. The subjects included in the research were students from the 3rd year of specialization "Food Products Engineering"(FPE). In both semi groups there are 16 students aged 21-22 years. In the first semi group, there are 10 girls and 6 boys, and in the second semi group, there are 13 girls and 3 boys. The function of the experimental sample, respectively the control sample, was performed successively. Thus, the results of the students were followed before and after the administration of the experimental factor. The type of assessment that was used as the diagnostic assessment that identifies students' needs, abilities, interests, preferences so that appropriate decisions can be made and individual support can be provided if necessary.

RESULTS AND DISCUSSIONS

Initially, was checked the level of knowledge at the beginning of the "Obtaining Milk Consumption" course. For this purpose, an assessment test was given to the students and included questions from the "Chemical Composition of Milk" course. Following the predictive test correction and the results were presented in Table 1.

Table 1. The results obtained in the predictive test

Sample	Number of students	Grade										Grades under 7	Average
		1	2	3	4	5	6	7	8	9	10		
3rd-year FPE	32	-	-	1	4	4	6	9	5	2	1	15	6,43

It is found that the results obtained are modest, with some grades of 9 and 10. Weak results obtained by students following the predictive test show that they have shortcomings in preparation.
Each student has his / her learning style, so it is necessary to know and understand these styles to help him or her learn more effectively. To attend the “Obtaining Milk Consumption" course, we organized practical laboratory exercises. In this way, students can demonstrate their technical and behavioural abilities, can use documentation sheets, individual worksheets, evaluation sheets, and can practice teamwork. For this purpose, we worked with the students of semi group 1 and 2 of the 3rd year of specialization Food Products Engineering, which we divided into groups of four students. We provided them with documentation and worksheets for the following laboratory tests: determination of acidity, determination of density, determination of milk contamination and determination of lactose content. The evaluation at the end of the laboratory was based on the initial results of the practical activity according to the evaluation sheets.
The results obtained from the application test were presented in table 2 and table 3.

Table 2. Results of semi group 1 in the applied test

Sample	Number of students	Grade										Grades under 7	Average
		1	2	3	4	5	6	7	8	9	10		
3rd-year FPE semi group 1	16	-	-	-	-	1	1	2	3	5	4	2	8,37

Table 3. Results of semi group 2 in the applied test

Sample	Number of students	Grade										Grades under 7	Average
		1	2	3	4	5	6	7	8	9	10		
3rd-year FPE semi group 2	16	-	-	-	-	1	2	2	3	5	3	3	8,12

Following the application of the work records and the practical tasks, it was found that the results obtained were visibly better. Although we started at a low initial level, following the Laboratory "Qualitative and Quantitative Reception of Milk" by the modern methods mentioned above, there was an obvious improvement in students' grades.
To verify if the efficiency is only momentary and if the assimilated notions of the students are lasting, at the end of the two courses and three laboratories we applied an evaluation test with items from the verification lesson and items from the chapter "Obtaining Milk Consumption". Students were notified in advance. The results obtained in the final evaluation test were presented in table 4.

Table 4. The results obtained in the final evaluation test

Sample	**Number of students**	**Grade**										**Grades under 7**	**Average**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
3rd-year FPE	32	-	-	-	-	1	1	8	10	9	3	2	8,06

As can be seen in table 4, the average was an improvement compared to the predictive test. There were only two grades under seven, demonstrating that the assimilation of the students was lasting, not just for the moment.
For a better comparison of the results, we plotted frequency charts for student's grades in the control phase, in the experimental phase and the final evaluation phase as well as the frequency histograms.

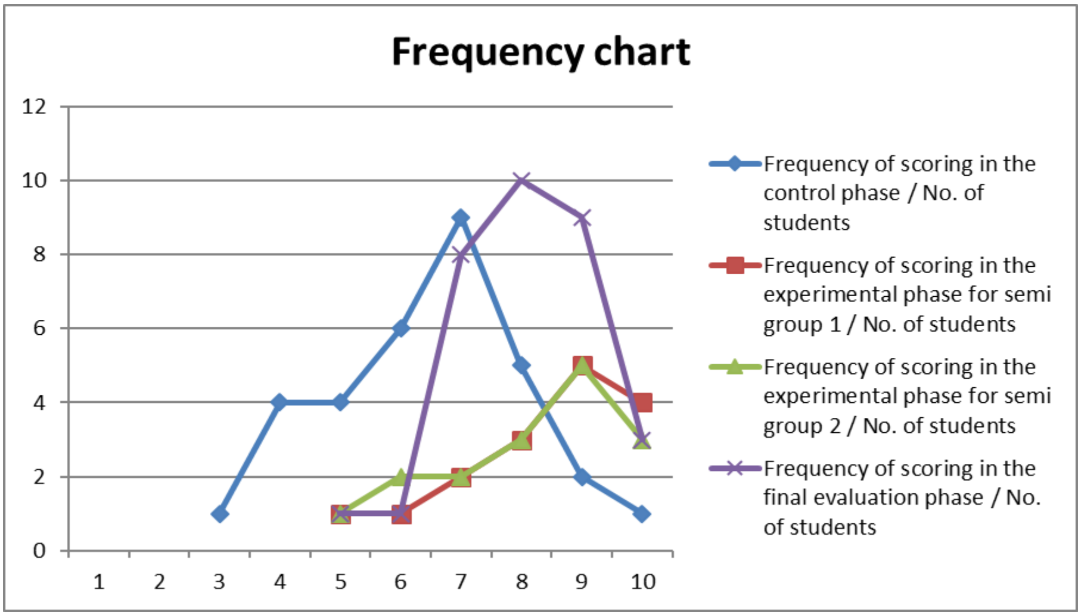

Figure 1. Frequency chart of grades obtained by students in the control phase, in the experimental phase and the final evaluation phase

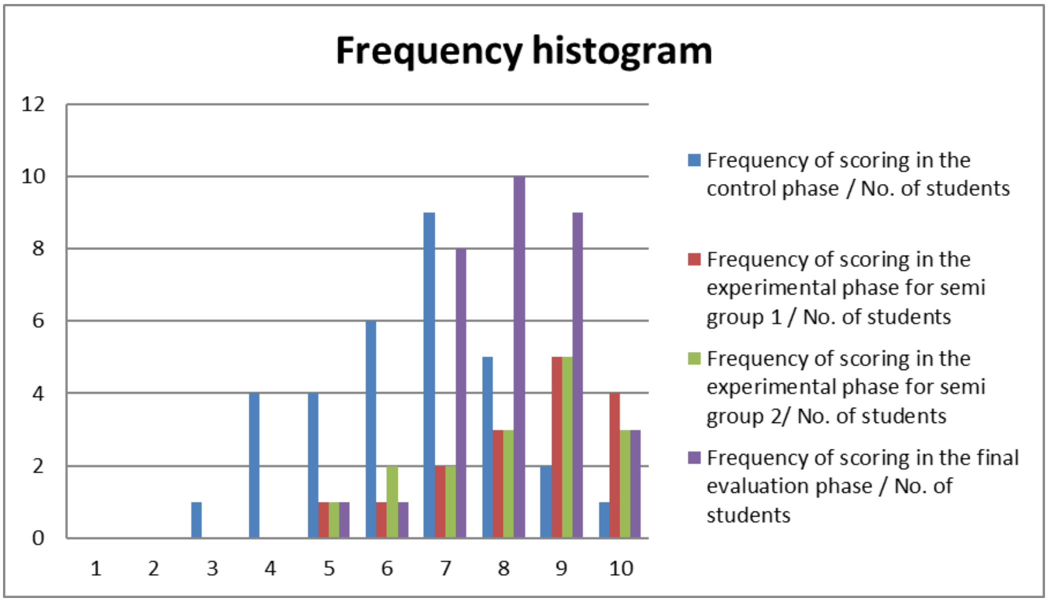

Figure 2. Frequency histograms of grades obtained by students in the control phase, in the experimental phase and the final evaluation phase

Figure 1 and Figure 2 show the frequency of the grades obtained by the students in the control phase, in the experimental phase and the final evaluation phase. As can be seen, the students' results improved during the scoring, which means that the methods presented above were successfully applied. The use of classical teaching methods leads to poor student results. They are not attracted to such methods because they consider them outdated and inefficient. Students need to understand what they are taught and especially to know how to apply this knowledge. he uses of modern methods, such as the active methods presented above, is a solution for solving these problems.

CONCLUSION

The main purpose of experimental factor administration in the 3rd year of specialization Food Products Engineering was to increase the efficiency of the training. To verify the successes of this didactic approach, we compared the performances from which it went with those achieved by the involvement of all the factors that made it possible to realize this goal. As we have shown before, the average predictive test was 6.43, a result that corresponds to performances below the standard level. The main reasons for the weak quality of the evaluation results are insufficient testing of the key and practical skills against the theoretical ones, the insufficient number of test items and ambiguous and unclear questions.

By comparing this average to that obtained from laboratory practice in the experimental phase, there is an increase with approximately 1.5 points. The evaluation process found that students quickly and easily mastered their work with assessment, self-evaluation, workbooks, preferring them as verification and assessment tools, to the detriment of conventional ones (oral evaluation, written works, extemporal).

Thus, the set of knowledge, skills and competencies that students have acquired over a period can demonstrate them after completing a learning process.

Following students as subjects of research, it was found that they agree with active learning, centred on individual worksheets. Students prefer working methods: work-based discovery, conversation, problem-solving, assaulting ideas. The teacher should adapt the teaching strategy to the student's learning style. Learning step by step for students to recover is a strategy to maintain the group at the same level, causing the weaker students to spend more time learning. Students have demonstrated that they do not like classical assessment methods (oral evaluation) that create a stressful condition. They prefer evaluation by evaluation or self-evaluation sheets made up of items that contain well-defined tasks.

It cannot intervene in changing the intelligence of students, but it can be modelled, creating the motivation to acquire the necessary knowledge, to fix and use them in future situations.

Therefore, it is necessary to realize some types of lessons with which to move the focus from the teaching-listening activity to the effective work of the students to acquire the essential notions under the competent guidance of the teacher.

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INNOVATIVE NEW METHODS FOR ENGINEERING AND BUSINESS EDUCATION – 2

Preannouncement of New Products: Overcoming Individual Adoption Barriers

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ABSTRACT .

The launch of innovative products very often encounters adoption barriers of consumers. A suitable communication with consumers is the new product preannouncement (NPP). It helps reduce adoption barriers and accelerates the adoption process. It is an important communication instrument for innovative SMEs. After defining NPP, the paper analyses the content structure of the main components contained in NPP from a consumer point of view. Based on the analysis of existing literature the authors found that there were only a few studies on the properties and quality of information communicated in NPP that influence a successful market launch of product innovations. Above all there is a lack of studies on NPP content in terms of a successful market launch of product innovations. The following analysis of the main NPP components enables to derive recommendations for SMEs on the communication policy for preannouncements and launching product innovations in order to reduce individual adoption barriers.

Keywords: *new product preannouncement, SME, customer adoption barriers, customer communication.*

IMPORTANCE OF INNOVATIONS FOR THE GERMAN ECONOMY

Innovations enable small and medium enterprises (SMEs) to maintain their competitiveness. That applies to process innovations as well as product innovations, (Hauschildt/Salomo 2011, p. 5). In a global world with big technological progress it is especially the SMEs that are faced with innovation pressure (Trommsdorff/Steinhoff 2013,1). Under these conditions SMEs can secure their existence by facing their competitors with a high innovation activity, generate competitive advantage and achieve profits on the markets. In 2017 German companies spent 166.9 billion Euro for their innovation projects. The share of innovation expenditures on revenues of the German economy makes about 3 %, whereas the innovation intensity in the industry makes 4.7% and in the service sector about 1.3% (Peters 2018).
There are 2.5 million SMEs in Germany, i.e. 99.3% of all German companies, thereof 2 million of micro-companies and 18,000 of big companies (Genesis 2019). 60.8 % of SMEs report innovation activities since they developed innovations or implemented them in their company. 31.9 % of German SMEs developed and sold innovations (innovative products and services) (ZEW 2017).

The highest innovation expenditures are in the pharmaceutical industry achieving 17.5 % of revenues followed by the branches of electrical engineering, measuring technology and optics with 13.1 %. Within the automotive industry the innovation expenditures are 10 % of revenues, in the shipbuilding, railway and aeroplane manufacturing 8.9 %, in the electrical engineering 8.4 % and in mechanical engineering 6.2 % (Statista 2019).

In 2017 SMEs achieved an overproportional increase of innovation expenditures compared to the 2016 with 6.4 %. The expenditures of big companies rose by 4.3 % only (ZEW 2019, p. 4). Brink et al. (2018) showed in their analysis that SMEs, including those without any research and development activities, generated within five years three quarters of innovations in Germany.

In 2017 they achieved total revenues with product innovations in the amount of 822.5 billion euro. That corresponds to 15.5 % of total revenue of German industries. From this total revenue 654.3 billion euro were generated by imitation innovations and 168.2 billion Euro by innovative products that had not been offered by any other company at the market before (ZEW 2019, p. 8).

Product innovations have an increasing share of the total revenue of companies. They represent the decisive value in the competition for demanding customers and early identification of customer needs. Product innovations must be developed and launched successfully within increasingly shorter time intervals.

LAUNCH OF AN INNOVATION

The paper understands product as a material item manufactured and offered for sale without consideration of service items. Product innovation is successful when it has been accepted by society, i.e. adopted at the level of individuals first. The adoption includes the purchase of the product innovation by an individual. It happens rarely immediately after the market launch, often it is delayed or it fails (Trommsdorff/Steinhoff 2013, p. 3). Product innovations are reported to have high failure rates of 40 % to 70 % (Hultink et al. 2000, p. 11). The rejection of a product innovation at the individual level may be caused, e.g. by insufficient marketing and sales measures (Cooper 2010, p. 23). Thus there occur barriers which may prevent consumers from an individual adoption of the product innovation (Ram/Sheth 1989, p. 5). Adoption barriers emerge when the product innovation cannot be evaluated adequately by consumer due to the lack of information and missing experience (Trommsdorff/Teichert 2011, p. 218). This is the origin of high insecurity perceived by consumer which acts as a barrier and may prevent or delay the adoption of product innovations. The shorter the product life cycles, the higher the challenges for the SMEs to reduce the adoption barriers already before the market launch of a product innovation, in order to ensure the innovation adoption as fast as possible.

Therefore, market launch preparation is crucial for the success of product innovation. Minimization of consumer adoption barriers requires correct communication policy, i.e. SMEs must communicate deliberately and intensively with consumers before the market launch. Up till now SMEs have had no specific guidelines on preannouncing their innovative products. Thus it is important for SMEs intending to achieve a fast and successful adoption of their product to know how to design and use NPP in order to reduce adoption barriers at the level of individual consumers as early as possible. The conclusions of the authors of this paper should help SMEs achieve this goal.

PAPER OBJECTIVES

Based on the analysis of relevant literature on NPPs the following questions are answered in the paper:

1. What is an NPP and what are its tasks?
2. Why is it necessary to communicate with consumers by means of NPP?
3. What are the components of a NPP?

4. How to design NPP in order to reduce individual adoption barriers?
5. What recommendations on communication policy should be followed by SMEs?

NEW PRODUCT PREANNOUNCEMENT AND ITS TASKS

Preannouncements of new products (NPP) are a part of the communication policy of a SME and thus an instrument to provide specific information for consumers before the actual market launch of the product innovation. NPP is the deliberate communication of information about product innovations before its physical market launch (Kohli 1999, p. 47). Consumers are provided with more time to get acquainted with the innovative product. The information communicated in a NPP help consumers to prepare for the innovative product that will be launched. It is possible to reduce uncertainties acting as adoption barrier. The communication of NPP is carried out preferably via press releases, conferences, fairs or web presences (Kohli 1999, p. 47).
Preannouncements of new products can be treated from timing and content aspects. The time component is characterized by the prefix „pre“ and shows that the preannouncement of product innovation takes place before its physical market launch. This differentiates the NPP from the classical advertisement which focuses on products already available on the market. The content component of NPP provides information about the product innovation. Scharffenberg (2000, p. 9) defines NPP as „(…) an instrument of communication policy of producing company serving as deliberate communication of product-related information before the market launch of a new product.“ Burke et al. (1990, p. 342) specify the communicated information and define NPP as “(…) formal communications that provide new information to consumers about a product's availability, features, applications, defects, or its discontinuation.”
In the literature there is a broad variety of definitions for the concept „new product or product preannouncement“ (Michaelis, 2016, p. 13). Since the focus of this paper is NPP which is directed at consumers we define NPP based on the statement from Kohli (1999, p. 47). Thus, NPP are consumer addressed and deliberately planned communication measures made by companies in form of information about the product innovation before its actual physical market launch.

ROLE OF NPP IN CONSUMER COMMUNICATION

NPP can address a broad scope of addressees, such as consumers, competitors, sales partners and investors. However, SMEs can manage, to a certain extent, that the NPP will reach and address the desired target group with relevant information through the choice of communication channels (Le Nagard-Assayag/Manceau 2001, p. 205; Rabino/Moore 1989, p. 42; Su/Rao 2010, p. 660).
Consumers are the final users of tangible and intangible goods and thus those who should use the product innovation in the end. They determine the success of the product innovation purchasing and using it, since a successful market launch is marked by its dissemination in society. (Rogers 2003, p. 5). In order to achieve a fast diffusion at the level of society, the consumer-related objectives of NPP need to be fulfilled in order to have a positive impact on the adoption, i.e. the acceptance of the product innovation at an individual level (Kohli 1999, p. 45; Su/Rao 2010, p. 667). The communication of NPP focuses on an early dealing of potential consumers with the product innovation. So the adoption process will start already before the market launch (Le Nagard-Assayag/Manceau 2001, p. 206) and hence, a purchase-ready consumer base is created.
Through the communication of NPP SMEs inform consumers and enable them to deal with the product innovation in an early state (Koku et al. 1997, p. 187; Montaguti et al. 2002, p. 25). The provision of relevant and convincing information has to generate awareness about the product - innovation and arouse interest as well as attention (Rabino/Moore 1989, p. 39). The NPP should also help consumers to get prepared for the product innovation. A successful market launch is only possible when consumers understand the product advantages (Trommsdorff/Steinhoff 2013, p. 36). Depending on the innovation degree and complexity of the product innovation NPP should be

communicated earlier or later. Early NPPs are communicated long before the date of market launch whereas late NPPs are made public shortly before the date of market launch (Lilly/Walters 1997, p. 10). The earlier the NPP is communicated, the more time is available for consumers to learn about the product innovation (Kohli 1999, p. 54). Only by gaining knowledge consumers can evaluate the product innovation (Rogers 2003, p. 174), i.e. reduce perceived risks and build up trust and positive expectations (Kohli 1999, p. 45; Le Nagard-Assayag/Manceau 2001, p. 208; Pae/Hyun 2006, p. 25). A positive attitude towards the product innovation supports not only its successful adoption but also stimulates positive word-of-mouth (Eliashberg/Robertson 1988, p. 283) that again boosts fast a diffusion of the product innovation at the market.

NPP should prevent consumers from buying a competing product. The primary goal is that consumers wait for the preannounced product innovation, postpone or even cancel their planned purchases of products that are already available on the market. The NPP also provides the possibility for SME to receive feedback about the product innovation still before its market launch (Brockhoff/Rao 1993, p. 213). This feedback may be used for the estimation of the product innovation’s market potential or it may be used as a basis for product adjustments or changes (Lilly/Walters 1997, p. 8). The objectives mentioned earlier indicate the potential of NPP. However, the communication of NPP is not without risks that have to be taken into consideration by companies. (Eliashberg/Robertson 1988, p. 283). The market launch of product innovations may lead to disappointments on the part of consumers, when their expectations build before and are not met. This is even more likely, if the NPP makes unrealistic promises in advance that lead to exaggerated expectations (Preukschat 1993, p. 10). Another risk can occur when the communicated date of market launch is delayed. If the date of market launch is communicated as obligatory and then is not adhered, it may lead to losses of image and trustworthiness of the company (Eliashberg/Robertson 1988, p. 283; Su/Rao 2010, p. 658).

NPP STRUCTURE AND COMPONENTS

The NPP structure follows the same principles as the design of classical advertisements. It is distinguished between content and formal design elements (Huth/Pflaum 2005, p. 282). The content elements include for example text and its structuring, pictures, as well as application of humour, various appeal forms and argumentation styles. The formal elements include for example considerations on typography, arrangement of text and pictures, format or use of colours (Moser 2002, p. 181 ff.). Figure 1 gives an overview of content and formal design elements of NPP (Michaelis 2016, p. 25).

New Product Preannouncement

Content Elements
- Text
- Pictures

Formal Elements
- Font
- Picture-Text-Relation
- Colours
- Language
- Placement
- Format
- Size

Figure 1: Content and formal design elements of new product preannouncement

The content elements provide information on the product innovation to consumers in the form of continuous text, structured text or pictures. The wording of content depends on the preannounced

product innovation. The arrangement of content elements also depends on the individual formal elements of NPP. The formal elements determine the layout of NPP (Seebohn 2011, p. 128).
The main components of a NPP are the headline, pictures, additional text and brand descriptions (Kroeber-Riel/Gröppel-Klein 2013, p. 356). The headline has a central position in the NPP, since it is perceived first, it catches attention and it should motivate consumer to read the whole of NPP (Diller 2001a, p. 605; Felser 2007, p. 388; Seebohn 2011, p. 89). Studies on consumer’s perception behaviour of advertisements have shown that pictures are of special importance. They are perceived earlier than continuous texts and strengthen the advertising message (Bak 2014, p. 100). The continuous text is the core of the content within a NPP and has primarily an information function (Zielke 1991, p. 74).
Since the focus of this paper is the design of NPP content, it is important to know the effects of the headline, pictures and text on consumer. The headline is integrated as a content element. The same applies to the text representing the description of the product innovation. Formal elements are an indispensable part of NPP. Therefore, the element picture is considered together with the use of colours. They are not related to the formal design of pictures but to the NPP as a whole. Colours are part of the concept of context including both content and formal elements. The context means that the pictures and colours in the NPP create a framework in which the text information is embedded. Figure 2 summarizes the layout of NPP (Michaelis 2016, p. 26).

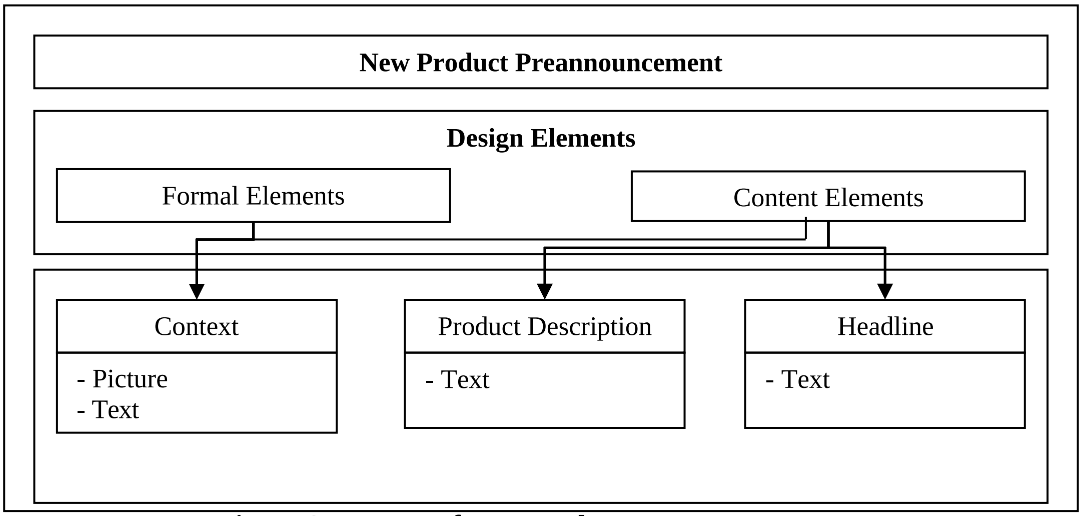

Figure 2: Layout of new product preannouncement

NPP DESIGN AND REDUCTION OF INDIVIDUAL ADOPTION BARRIERS

In the literature there are only a few studies on the properties and quality of information communicated in NPP, which are the key to the successful implementation of product innovations (e.g. Chaudhuri et al. 2010; Talke/Snelders 2013). The following short overview of relevant literature on the NPP in the period from 1980 to 2017 is the result of a systematic database query via the EBSCO (Business Source Premier), ScienceDirect, Emerald, Google Scholar and combined catalogue of the Ilmenau University of Technology. The analysis of studies on the NPP indicates that it is possible to elaborate systematic research on content aspects of NPP by the communicated information types, information properties, information quality and information content.
The information type includes the specific information communicated in NPP, e. g. price, launch date and functions of the product innovation. The information properties describe the way information is communicated in NPP, e.g. concrete or abstract form, positive or negative form. The

information quality covers information properties, such as trustworthiness, consistency, and comprehensibility. Wang and Strong (1996, p. 6) describe the information quality as information suitability for use by data consumers. The information content covers the level of detail of information communicated in NPP.

Studies dealing with the design of NPP content show primarily that there is a great diversity of various information types. Rabino and Moore (1989, p. 38 ff.) conducted in depth interviews with consultants of computer manufacturing companies and state that NPP may include technical information as well as information on price, performance, availability and delivery date of the product innovation. The interviews show that NPPs communicated long before the market launch of the product innovation contain only a general preannouncement without any further specific information. Concrete information follows at a later date. This means that the level of detail increases as the date of market launch draws near. This assumption is confirmed by Merkel (2007, p. 122), who proves in her interviews with marketing managers form the automotive industry that NPP communicated close to the market launch date contains higher level of detailed information than an early NPP. Preukschat (1993, p. 150) shows in his survey of companies from various industries that product and existence information can be communicated in an NPP for consumers. Existence information announces to consumers that a product innovation exists. This is conform with the opinion of Rogers (2003, p. 172) that generation of „awareness knowledge“ is considered to be an important starting point for the adoption since only the conscious perception of product innovation motivates consumers to ask for additional information.

The considerations show that the information type influences the perception and behavioural intentions of consumers. It is apparent that the influence of various information types may have various intensities. Talke and Snelders (2013, p. 738) show that person-related information, such as wish for uniqueness, acceptance, fun or environment-friendly way of life has the strongest positive effect upon adoption intention of consumers, followed by technical and financial information. Person-related information should address the consumer needs and show how a product can satisfy them. Thereby the authors justify also the strong positive effect of this information type. The technical and financial information embrace, e.g. technical equipment, functions, compatibility or price-performance ratio of a product innovation.

Chen et al. (2007, p. 1051 and further) show that various information types vary in their effect on the efficiency of NPP. They consider the information on product properties as corresponding to the concept of technical information by Talke and Snelders (2013). In addition they consider information about facts, brands and emotions. Brand-related information cover information about the relationship of the product innovation to the umbrella brand. Fact-related information describes the product innovation and informs about its existence. In contrast the emotion-related information emphasise subjective experiences from the use of the product innovation. The results of Chen et al. (2007, p. 1051) indicate that except for emotion-related information all information types have positive effects on the sale success and perception, e.g. in the form of positive word-of-mouth, whereby the positive effect of brand-related information is the strongest. Chen et al. (2007, p. 1049) explain this effect with a strong established brand that can reduce the insecurity level and hence, affects consumer’s attitude to the product innovation positively.

Niedbal (2005, p. 212) shows that companies may influence the consumer preferences in a positive manner if the information communicated in the NPP addresses the consumer needs. For this purpose SMEs must identify and interpret the consumer needs first. In this respect the order of communication of information types is also relevant (Niedbal 2005, p. 210 and further). According to these results the consumers must be aware of their needs first before they are able to evaluate concrete properties of the product innovation. First the new needs that are supposed to be satisfied with the product innovation have to be addressed and only later the product functions. However, this goes for radical innovations only as consumers already know their needs for incremental innovations (Niedbal 2005, p. 140 and further).

Bornemann (2010, p. 89) shows that the effect of information types also depends on the timing of NPP communication since consumers apply different evaluation criteria for early and distant events.

In his empirical research he deals with financial information in the form of the specific price of a product innovation and concludes that a higher communicated price in an early NPP has a positive effect on the perceived quality of the product innovation, whereas a higher price in a later NPP leads to the perception of high costs (Bornemann 2010, p. 93 and further). This effects the total evaluation of product innovation (Bornemann 2010, p. 98). Ernst und Schnoor (2000, p. 1333 and further) consider patent information as a specific information type. Robertson et al. (1995) investigate the effect of patent information on consumer perception and show that patent information as a signal of quality exert a positive effect on the perceived trustworthiness of NPP.

From the analysed studies follows that not only the communicated information types but also information properties and information quality exert a decisive effect upon the consumer behaviour. They support positive effects among the information types and target values. Chen et al. (2007, p. 1052) show that information communicated in an unambiguous or consistent manner enhance the positive interdependence among information types and sales success as well a positive perception of the product innovation. If e.g. NPPs are communicated in various time intervals with new information, it is important that the information remain consistent all the time. The consistent information also reinforce the positive effect of information types upon the sales success, however, not upon the perception of product innovation. Chen and Wong (2012, p. 215) extended this study by proving that unambiguous information have a positive effect on the information perception. Talke and Snelders (2013, p. 738) argue that the abstract and concrete representation of information enhances positive interdependence of effects among communicated information types and the adoption intention. Hence, the adoption intention is increased when person-related and technical information are represented in an abstract and financial information in a concrete manner. The abstract representation includes, e.g. pictorial descriptions and the concrete representation is based on facts (Talke/Snelders 2013, p. 736). The fact that information properties in combination with specific information types are also dependent from the target value that’s to be effected shows that technical information are to be communicated in a concrete manner in order to achieve a high willingness of consumers to pay. Whereas person-related information should be represented in an abstract manner, financial information in a concrete manner. This statement can be justified as the way of information representation has positive effect on the consumer imagination. (Talke/Snelders 2013, p. 741 and 743). Burke et al. (1990, p. 344) show that negative information, i.e. information emphasizing what the product innovation cannot do has a negative effect on the purchase intention whereas positive information have a positive effect on the purchase intention. The reason is that negative information has stronger weight for consumers and are perceived in a more conscious way. Therefore, companies should not emphasise in NPP, e.g. incompatibilities of product innovation.

The next question for SMEs is how much information should be communicated in order to support positive effects of NPP on consumers. The available studies show ambivalent results on the effect of information content on NPP. Schirm (1995, p. 142) as well as Ernst and Schnoor (2000, p. 1345) argue that the higher level of detail (information content) has positive effects on the perceived trustworthiness of NPP. However, a higher information content may arouse doubts about their feasibility, especially about radical product innovations (Gemünden 1985, p. 35). On the contrary Niedbal (2005, p. 210 and further) states a positive effect of high information content on the state of consumer knowledge arguing that only sufficient knowledge on own perception may enable adequate evaluation of the product innovation. The effect of higher information content on total perception of NPP is shown by Chen and Wong (2012, p. 215) in their empirical study. According to their results higher information content leads to high perception of non-ambiguity, to a consistent NPP. It can be concluded that the information content as a part of the content design is a relevant communication factor of an NPP.

The analysis of literature shows that the design of NPP content, i.e. the information types, information properties, information quality and information content influence the perception and thus behavioural intentions of consumers. Their effects must be taken into account especially in the design of the context product description and headline within a NPP. However, not all the statements in the analysed papers are always positive and without limitations. The positive effect of

NPP content is also dependent on product, industry and consumer-related factors (Ernst/Schnoor 2000, p. 1342; Preukschat 1993, p. 152 and others). It is always necessary to verify whether the product innovation has hedonic properties (associated with fun, joy, pleasure and positive feelings) or utilitarian properties (associated with purpose and use).

CONCLUSIONS: IMPLICATIONS FOR SMEs

The purpose of this paper was to fill in the gap in the NPP literature by summarizing and analyzing the most relevant contribution on this topic by the NPP elements in order to suggest recommendations for the SMEs in this field which had been missing as well up till now. The reduction of consumer adoption barriers caused by the launch of product innovations and accelerate the adoption process it is important to communicate with consumers before the product launch. NPPs are an efficient instrument for this purpose. If consumers perceive all components of an NPP as suggested, the adoption process and thus market launch of innovative product may be accelerated. The following recommendations can help SMEs achieve successful market launch of their product innovations:

1. NPP influence consumer preferences for product innovations in a positive way, if the communicated information addresses the consumer needs. That is, SMEs must identify and interpret the consumer needs first. The new needs aroused by an innovative product have to be addressed first and then product functions can be communicated. This is important especially for radical innovations, as the consumer needs are not known yet. A special quality signal is patent information which increases the trustworthiness of NPP.
2. Since the generation of „awareness knowledge“ is an important starting point for the conscious perception of product innovations by consumers and for their purchase motivation, SMEs should carefully consider and design the information about the product innovation communicated.
3. The timing is also an important factor in positioning NPP in the communication channels, because consumers evaluate early and distant events in a different way. Thus the information content should be increased with the approaching market launch date. In contrast a higher price communicated in an early NPP suggests a high quality of the innovative product, whereas a higher price in a late NPP evokes an impression of high purchase cost of innovation.
4. Since different information types are important in overcoming innovation barriers, the person-related information such as the wish of uniqueness, acceptance or fun should be strongly communicated in NPP. They influence the adoption intention of consumers in the most positive way, because they address the individual objectives of consumers. The brand-related information should also be reinforced in NPP communication, since a strong and established brand reduces insecurities and has a positive effect on consumer attitudes towards the product innovation. The influence of technical and financial information is not as high as for the other information types.
5. The information properties and their quality contained in NPP influence the adoption behaviour of consumers. Therefore, it is necessary to ensure that information communicated in NPP is unambiguous and consistent, because they enhance the interdependence of positive effects among information types and sale success as well as the positive perception of product innovation.
6. Since the way information are represented has a positive effect on the imagination of consumers, it is important to represent person-related and technical information in an abstract manner, e.g. by means of pictorial descriptions, and financial information in a concrete manner. In addition technical information must be communicated in a concrete manner in order to achieve a high willingness to pay.
7. The NPP components such as context, product description and headline create the information and evaluation base being perceived consciously or unconsciously by consumers. The headline is perceived first. It generates attention, arouses curiousness and motivates to continue reading. A motivation effect is also evoked by familiar formulations followed by contrasts, announcements and

utility-related, emotional as well as unexpected statements (Beltramini et al. 1986, p. 50 and further.). The context with pictures and colour creates the framework of a NPP. Since pictures are perceived earlier than texts, they strengthen the advertising message. If the NPP is designed for a utilitarian innovation product with preference of functionality and use, then functional pictures and colours should also be selected.

8. NPP evokes adoption intention and triggers the adoption process. Its final purpose consists in the creation of a purchase-ready consumer base. However, in order to support a successful market launch and create product acceptance in a society SMEs have to communicate with their target group(s) about the innovative product and inform them even beyond the NPP and satisfy the information needs of consumers on an ongoing basis.

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Incorporation of Practice Based Approach into Engineering Education at Master Level: Analysis of Needs of Teaching staff at Cape Peninsula University of Technology within PEESA III Project

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ABSTRACT

Company's work, growth and development are facilitated by the synergy between employee education and working. However, fresh employees who recently graduated from higher education institutions are often mismatched to their jobs due to their imbalances between skills offered or, in other words, education, and skills needed or, in other words, practice in the world of work. For bridging the gap between graduates' skills and company's needs, technical universities traditionally devote much time to students' practical training. The aim of the present paper is to analyse scientific literature on practice based approach underpinning empirical study of needs of teaching staff within PEESA III Project for incorporation of practice based approach into engineering education at master level in South Africa. The data was collected through focus group interview at Cape Peninsula University of Technology in May 2019. The findings of the present research are that university teachers' experience in practice based approach at universities in South Africa has to be enriched. The following research question has been formulated: How to organize a teacher professional development within teacher training for effective incorporation of practice based approach into engineering education at master level in South Africa? Directions of further research are formulated.

Keywords: *Definition, engineering education at master level, practice based approach, teaching staff needs.*

INTRODUCTION

Company's work, growth and development are facilitated by the synergy between theory or, in other words, education, and practice or, in other words, work. However, fresh employees who recently graduated from higher education institutions are often mismatched to their jobs due to their imbalances between skills offered or, in other words, education, and skills needed or, in other words, practice in the world of work (Department of Statistics, 2014). Skills mismatches can adversely affect labour productivity and can explain some of the existing cross-country productivity gaps (Nikolov, Nikolova, Ganev, Aleksiev, 2018). Consequently, skills mismatches are widely accepted as a factor that adversely affects potential economic growth and as such require concrete policy measures at the national level (Nikolov, Nikolova, Ganev, Aleksiev, 2018). Such a measure for bridging the gap between graduates' skills and company's needs, is students' practical training to which technical universities traditionally devote much time (Tarev, 2015). Against this background, most of research efforts were made

- To analyse didactics of practice-based approach to teaching university students (Higgs, Barnett, Billett, Hutchings, & Trede, 2012; Tarev, 2015), and
- To explore a practice-based approach to foreign language teacher preparation (Troyan, Davin, Donato, 2013).

Particularly, there is a paucity of research linking theory and education in the South African context (Cherrington, 2017). In order to bridge the gap between theory and practice in engineering education at master level in South Africa, the Erasmus+ Programme KA2 – - Cooperation for innovation and the exchange of good practices – Capacity Building in the field of Higher Education supports the project "Personalised Engineering Education in Southern Africa" (PEESA III).

The aim of the present paper is to define the practice based approach underpinning empirical study of needs of teaching staff for incorporation of practice based approach into engineering education at master level. The present research employs theoretical as well as empirical methods. The theoretical methods include analysis of scientific literature and theoretical modelling. The empirical methods were based on exploratory case studies that are set to explore any phenomenon in the data, which serves as a point of interest to the researcher (Zainal, 2007). Exploratory research was employed in the present investigation. Exploratory research is aimed at generating new research questions (Phillips, 2006). The interpretive paradigm was applied to the investigation.

DEFINITION OF PRACTICE BASED APPROACH

Practice based approach is an overall concept that refers to the opportunities provided to university students to integrate knowledge of theory and practice as part of their degree program (Thomson, da Silva, Draper, Gilmore, Majury, O'Connor, Vásquez, & Waite, 2017). The concept of "practice based approach" comprises the use of a variety of such terms as "practice based education", "practice based teaching", "practice based learning", "work based learning", etc. In the present research, the overall term "practice based approach" is mostly used.

For a proper incorporation of practice based approach into engineering education at master level, a definition of "practice based approach" is a necessity. In turn, the term "definition" has to be identified. The term "definition" is considered as the statement of the phenomenon notion, elements and process. (Ahrens, Zaščerinska, Andreeva, 2013, p. 35). Thereby, a definition's components as depicted in Figure 1 by Ahrens, Zaščerinska and Andreeva (Ahrens, Zaščerinska, Andreeva, 2013, p. 35) include phenomenon's notion, elements and process.

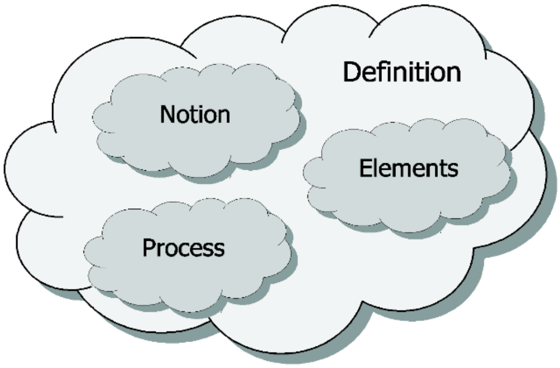

Figure 1: Definition's Components.

The notion of "practice based approach" means education, in which students are being prepared to practice in a diverse range of activities, profiles, and professions, that meets the needs of graduates and practitioners, as well as all the stakeholders: clients, employers, and colleagues (Tarev, 2015).
Many researchers tried to identify structural elements of practice based approach. However, they focused only on one aspect of practice based approach, for exampe problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (ie workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011). Analysis of the scientific publications on practice based approach allows the paper's authors to determine that practice based approach is the unity of the phenomena considered by Tarev (Tarev, 2015), Australian Learning and Teaching Council (Australian Learning and Teaching Council, 2011) as well as other researchers. Consequently, the present paper's authors imply that practice based approach is the unity of such strutural elements as shown in Figure 2, namely problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (ie workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011).

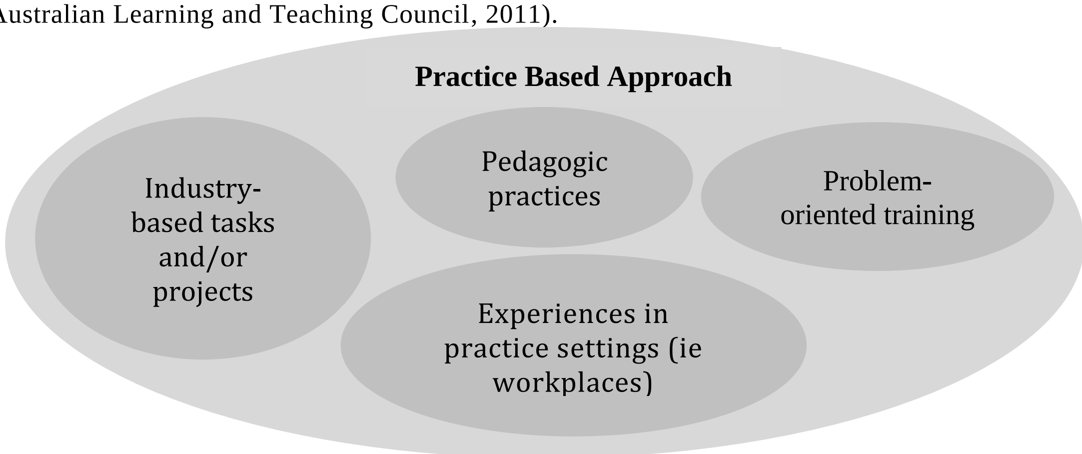

Figure 2: Structural Elements of Practice Based Approach.

Regarding the procedural aspect of practice based approach, Australian Learning and Teaching Council recommends to organize "before," "during" and "after" students' practice-based experiences

(Australian Learning and Teaching Council, 2011). Another pedagogical perspective on the implementation of practice based approach focuses on the cyclic nature of the educational process (Zaščerinska, 2011) as illustrated in Figure 3. The sequence of the implementation of the educational process gradually proceeds from teaching in Phase 1 to learning in Phase 3 through peer-learning in Phase 2 (Zaščerinska, 2011). Each phase of the educational process is separated from the previous one, and the following phase is based on the previous one (Zaščerinska, 2011).

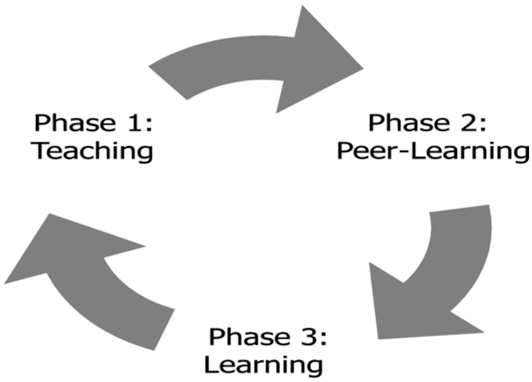

Figure 3. Phases of the educational process.

A comparative analysis of the implementation of "before," "during" and "after" students' practice-based experiences (Australian Learning and Teaching Council, 2011) as well as the educational process (Zaščerinska, 2011) allows highlighting such advantages of the educational process proposed by Zaščerinska (Zaščerinska, 2011) as

- the social nature of the educational process (teaching and peer-learning) as well as
- the movement of the educational process from the external or, in other words, social perspective (teaching and peer-learning) to the internal or, in other words, individual perspective (learning).

Practice based approach is implemented in various forms: in the form of games, hybrid activities, distance learning, in the classroom, etc (Tarev, 2015). It is important that the focus on practice is fixed in the curriculum, which reflects all of these kinds of activities (Tarev, 2015). Along with formal education, practical orientation is realized on the informal and non-formal levels of the educational system (Tarev, 2015).

EMPIRICAL STUDY DESIGN

The present part of the contribution demonstrates the design of the empirical study. The guiding research question is as follows: What are the needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa? The purpose of the present research is to analyse needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa via a focus group interview underpinning elaboration of a new research question.

The qualitatively oriented empirical study allows the construction of only few cases (Mayring, 2004). Moreover, the cases themselves are not of interest, only the conclusions and transfers we can draw from these respondents (Mayring, 2007). Selecting the cases for the case study comprises use of information-oriented sampling, as opposed to random sampling (Mayring, 2007). This is because an average case is often not the richest in information. In addition, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur (Flyvbjerg, 2006, p. 229). Random samples emphasizing representativeness will seldom be able to produce this kind of insight; however, purposive sampling is more appropriate where some few interesting cases are chosen for their validity. Typically, focus groups interviews within the present study are the method of data collection as focus groups interviews examine how knowledge, and more importantly, ideas, develop and operate within a given cultural context as well as explore exactly how the opinions are constructed (Kitzinger, 1995). Circle seating is usually used for a focus group interview (Krueger, 2002). A focus group usually includes from five to 10 participants (Krueger, 2002). The choice of participants for a focus group interview is based on three criteria: participant's knowledge on a given topic, participant's cultural difference and education's diversity (occupation, training, etc) and participant's hierarchy in the group. The number of participants depends on the heterogeneity of the focus group: the greater the heterogeneity of the group, the fewer the number of participants (Okoli & Pawlovski, 2004). Further on, smaller groups show greater potential (Krueger & Casey, 2000). Thus, five is a good number of participants for the study (Lopez & Salmeron, 2011).

The present focus group was composed of five university teachers from South Africa, Germany and Latvia in May 2019. All the respondents had been awarded doctoral degrees in different scientific fields such as mathematics, pedagogy, and engineering, etc. As the respondents with different cultural backgrounds and diverse educational approaches were chosen, the sample was multicultural. Thus, the group (age, field of study and work, mother tongue, etc.) was heterogeneous. The sample of six respondents involved two professors from Cape Peninsula University of Technology, South Africa, a PhD holder from Cape Peninsula University of Technology, South Africa, a professor from Hochschule Wismar, Germany, and a PhD holder from Centre for Education and Innovation Research, Latvia. In order to safeguard the confidentiality of information of the present research, the respondents' names and surnames were coded as follows: two professors from Cape Peninsula University of Technology were given the code FG R1 (Focus Group Respondent 1) and FG R2 (Focus Group Respondent 2), a PhD holder from Cape Peninsula University of Technology was pointed as FG R3 (Focus Group Respondent 3), a professor from Hochschule Wismar - FG R4 (Focus Group Respondent 4), and a PhD holder from Centre for Education and Innovation Research – FG R5 (Focus Group Respondent 5).

Respondents' cultural and educational experience emphasized the significance of each participant's opinion on research question (Luka, Ludborza, Maslo, 2009) within the present empirical study. It should be noted that opinion is determined as individual's view based on awareness and attitudes (Lūka, 2007).

The exploratory type of the comparative study (Phillips, 2006) was applied within the present empirical study. The exploratory type of the comparative study aims to generate new hypotheses and questions. The exploratory methodology proceeds (Melnikova, Zaščerinska, Glonina, 2015) from exploration in Phase 1 through analysis in Phase 2 to generating a new research question in Phase 3.

The interpretive paradigm was applied to the investigation. The interpretive paradigm aims to understand other cultures and establishment of ethically sound relationships (Taylor, Medina, 2011). Interpretative paradigm is characterized by the researcher's practical interest in the research question (Cohen, Manion, Morrsion, 2005). The researcher is the interpreter.

The focus group interview was semi-structured. The majority of questions of the semi-structured interviews are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues (Case, 1990). The semi-structured interview was based on the question, namely "What are the needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa?" The collected data were processed via structuring and summarizing content analysis.

RESULTS OF THE EMPIRICAL STUDY

FG R1 (Focus Group Respondent 1) highlighted the importance of the implementation of practice based approach in engineering education in South Africa. Due to the reform of higher education in South Africa, the period for practical placement (workplace-based learning) of engineering students at universities of technology has generally been shortened. In most new engineering qualifications, the period of practical training in industry has been halved, while in some it has been removed completely.
FG R2 (Focus Group Respondent 2) emphasized the lack of South Africa's university teachers' industrial experience. In certain engineering disciplines where the university experiences great difficulty recruiting academic staff, it is possible for lecturers to be appointed with strong research backgrounds but with limited or no industrial experience. Once university lecturers commence their academic career at university they rarely have an opportunity to update their industrial experience.
FG R3 (Focus Group Respondent 3) pointed that South Africa's university teachers in engineering departments are mostly qualified with degrees in their engineering discipline only. In South Africa, a pedagogic degree for university teachers is not a manadatory requirement for starting an academic career at university.
FG R4 (Focus Group Respondent 4) disclosed that students' master theses in South Africa are led and supervised by the university's academic staff only. Students' master theses are mostly elaborated without an active participation of industrial partners and stakeholders.
FG R5 (Focus Group Respondent 5) focused on the significance of teacher training for university teachers. According to FG R5 (Focus Group Respondent 5), teacher training has to include modern teaching and learning methods and tools for incorporation of practice based approach into engineering education at master level in South Africa.

FINDINGS OF THE EMPIRICAL STUDY

The present empirical study allows finding that practice based approach is on a high demand at universities in South Africa. However, university teachers' experience in the implementation of practice based approach at universities in South Africa has to be enriched. Teacher training has to enhance both, namely university teachers'

- industrial experience as well as
- pedagogical skills in the implementation of practice based approach to engineering students at master level.

CONCLUSIONS

The theoretical investigation carried out on practice based approach allowed defining practice based approach. The theoretical analysis of scientific publications on practice based approach resulted in identifying the model of practice based approach such as

- notion,
- structural elements as well as
- procedural aspect of practice based approach.

The novelty of the definition of structural elements of practice based approach proposed the authors of the present paper lies in the unity of structural elements such as problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (ie workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011). Another novelty in the definition of practice based approach is that the emphasis in the procedural aspect of practice based approach is put on

- the social nature as well as

- cyclic nature of the process of practice based approach.

According to the scientific findings disclosed in the present paper, the process of practice based approach proceeds from teaching via peer-learning to learning.

The findings of the empirical study allowed drawing a conclusion that, for incorporation of practice based approach into engineering education at master level in South Africa, teaching staff needs training or, in other words, a training course.

The following research question has been formulated: How to organize a teacher professional development within teacher training for effective incorporation of practice based approach into engineering education at master level in South Africa?

The present research has limitations. A limitation is the theoretical basis on practice based approach set on the inter-relations between definition (notion, structural elements and process) and practice based approach. Another limitation is the empirical study carried out at one university, namely Cape Peninsula University of Technology, in South Africa.

Further work could concentrate on analysis of methods and tools effective for incorporation of practice based approach into engineering education at master level.

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Training PhD students for teaching of engineering disciplines: Study of Russian Universities Experience

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ABSTRACT

The paper contains several findings of the study of the Russian universities' system related to pedagogical training of PhD students, which has been carried on in the framework of the ERASMUS+ Capacity Building for HE project EXTEND (# 586060-EPP-1-2017-1-RO-EPPKA2-CBHE-JP) - "Excellence in Engineering Education through Teacher Training and New Pedagogic Approaches in Russia and Tajikistan". The project itself is devoted to the training of new personnel for the engineering universities. The strengths and weaknesses of the Russian system of pedagogical training of young teachers are under discussion in this article.
The Introduction part of the paper describes the Russian system of education, EXTEND project main activities, Project Consortium participants, objective of the analysis of curriculum contents of PhD programs in engineering in Russian universities, including courses and internships on pedagogy, learning outcomes and PhD student's teaching competences and motivation. The methodology part of the paper draws the four stages of the research. The main part of the paper presents the results of the analysis of the 22 PhD programs collected by Russian universities' team. The Discussion part consists of four recommendations on how to enhance the Russian teacher preparation.

Keywords: *Erasmus+, Education Technology, Competence, Teachers Training, Engineering education, PhD education.*

INTRODUCTION

Russia's Higher Education (HE) system based on the Bologna principles partly includes the following levels of education (Study in Russia - Web-site of Ministry of Science and HE of the Russian Federation, 2019): bachelor's degree (4 years) – ISCED Level 6; master's degree (2 years) – ISCED Level 7; PhD degree (3-4 years) – ISCED Level 9; specialist degree (5-6 years) – ISCED Level 8; clinical internship (2 years) – ISCED Level 9. Along with the Bologna's three cycle

system a part of traditional Russian system has been kept for the most important and intensive education fields, such as medicine and several fields of engineering. In these fields there are 5 or 6-years specialist's degree programs offered, which are equal to ISCED Level 8.
The PhD degree programs were included in the system of HE degrees only in 2013 according to the Minister of Science and HE Decree #1259 from November 19, 2013 with modifications in April 2016. Before (between 1925 and 2013), such kind of programs were considered post-graduate education for specialists of highest qualification and were completely research-based. The aim of the PhD students was to prepare and defend a thesis to obtain the so called Candidate of Science degree, equal to a PhD degree from the EU system. If the PhD student failed to defend thesis, he or she didn't get any document of education. In 2012 new Federal Law #213-FS "On Education in Russian Federation" was issued and since 2013 the postgraduate education was included in the system of HE Russian Federation (RF).
After the year 2013, the PhD programs were the subjects to Federal State Education Standards (FSES) issued by Ministry of Education and Science of RF. The FSES include requirements to content, duration, learning outcomes and conditions of PhD programs of certain specialty. To be able to offer a PhD program, the university must get license and has to pass through the State Accreditation procedure every 5 years. Some characteristics of a PhD course are presented in the Table 1.

Table 1: Some characteristics of the RF PhD course

Type of the PhD Course	**PhD Course Features**
Entry requirements	Master's or Specialist Degree
Duration of study	3–4 years (full-time), 4–5 years (part-time)
Academic qualification certificate	Postgraduate Degree certificate
Qualification (Degree)	Researcher (qualification), research fellow (qualification), Candidate of Sciences (degree)
Type of study	Regular classes according to curriculum, teaching internship, research
Form of final state assessment	Three qualifying examinations for a candidate's Degree, state examination, dissertation's defense
Further career in a scientific and professional field	Doctoral Dissertation Defense
Employment	Research, analytical and scientific work in accordance with qualification

The PhD graduates have the right to be employed as university teacher. As an university teacher, one has to improve one's skills and study at professional training programs with the duration not less than 72 hours (2 ECTS) every three years. It is mandatory to pass through the so-called teacher attestation procedure for prolonging the labor agreement. There is no mention about the possibility to train the PhD students in the field of teaching.

In this context, we carried out a research of the Russian universities' practices of pedagogical training of PhD students. Our activities were done in the framework of the ERASMUS+ Capacity Building for HE project EXTEND (# 586060-EPP-1-2017-1-RO-EPPKA2- CBHE-JP) - "Excellence in Engineering Education through Teacher Training and New Pedagogic Approaches in Russia and Tajikistan". The applied methodology was validated and implemented by the eight partner countries (PC) universities from the project.

METHODOLOGY

The objective of our analysis was to identify the strengths and weaknesses of the system of pedagogical training and retraining of HE teachers based on the PhD programs analysis and teachers' retraining in Russian universities. The following tasks had to be solved to achieve the goal: selection and analysis of PhD programs, selection and analysis of teacher training programs, identification of strengths and areas of improvement of the system of pedagogical training and retraining of teachers of HE.
The methodology of analysis which was applied by us consist of the following stages: 1. Preparatory stage; 2. Data Collection Stage; 3. Analysis Stage; 4. Discussion and Exploitation Stage (see Figure 1).

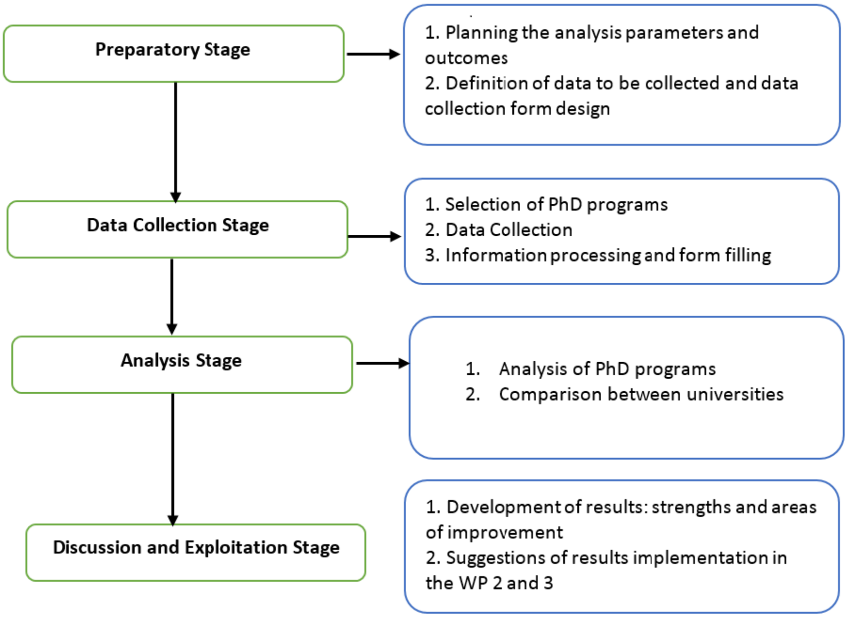

Figure 1: Stages of the Analysis.

Preparatory Stage

During the **preparatory stage,** the Project team has decided that each PC university should select several PhD programs (from 3 to 5) in the field of engineering.

Data Collection Stage

Data Collection Stage has been performed by the following Russian universities: Moscow State University of Architecture and Civil Engineering (MGSU), Bauman Moscow State Technical University (BMSTU), Nosov Magnitogorsk State Technical University (NMSTU), National

Research Mordovia State University (MRSU). In the end, data on 22 PhD programs were collected by the PC universities' teams. (see Table 2).
The current analysis of PhD programs focuses on two major research directions– engineering and science. The data collection performed by the Russian universities within the project was conducted both as a desk and field study. The following documents have been exploited to collect data for the research: federal state education standards on PhD programs, basic professional educational program (a set of documents describing the contents of the program, learning environment, teaching tools and learning outcomes), curricula, course descriptions, internship descriptions, PhD department and academic department reports, teacher interviews.

Table 2: Summary of the PhD programs analysed

Russian University	Number of PhD Programs	Number of full-time PhD students (statistics over 3 years)
MGSU	5	78
BMSTU	5	75
NMSTU	5	32
MRSU	7	63
Total	**22**	**248**

Analysis Stage

The methods of data analysis were comparison and content analysis. In Russia the Ministry of Science and HE develops and issues obligatory federal state standards, which contain requirements to the structure and learning outcomes of the PhD programs including competences that graduates should possess. New generation of federal state educational standards are aligned with professional standards and there are references to professional standard of Researcher and professional standard of University teacher. Table 3 shows types of the generalized labour functions and specific labour functions of graduates in accordance with professional standards.
Federal education standards of HE in RF is competence oriented. Each federal education standard of HE includes list of competences graduate should possess upon graduation. Competences are been divided into three groups: generic competences, general professional competences and professional competences.
Generic competences are set for all programs covered by one federal education standard. Generic competences show professional abilities of a person, ensuring successful human activity in a variety of both professional and social sphere (Mishin, 2018). Based on the fact, that the generic competencies are of a non-objective nature, their formation has been carried out within the framework of various forms of organization of the educational process regardless of the specific discipline. They are formed not by "teaching" at the subject-content level, but due to their systematic integration into the educational process through the content, technologies and environmental factors (Rozin, 2018), (Kazakova & Tarkhanova, 2018).
General professional competences reflect a set of fundamental professional abilities, knowledge and skills of a professional that are invariant for any professional activity in the specific field (Sivitskaya, Smishlyaeva, & Cmishlkyaev, 2010).
Professional competences are subject-specific competencies bearing the context of a specific professional activity and determine the competitiveness of the graduates (Piskunova & Erokhina, 2017).
In order to assess and develop the competences acquired by PhD programs' graduates, the learning outcomes are determined for each competence. Learning outcomes are not presented in the federal education standards, but they are determined by university. It means that the same competence could be under description in different learning outcomes from different universities.

Table 3: Types of the generalized labour functions and specific labour functions of graduates in accordance with professional standard (Professional standard "Teacher of vocational training, vocational education and additional professional education" - Order of the Ministry of labour and social protection of the Russian Federation, 2019)

Professional Standard Title	**Generalized labour function**	**Specific Labour Function**
Teacher (pedagogical activity in vocational education, HE, additional professional education)	Teaching for the PhD students and teaching professional training courses	Participation in the development of scientific and methodological support for the implementation of PhD programs and professional training programs
		Teaching of courses, disciplines (modules) for the PhD programs and professional training programs
	Teaching for the bachelor, master and specialist degree students and teaching professional training courses	Development of scientific and methodological support of supervised subjects, courses, disciplines (modules)
		Teaching of academic subjects, courses, disciplines (modules) on bachelor's, specialist's, master's and professional training programs
		Organization and supervision of research and project activity of students. Supervision of student's internships including advisory participation in the preparation of graduation thesis
		Carrying out career guidance activities for the students

According to RF's educational standards, the learning outcomes of each competences are divided into three parts: “Know”, “Able To” and “Possess Skills”.

Our analysis shows that 21 out of 22 PhD programs of Russian universities include one general professional competence in the field of teaching – “Readiness for teaching on the educational programs of HE”.

In MGSU two generic competences are related to teaching activities – “Willingness to participate in the work of Russian and international research teams to solve scientific and educational problems” and “Ability to plan and solve problems of professional and personal development”.

In MRSU also two professional competences in teaching are identified in every PhD program “Readiness for teaching in the specific field” and “Ability to develop scientific and methodological support of educational disciplines in the specific field”. It means that teaching is regarded as general professional skill for each PhD graduate although in some universities the role of the teacher is considered to have more importance than of a PhD graduate.

The content analysis of learning outcomes shows significant differences between universities in terms of what exactly should know, be able to do and which skills should each PhD graduate possess to be a university teacher. The generalized learning outcomes are the following:

- **Know:** the legal framework of HE, basics of psychology and pedagogy of HE, modern educational technology;
- **Be able to:** choose and apply modern educational technologies, choose relevant material for teaching, apply theoretical and methodological basis in the educational process; conduct teaching activities and develop educational and methodological support;
- **Possess:** teaching skills, skills of development of educational and methodological support, skills of modeling, application and evaluation of the educational process.

According to (Gülşen, Tosun, & Tas, 2015) and (Selvi, 2010) the general framework regarding teacher competencies were explained in nine different dimensions as field competencies, research competencies, curriculum competencies, lifelong learning competencies, social-cultural

competencies, emotional competencies, communication competencies, information and communication technologies competencies (ICT) and environmental competencies.
In Russian PhD programs, the focus in teaching competencies is made on the field and curriculum competences along with the research competences which are regarded to be the most important for the PhD program graduate. Other types of competencies are excluded, and it distorts teacher's competence model, distracts student attention from important soft skills necessary for the effective teaching and self-development. The research and teaching competencies are been disintegrated. At the same time, the contemporary concept of education is "education through research" which identifies the immediate prospects in the sphere of education reforms in the world. Today's Russia is only approaching to this problem consideration at the State level. The political directives made recently are still declarative (Karpov , 2015).
Pedagogical training in the PhD program includes courses on pedagogy, teaching internship, preparing for the state exam. According to the results of the State final exam, the graduates are awarded the qualification of "Researcher. Teacher-researcher". Each PhD program in Russia includes at least one course on pedagogy and teaching internship (see table 4).

Table 4: Courses and internships on pedagogy in PhD programs of Russian Universities

Russian University	Courses on Pedagogy	Teaching Internship
MGSU	Pedagogy and methods of professional education (2 ECTS)	Pedagogical Practice (3 ECTs)
BMSTU	Fundamentals of pedagogy and psychology of HE (6 ECTS)	Pedagogical Practice (18 ECTs)
NMSTU	Pedagogy and Psychology of HEI (3 ECTS)	Pedagogical Practice (9 ECTs)
MRSU	IT in research and education (2ECTS) Pedagogy of HE (2ECTS)	Pedagogical Practice (3 ECTs)

In Russian Universities each PhD program has at least one general course on pedagogy with the duration between 2 and 6 ECTS. In addition, in NMSTU the PhD students must acquire a good level of foreign language proficiency to be able to deliver lectures for foreign students and fundamentals of inclusive education to be able to deliver lectures for inclusive students. In MRSU, an additional course is included: "IT in research and education" (2 ECTS). The teaching internship is obligatory and its duration varies between 3 and 18 ECTS. In BMSTU the maximum share of curriculum dedicated to pedagogical training is 10%.
In addition, there are some other courses which contribute to development of related soft skills of the future university teacher, such as: History and Foreign Language (all universities), Communicative and Stylistic features of the Academic language and Writing (BMSTU), Professionally Oriented Translation (NMSTU).
Although the major part of the curriculum is dedicated to professional courses, there are courses on research methodology and research activities, as a consequence of the traditional Soviet approach in which the university teacher was considered a researcher and teaching- an additional activity which needed no special training.

Discussions and Recommendations Stage

The contextual background allowed identifying the similar structure of the PhD education in all Russian Universities; most of PhD programs are been aligned with Bologna system and regarded as HE of 3rd Cycle. The results of study allow us to formulate four recommendations.
Recommendation 1: Develop networking using university teacher's training system to create joint flexible courses and programs.

Analysis revealed that each university has different approaches to teacher training focusing on the specific areas of study. Networking between universities could help to joint efforts and achieve synergy effect in development and delivery of fully-fledged training programs for teachers (Fino, Zinchenko, & Solovyev, 2013). Networking would allow each university to excel in selected area thus improving quality of the whole program. Involvement of foreign partners could provide international dimension to the program.

Recommendation 2: Develop university teacher model of competences with descriptor of learning outcomes for the teacher of engineering disciplines

The competences on teaching used in PhD programs are standard in Russian universities but at the same are very vague and general. This confuses all stakeholders about the real competences an university teacher should possess. That is why there are significant differences between universities in description of these competences and achieved learning outcomes. On one hand, it allows achieve diversity in teacher training approaches but on the other hand it decreases the compatibility and portability of teaching competences, decreases opportunities for PhD student mobility and recognition of periods of study in other university, confronts the rights of student for the qualitative education. University teacher model of competences has to be used also for design of teacher enhancement programs. It would help to increase the continuity of teacher training and improve career opportunities.

Recommendation 3: Introduce modular approach to teacher training programs

Each university offer several (some of them offer dozens of) PhD programs where set of competences could vary as well as duration of the program/course. The modular approach could provide flexibility and scalability of the programs, design tailor-made courses and create network joint programs with partners. Analysis of teaching competences and real contents of the programs/courses allowed identify basic modules to be developed: Project Based Learning (PBL), E-learning and ICT Tools, Foreign Languages for Engineering + Academic Writing, Research Based Learning (PhD Students), Active Learning Strategies, Curriculum Design and Development, Assessment, Design thinking, Communication. The course development needs to be based not only on theoretical background but also on the practical experience of different European and partner university departments through the knowledge exchange practices. For example, BMSTU developed and successfully implemented the project-oriented technology of professional training for aerospace industry (Mayorova , 2011). Another case could be implementation of mind maps and algorithms flowcharts visualization techniques for Electronic Engineering education (Shakhnov, Vlasov, Zinchenko, & Rezchikova, 2013).

Recommendation 4: Specific courses or modules on “English for specific purposes” for teachers should be designed and offered because in the highly internationalized scientific environments teachers without good command of English language tend to lose professional qualification. Thus, they could gain recognition, publish research, study best practices and help students to adapt their skills to international job market. One of the opportunities to offer such courses is to establish joint or network teacher enhancement programs with partner universities.

CONCLUSIONS

The current study allowed to identify strength and weaknesses of training PhD students for teaching in Russian universities based on analysis of 22 PhD programs from 4 Russian universities. The study shows that teaching is one of the major types of professional activities PhD graduates are trained for. Every PhD program includes at least one pedagogical competence of the graduate and at least one course in pedagogy and teaching internship. Although the share of the teaching training is relatively low in the total structure of the PhD program, it shows that pedagogical training is treated as by-product of research activities in PhD programs. Identified learning outcomes and pedagogic training contents vary significantly between universities which decreases portability and comparability of qualifications, creates obstacles to the PhD students’ mobility. Based on the findings from this study, several recommendations were put forward in the paper. The future research should reveal the educational technologies implemented for pedagogic training in PhD programs in comparison with the observed results of the training. The limitations of the study relate to the relatively small number of programs that were analyzed.

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Teaching in Higher Education: Students' Deep Learning of Brewing by Labwork

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ABSTRACT

The amount of theoretical and practical information to be given to students from engineering food specialty is increasingly greater. Within this perspective, it is important to use teaching-learning methods which to develop students' cognitive ability through the efficient by of them of knowledge acquired at fundamental and specialized disciplines. The article aims to present in an integrated graphical manner the laboratory entitled "Determination of alcoholic concentration of beer by distillation" within the discipline of "Technology and control in the malt and beer industry" that is taught to students in the field of Food Engineering. The integrative approach to the laboratory theme is based on the generation of a graphical organization of the laboratory work content, thus enabling an efficient guidance of the teaching-learning process. On the same structure of the graphical organization of laboratory work are processed and interpreted experimental results, resulting in students' deep learning of brewing by laboratory work. In conclusion, the use of integrated graphical manner in the teaching of laboratory work allowed students to achieve much better results in the assessment of laboratory activity, to find an improvement in self-organizing and self-evolving and to be more confident about the scientific research activity.

Keywords: *engineering education program, teaching methodology, food, brewing*

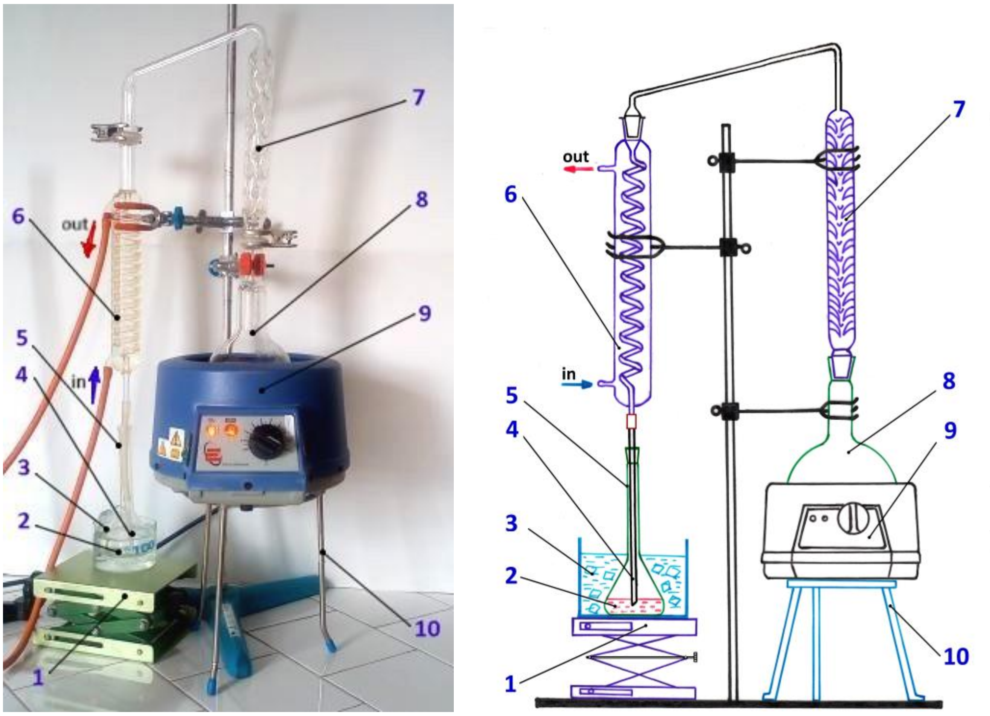
INTRODUCTION

Currently, teaching in higher education is focused on identifying teaching-learning processes as effective as possible on the development of high competences for all students (Davari Torshizi, & Bahraman, 2019; Vega, & Navarrete, 2019). An important role in this respect is given by quality of binomial teacher-teaching and by institutional conditions, which facilitate the quality of teaching-learning processes. In many scientific articles in the field of education in higher education it emphasizes the concern of the universities to improve the quality of the teaching process (Alhija, 2017; Baeten, Kyndt, Struyven, & Dochy, 2010; Balzaretti, & Vannini, 2018; Stewart, 2014) and the importance of the creative thinking of the teachers in the teaching practice (Baeten, & Simons, 2014; Henriksen, Richardsonb, & Mehta, 2017) which must find new teaching methodologies based on active participation of the students for skills development of them (Badia, & Chumpitaz-Campos, 2018). For students from engineering food specialty laboratory work is one of the most important teaching-learning experimental methods. In this sense, this article presents a new teaching strategy of a laboratory work for the students who have in the study curriculum the discipline "Technology and control in the malt and beer industry" through an integrative graphic approach of the content that must be transmitted and explained to the students. . The laboratory theme used in the study is "Determination of alcoholic concentration of beer by distillation". The main purpose of applying this teaching method is students' deep learning of brewing by stimulated analytical and integrative thinking of students which will lead to a solid individual professional development, which will allow them to successfully cope with *Erasmus* exchanges (study, practice or research) (Balzaretti, & Vannini, 2018; Rodríguez, Díaz, Gonzalez, & González-Miquel, 2019) and, finally, on the employment market, which is becoming more competitive.

LABORATORY TEACHING METHODOLOGY

Usually, within the laboratory work, students in higher education in the field of Food engineering, and not only, execute almost mechanically a succession of activities, without going into the depth of the topic and the results. This happens, most of the time, because the curriculum is loaded with a large volume of study subjects, which must be completed in a small number of laboratory hours. The immediate consequence is a poor training of the students, implicitly professional dissatisfaction for the teacher and graduate. In order to avoid these shortcomings, it requires optimum setting of laboratory themes/ topics and to identify new methods of teaching the laboratory curriculum. In this sense, this article is registered, which proposes a method of integrative graphic organization in laboratory teaching. In order to illustrate this teaching variant, the laboratory theme was selected "Determination of alcoholic concentration of beer by distillation", which should not be missing from the program of the discipline "Technology and control in the malt and beer industry", being, in its turn, an integrative analysis for understanding brewing. The content of the laboratory theme follows the Methods of Analytica *EBC* (*European Brewery Convention*), but in the teaching method by integrative graphic organization is taught comparatively, in the mirror, the method of determining the alcohol concentration, also starting from 100 mL of beer and collecting 100 mL of distillate. Also, original extract of the wort from which the beer is obtained and real degree of fermentation of beer is calculated. The proposed method allows the teaching of a greater volume of knowledge, in the same laboratory session, without causing discomfort to the students in the teaching process. The laboratory teaching methodology, that will be described below, has been applied in 2017–2018 and 2018-2017 academic years for students from food engineering program, 24 students. The phases of method by integrative graphic organization are: 1 - presentation of the theme and content of the laboratory manual; 2-installing of the distillation plant (fig. 1(a)); 3 - graphical representation of the distillation plant (fig. 1(b)); 4 - is presented to the students the content of table 1 (algorithmic steps and outcomes) and it is analyzed together with the students; 5 - during the course of the laboratory determination students complete table 2 (Practical calculation); 6 - knowledge verification test.

The student in the field of food engineering, who for his professional training, carries out a significant number of laboratory activities, must form an integrative thinking, in the sense that he must be able to explain why a certain sequence of items is being followed, during a laboratory determination/activity. In this sense, it must be trained and encouraged by the teacher to formulate a series of questions for which, based on the knowledge acquired in the fundamental and specialized disciplines, to try to find the solutions / explanations or to propose new alternatives for achieving a condition. In the case of the laboratory work taken in the analysis, “Determination of alcoholic concentration of beer by distillation”, may be formulated by students, individually or groups of 3-4 students, under the guidance of the teacher, the following cause-effect type questions:



(a) (b)

Figure 1: Distillation plant for the determination of alcoholic concentration of beer.
(a) – photo with distillation plant from laboratory; (b) – schematically representation of the distillation plant with component highlighting; 1 – laboratory Jack; 2 – collected distillate; 3 – crystallizing dish with ice and water mixture; 4 – glass tube to receive distillate; 5 - volumetric flask, 100 mL capacity; 6 – *Graham* water-cooler condenser; 7 – *Vigreux* air-cooler condenser column (rectifying column); 8 – round-bottom distillation flask, 500 mL capacity; 9 – electric heating mantle; 10 – tripod.

Question (*Why?* or *If Not, What's going on?*)	**Question** (*Why?* or *If Not, What's going on?*)
Why should beer be decarbonated?	What is the purpose of using laboratory Jack?
Why is it preferable to weigh, not to measure volume of sample of decarbonated beer or of distillate sample?	Why is the glass tube to receive distillate immersed at the same height in the distillate during distillation?
	What are the consequences of carbonization of the contents of the distillation flask on the determination?
Why use crystallizing dish with ice and water Mixture?	There is a connection between duration of distillation and volume of collected distillate?
Why should 50 mL of distilled water be added to the distillation flask?	What does it mean if less than (85 ÷ 90) mL of distillate is collected?
Why should 5 mL of distilled water be added initially to the distillate collection flask?	What is the difference between the two variants expressing the alcohol concentration of the beer?
Why should the glass tube to receive distillate be immersed in the distillate?	Can calculation of concentration of Original Primitive Extract be a method for assessing beer counterfeiting?
Why it is necessary to use two condensers?	What is the difference between the apparent and real extract of the beer?

Table 1: Main algorithmic steps and outcomes for determination of alcoholic concentration of beer by distillation

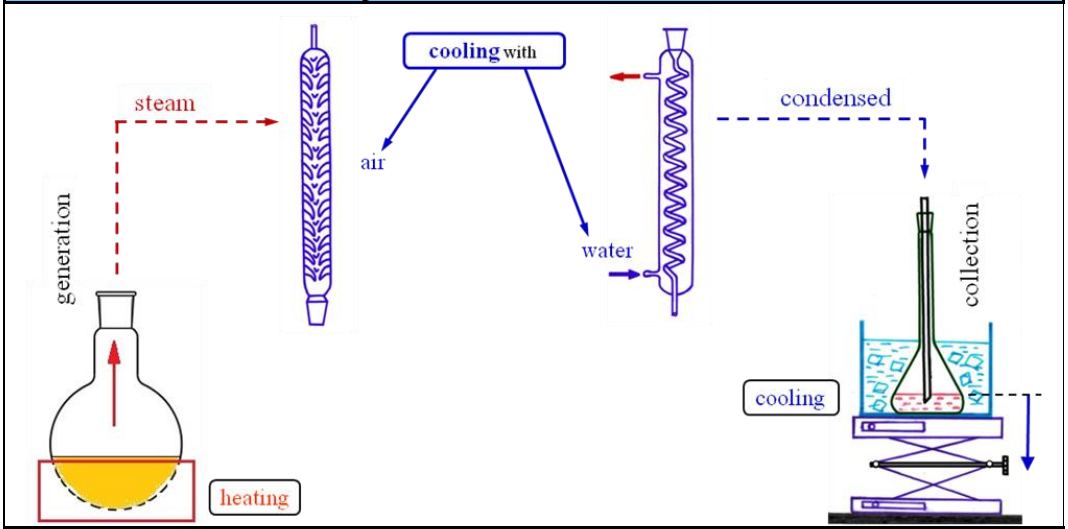
STEP 1 - Principle of method

Distillation of pale or dark decarbonated beer by direct heating and determination of specific gravity at 20°C of alcoholic distillate.

STEP 2 - Hypothesis

Alcoholic concentration of **beer**, A_B	[% w/w] / [% v/v]	=	Alcoholic concentration of **distillate**, A_D	[% w/w] / [% v/v]

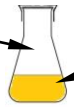
STEP 3 - Illustration of Principle of method



STEP 4 - Working procedure

Decarbonatation of beer
(remove excess carbon dioxide)

750 mL *Erlenmeyer* flask with wide neck



300 mL beer at (17-20)°C

Decarbonatation of beer (remove excess carbon dioxide); 750 mL *Erlenmeyer* flask with wide neck; 300 mL beer at (17-20)°C			-	
- weighing the empty distillation flask; ±0.1g	W_{EDF}, [g]		-weighing the empty collection flask; ±0.1g	W_{ECF}, [g]
- decarbonated beer at 20°C	100g (±0.1g)	**A**	-	
	100mL(±0.1mL)	**B**		
- distilled water	50 mL = 50 g		Distilled water	5 mL
Uniform rate of distillation				
		if		
- adjusting/regulation the heating so that it is avoided carbonization of the content from distilling flask.		◄─●─►	-glass tube to receive distillate is immersed at the same height in the distillate during distillation.	
Duration of distillation: (30-60) minutes.			When (85÷90) mL of distillate have been collected ↓ **STOP** distillation	
Residuum after distillation			***Collected distillate***	

homogenizing ***residuum*** and bringing contents of distillation flask with distilled water to:	100g (±0.1g)	**A**	homogenizing ***distillate*** and bringing contents of collecting flask with distilled water to:	100g (±0.1g)	
	100mL (±0.1mL)	**B**		100mL (±0.1mL)	
R	***R**esiduum*		***D**istillate*		**D**

STEP 5 - Measurement and calculation procedures

Determination of Specific Gravity of decarbonated beer at 20°C/20°C ($SG_{B(EA)(20°C/20°C)}$) with a pycnometer or an electronic densitymeter

↓ Extract table for beer Analysis or polynomial formula

Apparent Extract of beer (E_{AB}), [%w/w; °P] *or*

$$E_{AB} = -460.234 + 662.649 \times SG_{EAB} - 202.414 \times SG_{EAB}^2$$

A.R. Determination of $SG_{residuum(20°C/20°C)}$ of residuum brought to 100g(±0.1g), with a pycnometer or an electronic densitometer.

↓ *Extract* table for beer Analysis or polynomial formula

Real Extract of beer (E_R), [%w/w; °P],

or

$$E_R = -460.234 + 662.649 \times SG_{ER} - 202.414 \times SG_{ER}^2$$

Extract of Residuum = *Real Extract of Beer*
(E_R ; %w/w; °P) (E_{RB} ; %w/w; °P)

A.D. Determination of $SG_{D(20°C/20°C)}$ of distillate brought to 100g(±0.1g), with a pycnometer or an electronic densitometer.

↓ *Alcohol* table for beer Analysis or polynomials formula

A.D.1. Alcohol content of distillate %w/w (A_D(%w/w)) = alcohol content of beer %w/w (A_B(%w/w)).

$$A_B(\%w/w) = 517.4 \times (1-SG_D) + 5084 \times (1-SG_D)^2 + 33503 \times (1-SG_D)^3$$

A.D.2.

$$A_B(\%v/v) = \frac{A_{B(\%w/w)} \times SG_{B(20^\circ C/20^\circ C)}}{0.791} \quad \text{or}$$

$$A_B(\%v/v) = \frac{A_{D(\%v/v)} \times SG_{B(20^\circ C/20^\circ C)}}{SG_{D(20^\circ C/20^\circ C)}}$$

0.791 - Specific Gravity (*SG*) of ethanol (ethyl alcohol) at 20°C/20°C.

B.R. Determination of $SG_{Ri(20°C/20°C)}$ of residuum brought to 100mL(±0.1mL), with a pycnometer or an electronic densitometer.

↓ *Extract* table for beer Analysis or polynomial formula

Intermediate Real Extract of beer (E_{Ri}), [%w/w; °P], or

$$E_{Ri} = -460.234 + 662.649 \times SG_{ERi} - 202.414 \times SG_{ERi}^2$$

-measure the weight of the 100 mL of residuum after distillation (W_{Ri}), [g].
-calculate Real Extract of beer (E_R):

$$E_R = \frac{W_{Ri} \times E_{Ri}}{100} \quad ; \ [\%w/w; °P]$$

B.D. Determination of $SG_{D(20°C/20°C)}$ of distillate, result from 100 mL decarbonated beer, brought to 100mL(±0.1mL), with a pycnometer or an electronic densitometer.

↓ *Alcohol* table for beer Analysis

B.D.1. Alcohol content of distillate in %v/v (A_D(%v/v)) = alcohol content of beer in %v/v (A_B(%v/v)).

B.D.2.

A_D [g ethyl alcohol /100 mL distillate]

$$A_B(\%w/w) = \frac{\textbf{g}\ alcohol\ in\ 100mL\ distillate}{SG_{B(20^\circ C/20^\circ C)}}$$

STEP 6 - Integrative outcomes by determination of alcoholic concentration of beer
OG ⟶ Original/Primitive Extract (E_{OG}; *EP*) of the wort from which the beer is obtained, can be calculated with following formula: $$E_{OG}(^{\circ}P;\%w/w) = \frac{2.0665\times A_{B(\%w/w)} + E_{R(^{\circ}P)}}{100+1.0665\times A_{B(\%w/w)}}\times 100$$
DFR ⟶ Real degree of fermentation (DF_R) of beer (% fraction of E_{OG} which has been transformed into ethanol and CO_2 by alcoholic fermentation, is calculate by formula: $$DF_R(\%) = \frac{2.0665\times A_{B(\%w/w)}}{2.0665\times A_{B(\%w/w)} + E_{R(^{\circ}P)}}\times 100$$

In the 2017-2018 academic year the distribution of notes, between 4 (minimum) and 10 (maximum), obtained by the students (24) in the test of/problem for knowledge verification at the end of the laboratory work analyzed was the following: note 4: 0; note 5: 0; note 6: 0; note 7: 5; note 8: 5; note 9: 8; note 10: 6. This means an average rating of 8.62 (above note 8 is considered a very good score for the appreciation of the teaching-learning activity) and that 58.33% of the students obtained very good notes (of 9 and 10) and that there were no satisfactory and insufficient results. In the previous academic year, the test results, for a group of 22 students with similar level of competence and understanding and learning ability, were weaker, namely 7.95 for average rating, 36.36% for very good notes and two notes of 6.

These statements confirm the efficiency of the method used. The efficiency of the method was also verified in the academic year 2018-2019 with 24 students, when an average rating of 8.58 and a percentage of 58.33% of very good grades were registered.

Several important advantages could be formulated for the training of the students, based on the answers given by a questionnaire for the evaluation of the laboratory activity applying the method of integrative graphic organization: theoretical and practical information were easily understood, is warranted thorough learning, improving mental image formation related to a certain physical or calculation process, encouraging self-organizing development, individual and collective learning motivation is stimulate and the teaching method was considered attractive, non-boring.

Table 2: Practical calculation example for determination of alcoholic concentration of beer by distillation

STEP 1 - Principle of method			
On the label of beer to be analyzed are given: the concentration of the original wort (**11°P**) and the alcoholic concentration of beer **5.2 %v/v**.			
STEP 2 - Hypothesis			
Alcohol of beer will be distilled and recovered in distillate.			
STEP 3 - Illustration of Principle of method			
-installation of the distillation plant.			
STEP 4 - Working procedure			
Decarbonatation of beer to be analyzed.			
W_{EDF} = 191.06g		W_{ECF} = 46.31g	
W_{BDF} = 191.06 +100+50=341.06g initial		W_{DCF} = 46.31+5=51.31g initial	
W_{BDF} = 191.06 +100=291.06g final **A**		W_{DCF} = 46.31+100=146.31g final **A**	
V_{BDF} =*100mL* final **B**		V_{DCF} =*100mL* final **B**	
R	***R**esiduum*	***D**istillate*	**D**

STEP 5 - Measurement and calculation procedures

$$SG_B = \frac{W_{EP+B} - W_{EP}}{W_{EP+DistilWater} - W_{EP}} = \frac{74.7395 - 25.9251}{74.4180 - 25.9251} = 1.00663 \xrightarrow{extract\ table} E_{AB} = 1.70^\circ P$$

$$E_{AB} = -460.234 + 662.649 \times SG_{EAB} - 202.414 \times SG_{EAB}^2;\ [^\circ P]$$

$$E_{AB} = -460.234 + 662.649 \times 1.00663 - 202.414 \times 1.00663^2 = 1.7014 \cong 1.70^\circ P$$

A.R.

$$SG_R = \frac{W_{EP+R} - W_{EP}}{W_{EP+DistilWater} - W_{EP}} = \frac{74.9971 - 25.9251}{74.4180 - 25.9251} = 1.01194 \xrightarrow{extract\ table} E_R = E_{RB} = 3.05^\circ P$$

$$E_R = -460.234 + 662.649 \times SG_{ER} - 202.414 \times SG_{ER}^2;\ [^\circ P]$$

$$E_R = -460.234 + 662.649 \times 1.01194 - 202.414 \times 1.01194^2 = 3.0505 \cong 3.05^\circ P = E_{RB}$$

Extract of Residuum = *Real Extract of Beer*
(E_R ; %w/w; °P) (E_{RB} ; %w/w; °P)

A.D.

$$SG_D = \frac{W_{EP+D} - W_{EP}}{W_{EP+DistilWater} - W_{EP}} = \frac{74.0651 - 25.9251}{74.4180 - 25.9251} = 0.99270 \xrightarrow{alcohol\ table} A_D = 4.08\% w/w$$

$$A_D = 5.12\% v/v$$

A.D.1.

$$A_D = A_B = 4.08\% w/w$$

$$A_B = 517.4 \times (1 - SG_D) + 5084 \times (1 - SG_D)^2 + 33503 \times (1 - SG_D)^3;\ [\% w/w]$$

$$A_B = 517.4 \times (1 - 0.99270) + 5084 \times (1 - 0.99270)^2 + 33503 \times (1 - 0.99270)^3 = 4.08\% w/w$$

A.D.2.

$$A_B(\% v/v) = \frac{A_{B(\% w/w)} \times SG_{B(20^\circ C/20^\circ C)}}{0.791} = \frac{4.08 \times 1.00663}{0.791} = 5.1922 \cong 5.19\% v/v$$

$$A_B(\% v/v) = \frac{A_{D(\% v/v)} \times SG_{B(20^\circ C/20^\circ C)}}{SG_{D(20^\circ C/20^\circ C)}} = \frac{5.12 \times 1.00663}{0.99270} = 5.1918\% v/v \cong 5.19\% v/v$$

0.791 - Specific Gravity (*SG*) of ethanol (ethyl alcohol) at 20°C/20°C.

B.R.

$$SG_R = \frac{W_{EP+R_i} - W_{EP}}{W_{EP+DistilWater} - W_{EP}} = \frac{74.9528 - 25.9251}{74.4180 - 25.9251} = 1.01114 \xrightarrow{extract\ table} E_R = 2.85^\circ P$$

$$E_{Ri} = -460.234 + 662.649 \times SG_{ERi} - 202.414 \times SG_{ERi}^2;\ [^\circ P]$$

$$E_{Ri} = -460.234 + 662.649 \times 1.01114 - 202.414 \times 1.01114^2 = 2.8480 \cong 2.85^\circ P$$

-measure the weight of the 100 mL of residuum after distillation: W_{Ri} =298.08-191.06=107.02g

-calculate Real Extract of beer (E_R):

$$E_{R(\% w/w;\ ^\circ P)} = \frac{W_{Ri} \times E_{Ri}}{100} = \frac{107.02 \times 2.85}{100} = 3.05^\circ P$$

B.D.

$$SG_D = \frac{W_{EP+D} - W_{EP}}{W_{EP+DistilWater} - W_{EP}} = \frac{74.0576 - 25.9251}{74.4180 - 25.9251} = 0.99257 \xrightarrow{alcohol\ table} A_D = 5.20\% v/v$$

→ Into 100 mL of distillate there are: 5.20mL×07894 g/mL=4.105g alcohol.

B.D.1.

$$A_D = 5.20\% v/v = A_B = 5.20\% v/v$$

B.D.2.

$$A_B(\% w/w) = \frac{\mathbf{g}\ alcohol\ in\ 100mL\ distillate}{SG_{B(20^\circ C/20^\circ C)}} = \frac{4.105}{1.00663} = 4.0779\% w/w \cong 4.08\% w/w$$

STEP 6 - Integrative outcomes by determination of alcoholic concentration of beer
$E_{OG}(^{\circ}P;\%w/w)=\frac{2.0665\times A_{B(\%w/w)}+E_{R(^{\circ}P)}}{100+1.0665\times A_{B(\%w/w)}}\times 100=\frac{2.0665\times 4.08+3.05}{100+1.0665\times 4.08}\times 100=11^{\circ}P$
$DF_{R}(\%)=\frac{2.0665\times A_{B(\%w/w)}}{2.0665\times A_{B(\%w/w)}+E_{R(^{\circ}P)}}\times 100=\frac{2.0665\times 4.08}{2.0665\times 4.08+3.05}\times 100=73.43\%$

CONCLUSIONS

By using the method of integrative graphic organization in teaching of students their knowledge is more effectively hierarchized and fixed, achieved better results in the evaluation test of the laboratory activity, but more importantly, they are more confident in the teaching process, which is perceived as being oriented towards deep, not reproducing learning. These findings confirm the preference of students for practical instruction via labs and problem-based and work-based teaching-learning and a positive student feedback for *Teacher - New Method* tandem.

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Integrated Neuronal Network in ERP for Management Decision Making

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ABSTRACT

Enterprise Resource Planning systems have proven to be efficient and have become a de facto standard for coordinating vital business components. However, the obvious question has arisen: if each company uses the same ERP system, what happens to the competitive aspect of the business after the implementation of the IT systems?
While for some organizations, ERPs have only become a necessity for running and organizing business, others want to exploit it to exceed the performance of competitors.
Consequently, ERP systems are often a combined solution between the legacies of the systems they have replaced and the model proposed by the ERP provider, resulting in systems with unique, customized features. Keeping this idea, we aim to add to the present paper elements of artificial intelligence within a module for managing car sales within an ERP.

Keywords: *artificial intelligence, ERP, automotive, management*

INTRODUCTION

We live in an era known as the Information Age (or Digital Age), we are surrounded by information and the most important thing for a company is the organization, storage and especially the use of this impressive amount of data, to gain market advantages.
In the current trend, companies tend to become increasingly complex mechanisms, structured in several departments (typically, financial-accounting, human resources, supply, management, production, quality control, and sales). There is a need for more efficient relations, communication, and the flow of data and information between these parts. This efficiency of the information flow offers the company an advantage that can translate into increased productivity, more efficient use of resources, improved quality of products and services, lowered production costs, ideals to which any origination tends.
An ERP (Enterprise Resource Planning) system is a strategic tool that synchronizes, integrates and simplifies the flow of data and processes within an organization, concentrating all the activity of the company in an integrated system. (Madanhirea I., Mbohwab C., 2016)

According to the American Production and Inventory Control Society (2001) - ERP is defined as a method of efficient planning and control of resources within the production and distribution flow of products or services.
Currently, ERP has become a complex software application, the core of processing business information, structured on modules for various departments within an organization, interacting with each other and exchanging relevant information to help make decisions, to help increase efficiency, productivity and reduce costs.
In most companies, a well-managed ERP system is the backbone of the entire business (Handokoa B., Aryantob R., So I. 2015). Thus, the essential business processes are managed using ERP software, and most business transactions are recorded in the ERP system. Depending on the specifics of the business, the critical factor for business processes includes action planning, acquisitions, sales, accounting and finance, management, human resources, production, inventory management and more. Structured as a centralized and shared database system, ERP links the entire organization, ensure the input of information once and allows all users access to the information stored. The manufacturer can use a combination of ERP and the supply chain execution system to manage the production and distribution of its product. A product request starts as a customer order in the ERP system, creates a registration in the database that is complete and easily accessible. This way, the product can be tracked in different stages and production processes from the initial request, through production or supplier order, to the final delivery. The company has real-time visibility, traceability of customer orders, existing stocks, needs, or surplus. (Handokoa B., Aryantob R., So I., 2015)
Permanent changes in the car market lower prices and require a high level of flexibility in small and medium-sized enterprises. Numerous studies have shown that the exchange of information plays a decisive role in obtaining proper functioning at the level of the supply area. The results of information sharing include: faster coordination between partners, reduced uncertainty in internal and external environments, faster material flow, shorter order cycle time, reduced inventory costs and a contribution to the overall cost and at the level of performance services. (Oman S, Leskovar R., Rosi B., Baggia A., 2017)

HENCE THE NEED FOR AN ERP?

Especially for manufacturing companies, there was a tendency for an individual and separate treatment of transactions involved in the manufacture of a product or service. Involuntarily, the various structures of the organization engaged in the production process tend to compete with each other instead of collaborating and exchanging information. In such situations, the ERP intervenes, and no longer treats each process independently, but rather as an integrated part of a significant process, represented by the whole activity of the company. Moreover, it is assumed that the whole is greater than the sum of its parts. (Fosser E., Leister O., Moe C., 2008)

THE COMPONENT PARTS OF AN ERP

To implement an ERP, first of all, we need adequate infrastructure, represented by servers, workstations, and access to the Internet to facilitate the flow of information. Fortunately, due to the impressive technological developments of the last 10-15 years in terms of transfer speed, data storage capacity and data processing capability, all this infrastructure needed today for an organization can be obtained at a reasonable price.
Information processing is currently one of the most critical tasks. With the growth and development of information and telecommunications technologies, the volume of data transmitted over the Internet has increased. Simultaneously with the processing of large amounts of information raises the question of its protection. (Laboshin L., Lukashin A., Zaborovsky V., 2017).

Once the necessary infrastructure is created, depending on the structure of the company's activity, the component modules of the ERP are chosen:

- Production planning module: optimizes the use of production capacities and raw materials
- Purchase module: simplifies the acquirement process, keeps track of orders to suppliers and purchase prices for various raw materials or services
- Stocks management module: keep track and optimization of stocks
- Sales module: manages the orders received from customers, delivery times and invoicing customers
- Marketing mode: used for marketing campaigns or measuring customer satisfaction through questionnaires
- Accounting module: it is a central component of the system, which interacts with all the other modules and collects all the accounting data, invoices received/issued, receipts/payments and generates the financial statements of the company
- Human Resources Module: keeps track of employees, contracts, professional evaluations, specialized courses
- CRM module (customer relationship management)

Depending on the nature of the activity of the organization, there may also be various modules, specific to the different activities carried out: module for fleet of vehicles management (for transport activities), module for industrial equipment management (guarantees, revisions, technical interventions, spare parts), contract management module, internal procurement module (for example for medical units).

ARTIFICIAL INTELLIGENCE

Artificial intelligence is the ability of machines, especially computer systems, to perform processes specific to the human brain. These include voice recognition, learning, planning, problem-solving. Currently, we do not even realize that we are surrounded by equipment equipped with "more" or "less" artificial intelligence.

Neural networks are capable of learning complex relationships between data. Moreover, by copying brain functions, they can detect data patterns and then extrapolate predictions when new data is made available. The structure of a neural network consists of connections between "nodes" or "neurons". There are three types of neurons in an ANN (artificial neural network): input nodes, hidden nodes, and output nodes. Neurons are arranged in layers. Input layer neurons receive inputs for calculations. These values are transmitted to the neurons in the first hidden layer, which performs calculations on their inputs and passes their outputs into the next layer. The neurons located in the last hidden layer transmit results to the neuron or neurons that generate the final outputs of the network. (Mossalam A., Mohamad A., 2018)

A neural network consists of one or more neurons (example in figure 1). If it is made up of a single neuron, it is called a perceptron type neural network. In a neural network made up of several neurons, they are grouped into several layers.

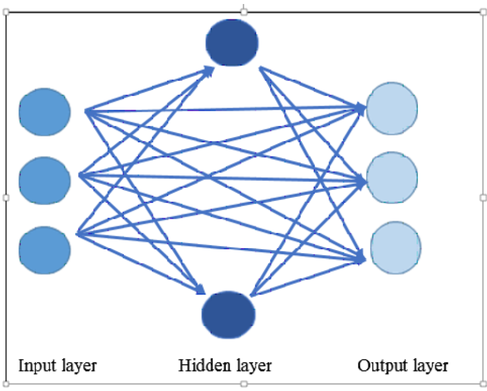

Figure 1. Neural network.

NEURONAL NETWORK SCHEME

Following the study of neural networks, it was found that most often one or maximum two intermediate layers are sufficient. The number of neurons used in the intermediate layer is variable, and there are several proposed variants:

nhl = 2 · nin + 1 (1)

nhl = 2 · nin (2)

nhl = nin (3)

nhl = nin + nout 2 + √ nt (4),

where nhl is the number of neurons in the hidden level; nin is the number of neurons in the input level; new is the number of neurons in the output level; nt is the number of observations contained in the training set.

Between the neurons of each level, connections are established, similar to the synapses of the human neurological system. Each synapse has a weight associated with it that is adjusted within the learning process. The learning is based on the historical data set and depends on the differences observed between the expected and actual results. Moreover, the weights are adjusted to increase the accuracy of the predictions generated. (Gallo C.2005)

INTEGRATION OF ARTIFICIAL INTELLIGENCE COMPONENTS WITHIN AN ERP

With many appliances in the field of software applications, the use of artificial intelligence and neural networks within an ERP comes into its own. The advantage of introducing artificial intelligence elements into an ERP comes primarily from the amount of information that exists in databases associated with an ERP. The role of the ERP becomes in this case not only to organize and store the enormous amount of data within a company, but also to use it to generate predictions about future development, to anticipate the moves that will lead to the development of the organization.

The first researches for integrating neural networks into economic-financial software applications were done in the early 2000s. In 2003, Nicholas Hall used a multilayer perceptron in a stock management application to predict the required stock considering the demand over the last 12 months. The next two papers bring together the two ideas that represent the base for the subject of this paper (ERP and artificial intelligence), even if the approach does not imply the introduction of artificial intelligence elements within the ERP. In 2007 researchers from Chia Nan University, National Chung Cheng University, WuFeng Institute of Technology and Miami University tried to develop a neural network that compares the performance of several ERPs to identify the optimal implementation

variant for the various organizations studied. In 2012 researchers from Kurunya University developed a neural network used as the link between an ERP and customer relationship management (CRM) to generate marketing decisions and actions to attract new potential customers.
Another paper that reaches the subject belongs to Jad Farhat, Michel Owayjan. In ERP Neural Network Inventory Control (2017), the authors broadly describe the integration of a neural network into an ERP. Farhat wants to estimate the demand on different product ranges, taking as an example a cosmetics distribution company. The neural network is trained in advance with data related to sales from various periods in which important events have taken place, which influence demand both in terms of quantity and quality of products.
The success of the artificial intelligence implementation within an ERP, using as the basis the neural network and the mechanism imagined by Farhat and Owayjan is based primarily on identifying as many events that influence the significant variable studied, in this case, the quantity sold from a particular product or group of products. Unfortunately, these factors differ significantly from one economic sector to another (drug sales, gadget sales, car sales) or from one region to another (underdeveloped countries, developing countries, developed countries). Differences can occur even in the same country, where there may be regions with higher economic development, greater purchasing power, and more deprived areas. (Farhat J., Owayjan M., 2017).

INTEGRATION OF A NEURAL NETWORK WITHIN AN ERP FOR CAR DEALERS

The purpose of the paper is to design a neural network, test it, and finally implement it within an ERP to produce forecasts on the level of new or used car sales for a specified period.
The neural network is to be implemented in an ERP developed in Java with the Mysql/SQL Server database. The ERP software is addressed to several sectors of activity, built modular, depending on the client's requirements. It is continually being adapted or added with specific modules. It is used at this moment by over 200 clients, with a wide variety of economic activities: sales, production, services, car dealers, transport, leasing, and insurance companies. An essential part of the client portfolio is car dealers, belonging to several networks. For them, the software application offers support for the entire activity of the company: financial-accounting department, car service, sales, human resources, and others.
As mentioned earlier, the most critical aspect in the design of the neural network is the correct identification of the factors that influence the sales volume of new or running vehicles. To identify these factors, discussions were held with the client's staff, especially with those directly involved in the process of selling cars. Following these discussions, several factors were identified which, depending on the degree of presence or absence, we agreed they influence the number of cars sold during a period. These, according to their nature, can be divided into several types, the most important being economical, political, legislative (most often influenced by politics), and social.
For the design of the neural network, the following factors were taken into account. They may influence car sales in a certain period:

- Exchange rate
- Interest rate
- Lending conditions (payment facilities)
- Inflation
- Increase in earnings
- The National Program for Stimulating the Renewal of the Car Park.
- Season: spring, summer, autumn, winter
- Holidays, considering that there are people who can associate, even symbolically, the purchase of a new car as a Christmas or Easter gift.
- Fuel price

- Investments in road infrastructure (highways, parking in big cities)
- Political disorders (government changes)

We used the NeurophStudio application to shape the neural network. The input values used were 0, 1, or 2, indicating the absence, presence, or active presence of the respective influence factor. The neural network has 21 inputs on the first level, one layer with 20 neurons and one output on the last level. The transfer function chosen was "Sigmoid", and the learning type "Back-propagation". For the training of the network, real data related to the volume of car sales were used, from January 2014 to April 2019, for each period, identifying the degree of presence of the factors taken into account (example in figure 2). Given that the output of the neural network used (a multilayer perceptron type) is in the interval [0,1], in the training dataset, the volume of sales (representing the output of the neural network) has been scaled in the interval [0, 1].

Inputs on the first level	**Month/Year**			
	12/2016	11/2017	1/2018	2/2019
Currency exchange rate increase	0	2	0	0
Currency exchange rate decrease	0	0	0	0
Interest rate increase	0	0	1	0
Interest rate decrease	0	0	0	0
Tightening credit conditions	0	0	0	0
Relaxation of credit conditions	1	1	0	0
Rising inflation	0	1	2	0
Lower inflation	0	0	0	0
Salary increases	2	0	0	0
Lower salary	0	0	1	0
The National Program for Stimulating the Renewal of the Car Park	1	1	0	0
Winter	1	0	1	1
Spring	0	0	0	0
Summer	0	0	0	0
Autumn	0	1	0	0
Christmas	1	0	0	0
Easter	0	0	0	0
Fuel price increase	1	1	2	1
Decrease fuel price	0	0	0	0
Infrastructure investments	0	0	0	0
Political disturbances	0	0	1	0
Number of cars sold	59	50	18	24
Output	0.9833	0.8333	0.3	0.4

Figure 2. Car sales.

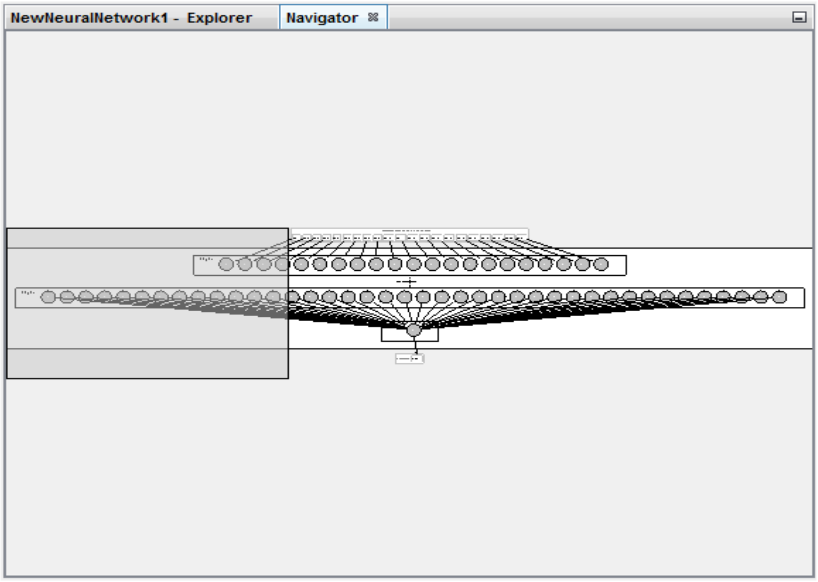

Figure 3. Output of neuronal network

After running the training data, the network was verified with a series of test data, representing various scenarios or positive and negative opposites. The analysis of the results showed that the neural network has appropriately adapted its weights within the training process. During the tests, it was observed that the volume of anticipated sales increases with the presence of the "positive" factors, such as the beginning period of the National Program for Stimulating the Renewal of the Car Park and a high level of promotions and other benefits.

CONCLUSIONS

This study concludes that the level of car sales can be predicted according to certain factors, using a neural network. The next step is to implement the proposed and studied model at the level of ERP application and extended to a broader range of applicability, taking into account the use of this software application in several fields. Such a model can be used to predict sales in other areas of activity, and it can be used to manage stocks or human resources within an organization.

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Improving the Effectiveness in Research and Developments Department from Automotive Industry

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ABSTRACT

The scope of this paper is to propose a solution for decreasing the rework that has to be made inside a team, in a new offshore Research and Development department, mainly because of assumptions and lack of experience. This is based on learning and applying the lessons learned. First, it will be presented an order assignment in an offshore branch in the field of automotive software companies. From the concept, further on, the usual process that takes place is presented and the potential flaws are analyzed. The major problems identified are random allocation of the orders and assumptions that are made in the branch offices. After inspecting the steps of the process, a model of process is proposed in order to avoid the problems identified at the usual process. This proposal has the principles from Advanced Product Quality Planning and the Scrum framework. The goal is to reduce the rework using the learning process presented. If no assumptions are made, if everything is clear from the beginning, if all the necessary documentation is done, if the proper mentoring is made and if the process is continuously improved, the probability of the identified problems to occur again is highly decreased.
The most important points in the proposed process for improvement are the following: weekly meeting for status update, assigning the orders according with the needs, assign a mentor for new entries, eliminating the assumptions, discuss the problems as fast as possible and obtain feedback fast from the client to check the direction of the work.

Keywords: *process improvement, task assignment, software, management.*

INTRODUCTION

In a software automotive company, Research and Development department (R&D), the orders or the tickets are usually given randomly without a specific plan, which includes the complexity of the task, to the employees who don't have a task and because of the random allocation of the tasks to the employees, there are high chances that the most complex orders are assigned to the most unexperienced employees. This allocation usually leads to:

- Tests or software implementation not done correctly or according to the client's requirements or specifications of functionality, this causing a high probability of rework for the task.
- Stress on the employee.
- Knowledge is not increased step by step.

- Exceeded deadlines.
- The quality has a high chance to not meet the customer's expectations.
- Money loss and affecting the image of the company.

This is predominant in the case when the company opens a new branch. The orders that are coming from the headquarters to be solved~~,~~ should be assigned properly in order to avoid one of the causes enumerated earlier. Assigning the tasks suitably means that each task is assigned based on certain criteria to the employee. For developing the offshored branch at the same level with the headquarters, certain steps must be made.
Herbsleb notices that the technical work and the challenges for a project are at least equal in the situation in the distributed teams as in grouped teams (Herbsleb et al., 2005). It can be expected that due to distance the challenges met while the project is running, are at least at the same size if not increased. In practice there have been observed some cases where due to the project management inexperience on the part of service provider the plan that was made was late, without details and unrealistic (Herbsleb et al., 2005). Another cause of projects not running healthy is the process immaturity, which leads to major problems (Herbsleb et al., 2005). It has been observed that giving the teams, in the lowest appropriate level, decision power, it has saved time and effort (Herbsleb et al., 2005).
The most common problems that appear in a company which has opened a new branch and where the knowledge transfer must be made, are the following:

- Communication problems between the sites.
- Different behaviors in managing the teams.
- Diverse approaches towards conflict.
- Different decision-making styles (Radoff, 2006).
- The written documentation is rarely suitable when solving misinterpretations about the requirements or changes in the requirements' specification (Conchúir et al., 2009).
- When a project is built in different branches, inconsistencies can occur in the work and documents (Bhat et al., 2006).

The success of a software development project is strongly linked with the quality of the project management activities. The project management activities are the following: handling the resources, shaping the software teams, assigning the tasks to appropriate stakeholders, time, budget and resource checking. These activities can be done in different ways, depending on the project management approach each company decides to follow. In a software development process, the project manager has a very important role in task allocation. The central task of a project manager is to allocate orders to the project teams with the next attributes in the mind: knowledge, skills, experience, and proficiency (Masood, 2017).
Task or order assignment is one important topic not only in the automotive industry, but also in mobile crowdsensing. Crowdsensing is referring to a technique where a big group of individuals are using mobile phones or tablets capable of computing to collectively share and extract data for computing, evaluating, assessing or predicting of a process of common interest. In this area, task assignation has the goal of reducing the task penalty consequence and to maximize the quality of the task. High quality and low employment costs are vital objectives in the plan of effective task assignment aimed at mobile crowdsensing. Gong, discovered that the performance can be significantly improved if the tasks are no longer attributed randomly but it can choose the best path for the user and the human involvement is marginally bigger. An algorithm was proposed for improving the solutions (Gong et. al., 2019).
The objective of this concept analysis is to propose a new model in which the time delays are reduced and a new process for task assignation inside the team.

THE CONCEPTUAL MODEL FOR ORDER-EMPLOYEE IN A SOFTWARE AUTOMOTIVE COMPANY

The customer is satisfied if the product is delivered on time and at a cost that represents value. Advanced Product Quality Planning (APQP) is an organized method for defining and establishing the compulsory phases to make sure that a product is scheduled, calculated, built and sent to the customer so the buyer's needs are fulfilled. The main goal of this method is to enable communication and update the status at different stages between all the parties involved in order to make sure that all the steps are done properly and on the specified time frame (Chhim, 2017).
One of the goals of the process planning is to develop a process with a foreseeable result. Hence, the decisions taken in the process planning influence the manufacturing conditions for the final product quality (Magnus Lundgren et al., 2016).
The global trends like the increasing product complexity, rising the time pressure and the reduction of the internal costs have an effect on the general product making process like more error-prone due to the higher complexity of the product (Kiefer et. al., 2017).
The following chart, Product Quality Planning Timing Chart, shows that the feedback assessment should be present from the beginning to the end of production:

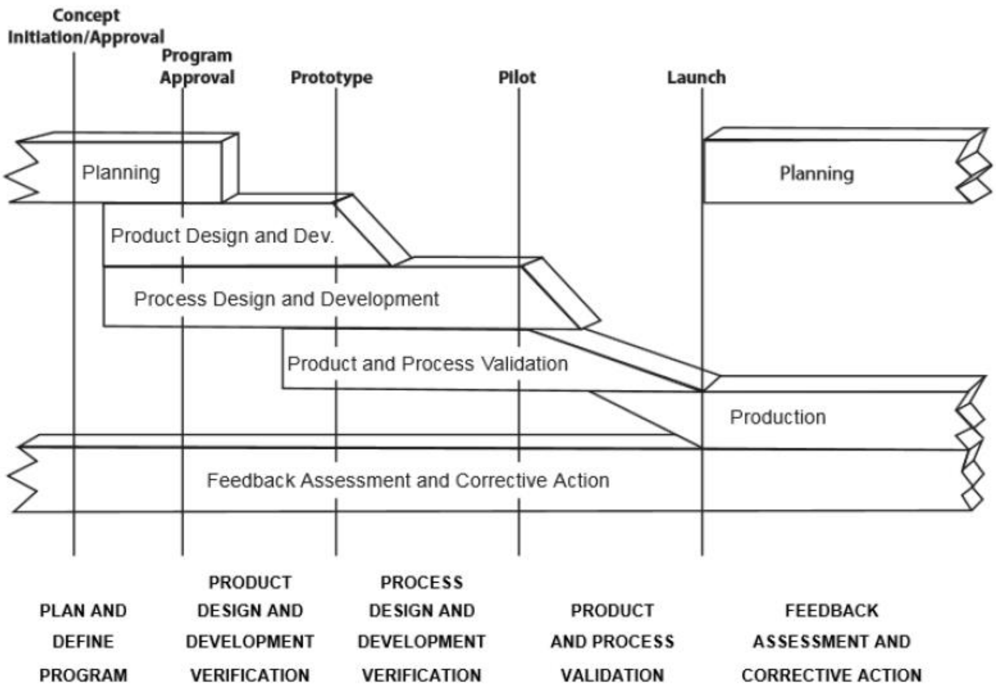

Figure 1: Product Quality Planning Timing Chart (APQP, 2008)

The principal steps of the APQP are:

1. Prepare for APAQ.
2. Plan and define program.
3. Product design and development.
4. Process design and development.
5. Product and process confirmation.

6. Reaction, assessment and corrective action (Chiliban et al., 2014).

The following picture is a definition of a concept model order-employee for creating conditions as close as possible to perfection out of imperfect situations. An order can be external, which comes directly from the client to the employee, or it can be internal, coming from somebody who works inside the company to another colleague. In this article the orders will be treated from the internal orders' perspective.

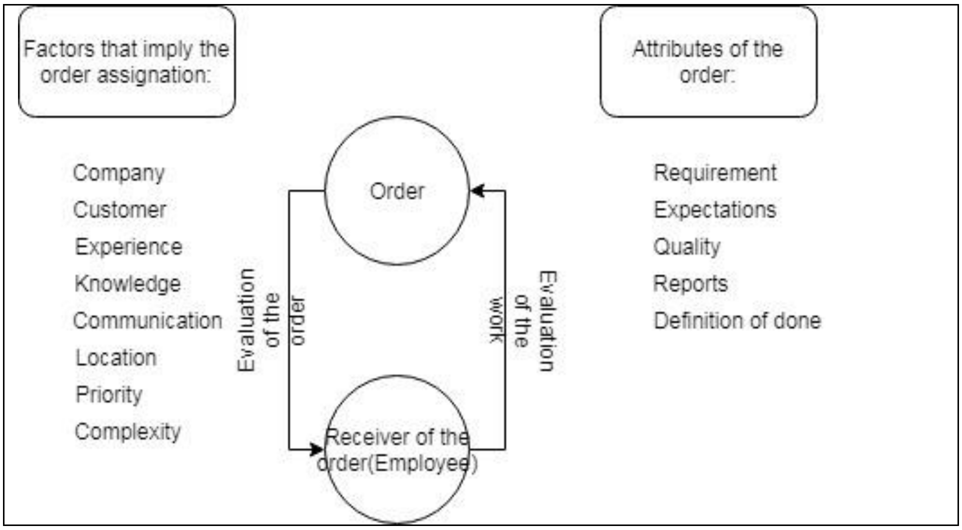

Figure 2: The conceptual model of an order-employee flow.

The factors implied in the order creation and the order attributes for the employee working on the ticket are observed. This is a general model in a software automotive company and presents the interaction and the necessary factors and attributes for a successful one. In the proposed model, the order from the client will be assigned to an employee, only after a specific process of order evaluation. The order will be evaluated based on objective facts, like complexity, to find the most suitable employee to be assigned to the task, so the following objectives will be achieved:

- Fulfill the quality requirements.
- The documentation is updated and available.
- Give to the customer the highest quality product.
- Finish the task in the agreed time interval.
- Grow the experience and the knowledge of the team members.

USUAL ORDER-EXECUTION FOR A NEW BRANCH

The usual process in a new offshored branch can be seen in the next figure:

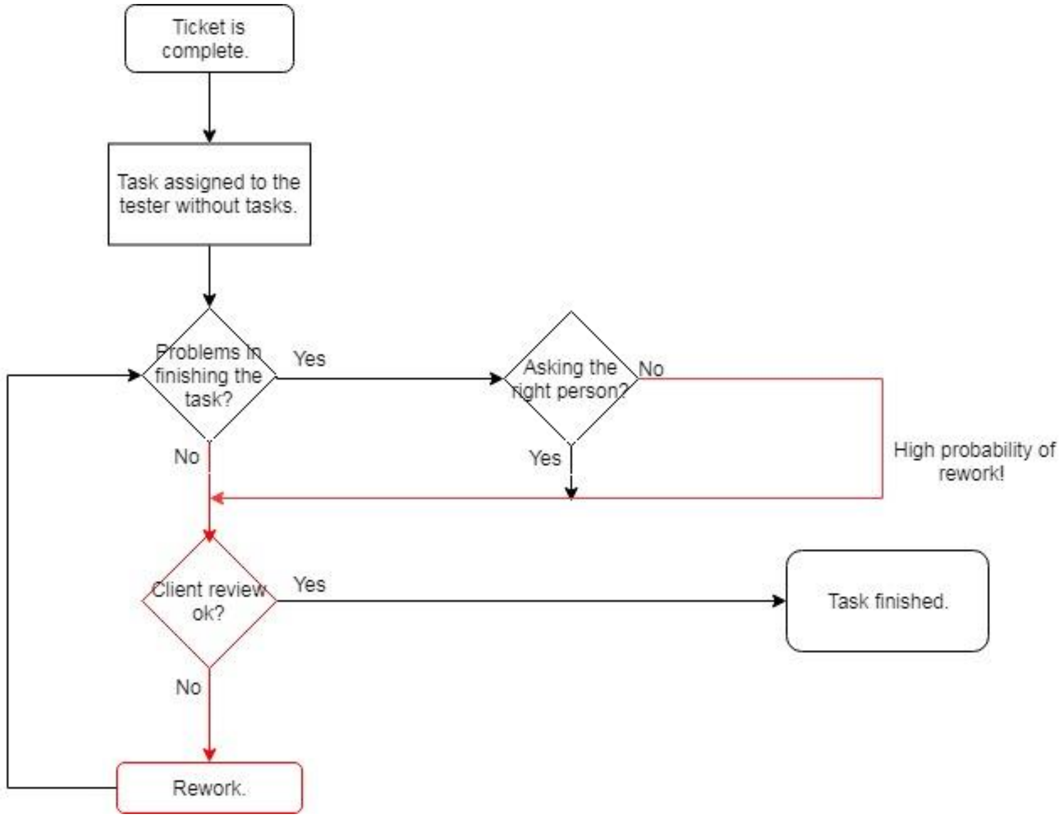

Figure 2: Usual order execution process in an offshore branch.

As it can be seen in figure 2, once the ticket is sent to the company and the employees from the head quarter have enough tasks, the ticket is sent to the offshored branch. When the ticket is in the branch center, it is assigned to an employee without task.
Since this is a new R&D branch, all the tickets that are coming represent new projects and after a time they can be seen as a type of ticket that was already made.
During the task for example in software testing, there is the following workflow:
1. Review of the requirements: In this step of the process, all the requirements must be carefully read and a first impression of the functionality of the software is obtained. The tester must check if the requirements can be tested or if relevant information is missing. If it is a black-box testing, the access to the code is forbidden. In case that exists one or more requirements, which are not testable, the responsible requirement engineer for the software that is tested, must be informed. After this step, there is the possibility to estimate the implementation time of the requirements. In case if the requirements are in a different language than English, the requirements are sent to the translation department.

2. Development of the software test or software module. During this process it is a high chance to have problems in developing or testing the code:

i. Not understanding the functionality.
ii. Not enough knowledge for implementing or testing the requirements.
iii. Insufficient information in requirements.

iv. Unexpected behavior of software.
v. Opposite requirements.
vi. Changing of requirements without informing the developer or tester.
vii. Wrong usage of the tool.

3. Analyze and report findings.
4. Review of work.
5. Rework of findings.
6. Close the ticket.

The steps from the figure 2 are the following:

a. The task is started, and if there are problems in resolving the task, usually the local team is asked about how the problem should be solved. If the project is new, and also the process for this specific project is new, so when a problem regarding how to proceed in certain situation is discussed just in the local team without involving the colleagues from the headquarters, they can only make assumptions since the team is new.

Assumptions are usually made because the new formed team wants to impress the colleagues from the headquarters.
When assumptions are made, there is more than one opinion, and time is consumed in choosing what the team thinks that it is the correct answer.
If a solution about the process, for example, from the local team is implemented, it has a high probability to be reworked based on the fact that specific part from the process is implemented in a different manner in the headquarters. It can delay the entire project if the solution proposed locally is found later in the project and it needs a lot of time to be corrected.
Developers can take more time to resolve a problem because they do not have the ability or may not even know the appropriate contact person for asking for help. This happens because the meetings with the scope to get to know each other are not held (Bird et al., 2009).
Because the communication is deficient and the level of awareness is low, these facts increase the difficulty in coordination of the projects and also the number of failures in the code developed by the teams from other branch is bigger (Bird et al., 2009).
The Scrum principle says that the project should be presented as soon as possible to the customer for checking if the direction is the right one (Rossberg, 2019). This can be observed on the left side of the proposed process, in figure 3, where it is suggested that a weekly meeting should be held with all the team members implied in the project so that everybody knows the status and the problems. If the questions are discussed from the beginning with the more experienced colleagues, the rework is no longer present in the orders and the quality of the product is obtained much faster.
Herbsleb and Grinter made a study that revealed that in the case of Lucent company, between the sites from Great Britain and Germany there have been discovered major national cultural barriers (Bird et al., 2009). Because of these facts, the managers can propose to develop a process that is not changing often and also the code that they are developing does not have an increased complexity (Bird et al., 2009). This kind of misinterpretations can exist and they should be discussed so they don't become major issues.

b. After the task is finished, it is verified by the colleagues from the headquarters. This is a good idea in maintaining the quality of the output of the task, especially in the new projects. Another advantage of this review made by peers from the headquarters is that the employees from the offshore branch can learn the criteria and the “how to”- methods to have in the end qualitative results.

Usually the assumptions made in the team for solving the problem are not the most efficient and correct. This fact can be observed in the result of the client review. The assumptions are wrong in a high percentage and lead to a lot of rework. This is a strong reason for not having assumptions in the team regarding the functionality of the project or about the details of the process and how the stages of the process should be made. The process takes a longer time at first sight, but afterwards it will be made correctly and accordingly to the standard and the demanded quality. A good idea about which questions should be asked inside the local team are the questions about programming syntax, a peer review over a new test case, helping in implementing the ideas received from the internal customer, sharing the knowledge about a certain topic, e.g. slide angle, understeering or oversteering in physics.

An example of how assumptions can be destructive is the following: in a branch team from a company which has its headquarters in Germany, a task is given from a colleague from Germany to a colleague from Romania. The other two colleagues don't know about this task until the next morning. The entire team is engaged in finishing the order, but some questions arise about when it is considered that the order is finished. Should it be made more steps or what was asked? A lot of discussions took place inside the Romanian team, without asking the colleague from Germany, because the connection member thought that he is too busy to answer our questions. This thing brought a lot of stress over the team members. At around 20:00, the entire Romanian team manages to discuss with the coordinator from Germany, just to find out that the team made extra and unnecessary work over the order.

PROPOSED MODEL FOR INCREASING THE EFFECTIVENESS OF THE TEAM

The goals of APQP presented earlier were also part of the goals for the propose model. The most important thing is that the customer is happy with the delivered products. This implies that resources are used properly, that the software respects the customer's requirements and that the product is finished on time with the lowest costs.

From the way APQP is organized, it makes sure that a product is scheduled and calculated. The following process takes into consideration that the orders which are coming from the client are treated with an objective approach and with the main objective in mind that the customer receives the best quality for his software products.

A process is required so the management of the offshored team is done in a transparent, clear, qualitative and learning oriented manner. Like Javidan observed, the culture is not the direct factor influencing the knowledge transfer process, rather the poor management can cause the plans and projects to fail. An example would be a clear definition of success and goals, aspects which have to be defined in advance. If the regular contact between the involved parts is maintained, the difficulties are reduced and a stronger mutual support is created. Knowledge development is path-dependent and accumulative in the way that it includes an ongoing, gradual and incremental process of learning about the development of the product. Involved parties wrongly assume that their criteria for success and their objectives are identical (Javidan et al., 2005).

The proposed model, in order to have a more efficient work distributed in the team for these activities, is the following:

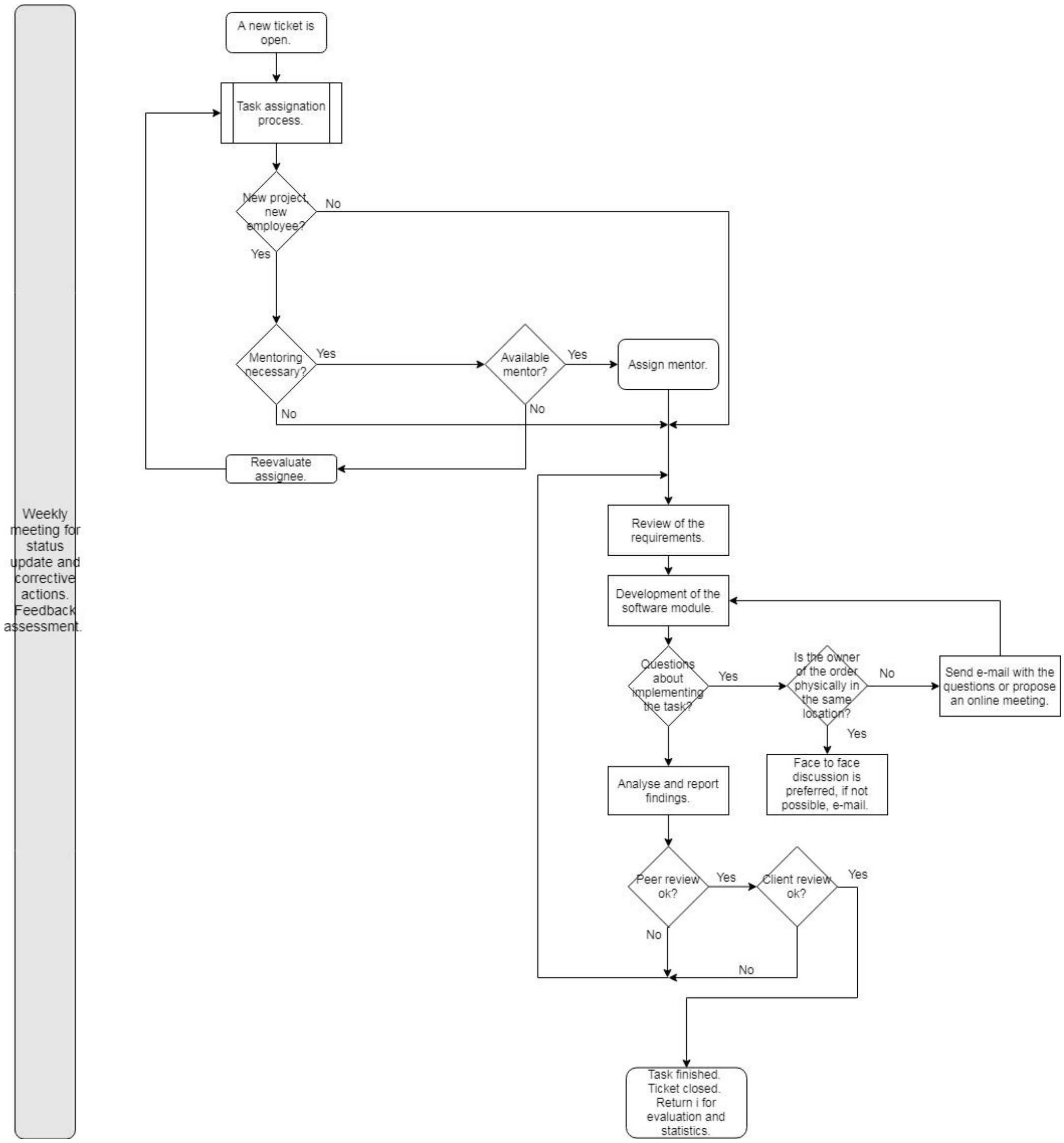

Figure 3: The proposed model for effective order assignment and execution.

In the proposed model for effective order assignment and execution are the following steps:

1. A new ticket is open.
2. It starts the task assignation process, process which is described later on.
3. Is it a new project or a fresh employee?

Starting with point, the learning process begins.

4. If the answer is yes, then mentoring is necessary, if the answer is no, the order is assigned.
5. The next steps, are the review of requirements and development of the software module.
6. If there are questions about the task implementation, and if the person is in the same location then the step 7 is strongly recommended, otherwise steps 8, 9 and 10 must be made.

7. If the person is in the same location, a meeting is the most practical way to answer the questions.
8. If the contact person is not in the same location, an-email with the questions must be sent.
9. If the response from the e-mail is received, the work can continue, otherwise, the next phase is step 10.
10. If an answer is not received in a reasonable time at the sent e-mail, the receiver of the e-mail should be called for reminding him about e-mail. This step is rare in the industry, but we must know how to handle it.
11. After the response is received and all the questions have been answered, the next step is Analyze and report findings.
12. Analyze and report findings, at this step, if there have been found any problems in the software implementation or the system's behavior is not as expected in the requirements, a detailed report must be sent to the manager.
13. Peer review: after the work is considered to be done, before handing the results to the client, a good idea is to check with a colleague the most important points of the order. If this step is revised properly, the next step can be implemented.
14. Before the order is closed, a review has to be made by the client. If the client review is passed, the order can be closed.

In order to compare the proposed model with is actually happening, in figure 2, where the usual process takes place in an offshore branch, it can be observed that the task is assigned to the available employee, after the ticket order is complete, regardless of the employee's experience.
The assignation of the task to the next employee that does not have a ticket is not the right path to follow, because the priority can be set high and if the employee is new in the project or inexperienced, the task will have a high chance to be delayed.
The problems of the usual task assignment are the following:

- Tickets not assigned to the employee who fits the best.
- Tickets are not weighted by the deadline or complexity.
- The employees do not follow a natural path of development of their skills.

The next step from figure 2, *Problems in solving the order,* is the step where questions arise about the order. If there are questions or problems about how the task should be solved, they should be addressed to the specified employee from the order ticket, not make assumptions like in the proposed model from figure 3. The step when the problems arise, as it can be seen in figure 3, if the person is in the same location, a face to face discussion would be preferred, but if it is not in the same location, then an online meeting should be requested.
The technical staff should know or should be able to discover who they can contact about a problem that can occur during the project. The communication should not be slowed down by a person or by the process, like channeling completely the communication through a project manager (Herbsleb et al., 2005).
A very good suggestion for improving the communication between teams who do not work in the same location, is to spend the travel budget in the early steps of the project. Once the teams have met and worked together for some time, all the work runs smoother. There are more advantages from meeting the person face to face, like: overcoming the cultural differences, developing trust and improve all other means of communication (Herbsleb et al., 2005).
Following this idea, from the beginning of the project a list containing all the team members and their roles should be exchanged between the teams, in order to know each other better.
Another topic that has a high importance is the update of the documents. An easier way to keep them updated is to create a "virtual site" as much as it is possible. If the code is developed at multiple sites, the development of the code should be made and maintained on a single branch of development (Herbsleb et al., 2005).
If the code is developed at multiple sites, the development of the code should be made and maintained on a single branch of development. If the scrum principle is respected with the daily

meetings and daily builds of the code, the problems will be fixed as soon as possible (Herbsleb et al., 2005). By implementing these ideas the APQP objective to keep the documentation updated and available for all the team members is easier to achieve.

The next process is proposed with the following goals: the new starter, or in this case, the new team, must be brought to the same level as the other colleagues from the headquarters regarding the processes and how-to do the orders and to have interaction with the more veteran employees in order to learn as much as possible from them. The new entries will learn how to handle the exceptions, how to apply the rules to real projects and how to interpret the environment. The top priority should be to find ways for forming new distributed communities (Herbsleb et al., 2005).

From the APQP principles, that a product is correctly calculated and scheduled, these steps must be verified periodically. Because the teams cannot meet every week for the status update, a weekly meeting must be planned, meeting where all the team members from both sites present their status and problems. In this way everybody is updated with the status and the problems and if somebody else had these type of problems, they can share their knowledge in how to fix them.

The vertical column that is available for the whole proposed process is another principle of APQP as it can be seen in figure 1, where the feedback loop is present during the entire process. The internal processes can be adjusted to fit the current projects or situations.

Companies can be compared with living organisms, so they must continuously adapt to the environment. This means that the proper process identified at one point in time, at a moment it will have to change or adapt the process, due to changes that are arising. For example, the strategy for knowledge management that is acknowledged as suitable at a specific point in time, will have to be transformed or reformed because the knowledge changes through the structural cycle to a different stage (Rifat et. al., 2009).

When a lot of orders are coming from the customer the project team leader must assure that those are ready until the deadline.

When discussing the step of mentor assigning, it must be taken in consideration that the number of mentors inside the team should be correlated with the number of unexperienced employees a team has. There can be the following situations:

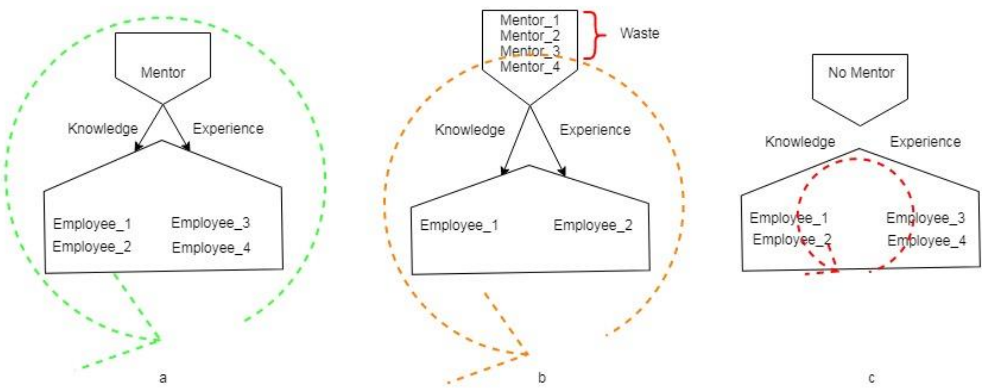

Figure 4 Possibilities of distributing the mentor inside the team

Subfigure a, from figure 4: there is one mentor assigned for four new employees for knowledge and experience sharing. The circle of learning includes all the team members involved in the process.

Subfigure b: it can be observed that the number of mentors exceed the number of fresh employees, and when discussing about the teaching process, this is considered a waste. The circle of learning from the mentors, limits the full implication of all the mentors.
Subfigure c: there is a waste of time and rework since there is no mentor assigned therefore the employees must learn from their own mistakes.
By using the process from subfigure a, the learning process is more efficient.
The next proposal comes with a strategy for helping in achieving the objective of completing the orders to meet the deadline.
The proposed model for assigning a ticket, with keeping in mind that the first criteria for assigning a task is the priority and afterwards the complexity, both attributes being established by the client, is the following:

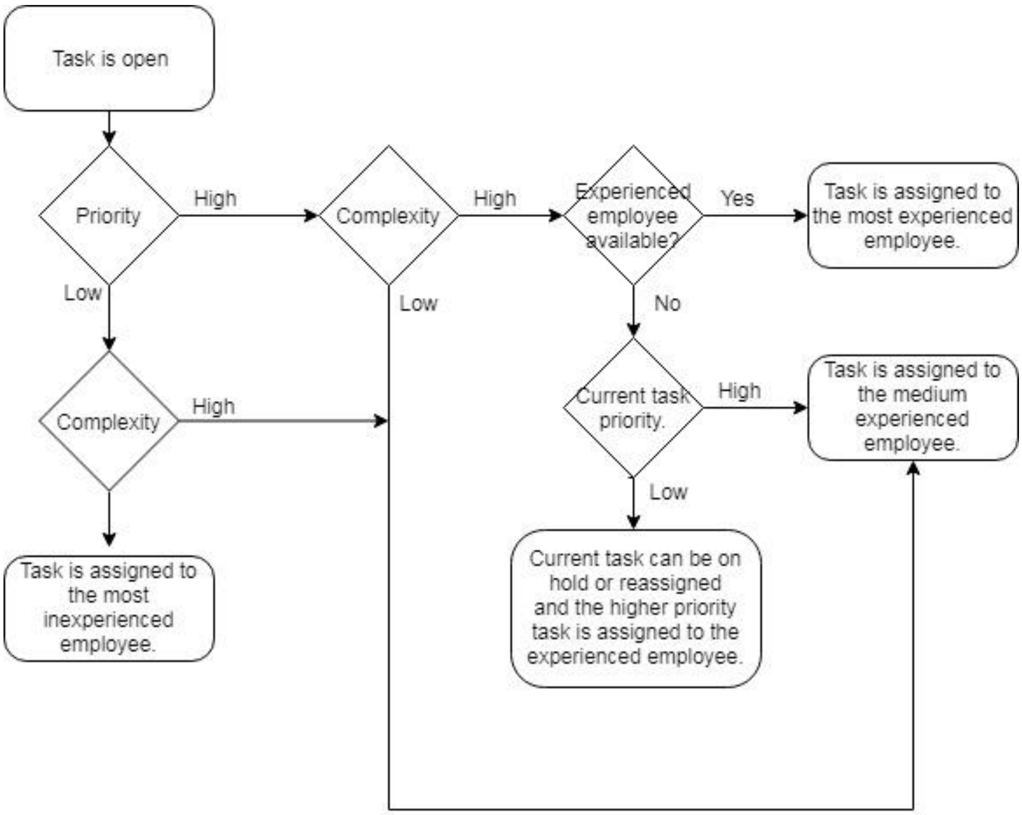

Figure 5: The proposed process for assigning a ticket.

This process is developed for fixing the mentioned above problems. It is very important to assign the right task to the right person. The most complex one should be done by the most experienced employee. Both the company and the employees will have the following advantages:

- Increased probability that the task will be finished in time.
- The challenge will motivate the employee.
- The probability that the task is done correctly is increased.
- Increased probability percentage that the feedback from client will be positive.

If the order has a low complexity and low priority, it is better for the task to be assigned to the most inexperienced employee, because of the following reasons:

- The confidence of the employee is increased.
- The probability that the task is done correctly is increased.
- The skills of the employee are developed in a way that it is not stressful and the knowledge is built on strong base.

The idea of task evaluation is to not waste resources and as a comparison, it is not necessary to have a powerful car to go to the market for groceries.
On the other hand, it is not a good solution to assign the task to a person who has not the necessary skills to reach the mentioned objectives. When we need to carry heavy loads, a powerful car is needed, it is a necessity, not a waste of resources.
In the figure 1, for the evaluation of the work part from the conceptual model, the assessment of the task is needed to verify that the order is being done so that the requirements and the client's quality standards are respected. The experience and know-how progress of the employee can be measured. If the employee has sufficient knowledge and experience, he can be assigned on tickets with higher complexity or he can help other colleagues with less experience, to finish their orders.

CONCLUSIONS

In order to solve the orders based on their complexity with the most suitable employees a process must be followed. This process was built in a manner that it can be easily shaped based on the company's necessities.
The following concepts can be resumed from the proposed processes:

- No assumptions should be made inside the team.
- Clarify everything, so the rework is avoided.
- Assure proper mentoring.
- Documentation must be updated and clear enough to be understood.
- Continuous improvement of the processes.

Although these principles cannot guarantee the success of a branch opening, they will raise the changes of having a more qualitative work.
If the mentioned methods are implemented, the knowledge inside a team will be at almost the same level, the communication between the teams will be improved, thus the problems will be solved much faster, this meaning saving both time and money.

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COOPERATION BETWEEN ACADEMIA AND BUSINESS

The South African Technical and Vocational Education and Training System from a German Perspective

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ABSTRACT

This paper provides information about the South African Technical and Vocational Education and Training (TVET) system from a German perspective as well as about South-African - German cooperation in this system gathered by literature reviews.
Due to a shift in South Africa's economy towards the service sector, the existing skills composition does not fit the needs anymore and may hinder further development. Foreign and local companies have a high demand for skilled workers.
A short introduction to the TVET system is provided and challenges are pointed out. Furthermore the role of the Skills Education Training Authorities in TVET is described. Finally, the current state of South African - German cooperation in the TVET sector including a selection of projects on different levels involving German and South African institutions is outlined.

Keywords: *TVET South Africa, South-African – German cooperation, higher education business cooperation*

BACKGROUND

As a member of the so-called BRIICS (besides Brazil, Russia, India, Indonesia, and China), South Africa is one of the world's most important economies. According to the Organisation for Economic Co-operation and Development [OECD] (2008), its trade structure differs from other African countries and the skill composition of its labour force is similar to middle income countries.
But as the country's economy changed from manufacturing and resource-based industries towards the service sector in recent decades, the existing skills composition does not fit the needs of the country anymore and may hinder its further development (OECD, 2017).
South Africa's unemployment was 27,8 % in the fourth quarter of 2018. The unemployment rate of youth labour force during this period was even 53,4 %. But for the groups of those who got an upper secondary or below secondary education, the unemployment rates are 25,4 % respectively 27 % while those students who finish a tertiary education have a low unemployment rate of 6.2 percent. (OECD, 2019)

GERMAN COMPANIES IN SOUTH AFRICA

In South Africa's economy, German companies play an important role. Approximately 600 German companies are located in South Africa and have created over 100.000 jobs in the country. Examples for companies with sites in South Africa are BASF, Bayer, Bilfinger Berger, BMW, DHL, Deutsche Bank, Lanxess, Mercedes Benz, MTU, SAP, Siemens, ThyssenKrupp and Volkswagen. (Federal Foreign Office, 2019)

These, as well as domestic companies in South Africa, have a high demand for skilled workers. As the outputs of the South African post school education system still do not fit the needs of the economy, in many cases foreign as well as domestic companies develop their own training measures to educate their employees.

VOCATIONAL EDUCATION IN SOUTH AFRICA

Technical and vocational education and training (TVET) is very important to create the skills needed by the economy and thus for a country’s sustainable economic development. If the education fits the needs of the labour market, it increases not only the students’ employability but contributes to political and social participation as well (Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ], 2019)

At grade 9, students may stay in school until grade 12 and should finish school with the National Senior Certificate (NSC), which is also known as the matriculation or matric. Alternatively, they may continue with vocational education at TVET colleges.

During the Apartheid Regime from 1948 to 1994, only the white population had access to university and higher vocational education in South Africa. In 1996, the parliament passed the South African Schools Act (SASA) and National Education Policy Act, which banned (racial) discrimination in education. (Republic of South Africa, 1996;1996 b) In 1998, the Skills Development Act has been passed with the aim “to provide an institutional framework to devise and implement national, sector and workplace strategies to develop and improve the skills of the South African workforce“ (Department of Labour, 1998, p.1).

An institutionalised “dual” system, as it is place in Germany for Technical and Vocational Education, does not exist in South Africa. In the German dual system, companies (mainly small and medium sized ones) cooperate with vocational schools. The trainees spend some days of the week at their work place and the other days at vocational schools. The curricula are standardized for about 330 occupations. So, the trainees get the same education regardless of region and company and potential employees accept the degrees as a proof of the trainees’ competences. (Bundesministerium für Bildung und Forschung [BMBF], 2019 b). The German system has to be constantly adapted to meet challenges. A current challenge is the shortage of skilled staff in some industries and regions in Germany as it exists in South Africa as well.

The state of TVET at the TVET colleges in South Africa may seem confusing for “outsiders” as two different systems exist at the TVET colleges in parallel. These two options are on the one hand the “Report 191” or National Accredited Technical Diploma (NATED) programmes and on the other hand the National Certificate (Vocational) called (NC(V)). To obtain a NATED diploma, the students must prove 18 months or 2000 hours of working practice additionally to 18 months theoretical studies in classes (Human Resource Development Council of South Africa [HDRC], 2014).

The NATED programs date back to the National Education Policy Act from 1996 and were planned to be phased out in 2009 when they were partly replaced with learnerships. In 2007, the NC(V) programmes were introduced to replace the NATED programmes. But the NATED-programmes have been reinstalled due to criticism from business and industry by the ministry regarding employability of NC(V) graduates in the following years (Parliamentary Monitoring Group [PMG], 2017).

The criticism existed despite the fact that the NC(V) curricula included theory and practice and had the purpose to allow “learners to access and master skills, knowledge, values and attitudes for lifelong learning; to continue horizontal education and training; to enter higher education; and to pursue self-employment or employment opportunities” (PMG, 2015). But in the curricula of the NC(V) programmes no workplace practice is required (Balfour, 2015). The lack of workplace

practice probably plays an important role in the continuous existence of the lack of employability criticised by the industry.
According to the Human Resource Development Council of South Africa (2014), the NC(V) play a dual role. The NC(V) originally was meant for students who completed grade 9 to continue their studies. But in reality, NC(V) students include those, who finished grade 9 and continue their studies with the NC(V), those who dropped out of the system between grade 9 and 12, and those who already finished grade 12 and received their National Senior Certificate (NSC), which is also known as the matriculation or matric, which leads to groups of students with very different competencies (Human Resource Development Council of South Africa, 2014).
According to The Centre for Development and Enterprise [CDE] (2012), education in South Africa may be divided into three categories: General education, vocational education, which should enable the learner to be “productive in the work place immediately”, and vocationally-oriented education in which the graduate “requires further training before entering the workplace” (CDE, 2012). The Nated Diplomas could be categorized as vocational education while the NC(V) seems to be more vocationally-oriented following this approach.

SKILLS EDUCATION TRAINING AUTHORITIES

Levies are imposed on employers to encourage learning and development in South Africa. Companies registered as an employee in South Africa are encouraged to provide workspace training through a levy system and tax incentives for hiring learners (OECD, 2017). The companies have to pay a Skills Development Levy (SDL) of 1 % of their total salaries if these are more than 500.000 Rands (about 31.500 € in July 2019) including overtime payments, leave pay, bonuses, commissions and lump sum payments (South African Revenue Service [SARS], 2019).
The SDL are distributed to the Skills Education Training Authorities (SETAs), which receive an 80% share and the National Skills Fund, which receive a 20% share. Companies get back a share of 20% of the levy they paid if they submit a Workplace Skills Plan (WSP) and an Annual Training Report (ATR) (Western Cape Government, 2019). The submission of the WSP and ATR help to gather data on training needs of the economy.
The establishment of the SETAs goes back to the Skills Development Act 97 from 1998. In chapter 3 of the act, the functions of the SETAs are described. The first two functions are “to develop a sector skills plan within the framework of the national skills development strategy” and to implement this sector skills plan. (Department of Labour, 1998, p.4)
In 2000, 23 SETAs were established, each belonged to one of the 23 sectors in which the South African economy has been divided. SETAs are responsible for both the private and public sectors within their sector.
A reduction from 23 to 21 SETAs was planned with the SETA landscape from 2010 and has been implemented in 2014 (PMG, 2010; PMG 2011; National Skills Authority [NSA], 2014).
In 2018, a further regrouping and merger of SETAs has been discussed by the Department of Higher Education and Training (DHET) and the Portfolio Committee on Higher Education and Training. During the meeting, the minister also stated that some of the goals of the new National Skills Development Plan “could not be achieved without making use of research centres to help inform the decisions of planning.” (PMG, 2018). The minister mentioned that “the university sector was ready and could support some of plans made, but far more support work and capacity development was necessary for the TVET (…) systems.” (PMG, 2018, “Minister’s response”, para. 4).
No decision seems to be made until July 2019. But the continued discussions show that there is still a need for discussion regarding the SETA landscape which has implications for business and industry involved in TVET. The minister`s opinion shows that research and especially the role of universities opens new opportunities for research-based reforms. The idea of involving universities in the discussion is not new. It has already been raised in the Whitepaper from 2013. The Paper

states that universities should engage with industry stakeholders and SETAs to examine how their programmes could be adjusted to deepen the collaboration between the skills system and the universities. (Department Of Higher Education and Training [DHET], 2013, p.64-65)

CHALLENGES IN THE TVET SYSTEM

According to Terblanche, the reinstatement of the NATED programmes is a big challenge for the TVET colleges as they have to deal with the implementation of the NC(V) curriculum in parallel (Terblanche, 2017).
Another important challenge for the TVET colleges is that the lecturers lack practical knowledge as well as industry experience. Furthermore, in many cases, subjects and technologies forming parts of the curricula are outdated (OECD, 2017; DHET, 2013). So, according to feedback from some industries, while the NC(V) graduates' theoretical knowledge is fine, they also lack practical skills (HDRC, 2014).
According to Kraak, Paterson, and Boka (2016, p. X), the difficulties the TVET colleges face, result from various forms of change over the past decades. These changes include the rationalisation of colleges in numbers and size, the introduction of the NC(V) and plans to phase out the Nated programmes, as well as further changes including "shifts in staff employment regimes, interspersed with sporadic lecturer training."
In South Africa, Technical and Vocational Education and Training is not considered as a good option by students and parents compared to university education. But this is not only the case in South Africa. According to Clement (2014, p. 7), TVET is "perceived in developing, emerging and even in industrial countries as a 'second-best option' " in comparison to general or academic education".
A substantial share of employment takes place in the informal economy (OECD, 2017) Another issue which should be addressed besides the education in the TVET colleges is the recognition of skills developed outside the system. During a briefing of the National Council of the Provinces, the chairperson prompted that "there were thousands of people with no certificate, but they had a skill, and those people needed to be assisted. (PMG, 2015, "preliminary discussion", para. 7).
A further challenge experienced on a higher level (e.g. for the SETAs) is the availability of data on TVET provided by business and industry involved. The OECD states that for South Africa availability of information about skills and occupations in shortage is limited and the quality of the available data is poor. Many companies, mostly small and medium enterprises (SME), do not deliver their Workplace Skills Plans (WSP) and Annual Training Reports (ATR). As a result, the data is not representative. To deal with this challenge, a plan has been announced to simplify and standardize the templates for WSPs and ATRs (OECD, 2017).

CURRENT STATE OF SOUTH AFRICAN - GERMAN COOPERATION IN THE TVET SECTOR

To overcome the challenges in the TVET sector, the South African government cooperates with several organisations and governments. One example is the German government funding a range of organisations which cooperate with their South African counterparts to integrate parts of the German dual TVET system to the South African system.
While in the past German organisations often followed a systemic approach, which tried to introduce the dual TVET system without taking the local conditions in account, today a cooperative approach is followed (Tsimoshchanka, 2014).
In 2013, the South African Workgroup for Technical and Vocational Training has been institutionalized. The delegations of the South African Ministry for Higher Education and Training (DHET) and the German Ministry of Education and Research (BMBF) agreed on an exchange of

experts and the establishment of the South African Institute for Vocational and Continuing Education and Training (SAIVCET) (Bundesinstitut für Berufsbildung [BIBB], 2019 b).
In 2017, during a meeting of a working group which consisted of representatives of German and South African ministries and organisations in Pretoria, the participants agreed to extend the collaboration in the field of cooperation with the private sector and with the social partners and to increase the support of qualification of the vocational training personnel (BIBB, 2017).
In a press release from February 2019, the BMBF states that the economic success of German companies which are active in South Africa depends on well-trained skilled workers in the country. The press release also mentions the aim of strengthening the role of companies in the TVET cooperation (BMBF, 2019).

EXAMPLES OF TVET COOPERATION BETWEEN SOUTH AFRICA AND GERMANY

TrainMe

Funded by the German Federal Ministry of Education and Research (BMBF), the project „TrainMe“ (Modular training and education of South African TVET lecturers in mechanical and electrical engineering) run by the Inter-Company Training Center in Easter Bavaria – Überbetriebliches Bildungszentrum in Ostbayern (UEBZO) has its focus on practical training and further education of lecturers already teaching in the TVET colleges in the fields of electrical and mechanical engineering. In the project, emphasis is put on Industry 4.0. “Train Me” develops Online Modules for practicing lecturers, which shall be available as further education and train the trainer courses at TVET colleges. (UEBZO, 2019).
The project aims to enable TVET teachers to “continuously expand their technical, didactic, and pedagogical competences, such as e.g. design, implement and - academically accompanied - reflect guided teaching and learning arrangements” (UEBZO, 2019, para. 4). In doing so the project is supported by the GIZ, which creates a training centre with the focus on mechanical and electrical engineering (UEBZO, 2019). Train Me puts a focus on the current shortage of practically trained trainers in the TVET sector.

E4D

The GIZ is also running a project which focuses on Micro, small and medium enterprises (MSME) called “Employment for Sustainable Development in Africa” in a range of African countries with the aim to improve the quantity and quality of employment. By implementing the Africa policy of the Federal Ministry for Economic Cooperation and Development (BMZ), it uses public private partnerships. In the framework of the project, companies provide the data and information needed to identify the skills needed. So, the challenge of limited availability of data is addressed.
The project uses two approaches. The first is to run sub-projects in partnership with business to increase the demand for skilled labour and the second to enhance employability of individuals and availability of skilled labour in both, the formal and the informal market through training and work place programmes with private sector partnerships. (GIZ, 2018; BIBB, 2019 e)

Comprehensive Africa Agriculture Development Programme (CAADP)

In the framework of the “Comprehensive Africa Agriculture Development Programme (CAADP) founded and run by the African Union, Agricultural Technical Vocational Education and Training is supported by GIZ and funded by BMZ. Aim of the project is to successfully implement Agricultural

Technical Vocational Education and Training as an innovative concept. In the framework of the project, the development of supply chains is supported as well. (BIBB, 2019 d)

Vocational training partnership between German Chambers of crafts and South African education institutions.

A cooperation between the Erfurt Chamber of crafts and the Eastcape Midlands TVET College, the Lovedale TVET College and the Port Rex Technical High School running from 2016 to 2019 aims to improve qualification and employability of graduates especially in the car repair business. The means to achieve the targets are increasing involvement of local businesses in designing of curricula, providing trainings for teachers in South Africa and Germany as well as equipment and training materials (BIBB, 2019 g).
A cooperation between the Sequa, a German non-profit development organization, the Steinfurt-Warendorf Guild of Craftsmen and the Umfolozi TVET College in Richards Bay, Kwazulu Natal, aims at improving the employability of graduates of the college as well. By increasing training capacities and introducing new training approaches, incentives to participate in the cooperation with the college are offered to business and industry. In the framework of the project, a centre of entrepreneurship is created at Umfolozi TVET College as well. (Sequa, 2019; KH Service- und Wirtschaftsgesellschaft mbH, 2019; BIBB, 2019 f)

Go-Vet/ Saicvet

On a higher level, the German and South African governments are cooperating in the creation of the South African Institute for Vocational and Continuing Education and Training (SAIVCET) in the framework of the Go-VET initiative. The focus of the institute is on research, innovation, and curriculum development (BIBB, 2019). The creation of the institute was necessary because there was limited support offered to colleges in regard to curriculum development, governance, administration and other matters (PMG, 2012). Furthermore, the SAIVCET was created to deal with lecturer development and research on the programme qualification mix of colleges. The SAIVCET shall also support the TVET colleges to deliver qualifications for which responsibilities are shared between different agencies of the system by putting mechanisms in place for a detailed syllabus development to meet the qualification requirements given by the different agencies. The institute is funded by the DHET and the National Skills Fund (NSF). Due to budgetary constraints, the institute has not been established as a standalone entity yet and is managed by the Department of Higher Education and Training. Until 2018, SAIVCET mainly worked on a lecturer development strategy (PMG 2017b; PMG 2018 b).

CONCLUSIONS

TVET is an important factor in South Africa’s economic development. Challenges in the country’s TVET system exist regarding various aspects. The need for development of lecturers is an important aspect which is addressed in current projects of South African – German cooperation in the TVET sector.
The integration of universities in the development of curricula and lecturer competencies in the TVET sector should be increased in the future. The SETAs might also be involved in the cooperation between colleges, ministries, business and industry, private sector, the social partners and universities as they seem to play an important role regarding the gathering of data on TVET from the industry.

The author is currently at the beginning of the research process and will continue his research by conducting semi-structured interviews with stakeholders of the South African TVET system to gain deeper insights in the system. A focus will be on interviews with representatives of German companies located in South Africa.

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Vocational Employer-Sponsored Education of Employees of the Water Supply and Sewage

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ABSTRACT

The provision of a complex development of an enterprise, the implementation of innovative projects, the introduction of the efficient management systems requires the assistance of the corresponding staff. The rates of engineering and technological development stipulate the demand for constant increase of the level of professional skills of the staff. The requirements to the systems of training and improvement in specialists' skill are changing as well. Nowadays traditional requirements to the level of pedagogical staff and technical equipment are supplemented with the requirements of versatility, the ability to respond to technical innovations and socio-economic changes promptly, to foresee a possibility of individualization of the training trajectory according to the professional requirements of an employer. The experience of O.M. Beketov National University of Urban Economy in Kharkiv in cooperation with the public utility company "Kharkivvodokanal" on implementation of the project of industry-specific employer-sponsored training of an enterprise staff aimed at increasing the level of their theoretic and practical training has been described in the article.

Keywords: *staff development, specific training of engineers, employer-sponsored training, water and sewage enterprise.*

INTRODUCTION

The European Union Water Initiative (EUWI) supports the achievement of the water-related Sustainable Development Goals (SDGs) and takes a partnership approach with national governments, donors, the water industry, NGOs and other stakeholders. Countries of Eastern Europe, the Caucasus and Central Asia (EECCA) are currently adopting a range of policy reforms regarding water management in cooperation with the EUWI. The EUWI EECCA component is financially supported by the European Union and other donors. One of the key objectives in water supply and sanitation is encouraging investment and ensuring the financial viability of utilities (EUWI Report, 2016). Each state is to provide the necessary level of the quality of water supply and sewage services for all the subjects of business activities at a reasonable price. The solution of such global problems requires an introduction of modern technologies into water and sewage utilities, encouraging investments and corresponding staff assistance.

The complexity of the projects on the introduction of modern technologies into the water industry stipulates the necessity of all-round training of specialists for water industry – technical, legal, economic, managerial, ecological and social. However, staff assistance in municipal economy of Ukraine is characterized by a number of problems, in particular, more than 40 % of employees in public utility companies do not have industry-specific education. Imbalance in salary level and occupational prestige, population migration (labour, displaced people from conflict zones), outdated material and technical facilities of educational establishments are considered to be the negative factors in the context of the staff assistance. The demand for modernization and technical re-equipment stipulates the urgency of the problems of retraining and improvement in the staff's skill at the public utility companies of Ukraine.

INTERNATIONAL EXPERIENCE

Nowadays Higher educational establishments, scientific and production organizations of different countries with different level of development and technical state of water supply and sewage systems deal with the problems of staff assistance.

Germany is the country that does not face the problem of water scarcity. However, there are three main problems: water quality improvement, the provision of public water supply and sewage as well as the protection of the population and the infrastructure against floods (Sewilam, et al., 2017). Engineers, technicians and mechanics should upgrade their knowledge to cope with the complex management and modern technological equipment. The approach based on the comparison of the level of employees' competence with the standard competence level for each kind of work has been worked out for this purpose. RWTH Aachen University in cooperation with its partners worked out a game approach (SeCom2.0) based on the game technology to give specialists, dealing with flood risks control, a chance to study different flood risk situations in virtual environment.

Water supply is one of the key problems in Malaysia. Management is considered to be the major problem of all the aspects connected with the use of water resources. Therefore, the work on the improvement of water supply departments functioning is controlled by the government by means of training and improvement of the employees' skills is carried out (Chan, 2009). Constant upgrading and modernization of knowledge is one of the most important factors of socio-economic development in Azerbaidzhan. The next stage is the postgraduate industry-specific training allowing enterprise employees to increase their educational, scientific and professional level on the basis of Higher industry-specific education (Mammadov, 2019).

Such ideology puts into practice the criteria of lifelong learning, which embraces the whole life of a person, the diversity of the content, means and methods, time and place of getting education, equal assessment and recognition of the education not by the form of education, but by the real results as well as by the publicity and flexibility of the education (London, 2012). Open global market of postgraduate education requires new educational programs offering flexible and innovative technologies. It is true in vocational and applied fields, in particular such as engineering (Gruenwald et al., 2010; Anderson and Staubb, 2015). The systems of distance learning got wide implication due to essential advantages: organization of lifelong learning and constant monitoring of the knowledge and skills obtained; increasing the education quality using modern means of audiovisual reproduction of learning materials; simultaneous teaching of a great amount of students; reduction of expenses on education. For example, a national poll of the students and graduates who had a distance form of education in Romania found out that they did not consider the level of their education worse than at other forms of education (Andronic, et al., 2012).

EMPLOYER-SPONSORED EDUCATION OBJECTIVES

Nowadays the main target of the system of an employer-sponsored education is training of a new generation of specialists, understanding technical, social and economic significance of water supply and sewage systems, able to create systems, to foresee the trends of their reconstruction and modernization, to make appropriate decisions in a short span of time, to possess a high level of professional competence in a wide range of specific problems. Consequently, alongside with the professional trends connected with water supply and sewage systems, there is a demand for do-all specialists with a high level of not only technical education but also with the competence in legal, economic and managerial spheres. A separate line of training in an employer-sponsored education is the specific training of engineers who are retrained for a new occupation. They often have gaps in their knowledge concerning modern technologies and work practice, automation systems and application of information technologies.

AIM OF THE PAPER

The aim of the paper is to present the experience of the development and implementation of the project of the employer-sponsored industry-specific education of the employees of the water and sewage enterprise “Public utility company “Kharkivvodokanal” at O.M. Beketov National University of Urban Economy in Kharkiv.

Project participants

Public utility company (PUC) “Kharkivvodokanal” is the main organization in Ukraine on scientific and research works in the sphere of power saving and developing the alternative sources of power, sanitization technologies of water supply and sewage nets, upgrading the quality of drinking water and mastering new information technologies in water supply and sewage systems.

Implementation of the investment policy at the PUC “Kharkivvodokanal” is the basis of attracting financial resources for technical modernization of the enterprise with the purpose of achieving the standards of the European Union in the sphere of water supply and sewage systems. The investment projects developed at the enterprise presuppose modernization of the main production processes using new technologies, modern energy efficient equipment, the systems of automated control. At the same time, the use of more complex technological solutions, introduction of energy efficient technologies and equipment supplied by the companies of the European Union raises a question if the enterprise specialists are ready for such innovations. The experience of the implementation of investment projects at the enterprise from 2002 to the present time has shown that with the specialists having professional training and the certificates for the work with new equipment and technologies, the terms of becoming familiar with new technologies is reduced and which allows to decrease the return on investment period of the projects.
O.M. Beketov National University of Urban Economy in Kharkiv (NUUEKh) was founded in 1922 and is the oldest industry oriented Higher educational establishment in Ukraine. The NUUEKh trains specialists of all educational levels in a wide complex of specialties and educational programs for providing vital activities of modern cities and their stable development. The NUUEKh has partner relations and cooperates with the enterprises and organizations providing vital activities of Kharkiv and other cities of Ukraine. It has close connections with municipal and local authorities. Graduates from the NUUEKh are in demand at the leading enterprises of municipal economy, in the services sector, hold key positions in the system of management of housing and communal services and in the bodies of the state and local government.

IMPLEMENTATION OF THE PROJECT

The idea of the employer-sponsored education of engineering and technical employees for implementation of the investment policy was suggested by the department of investment policy, science and innovations of the PUC “Kharkivvodokanal” in April 2016. The aim of the project:

- To increase the level of theoretical and practical training of the employees of the PUC “Kharkivvodokanal” in the field of introduction of innovative technologies of water supply and sewage systems and water purification.
- To improve employees’ skill in economic, legal and managerial aspects of the enterprise activity. To master modern information and computer technologies.
- To meet the requirements of foreign creditors concerning the increase of employees’ professional level as a condition of crediting the investment projects.
- To create a personnel resource of the enterprise.

Preparation Stage

The project of the employer-sponsored training of specialists was developed by NUUEKh for the PUC “Kharkivvodokanal” at the educational program “Water supply and sewage systems”. The specialty “Construction and civil engineering”, specialization “Water supply and sewage systems” at the educational qualification level “Specialist” was taken as the basis to implement the program of the employer-sponsored education. Besides, the employer-sponsored character of the project, it is characterized by the increase of the volume of the training content (150 credits ECTS) and the terms of its implementation: from 01.09.2016 to 31.01.2019. The content of the program, the level of competence in technical, managerial, legal and economic aspects were discussed in detail and agreed by the NUUEKh with the PUC “Kharkivvodokanal”.

The result of the work is the standard of the program developed by the department of water supply and sewage systems and water purification of NUUEKh and coordinated with the Scientific and technical council of the PUC “Kharkivvodokanal” and confirmed by the Scientific Council of the University. A great amount of organizational work has been carried out at the NUUEKh and at the PUC “Kharkivvodokanal” for implementing the program. An expert committee for an unbiassed knowledge evaluation of the candidates for training and a committee on the competitive selection of employees for the employer-sponsored education on the program “Educational and professional program of training a specialist” have been formed at the enterprise. The department of the investment policy, science and innovations was appointed to be in charge of the educational process and the fulfilment of the program. Direct fulfilment of the program requirements and educational contracts between the NUUEKh, the enterprise and students was carried out by the department of science and innovations of the PUC “Kharkivvodokanal” according to Ukrainian legislation.

The following documents have been developed: an agreement between the PUC “Kharkivvodokanal”, the Higher educational establishment and a student on providing educational services; an agreement between the PUC “Kharkivvodokanal” and the enterprise employee on paying the fee for education by the enterprise. Regulations on the conditions of education and its payment covered by the enterprise. These regulations reflect the conditions and the responsibility of students to the enterprise (maintaining labour relations with the enterprise for not less than 5 years or return of money paid by the enterprise for their education). These documents have been agreed by the Legal department, Finance and economics department and Management department of the enterprise. The agreements on providing educational services between the PUC “Kharkivvodokanal”, NUUEKh and the enterprise employees were signed in August 2016.

The employees for training on the employer-sponsored “Educational and professional program of training a specialist” were selected on the basis of suggestions of structural divisions of the enterprise and the results of the test-control of the retained knowledge of employees recommended for training. The group for participating in the project included reputable engineering and technical employees, directors and deputy directors of structural divisions. The expert committee selecting the employees for training confirmed 34 students.

In the development of the curriculum, the main directions of water supply and sewage enterprises functioning and upgrading were taken into account. Academic disciplines covered the main areas of enterprise specialists' activities: theoretical foundations, implementation features and development directions for treatment of natural and wastewater; equipment, materials, operation and reconstruction of water supply and sanitation systems; organization, economics and planning of water supply and sewage enterprises; features of legal issues regulation at the enterprise.

The teaching staff responsible for developing the curriculum content of the NUUEKh disciplines for the employer-sponsored educational program was appointed by the order of the rector of NUUEKh. The programs of the disciplines in accordance with the content of the educational and professional program were developed by the teachers and presented to the vocational departments of the PUC "Kharkivvodokanal" for reviewing. The comments received were inserted into the programs of the disciplines and taken into account when preparing the curriculum content of theoretical and practical classes, developing the forms of the current and final assessment of students' knowledge and distance courses of the disciplines. To increase the quality of implementing the employer-sponsored educational program the teaching staff was strengthened with the leading specialists of Kharkiv in such fields as reconstruction of waste treatment facilities, pipeline protection, automation of technological processes.

Organization of the Educational Process and the Quality Assurance System

The approach to the implementation of the educational program is unique. The educational process is organized on the basis of correspondence and distance forms of education. The distance courses have been developed for all the disciplines and it allowed to organize lifelong education and constant monitoring of the knowledge and skills gained by the students. Besides, classes on Saturdays are provided according to the academic calendar (Figure 1).

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Months	September					October					November				December				January					February		
Mon		4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19
Tue		5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20
Wed		6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21
Thu		7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8	15	22
Fri	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23
Sat	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24
Sun	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25

Weeks	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Months	February	March				April				May					June				July				August			
Mon	26	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20
Tue	27	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21
Wed	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22
Thu	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23
Fri	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24
Sat	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25
Sun	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26

- classroom training, examination sessions   - classroom training   - practice

Figure 1: Study schedule, 2 year, 2017-2018.

Special attention has been paid to practical training, which presupposed getting acquainted with the facilities of the PUC "Kharkivvodokanal" and with the experience of reconstruction and implementation of the investment projects of water and sewage industries of Ukraine, organizing workshops conducted by the specialists of the leading design and scientific and production companies. Students of the program got acquainted with features of projects implementation: reconstruction of reagent facilities of a water treatment plant; introduction of denitrification technology at a sewage treatment plant; use of equipment for sludge treatment; organization of water utility activities under a commercial concession agreement; achievement of modern requirements for water quality control.

There were some problems in financing the education and organizing practical training. The introductory practical training at the facilities of water and sewage enterprises of Poland did not take place because of the lack of finance. On the basis of the program, developed by the specialists of the NUUEKh in August 2017, the students got acquainted with experience of implementing innovation projects, application of modern technologies in water supply and sewage systems at Zaporozhian and Dnipropetrovsk water canals. In July 2018 the students had technological training at workplaces. Pre-graduation practice took place at the private joint stock company “Kyivvodokanal” and Co., Ltd “Bilotserkovvoda” in September 2018. The results of the practice were discussed at the meeting of the section “Water supply” of the scientific and technical council of the PUC “Kharkivvodokanal”.

At the NUUEKh the system of internal quality assurance was based on the principles of Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG, 2015): Institutions should have a policy for quality assurance that is made public and forms part of their strategic management. Internal stakeholders should develop and implement this policy through appropriate structures and processes, while involving external stakeholders.

The Office of Science and Innovations of the Department on the investment policy, science and innovations of the PUC “Kharkivvodokanal” has been monitoring the educational process, absence rate, the quality of knowledge and the academic ranking for 2 years and six months. The Heads of the departments attended lectures and classes, communicated with the students. The results of training were discussed at the meetings by the representatives of PUC “Kharkivvodokanal” and NUUEKh. Monitoring the educational process allowed to estimate the attitude of students to the educational program. However, not all the students managed to combine industrial activity, daily routine and education. 8 students were sent down from the NUUEKh for various reasons: three of them – for the academic failure, and five – at their will.

Project results

The defence of graduation papers took place from 28.01.2019 to 30.01.2019. 40% of students got excellent marks for their graduation papers. According to the level of students’ grades (Figure 2) and the results of the defence of graduation papers 13 students (50%) got the diplomas with honors.

In the estimation of the teaching staff of the department of water supply and sewage systems and water purification of NUUEKh and the members of the State Examination Board the students were scrupulous about their graduation works, the subjects of their papers corresponded to the tasks of modernization, introduction of innovative technologies (the improvement of the effectiveness and safety of the processes of drinking water neutralization, the improvement of the processes of sewage water treatment, biogas production, trenchless pipe-laying and their sanation) solved by the enterprise.

In spite of the technical focus of the educational program the availability of the disciplines, forming fundamental managerial and economic and legal competence (Figure 3), allows the students to participate in developing investment projects and their implementation.

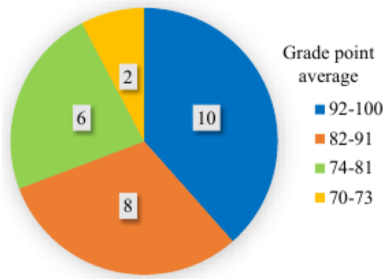

Figure 2: Rating of students by the average grade for the course, the number of students.

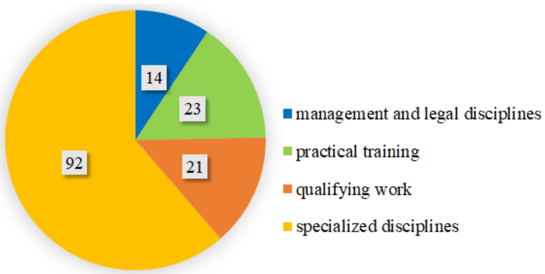

Figure 3: Distribution of study time, ECTS credits.

PROJECT PUBLICITY

The plans and results of implementation of each stage of the project were discussed at the PUC "Kharkivvodokanal" and at NUUEKh, obtained media coverage and were presented on official sites of the project participants as well as presented at the following meetings:

- On June 12-16, 2017 at the International Congress "ETEVK-2019" as one of the trends of implementation of the "Concept of developing water and sewage industries of Ukraine" in the context of staff assistance of the development of the investment activities of water enterprises;
- On May 15, 2018 at the roundtable conference "The problems of improving employees' skill and the ways of solving them" within the framework of the meetings of Ukrainian Association of water and sewage enterprises "Ukrvodkanalekolohiia";
- On September 14, 2018 at the meeting of the Council of the Association "Ukrvodkanalekolohiia" with the representatives of associations and research institutions when discussing the master-plan "Education and improvement in employees' skill in the water industry of Ukraine with the participation of "Ukrvodkanalekolohiia";
- In August 2018 the initiative of the PUC "Kharkivvodokanal" on training the enterprise specialists for the introduction of innovative technologies within the framework of the project "The improvement of silt management at waste water treatment plants of Kharkiv" was approved by the representatives of the International bank of reconstruction and development.

CONCLUDING REMARKS

Implementation of the employer-sponsored project of improving the employees' skill of the PUC "Kharkivvodokanal" provided them with the competence for solving theoretical, applied, managerial tasks in accordance with the strategic plans of the Company as well as the tasks of the innovative development of the water and sewage industry as a whole. The experience of implementing the employer-sponsored educational program was taken as a principle for developing the Master educational program. Nowadays 22 students study at NUUEKh according to this program. The content of the program meets the vocational requirements of the employers.
The analysis of the project results allowed to point out the most complicated problems, the solution of which requires special attention including the development of the perspective programs:

- The appropriateness of the staff and material and technical support of the educational components connected with the use of innovative technologies;
- The development of the educational program meeting the requirements of the industry in conditions of uncertainty as for the perspectives of technical modernization of the enterprise;

- Individualization of the educational programs taking into account the students' demands from different departments and enterprises;
- Financial problems of the implementation of the employer-sponsored educational programs, in particular practical training of the students.

Strategic partnership of Higher educational establishments and industrial enterprises is the demand of time. The main incentive of the formation of long-term partner relations is the mutual interest in increasing the quality of specialists' training.

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Academia-industry Collaboration for Augmented Reality Application Development

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ABSTRACT

Due to our previous experience in AR development, with this research project we propose to study how Augmented Reality (AR) can be adopted by an industrial partner and which are the major outcomes from which a company may benefit. For this purpose, we partnered with a forward-looking company willing to embrace the idea of implementing new technologies for industrial purposes. In this research we identified that the most significant impact which AR may have for our industrial partner is in providing remote assistance and for product exploitation and marketing purposes. For the latest we developed a customized AR application which is currently available on Apple's App Store. By analysing the app analytics data, we found out that this application is a success in terms of marketing and not only. For the remote assistance AR app, we chose to use a commercial solution that can be adapted to fit our industrial partner's needs. We also tested this application and found out that it greatly improves the communication between remote users thus dismissing the required assistance time.

Keywords: *Augmented Reality, Remote assistance, Industrial application, AR marketing*

INTRODUCTION

Augmented reality (AR) technology has currently reached the maturity level which enables small industrial uses. According to Gartner's Hype Cycle AR is currently on the verge of moving to the "slope of enlightenment" phase (Gartner Inc., 2018) which is the last step before mainstream technology adoption. Due to our previous experience in AR development for industrial purposes

(Bondrea & Petruse, 2015), (Petruse, Grecu, & Chiliban, 2016), (Ćuković, 2015), we propose to study how AR can be adopted by an industrial partner and which are the main advantages from which a company may benefit.
Many of the companies that seek to introduce AR into their work processes talk directly to the software providers, but there are cases when the companies look at an academic partner for example like in (Jakl, Schöffer, Husinsky, & Wagner, 2018). Jackl et al presents two use cases called *Real-Time Machine Data Overlay* and *Web-Based AR Remote Support*. While developing the two solutions, they were focusing on efficient data transmission, software that runs on cheap devices that are certified for industrial environments and usability of the proposed solutions. For the first solution, on the hardware part they used the HoloLens Mixed Reality headset as it was already fulfilling several safety standards. On the software part, a combination of OPC UA for machine data and a Node.js proxy server to reduce the OPC protocol overhead when transmitting data to and from HoloLens headset. For the remote assistance use case, the customer that needs support is using a smartphone as hardware. The software of this AR remote assistance solution consists of a mobile application that streams the video to the supporter computer within the web browser. The data transmission is done using WebRTC in this case. There is also a Node.js server that is used at the beginning to help the two peers to exchange their ICE (Interactive Connectivity Establishment) information to be able to establish a peer-to-peer connection. Beside the technical details of the solutions, the authors also present a combined architecture for the two solutions and gives several recommendations for developing an AR application based on their experience while developing these two solution prototypes.

PROBLEM STATEMENT

The first step was to identify an industrial partner that presents suitable use cases for AR implementation. The next challenge was to find a forward-looking company willing to embrace the idea of implementing a new technology for industrial purposes. We found our partner in Maier Werkzeugmaschinen, a German trend-setting company, which produces highly customizable CNC machines and automation solutions.
MAIER CNC Swiss-Type Automatics are highly customizable, sophisticated machines, built to the finest client requirements and adaptable to many applications. Because of this complexity, the potential clients are having difficulties in envisioning the capabilities of the finished product based on classic promotional materials such as brochures and presentations. A 3D representation of the machine's capabilities is often required so that the potential clients better understand the machines characteristics.
On another topic, considering the high complexity of the machines, it is required that Maier's highly specialized know-how to be shared with the client's operating personal as end-user support services, so that the machines can be exploited at their full potential. These services cover almost every aspect, from basic instructions such as setting up the machine (
Figure 1) to the most complex tasks. Moreover, we have also identified that most of the client's issues are determined by an improper equipment use due to the client's failure to comply with the machine's instructions.
Due to this, often, post product delivery assistance has to be provided at the clients' location. This, post product delivery assistance, involves maintenance operations, end-user guidance and training, operational improvements (e.g. solutions to improve manufacturing times and/or fabrication processes) and best practices guidance. The issue is that in most cases the travel time exceeds the required operational time. For example, if the client is at a 3-hour drive that means that Maier's specialized personnel wastes 6 hours just to reach the client and back. In most of the cases, the operational time takes only 20% of the whole delegation time.

Figure 1. Maier machine installed at client's location

Another matter is when highly skilled people are sent to the customer to perform basic operations. This is happening when the customer's unskilled personnel don't provide enough information for Maier's employees to be able to figure out which are the issues or due to poor communication because of language barriers. E.g. a client does not respect the correct procedure of turning on a robot and switching it into automatic working mode. For a skilled worker this procedure usually takes around 5 minutes. However, doing it remotely, over a phone conversation, it can take up to an hour.

Solution description

By analysing the problems mentioned above, we developed several solutions to reduce these limitations. These solutions are based on the involvement of Augmented Reality (AR) into these customer-oriented processes. The solutions that we identified are the following:

- An AR application where the user can view the 3D representation of the equipment with basic instructions and characteristics. This application must be able to detect specific objects from the environment (e.g. specific features from the physical world) and superimpose the right information over them. Within this application, the user must be able to interact with the digital information by gestures or by voice inputs. Beside the equipment's technical information, this AR application can also provide basic instructions (e.g. start-up instructions) and best practices guidance (e.g. maximum equipment loads).

This application can also serve for marketing purposes, for example when a client looks at Maier's products brochure it will have an enriched perspective over the product's specifications by being able to analyse a virtual representation of the product with the aid of AR. Moreover, a client can place a 1:1 scale virtual representation of the equipment over its designated position in the physical world so that it can check if there are any issues (e.g. safety problems, collisions with other equipment, unreachable components, etc.).

- AR aided remote assistance solution which will empower Maier's qualified personnel to remotely supervise and offer assistance for various purposes. This solution enables that skilled employees can supervise simple maintenance operations remotely where and when needed and additional instructions can be provided as well to the client by using AR. With this solution, expertized process (e.g. machining parameters, robot paths, etc.) evaluations can be remotely performed, and by using AR, and the identified improvements can be remotely highlighted directly over the clients' physical system. Moreover, the operator that will apply the improvements can be supervised and guided remotely using instructions provided with AR.

Also, these AR applications can be customized based on the client's needs (e.g. machining operational instructions) and at the same time, similar AR applications can be implemented to improve Maier's production processes, by replacing or augmenting the production related information supplied “on paper”. For example, assembly instructions can be provided using AR or technical drawings can be improved with superimposed 3D models.

Solution implementation

The first step of the implementation process consisted in identifying which are the desired outcomes from the AR apps. After consulting with the experts from Maier Werkzeugmaschinen the desired outcomes where outlined and it was determined that at least two AR applications were needed. One for product exploitation and marketing purposes and one for the remote assistance services.

Product exploitation and marketing AR app.
By analysing the Maier’s existing infrastructure, we decided that Apple’s ARKit is the most suitable AR software development kit to build the product exploitation and marketing purposes app. After choosing the AR development software, the next step involved converting different 3D models provided by Maier, from the CAD format to a retextured model that is compatible with the AR software. CAD models are very complex and in different file formats. Since the application runs on a mobile phone, to improve the performance and to reduce battery consumption of the mobile application, these models needed to be simplified in terms of number of surfaces (
Figure 2).

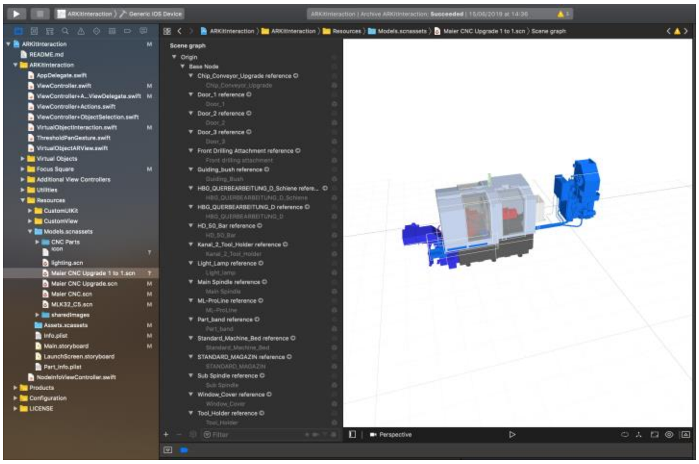

Figure 2. Converted CAD model imported in Xcode

From all the supported file formats of ARKit we choose to convert the CAD models to a DAE format because it preserves materials, animations etc. Another advantage is that we can modify the DAE file from Xcode IDE (e.g. adds lights to the scene, group different nodes, etc.).
During this process, we have identified that we require a CAD software and another software specialised in 3D animation in order to obtain high quality DAE models.
For this purpose, we have tested different CAD software (Catia V5, SolidWorks, ProE and 3Dexperience) to see which can export the highest quality files that are also compatible with the 3D animation software. For the 3D animation software, we tested 3DS Max which is exceedingly complex for our requirements and we ended up using Blender.
After several attempts, we discovered that the best method is to use SolidWorks (because the native files were created in SolidWorks) to convert the whole assembly into separate STL files (STL files are 3D models composed of vertexes with no material or texture properties). After this, STL files

were imported into Blender where they were rescaled and a vertex dismissing process was applied. The dismissing process was required because the original files were too big and too complex to be used in an AR application which is supposed to run on a smartphone. This operation reduces the size of the app by reducing the number of vertexes (e.g. a 110 MB 3D model with 18000 surfaces – approx. 500000 vertexes is reduced to a 11 MB file). This whole process created the required DAE files onto which we could apply material and use in our AR apps.
Further, the interaction methods with the digital content were developed (Figure 3). The following gestures can be used to interact with the loaded 3D model: Taping on the screen: Selects the model, Highlights a node (part) of a model if tapped on a model, Can provide additional information about the node and changes the position of model to the tap position if tapped outside of superimposed model. Pan: Changes the position of the selected model in the 2D plane. Pinch: Changes the scale of the model. Rotate: Rotates the model around its vertical axis. Double Tap: Hides the double tapped node. Long Tap: Makes a hidden node visible again.

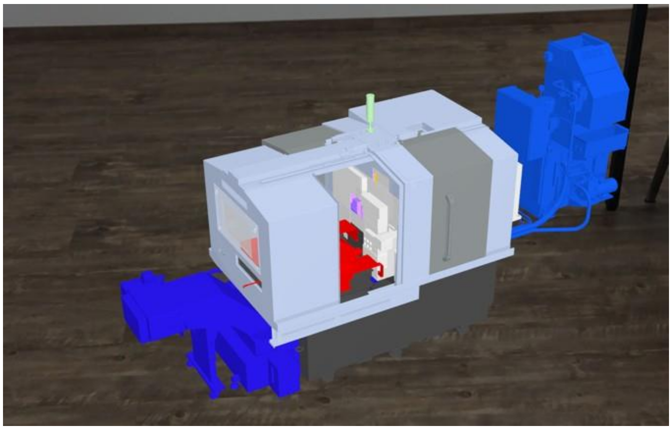

Figure 3. AR superimposed 3D model with interaction capabilities

The last part of the AR app development consists in choosing the right tracking methods for each scenario. Three different tracking methods were tested:

- 2D markerless tracking – this method is used to superimpose 3D models over 2D representations. We used it to superimpose 3D models over Maier's brochures.
- 3D markerless tracking – this method is used to identify 3D landmarks from the physical world and use them as markers for the superimposed 3D models. We use this method to superimpose digital content over the required equipment.
- World tracking – this method maps a large part of the physical environment and enables the placement of digital content within the charted area. We use this method to superimpose 1:1 scale 3D model in a designated area (Figure 4).

Remote assistance AR app:
For the AR assistance app, we studied multiple solutions from the hardware and software point of view:

- AR assistance using AR glasses for both the client and Maier's expert. Even though this solution is viable it has a big disadvantage. The client is obliged to purchase AR glasses compatible with the ones used by Maier's experts. Moreover, AR glasses technology has its limitations

(computing power, battery life, restricted mobility, etc.) and may violate some privacy and safety laws.

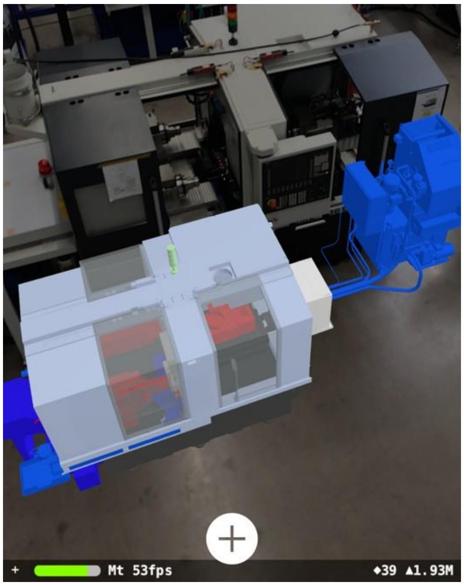

Figure 4. 1:1 scale model (mobile device screen capture)

- AR assistance where only the client uses AR glasses. This solution excludes the compatibility issues, but it does not eliminate the other disadvantages. Additionally, this approach may create supplementary issues regarding connectivity.
- AR assistance using two mobile devices. This approach seems to be the most viable, since almost anyone has access to a smartphone with internet connection.

Regarding the software, several options were tested, commercial (TeamViewer Pilot and Vuforia Chalk) and self-developed. We opted for the commercial solution for this kind of application for the following reasons: high infrastructure requirements, privacy and security concerns, support for multiple devices with different OS and automatic quality selection.
After testing the TeamViewer Pilot and Vuforia Chalk we opted for the Vuforia option due to the advanced 3D annotation possibilities. We have made several tests with the Vuforia Chalk during the remote consultancy sessions. We determined that by using the Vuforia Chalk it significantly improved the communication between us in comparison to a traditional videoconference (Figure 5).

RESULTS AND DISCUSSION

As a highly mediated technology, we expect that by using the AR marketing app at industrial fairs and in other events where there are interactions with potential customers, it will have a great positive influence on the client's decision in using Maier's equipment. However, another feature that the AR marketing app enables, is that the client can make a pre-validation (before purchasing and during the equipment production) which will test if the machine will fit, that it won't interfere with other equipment and that it is placed in an ergonomically corresponding position.

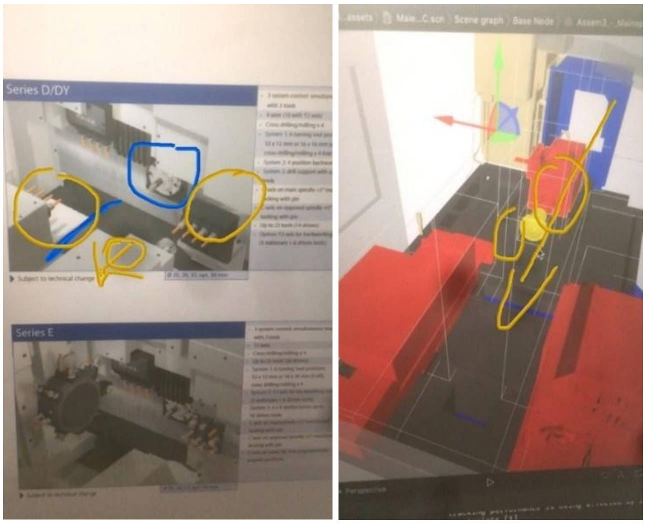

Figure 5. Vuforia chalk session (mobile device screen capture)

Currently the product exploitation and marketing AR app (Maier AR) is available on Apple's App Store free of charge. By evaluating Apple's App Analytics Data (Apple, 2019) for our app we can say that it has reached its expectations. Since its launch in 5th of June 2019 till 10th of August the app has been visualized in the App Store by 760 different devices from which 85 visited the product page (Figure 6). All these results were obtained without any marketing for the app.
We also expect that the AR remote assistance app will improve the communication with the clients when remote assistance is required, consequently lowering the intervention times. This translates into a drastically reduced maintenance time (with significantly reduced costs due to the travel expense) and higher uptimes.
Regarding the investment required to implement these AR apps, we can confirm that in our case is very low because we used existing equipment (smartphones and tablets). The only significant investment is the application development costs which include software development, CAD to AR 3D model conversion and the application maintenance and update costs. An operational costs estimation is: Apple Developer account (88EUR/year) for the marketing app; Remote assistance AR app services (from 25EUR/month); Up to 2 months a full-time payed employee that will have the task to maintain and upgrade the AR app.
The most important limitations that we encountered are due to the hardware limitations of the devices we used. E.g. some older smartphones got very hot when using the AR app and crashed. Additionally, we found out that the fluorescent lighting sources strongly interferes with the real-world tracking system due to the flicker rate that it's invisible to the human eye but highly visible on a variable fps video capturing device (such as the one that we are using for AR).

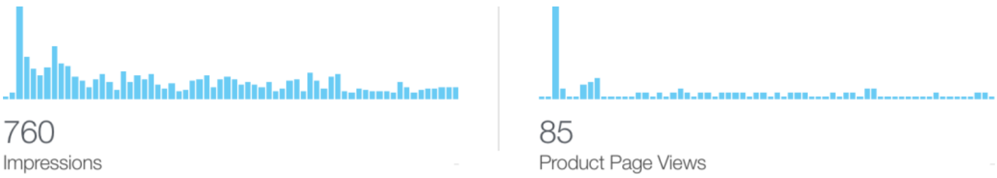

Figure 6. Apple's App Analytics Data for Maier AR app (Apple, 2019)

CONCLUSIONS

From this experience we can conclude that academic research is greatly improved when it is applied in real uses cases from industrial partners. During this project we encountered obstacles and developed solutions which in other surroundings would not have occurred.
Regarding the developed application, it turns out that the product exploitation and marketing AR app increases the company's popularity and will attract new clients in the future. Another major impact is that the AR remote assistance app improves the communication with the clients when providing remote instructions. This AR app enables Maier's skilled employees to perform remote tasks with higher efficiency, lowering the time required for these operations thus lowering the intervention costs.

ACKNOWLEDGEMENT

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Training Concept for Raising Awareness and Building Skills for the low Carbon Economy

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ABSTRACT

Decarbonization and achieving a low carbon economy and lifestyle are important goals for the next generations of young people. The concept proposed in this paper aims to introduce the Romanian students, on a voluntary bases, to the field of climate change mitigation through decarbonization, by organizing a series of workshops and trainings. We will address topics like renewable energy, circular economy, zero waste systems, cleaner production, new resources, innovation management and smart solutions. The participants to the events of the project are intended to become "message bearers" and to act as change agents in their future work places. A community will be formed in the virtual environment (Facebook page, email group, Twitter account, YouTube channel) with all the persons involved in the activities of the project, that will permit the continuation of information and good practices exchange.

Keywords: *decarbonization, training, low carbon economy.*

INTRODUCTION

Decarbonization and achieving a low carbon economy and lifestyle are important goals for the next generations of young people. This is a very big challenge as our entire way of life is built around using fossil fuels. The challenge not only applies to energy and transportation, but also to construction materials, plastic industry, agriculture and even synthetic fibers for clothing. In this effort, a significant role should be played by engineers and economist that help design new products and new technologies. Once they have a mindset adequate to diminishing the carbon footprint on a large scale, which is achievable through higher education, the currently developing contributions of researchers in this area will enter mainstream circulation and will be applied globally, thus truly lowering the amount of carbon dioxide that is released into the atmosphere and limiting the consequences of climate change.

THE CONCEPT’S VISION, AIM AND GOALS

According to the available 2018 data (European Environment Agency, 2018), the EU will met the 2020 reduction target but will miss the one set for 2030, with the energy sector and manufacturing having the largest footprints. This, however, is considered a minor setback in a very ambitious plan for a “climate-neutral Europe by 2050” assumed in November 2018 (European Commision, 2018). While the technical dimension is very well discussed in studies and publications, and the framework conditions are starting to be addressed from a scientific perspective, in (Busch, Foxon, & Taylor, 2018) or (Rogge & Dütschke, 2018), we have found that the human dimension and especially training approaches in this are rather underrepresented.

The concept proposed in this paper aims to introduce the Romanian students, on a voluntary bases, to the field of climate change mitigation through decarbonization, by organizing a series of workshops and trainings. The goal of this approach is aligned with the need to help speed up changes in attitudes, know-how and practices in universities and academic communities with respect to the ongoing challenges the world economy faces in relation with climate change. By organizing dissemination events and free training programs in universities, we aim to help new generations of students become aware of and understand the impact their decisions in manufacturing or service companies will have on the environment.

The workshops will help in raising awareness regarding this topic and will contribute to revealing the link between engineering, product development, marketing and changes taking place within the global climate system. We will invite experts and public figures that have a good public track record in this area to deliver presentations and answer the questions of the students from the bachelor and master programs.

The training will focus on developing the proper skills to address these challenges and will constitute a complementary and additional specialization to the one given by their home universities. We will address topics like renewable energy, circular economy, zero waste systems, cleaner production, new resources, innovation management and smart solutions.

By basing the presentations on scientific knowledge and good economic and engineering practices, as well as on international policy recommendations in this area (such as those from UN's IPCC or the EU), we will ensure that future professionals will gain an accountability related dimension to their higher education experience. Also, we believe that a multiplying effect will be generated and once a group of participants will be trained, they will pass on their know-how to their peers and co-workers, thus helping further extend the impact of this proposal. At the same time, we hope to generate interest and emulation on the topic in such a way that similar or larger scale initiatives could be implemented with the same goals or that the universities in Romania will pick-up this good practice and integrate in into the regular curricula for some of their study programs.

Due to their involvement in the local communities, the host universities could act as conduit for the topics on which this course is focused to become more mainstream in Romania. University cities have vibrant communities of engaged and socially active young people that can push further the ideas of low carbon economy in the companies they work and groups they belong to.

The main beneficiaries of the proposal will be university students. The background of these students will be in engineering (mechanical, electric, civil etc.) and economic sciences. They will be in a good position to enter the workforce in positions that will handle new product development, material choice and technology selection, thus having the potential to impact the transformation towards the low carbon approach of the Romanian economy.

Students represent a very powerful instrument to help change the way Romanian society approaches these issues. Because of their youth and enthusiasm, the know-how they will accumulate regarding climate change threats and way to mitigate them by reducing the carbon footprint, has an increased chance of being disseminated into the society and then accepted over the long run. Each of the students targeted by the concept could become an agent of change and inspiration to other people from their peer groups, families and communities.

EMPIRICAL RESEARCH FOR FOUNDATION DEVELOPMENT

In order to develop a concrete form of the proposed approach, the authors conducted an analysis of the requirements of the target group based on the current trends in decarbonization science and educational good practices. A focus group of 14 students in engineering sciences has been assembled and questioned about three categories of requirements related to the foreseen program: content, delivery and administrative issues. They have been presented with sets of requirements proposed by the researchers in each direction and, after discussion and clarification, asked to rank them using the Analytical Hierarchy Process as implemented by the software Qualica QFD. First, the three categories were ranked, then the requirements inside each of them and then, the final results were generated by compounding the intermediary values and normalizing the outputs (Figure 1). Care has been taken that the consistency index, which measures internal coherence of the pairwise comparisons, to be below the quality threshold of 10%, with the actual values ranging between 3.00% and 9.95%.

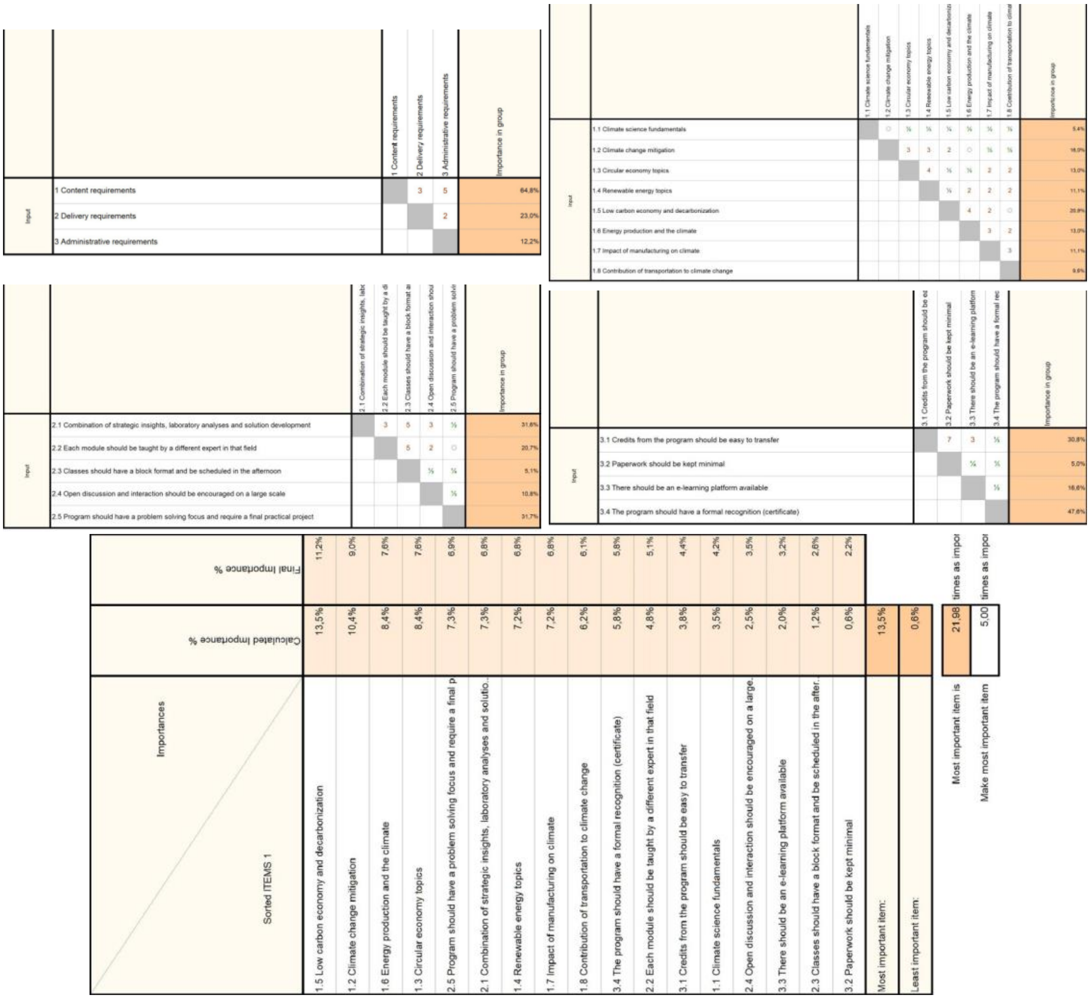

Figure 1. Ranking of (clockwise): general, content, delivery, administrative requirements and final results

As it can be seen, the first four resulting elements are content related aspects, defining the first four topics to be addressed in the study program, and the two next ones are related to delivery, which should approach both policies and technical solutions in a practical and hands-on manner.

PRACTICAL DEPLOYMENT OF THE CONCEPT

The concept is designed to be deployed through 3 main steps: Scouting and communication, Organizing workshops for raising awareness and Organizing training sessions for developing skills, completed hopefully by a follow-up and systematization / institutionalization phase (Figure 2).

Figure 2. Proposed training concept phases.

The *Scouting and communication activity* will have the goal to attract the participants to the workshops and trainings organized in subsequent activities. Since decarbonization of the economic / industrial activities is not well known in Romania, this task aims to transform the "cold" market into a "warm" one, by presenting to possible participant niches the importance and opportunity of the topic. The actions to be performed will be divided into two main areas: Preparing the communication message and materials, based on scientific studies and marketing best practices, and Distributing the materials and message in printed and electronic form, as well as giving live presentations in universities. Participants lists will be drawn up and continued communication will ensue to help the attendees make the decision to participate in the project activities.

Organizing workshops for raising awareness will be a task focused on organizing 1-day events in the universities contacted in phase 1 that agree to collaborate on this subject. The workshops will include presentations and discussion sessions, as well as coffee breaks and lunches for professional networking. Each workshop will have 1-2 speakers which are experts in one or more areas related to decarbonization, which will be joined also by a local team from the host institutions. General and broad-view topics on climate change mitigation and low carbon strategies in various fields, as well as in everyday life will be presented and discussed. The participants will also be encouraged to make a longer time commitment and join the training sessions proposed later. As components sub-activities, this activity will be divided into Preparation of the workshops, including agenda development, speaker invitation and contracting of services (based on sponsorships) and Delivery of the workshops, which contains the actual events.

In the last phase, *Organizing training sessions for developing skills*, several students at each institution will be enrolled in a longer training program aimed at delivering skills related to decarbonization and low carbon economy, using face to face and web-based training sessions held by specialists in the field. In total, there will be 3 full days of training spread over 3 months and the participants will receive certificates of attendance at the end.

The effectiveness of the envisioned activities will be measured directly and indirectly. The promotion actions included in first activity will be measured during and after implementation, using web-related metrics (web page hits, social media post engagement) and feedback questionnaires. During the events to be organized within the scope of the second and third stages, the participants will receive detailed feedback questionnaires to check their understanding of the topics and quality of the events, including organization issues, the delivered content and the discussions with the speakers and trainers. The data collected in this way will be processed and analyzed to improve activities as they go along and to tailor the sustainability strategy focusing on the long-term impact of the initiative. Since the main goal of the program is to determine a change in the public and specialized knowledge related to the topic of low carbon economy and the way in which product and process redesign can lead to a reduced carbon footprint, we consider that effective communication is as important as the content of the workshop and training activities. Also, after the conclusion of the events, the participants will be contacted via email to gauge their continued involvement with the topic of decarbonization through surveys and email interviews. The social media pages to be developed will also serve as indirect means to assess the success and impact of the project activities on the participants by determining the way in which they apply the learned skills in their day to day careers. Statistical determinations will be performed on the aggregated data and the conclusions will form part of a sustainability plan a list of recommendations to be sent to the leadership of the host universities.

CONCLUSIONS AND OUTLOOK

The participants to the events included in the concept are intended to become "message bearers" and to act as change agents in their future work places. A community will be formed in the virtual environment (Facebook page, email group, Twitter account, YouTube channel) with all the persons involved in the activities of the project, that will permit the continuation of information and good practices exchange. As they are expected to progress along their career paths, they will gain more expertise and know-how and will be able to also share it with their colleagues for peer-based learning. The goal of this sustainability mechanism is to create over time a community of specialists capable of producing change in their organizations and capable to assist other organizations in their community in a voluntary manner.

Institutionally, the host universities will gain the possibility to transform this experience into an example and pilot test for developing new teaching approaches in their fields (technical or economic sciences) that could reach future students either through entire study programs integrated in the topic of decarbonization or through specific courses that can be included in other, more traditional programs. In the first category, possible programs that should be investigated included Renewable energy, The circular economy, Electric vehicles, Carbon recapture technologies or Decarbonization of manufacturing. In the second category, the courses that will be targeted include Solar energy systems (civil engineering), Biofuels (automotive engineering), Smart materials (mechanical engineering), Industry 4.0 solutions (industrial engineering), Sustainable agriculture and Sustainable tourism (economic sciences), etc. We are hoping to determine the leadership of the host institutions to acknowledge this need and take bold action in committing the educational development of future generations of students on this path, as well in advancing scientific research in the field. It is our belief that continued attention to the topic of decarbonization from all members of the academic community is necessary at this time in history.

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Value Chain Planning in Cross-Industry Meta-Cluster Initiatives

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ABSTRACT

Cross-industry meta-cluster initiatives may play a crucial role in speeding up conceptualization and launching of viable innovations. In this context, this paper introduces a methodology for integrated planning of hybrid value chains. Using a roadmap of interrelated planning matrices, appropriate projects, mechanisms and institutional constructions can be formulated and cross-industry meta-cluster initiatives can be built in a structured, systematic and systemic way. Theory is exemplified for planning new generations of innovations at the intersection of ICT and agriculture sectors. The case study shows the potential of the methodology to provide a comprehensive qualitative and quantitative assessment of the current state and to highlight the major challenges for reaching a competitive viability of the emerging innovations within a hybrid innovation eco-system.

Keywords: *meta-clustering, cross-industry collaboration, value chain, integrated strategic planning, product-service systems, innovation, emerging industries, agriculture 4.0.*

INTRODUCTION

Modern economies are strongly based on science and technology (Chen, Lu, 2016, p. 54). Internet and other communication technologies have facilitated the development of global value chains in almost every economic sector, including financial, industrial and agricultural ones. Also, the value chains of service sectors have evolved in strong dependence with the evolution of mobility and information technologies (Singh, 2016). These evolutions have led to an even higher relevance of economic clusters in relation to economic competitiveness and differentiation of geographic regions (Barbara et al., 2016, p. 226).

Economic clusters are usually related to sectorial economic fields (Resbeut, Gugler, 2016). They agglomerate in geographical proximities a critical mass of companies in particular fields, together with suppliers, service providers, and associated institutions (Porter, 2008). Despite the proved value of suppliers' proximity for cluster productivity, construction of complete value chains in a small geographical area is not always possible due to different reasons, including availability of all pieces of know-how and human resources (Ketels, Memedovic, 2008, p. 378). Therefore, in many economic sectors, trans-regional meta-clusters are important for regional economic development (Welck, 2012). Due to their demonstrated advantages for developing high-end complex products, services and technologies, meta-clusters have gotten important positions on policy makers' agenda. Beyond the need to cover a complex value chain, trans-regional meta-clustering is well-aligned with regional smart specialization (Foray, 2015). Through the extended connection, synchronization and

harmonization between sectorial clusters from different regions, local industries can better adopt and follow strategies for product and service differentiation.
Although sectorial meta-clustering is important for improving economic competitiveness, nowadays breakthrough innovations are happening at the intersection of more economic sectors (Jong et al., 2013). Cross-industry meta-clusters are key elements in setting up new economic sectors, also called emerging economic sectors during their early phase of life-cycle (Monfardini et al., 2012). A simple survey in the scientific literature reveals a lack of knowledge on how to approach integration of sectorial innovation eco-systems in an effective way such as to sustain cross-industry product-service systems. Strategic aligned cross-industry meta-cluster initiatives might significantly contribute to the realization of such desideratum. In line with this goal, a methodology for integrated planning of the value chain for developing new market offers at the intersection of more industrial sectors is introduced in the following sections of the present paper. It also considers the framework of meta-cluster initiatives as a necessary component to build the cross-industry innovation eco-system. From this narrow perspective, this paper is looking for strategic planning of new systems.
Before the description of the methodology, a literature review in the field of strategic planning of value chains is presented. The goal is to highlight transferable know-how from a more general field to a narrow subject. The third section of the paper provides details of the methodology. It is grounded on a roadmap of interrelated matrices, where generic requirements of the markets are deployed into generic product-service systems and further into sectorial value chains, which at their turn are deployed into the integrated innovation eco-system related to emerging cross-industry sector. Current gaps are visualized and quantified in terms of criticality. They are analyzed in three major directions for consolidation of the emerging innovation eco-system: suppliers, policies and smart specialization actions plans. The graphical format of the methodology captures in a condensed manner the whole picture for strategic planning of the cross-industry meta-cluster initiative. This facilitates definition of appropriate projects, mechanisms and institutional constructions. From this point, practitioners can systematically build cross-industry meta-cluster initiatives. This methodology is seen as a practical tool to provide an answer to the following research question: how to construct a meta-cluster initiative in close symbiosis with the needs of building up an emerging economic sector and how to balance distribution, allocation and prioritization of resources to maximize results and minimize time-to-viability of that sector? The proposed framework in this paper is exemplified for the emerging sector of agriculture 4.0; that is, the intersection of information technologies, Internet of Things, robotics and agriculture to develop the cross-sector of smart agriculture. The case study considers in its foundation the specificity of the Balkans meta-region of Europe. Conclusions from this research are extracted and highlighted in the last part of the paper.

BACKGROUND

For the purpose of this research, literature review is focused on issues about value chain strategic planning. Thus, the attention is paid on tools and frameworks that help in defining development strategies, directions of evolution, and resource allocation considering also the inevitable constrains. To this, a particular investigation of current researches to plan value chains for cross-industry sectors is also considered. The basic tool for understanding how value is created in a given economic sector and related organizations is proposed by Porter (Porter, 2008). This model describes the value chain in a way that is common to all businesses. From this angle, Porter’s value chain representation is very useful in the construction of strategic plans for a given economic sector. Value chain is often treated in literature only from the narrower perspective of supply chain or supply network. This is a traditional view on value chains, considering only the external suppliers along the flow of value creation for customers. Also, planning is mostly viewed in terms of quantities to be supplied, and less on planning from the perspective of strategic formation of the network of suppliers. A relevant work in this respect is done by Sahling and Kayser (2016), where

stochastic analysis and linear programming formalisms are used in the network planning problem. The limitation still remains in the identification of the types of vendors and in the conceptualization and construction of supplier network that best fit to an emerging business model and product-service system, in a business environment with various constrains. In the same line, with similar applicability limitations, is the research reported in (Badri et al., 2016).
A multi-objective mixed integer linear programming model is proposed by Mota et al. (2015) to approach the problem of designing and planning sustainable closed loop supply chains from a broader perspective, which includes decisions on facility location, definition of transportation modes, technology selection and allocation, as well as tactical decisions. It lacks the same issues as mentioned with respect to the previous two references in this paragraph, namely before optimizing a network system it is necessary to have that system in place. An indication on mapping value chain network at a strategic level is given in the paper (Kang, 2016). This work introduces an approach for segmenting customers and suppliers and analysing them from a strategic and geographic perspective in the case of an emerging industrial sector (i.e. renewable energy). It is a valuable work on how responsible public authorities must contribute to the creation of large scale innovation ecosystems. Still, the approach proposed in this research does not move further, on investigating innovative paths to construct the clusters and cluster networks to support the materialization of the emerging economic sector.
Park and Lee (2015) highlight the importance of constructing the value network from the very early stage of product and product-service system conceptualization and design. This is a very important message from a strategic point of view. Best value co-creation requires optimization of network suppliers from the very early stages of new product formation. But, for doing this, a preliminary step is about identification of potential participants in the value co-creation effort. For many emerging industrial sectors, it might be possible to occur gaps in the value chain because of lack of suppliers, either locally or globally. In such cases, strategic projects have to be considered for the creation of those suppliers that are necessary to cover the gaps.
A detailed survey on literature databases was conducted to identify research reports on value chain planning for cross-industrial sectors. Till this moment, no paper in this niche of research is reported in international specific databases. The same lack of results is in the area of strategic planning of network partners in the construction of an emerging industry, despite the relevance of this problem for creation of new markets, as well as for revitalizing economies in the periods of extended crises. This gap is fructified in the current paper by conducting researches to set up a systematic construct for planning emerging industries from the perspective of strategic aligned cross-industry meta-cluster initiatives.

METHODOLOGY

This section introduces a structured roadmap for planning the development of value chain networks for emerging industrial sectors or sub-sectors, characterized by provision of innovative products and product-service systems at the intersection of two or more traditional industrial sectors. Emerging industries are characterized by a high growth potential, being usually driven by key enabling technologies (Monfardini et al., 2012, p. 10). Considering the key characteristics of emerging industries, a viable methodology for strategic planning requires the presence of the following elements: generic needs and demands of the market such as to enable structural changes, generic components of possible (not yet complete defined) emerging product-service systems in the respective economic sector, primary and support processes of the interlinked economic sectors, players capable to cover the interconnected hybridized value chain, mechanisms to identify the robustness of the innovative ecosystem, as well as areas for differentiation in a global market of the related economic clusters. It was concluded that deploying needs and demands coming from society and environment into the components of value chains is an adequate approach to plan the ecosystem of the emerging industry. In the following part of this section, the proposed methodology is introduced:

- Step 1: identification of the major driving factors (or attractors) that justify the emergence of a cross-industry sector
- Step 2: extraction of the emerging market, of its generic customers, as well as of their generic demands and needs
- Step 3: formulation of the generic product-service systems portfolio, competences and business models required for the emerging cross-industry sector
- Step 4: deployment of step 2 into step 3 in order to see the robustness of solutions formulated in step 3
- Step 5: formulation of primary and support activities in the value chain of all industrial sectors included in the hybrid sector
- Step 6: planning the cross-industry ecosystem
- Step 7: formulation of the smart specialization strategy of the meta-cluster
- Step 8: aligning smart specialization with meta-cluster resources

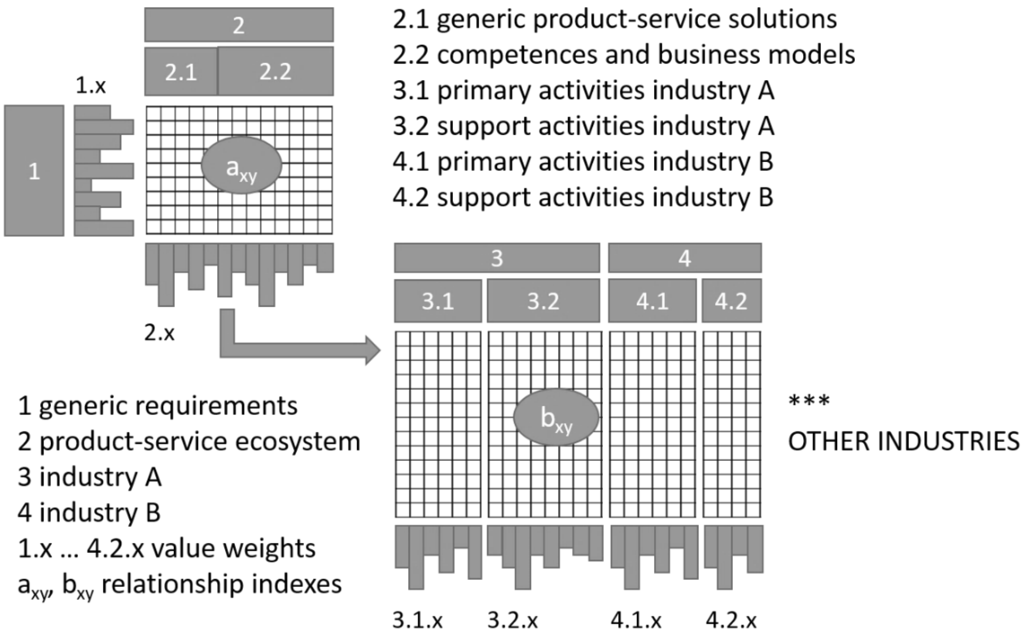

Figure 1: Graphical representation of the first five steps of the methodology.

A top-level graphical representation of the first five steps of the methodology is illustrated in Figure 1, whereas Figure 2 provides details of the last three steps of the methodology. With reference to Figure 1, the ranks 1.x of the input generic requirements (demands) can be determined via several approaches. A possibility is to ask opinions of an expert group and to allocate the mean values of the individual opinions. Another possibility is to use more sophisticated approaches, such as Analytical Hierarchy Process (AHP) (Angiz et al., 2012). Relationship indexes a_{xy} in Figure 1 describe the strength between generic requirements and generic elements of the product-service ecosystem. Value weights 2.x in Figure 1 reflect the relative impacts of the product-service ecosystem's elements to satisfy the generic requirements. They are calculated in absolute values as Σ_y (1.x $\cdot$ a_{xy}), and then converted into percentages (Cohen, 1995). Value weights for the primary and secondary activities are calculated using the same procedure, but instead of the ranks 1.x and indexes a_{xy}, the value weights 2.x and indexes b_{xy} are considered.

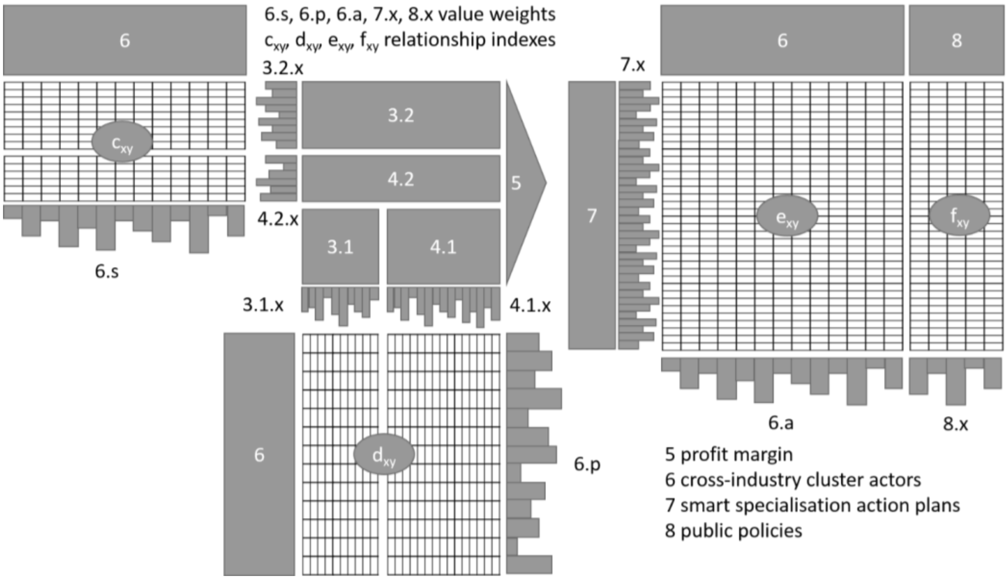

Figure 2: Graphical representation of the last three steps of the methodology.

With reference to Figure 2, the relationship indexes c_{xy}, d_{xy}, e_{xy}, f_{xy} belong to the set of variables {0 – no; 1 – weak; 3 – more than weak; 5 – medium; 7 – less than strong; 9 – strong}. Ranks 7.x for the action plans in the smart specialization strategy can be defined through various approaches, as in the case of ranks 1.x. The value weights 6.s, 6.p, and 6.a reflect the impacts of cross-industry cluster actors from different perspectives: support activities, primary activities, and smart specialization. The value weights 8.x highlight the impacts of public policies towards realisation of smart specialization. Value weights 6.s, 6.p, 6.a, 8.x are calculated with the same procedure as in the case of 2.x. If the cross-industry sector is constituted from more than two traditional industrial sectors, additional matrices will be added both in Figure 1 and Figure 2.

CASE STUDY

The next section of this paper illustrates the application of the proposed methodology for the emerging sector called “agriculture 4.0”. Particularities are considered for the meta-region of Balkans, where a cross-national cluster networking initiative exists since 2014. Results are shown in Figure 3 and Figure 4. Deployment of the cross-industry ICT-AGRI product-service ecosystem into the extended ICT-AGRI value chain is not illustrated in this paper because of the size of matrices. This study identified that major challenges in the Balkans region for setting up competitive ICT-AGRI solutions on the ICT side stands in the following areas: integration and installation of ICT-AGRI solutions in farms, market education and training resources of end-users, as well as in after-sale services.

Stakeholders	Demands	Rank	genetic modelling and simulation	data mining for agro-research	just-in-time supply for farmers	irrigation optimization	fertilise optimization	field monitoring	smart farms	insect protection of fields	environment and weather tracking	smart greenhouses	weather protection	pipelining	IoT connected agro-machineries	IoT technologies for farms and fields	robotic agro-machineries	pest detection	precision agriculture	connect consum…	smart…
			Product-service systems																		
Consumers (0.4)	Fresh products	0,1				4	5			6	1,5								3,5	16	12
	Organic (bio) agriproducts	0,1				14	16	6	1,5	17	2	7	5,5			6		12	9	6	
	Highly diversified agriproducts	0,05				4,5				12	7		12					6	5,5		1
	Delivery at the door in due time	0,05	6						3							6				14	9
	Affordable prices	0,1	12		7	5,5	12			9	2	7	5,5			9	6	5,5	3	1	
Farmers (0.4)	Cost-effective solutions to seed large fields	0,1	12				9		2		6					4	12		9		
	Cost-effective field protection against bad weather	0,1	14			1					9	6	10	2,5		5,5			6		
	Affordable technologies in terms of investments	0,1							9		9				9	3	9				
	High productivity of crops	0,1	14	6		12	12	3	6	14	9	6	9	6		3		6	9		
Machinery producers (0.2)	Capabilities for remote monitoring	0,1			6	6	6	9	9	6	9	9	9	7	16	9	6		6		
	Control and maintenance of solutions over the life-time	0,1						6	8			8		8	14	14	8		6		
			5,5	0,6	1,3	4,475	6	2,4	3,7	5,8	5,1	4,3	4,5	2,35	3,9	5,65	4,1	2,65	5,425	3	1,7
			3,3435	0,3647	0,7903	2,7204	3,6474	1,459	2,2492	3,5258	3,1003	2,614	2,7356	1,4286	2,3708	3,4347	2,4924	1,6109	3,2979	1,8237	1,0334
			7,8571	0,8571	1,8571	6,3929	8,5714	3,4286	5,2857	8,2857	7,2857	6,1429	6,4286	3,3571	5,5714	8,0714	5,8571	3,7857	7,75	4,2857	2,4286

Stakeholders	Demands	Rank	precision agriculture	connect consumers with producers	smart silos and warehouses	distribution tracking	food safety and sanitation control	smart packaging	food tracking	food production remote monitoring and sanitation control	smart delivery	on-line direct sales	just-in-time supply for consumers	door-to-door retailing	recycling and reuse of waste	data-based decision making	cloud computing	natural user interfaces	integrated information systems	agriculture intelligence	producer aggregation	alternative food distributi…	new chains f…	c…
			…ms														Competences							
Consumers (0.4)	Fresh products	0,1	3,5	16	12		1	11	9	6		9		6	6							9	6	6
	Organic (bio) agriproducts	0,1	9	6			6		6	6		9		6						9	3		6	9
	Highly diversified agriproducts	0,05	5,5		1			1								9	3			9		3	1	12
	Delivery at the door in due time	0,05		14	9	9			7		9	7	14	9					3			11	6	6
	Affordable prices	0,1	3	1		1					1,5	10									12	12	3	6
Farmers (0.4)	Cost-effective solutions to seed large fields	0,1	9													6	6		3	12	10			
	Cost-effective field protection against bad weather	0,1	6													9	6		3	12				
	Affordable technologies in terms of investments	0,1														9		12	7		12			
	High productivity of crops	0,1	9												7	10	3			9	9			
Machinery producers (0.2)	Capabilities for remote monitoring	0,1	6			14	14			12						9	9	9						6
	Control and maintenance of solutions over the life-time	0,1	6														3	9	12	6				
			5,425	3	1,7	1,95	2,1	1,15	1,85	2,4	0,6	3,15	0,7	1,65	1,3	4,75	2,85	3	2,65	5,25	4,6	2,8	1,85	3,6
			3,2979	1,8237	1,0334	1,1854	1,2766	0,6991	1,1246	1,459	0,3647	1,9149	0,4255	1,003	0,7903	2,8875	1,7325	1,8237	1,6109	3,1915	2,7964	1,7021	1,1246	2,18
			7,75	4,2857	2,4286	2,7857	3	1,6429	2,6429	3,4286	0,8571	4,5	1	2,3571	1,8571	6,7857	4,0714	4,2857	3,7857	7,5	6,5714	4	2,6429	5,14

Stakeholders	Demands	Rank	producer aggregation	alternative food distribution	new chains for waste reduction	collective public-private initiatives for food hubs	technology-as-a-service	cut-off intermediary chains	agile mobile retailing	co-ownership of the supply chain	created shared value	agile intermediaries	shared facilities for product deposition and animal housing	networking of technologies from various producers	circular economy-driven production-distribution-recycling	short delivery chains	high-value added agro-product in familial farms	system integrators for smart farms	urban agriculture in vertical farms
			Business models																
Consumers (0.4)	Fresh products	0,1		9	6	6		12	9	6			7		12	14	9		9
	Organic (bio) agriproducts	0,1	3		6	9		9	9	3	9				9	9	12		9
	Highly diversified agriproducts	0,05		3	1	12		9	5	9		6			9		9		9
	Delivery at the door in due time	0,05		11	6	6		12	12	6			7			12	6		12
	Affordable prices	0,1	12	12	3	6		13	13	6	6	6	9			13	6		6
Farmers (0.4)	Cost-effective solutions to seed large fields	0,1	10				8												
	Cost-effective field protection against bad weather	0,1					9												9
	Affordable technologies in terms of investments	0,1	12				15					7	7	7				6	
	High productivity of crops	0,1	9																
Machinery producers (0.2)	Capabilities for remote monitoring	0,1				6	17					6	6	11				11	6
	Control and maintenance of solutions over the life-time	0,1					14							6				7	
			4,6	2,8	1,85	3,6	6,3	4,45	3,95	2,25	1,5	2,2	3,25	2,4	2,55	4,2	3,45	2,4	4,95
			2,7964	1,7021	1,1246	2,1884	3,8298	2,7052	2,4012	1,3678	0,9119	1,3374	1,9757	1,459	1,5502	2,5532	2,0973	1,459	3,0091
			6,5714	4	2,6429	5,1429	9	6,3571	5,6429	3,2143	2,1429	3,1429	4,6429	3,4286	3,6429	6	4,9286	3,4286	7,0714

Figure 3: Deployment of demands in the value chain.

Problems are also identified in the areas of ICT service integrators and service providers on data analytics. There is a huge gap in the area of ICT hardware resellers and hardware waste management, especially on refurbishing and reusing. On the agricultural side of the cross-industry ecosystem, top issues with missing capabilities in the Balkans region are referring to land irrigation, fertilising and mostly to crop protection using natural (organic, bio) solutions. For developing a competitive smart agriculture, gaps have been identified with respect to drying, cooling and eco-storage of agriproducts, as well as with respect to regional capacities for international trading. Waste management is another drawback in the Balkans region, with lack of capabilities in place, as well as financing of the sector (e.g. loans, insurance). Also, interdisciplinarity in ICT-AGRI research is close to zero in this region, even if there are very good sectorial capabilities. Still, such research units act independent, with no action plan for integration in order to generate ICT-AGRI innovations with high technical impact and practical relevance. Smart specialization actions are deployed into the key stakeholders for the ICT-AGRI sector and into recommended public policies to be run by the national governments in the Balkans region to support the emerging sector of smart agriculture. Results are introduced in Figure 4.

			Top level stakeholders (detail them for deeper planning)									
Code	S2 action	Rank (calculated with AHP method)	Cluster initiatives	Suppliers	IFCs	Universities & Research units	Partners (e.g. media, banks)	Intermediaries	Markets	Other regulatory bodies	Gorvenments	Clusters' members
S1	Develop strategic aligned meta-cluster ICT-AGRI initiatives	6,4	9	5	3	1					1	9
S2	Run promotional actions to inform and educate various stakeholders	5,1	9		7	3	7					
S3	Identify niches for developing PSS solutions/technologies	5,2	5	3	3	9		1	9	5		9
S4	Facilitate and run organized task-forces for entrepreneurial discovery	5,4	7	3	5	9		1	9			9
S5	Facilitate and run R&D projects for integrated ICT-AGRI	6,7	3		3	9					9	5
S6	Run KT in ICT-AGRI	2,9	3		3	7					9	5
S7	Facilitate the creation of pilot smart farms, smart fields and living labs	5,3	5	3	1	9					9	7
S8	Organize T-V actions to support the construction of a complete value-chain	6,6	9		3	1		3				
S9	Develop specialized business accelerators for ICT-for-agriculture start-ups	4,9	5		9	9		3			9	5
S10	Construct alliances for S2 in SA and facilitate the creation of related BM	7,6	9	5	7	1		9	3			9
S11	Develop and run smart schemes for financing businesses	7,8	1		3		7	3			9	
S12	Run MSc study programs on smart agriculture	2,9	1			9					3	
S13	Run Open Education programs	2,9	9		3	9		3				
S14	Support consulting to absorb public funds	5,1	5		5	9		9				
S15	Educate market to change behaviour	5,8	9		7	3		3		9		3
S16	Consolidate the regional value chain with extra-regional players	1,5	5		9	1		9	1			9
S17	Support innovative models of resource sharing	3,7	3	1	3	1		5			3	9
S18	Put in place adequate legislation	5,9	1		3					9	9	
S19	Define and support the activation of circular economy	4,3	5		3	3	3	3		9	9	
S20	Run studies to better understand the potential of all agricultural areas	1,5	3		9	9					9	
S21	Facilitate inter-governmental treaties and agreements	2,5	1		1		3				9	
			542,4	121,4	418,1	450,8	110,7	253,8	119,7	170	402,4	395,2
			18,174	4,0677	14,009	15,105	3,7092	8,5039	4,0107	5,6961	13,483	13,242
			4,8997	1,0967	3,7769	4,0723	1	2,2927	1,0813	1,5357	3,635	3,57

	Top level public policies														
Code	Programs for smart financing schemes	R&D and TT programs from public funds	Incentives for ICT businesses that develop solutions for SA	Incentives for smart farms	Incentives for smart fields	Incentives for circular economy and dedicated grants	Programs for HR development in SA	Public study grants for SA	Public funds for meta-cluster initiatives on SA	X-lateral inter-governemental public funds for SA	Harmonization of legislation in Balkans in relation with SA	Co-financing from public funds European projects on SA	Trans-national economic treaties on SA agro-products	PPPs to support high risk components on the value chain of SA	PPPs for entrance on international markets of SA agro-products
S1						9			9	9		3	9	9	3
S2						9			5					3	
S3		9	9	5	5	3				9		9		9	
S4		5	9	5		3				9		9		3	
S5		9	9	9		3				9		9		3	
S6		9	9	5		3	5	9						3	
S7	5	5	3	9	9	5						3		3	
S8						9			9	9			7	5	3
S9	7	9	3	3		7						3	3	5	
S10		5	9	5	5	9			3	9			5	7	5
S11	9					7				9				9	
S12			3	9		9	9	9					5		
S13			3	9		9	9	9	3						
S14		9				9	9			9		9			
S15				7	7	9	9		3	9			5		
S16			3	5		5			9	3		9		3	9
S17	7		5	5	9	9			3			9	1	5	3
S18						9			1	9	9		9	7	
S19		3		5	5	9			1				5		
S20				5	5	9			3	9		3	9		
S21						9				9	9		9	3	5
	156,9	327,6	321,2	376	214,6	726,2	164,8	78,3	230,7	603	75,6	302,7	314,3	433,3	114,1
	3,5343	7,3795	7,2354	8,4698	4,8341	16,358	3,7123	1,7638	5,1968	13,583	1,703	6,8186	7,0799	9,7605	2,5702
	2,0754	4,3333	4,2487	4,9735	2,8386	9,6058	2,1799	1,0357	3,0516	7,9762	1	4,004	4,1574	5,7315	1,5093

Figure 4: Deployment of smart specialization action plan.

Figure 4 also shows that materialization of smart specialization for agriculture 4.0 in the Balkans region requires simultaneous application of the whole package of the proposed public policies. Many stakeholders have to operate in a synchronized way, having in front of them a common vision and a unitary understanding of challenges and resolution mechanisms. In this landscape, the highest credit to catalyze constructive energies is given cu cluster initiatives. It seems that these cluster initiatives should act in close cooperation with national governments in the region.

CONCLUSIONS

The major contribution of this paper is the idea of deploying demands related to an emerging industry into various layers and elements that describe the related ecosystem, as well as the application of relationship matrices to weight the importance of these elements and to visualize the map of critical intervention points. The systematic deployment process forces experts to approach every issue in a structured way and obliges them to document exhaustively, be creative and bring in the planning map a comprehensive set of innovations, innovative concepts and topics. The resulted picture of mapping permits a fast and clear identification of the crucial areas. The global image provided by the methodological framework proposed in this paper facilitates convergence of various perceptions and higher chances to formulate a unitary perspective of reality by different stakeholders and action agents. Various concerns and criticalities can be listed in a structured

manner and alignment to a common plan for resource identification and/or generation, as well as optimal resource distribution and allocation can be better realized.
The methodology has a general applicability, regardless of economic sector. We claim that the effort required to document, collect information, generate ideas, plan the system, and analyze gaps worth it for the effect produced. Nevertheless, the methodology is subject to future refinements and developments. The primary focus is the calculation of critical mass of qualitative and quantitative capabilities to the level of each stakeholders group such as to pass the tipping point for moving the emerging sector to the level of economic viability. Synchronized movement of all stakeholders, and synchronized movement of stakeholders' members in a complex environment with many attractors and unexpected influence factors is another open issue that calls for scientific solutions. From this perspective, this work promotes a combination of empirical research for data collection and understanding of causes and behaviors in relation with an expected future goal, with engineering-type research for constructing gap-driven solutions under the constrains of time and other resources.

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From Classroom to Career in Sibiu Romania – Engineering Students' Perception on Internships and School Practices

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ABSTRACT

This article aims to highlight the most important ideas about internships and school practices from students' point of view. The paper is structured in three parts. In the first section the topic based on building a career in Romania while being a student is discussed along with the employers' expectations of having experience for getting a job and the problematic of today educational system. Further on the differences between traineeships and internships are detailed according to the Romanian framework and international sources to see exactly what do these mean and which one weights more for a company at the time of interviewing. Taking into the account what has been mentioned a survey was conducted among students from Faculty of Engineering where 100 replies were received. The questions asked highlighted how often Romanian students are being a part in such an activity, which are means of information they use to find out about the open positions and the students' degree of satisfaction about the opportunities internships and school practices offer them, on a long-term aspect.

Keywords: *internship, experience, career, students*

BUILDING A CAREER IN ROMANIA WHILE BEING A STUDENT

The term "internship" has emerged and developed in Romania when multinational companies started to come, initially being used as a substitute element for the traineeship of students / master students to complete their studies. At this moment, the Law in Romania demands that every student has to be a part of a school practice or internship, to get some insightful ideas about what his profession will look alike in his field of studies. This is regulated by Law 258/2007 as a mandatory condition to complete the studies, completed by a Minister Order 3955/2008, where the framework of practical training is detailed. But there is no legal restriction on how much long this internship or school practices should be, it is specified only a numbers of hours that the trainee should have done in the company (usually it is around 3 weeks but the collaboration between students and company can be extended if both parties agree on).
Internships and traineeship are the first step that students can take, to make sure they gain experience in their field of studies, which will help them have the career they are preparing already in the classrooms of University. Practical experience is not just well appreciated for companies but quite mandatory, when it comes about getting a specific position as bellow described. The need for having done an internship in a student CV, at the time of interviewing for a position, will put him in a good light in front of his possible employer. One of the platform of finding a job or posting the

vacant positions from a specific company in Romania (bestjobs.ro) has carried out a survey to see how much weight for an employer that his candidate has or has not experience. The results were indicating that for one of two companies having experience is an eliminatory criterion. For a graduate, a real work experience gained during the studies period will increase the chance to get a qualified job in a good company, reducing the major difference between theoretical training and labor market requirements. Such a real experience that brings useful skills for the future graduate is the school practice/ internship, the best method of transition between the educational system and the specialized field of work.

DIFFERENCES BETWEEN A TRAINEESHIP AND AN INTERNSHIP

Traineeships and internships remain the best option for students to acquire that experience that proves to be an elimination criterion in an interview. According to the law, internship / traineeship is the work done internally within a host organization that aims to deepen the theoretical knowledge and improve practical skills (internship.uniunea.ro/proiectul-de-lege). Yet, the two concepts differ greatly through the following aspects detailed below:

- *Who performs it* – internships can be carried out by bachelor students, master students and graduates, while school practices are done almost exclusively by students, especially because these are a compulsory part of their University curriculum.
- *Recruitment* – the internship recruitment process is more complex, and may include tests similar to interviews for a real job, while for a traineeship, in most cases, there are agreements established between the University and companies, so students can be sent directly to a specific firm, without being interviewed or tested.
- *Time frame* – A traineeship can be done at the end of the semester / year of study according to the curriculum, while internship can be done throughout the year.
- *Working tasks* – work tasks are more complex during an internship due to the fact that the duration is between 2 up to 6 months and employers have more time to explain more working procedures compared to a school practice.

In a recent report (Hora, Wolfgram & Thompson, 2017, p. 6), about internship in United States, the authors tried to explain the distinctions between different types of work-based learning. Internship it is seen as “a short-term opportunity for students to work (paid or unpaid) for an employer where ideally their academic learning can be applied to real-world tasks”. On the other side, traineeship (practicum) is “a component of some educational programs where students are placed in a job site and observe the work of professionals while also spending some time performing tasks themselves. Typically, students are also enrolled in a course connected to the practicum for deeper understanding and meaningful facilitation of what is being learned during the experience”.
For many employers an internship weighs more than a practice, because the student has more time to develop, learn more and get acquainted with the labor market. According to the study by Catalyst Solutions, 29% of interns commit to the end of the program in the company where they worked. But traineeships are also appreciated in the resume of the person.

RESEARCH METHODOLOGY AND OBJECTIVES

It is chosen a descriptive research that is characterized by addressing "in detail only a certain segment of the population of interest" (Cernușcă, D. and Thistlethwaite, P., 2001, p. 81) to determine statistics aimed at the "population of interest" in full.
Research motivation (research proposal) **–** The graduates of the faculties in Romania encounter a strong resistance to entering the labor market. This is primarily due to the requirement of large companies regarding the experience of job applicants. School practice and internships remain the best option for students to gain that experience which proves to be an elimination criterion in the

case of an interview. It is the transition method most conducive to reducing that gap between education and the labor market.

It is desired to carry out an analysis to see what is the current situation of the school practice and internship to find methods of improvement for this periods of practice, so that the graduates of the Faculty of Engineering have an easy passage in the real work field and that the lack of experience is getting smaller and why not, if it can be nullified. As the internship is compulsory for ending the bachelor studies, one wants to become aware of the importance that the practice offers to a student, both, for acquiring specific skills in the working environment, and specialty competencies, but also regarding the seriousness of her treatment to become that coveted experience of employers. Taking into account the statistical analysis on the situation of the integration of young people in the labor market made by the European Commission and taking into account the data obtained from the secondary sources, it was concluded that a complete analysis of the three parties involved in these activities is necessary to improve the communication between the Faculty of Engineering and the partner companies in the city of Sibiu, but also for increasing the degree of satisfaction of the engineering graduates on this aspect.

Primary objectives – drawing up and studying the present situation regarding student school practice and internships from the perspective of the students, the teaching staff and partner companies and finding practical ways to improve the communication between the parties involved.

Secondary objectives:

- establishing the deployment framework and the conditions for the school practice and internship
- identification of the respondents' opinion on the degree of satisfaction and on the expectations of the subjects regarding the activity carried out
- determining the aspects to be improved and how to evaluate the activity
- determining the contribution of the faculty in finding school practice and internships for students
- analysis of the main characteristics of the respondents

Research hypotheses:

- companies highly appreciate in the job interviews that candidates have completed school practice or internship during the studies
- there is a high probability that after completing the internships or the student internship they will be offered the continuation of the activity in the same company
- “evidence indicates that internships improve students’ employability, academic outcomes, and career crystallization” (Hora, Wolfgram & Thompson, 2017, p. 2).

The questionnaire is made up mainly of predetermined answers, but also contains some open questions to see the direct opinions of the subjects without restricting their possibilities of answering or inoculating a certain variant. The questionnaire was made by the online survey method, being posted on different social groups used by the students from the Faculty of Engineering, thus using an indirect method, giving the respondents the opportunity to respond as quickly, simply, whenever they can, but also by the classical method, printed on paper and distributed among students, teachers and companies, ensuring that the recovery rate of the questionnaires will be as high as possible. The results were automatically collected in an Excel spreadsheet when filling in online and manually adding the answers to the existing ones for those that were completed classically.

A total of 100 questionnaires were completed by students from students and recent graduates of Faculty of Engineering from University “Lucian Blaga“ of Sibiu. To understand more our target audience, we notice that from out 100 respondents who filled in the questionnaire, 59 are in "Bachelor's Degree Program” only 16, are those who recently graduated all studies and the difference is doing the master degree. Only 47% of the respondents are women, as we can notice men still are predominant in the technical area.

In this paper we have chosen to present a small part of the research done on this topic, the one that concerns the opinion of the students related to school practice or internship. The research component that analyzed the employers' opinions related to this process was presented in another paper (Miricescu & Tabusca, 2017).

THE STUDENTS' POINT OF VIEW ON INTERNSHIPS/ SCHOOL PRACTICES

An analysis was carried out to find out what is the current state of traineeships and internships in order to find ways of improving them so that the students will have an easy transition in the real work field and build a great career.
To establish the framework and the required skills by employers related to internships and traineeships we started by asking our respondents if they been a part of an internship or a school practice (Figure1).

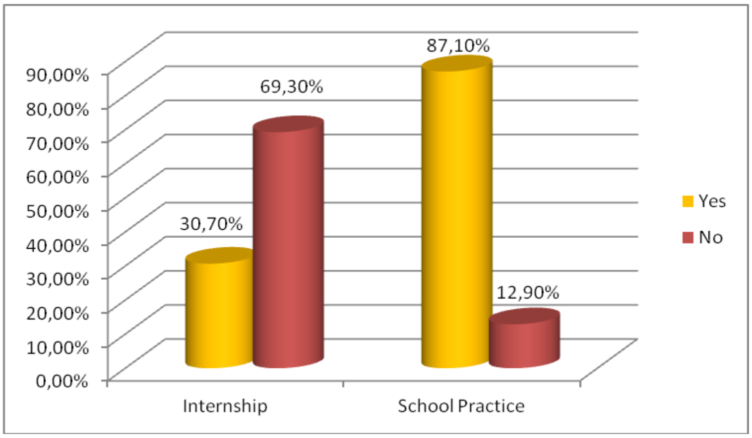

Figure 1: The level of participation of the subjects in internships or school practice

As can be noticed in Figure 1, traineeships are more common among Romanian students than internship, 87.10% of them have been doing a school practice and only 30.70% have ever been a part of an internship experience. This is understandable given the fact that for the students / graduates of Faculty of Engineering from Sibiu traineeship is a mandatory condition in the 2nd and 3rd year of bachelor, while internship remains a choice.
The benefits that an internship and a school practice comes with have been already mentioned. Getting the chance to work in their field of specialization, meeting professionals from their own domain up to increasing employability for a good job are well known for both sides. What was interesting to see was how the Romanian student gets to know about these available positions in good company in order for him to get all these opportunities.

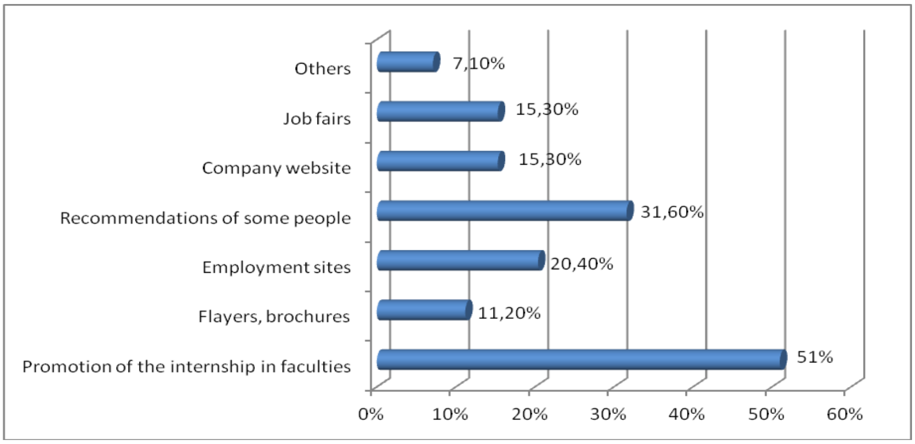

Figure 2: Information channels used for school practice or internship information (multiple answers was possible)

It is clear that most students learn about the available posts due to presentations in faculties based on a partnership agreement with the business environment (Figure2), around 51%, followed by 31.60% who are recommended by someone inside from the company. The least ones, 11.20% of respondents use "flyers and brochures" to inform themselves.

Building a career will take time, patience, passion and effort to grow. It can be easy to be a classic student. Be present physically in the classroom, go to your exams and don't miss the mandatory classes. There are students who fit in this category. But behaving like that won't be helpful for your professional road, at least not to touch the peaks. Excitement and involvement will push you to a brighter side and for the analysis was mandatory to know "what were the reasons for which students would do an extra traineeship apart from the mandatory one?". In order to understand the true determination of students to perform such an activity, it was preferable to omit the compulsory traineeship and to observe the answers of those who attended a program other than that required by the curriculum (Figure 3).

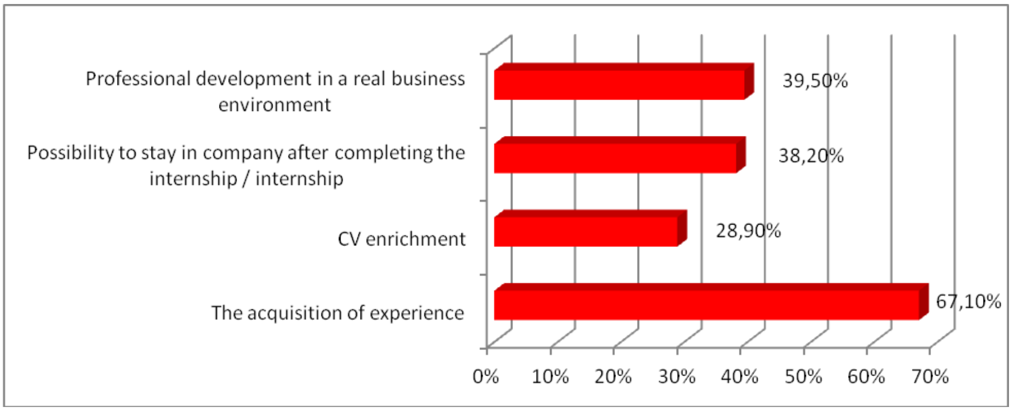

Figure 3: The motivation of the students to get involved in an internship or in a school practice other than the compulsory one (multiple answers was possible)

So, we find that 67.10% of students chose to do an extra traineeship/ internship (Figure 3) for "acquiring experience"; 28.90% of the respondents have opted for "enriching C.V". Interestingly, only 38.20% chose "the opportunity to remain in the company after the end of the period."

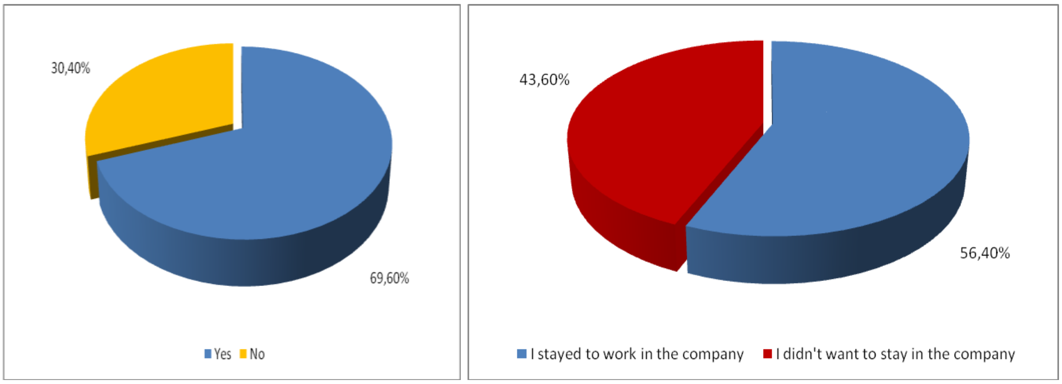

**Figure 4: Have you been offered to remain in company after completing your practice or internship?
If the answer was yes, then what was your choice?**

There are some companies that are amazed by some students so they want to offer them a position at the end of the traineeship/internship. This aspect of the possibility of staying in the company after the end of practice was among our interests to observe since getting a real job can be the start of a beautiful career. This question was addressed to students to see what their response is (Figure 4). It can be noticed that for 69.6% of the respondents, the chance to remain in the company was granted, but only 56.4% of them chose to accept it.

We were discussing in the first part of this article how important is to have such experiences in CV’s when building a career while being a student. In the graph above (Figure 5) we can see if Romanian students share our belief that a traineeship or an internship it is quite useful when discussing the professional future.

Figure 5 includes the results from two questions: "How satisfied are you with your internship / school practice?" and "How useful to your future career you think this traineeship / internship? Was?". 44.03% consider that this traineeship is "very much" useful for the professional future, while only 37,10% agree the same criterion of satisfaction of the performed activity. Although the utility rate has achieved a higher percentage, it also has 1% of the correspondents who consider it "very little" useful. Overall, taking into account the "much" criterion, the majority of respondents have a good opinion about the degree of satisfaction of the activity, but also its usefulness for the future career.

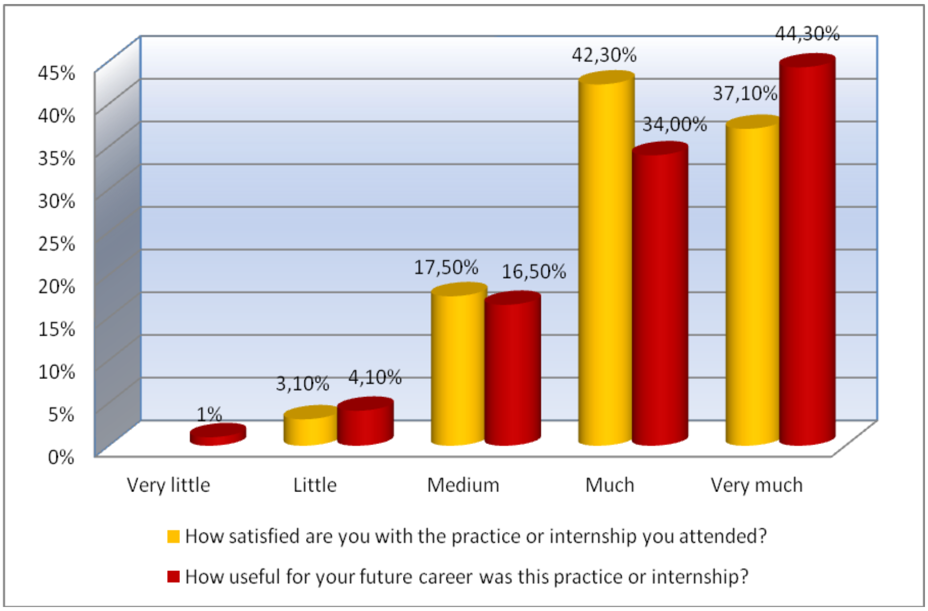

Figure 5: The level of student satisfaction related to the school practice or internship and to the possibilities of personal development in the career

To conclude following one of these programs are useful for a better chance in building a bright and successful career after graduation as we can notice that our respondents answered.

CONCLUSIONS

The analysis of the results of this research regarding the perspectives of the real beneficiaries of the school practice as well as the internship, clearly demonstrates that the practical experience among the students is more and more sought and appreciated, this being considered as an important competitive advantage for finding a job in the field, as well as for career achievement. It is normal that the theoretical study in engineering should be supplemented and enriched with these practical experiences, but it is an encouraging fact that the students of the Faculty of Engineering understand the importance of this approach. All these are complemented by the fact that, at this moment, there is a major development of the industrial sector in the Sibiu area, and the demand for skilled labor force is increasing. The unemployment rate in Sibiu County in April 2019 is one of the lowest in the country, 1.7%, and the gross domestic product per inhabitant is one of the highest in Romania, 44289.1 lei (www.sibiu.insse.ro – accessed on 01.07.2019).

Many of the working hypotheses of the study have been confirmed, and one of the most important stakeholders in this process, the students, has an open and favorable attitude to the idea of going through an school practice or internship within a company. The most important motivations behind the involvement in this process are: the desire of companies to attract the young workforce and to gain the experience, the increased interest of the students, eager to be able to pass on the CV elements that would give them an advantage in employment, acquisition of experience in the field, professional development and the possibility of to remain in the company after completing this internship.

It is noteworthy that the expectations of those who have gone through a school practice or internship have been met by the industrial companies in the Sibiu area, 61.60% of those questioned being offered by companies with jobs within the company, and more than half of those offered (56.40%) also accepted employment in the company. All these justify the high level of satisfaction regarding the school practice or internship and regarding the consequences of this activity.

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The Use of Financial Products in Liquidity Risk Management by SMEs

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ABSTRACT

Risk, which is inherent to any business activity, is an issue that should be considered as early as at its conceptual stage and the very idea of its creation. The awareness of its existence and effective risk management is one of the factors which decide whether an organization will prosper or not. Control over possible risks can be exercised in several ways, one of which is outsourcing of risk to other market participants, such as financial institutions. This option is not a widespread solution in the Polish market, which may be due to low awareness among managers in the field of both risk identification and diversification. In the era of entrepreneurial economy, SMEs, which account for 99.8% of the European population and generate about 50% of GDP, having a significant impact on international trade, should become the primary addressees of training and education initiatives to inform them about risks and possibilities of their mitigation. The purpose of the article is to indicate financial services, mainly factoring, offered by money market institutions as an opportunity to improve current financial liquidity of enterprises, and to demonstrate the importance of education in adequate understanding and promotion of those solutions.

Keywords: *SME, internationalization, risk management, factoring.*

INTRODUCTION

Risk has for the first time been described in the literature on the subject by Cardano (1501-1576), Italian physician, physicist, constructor, mathematician and gambler. In his book Liber de Ludo Aleae (Book on Games of Chance), as a forefather of the new science, he attempted to establish statistical rules of probability (Buchanan &O'Connell, 2012, pp.85–95). Others who followed him in tackling the topic risk and uncertainty included Pascal (1623-1662), co-creator of the method of calculating the probability of a specific random event (Buchanan &O'Connell, 2012, pp.85–95) or Halley (1656-1742), whose work served as the mathematical foundation of insurance (Krimsky & Golding, 1992, pp.7-23). Risk is also an inherent element of entrepreneurship, which is defined in the relevant literature by, for example, Knight (1921) as the profit achieved in exchange for the willingness to accept some uncertainty, or Drucker (1909) as improvement activities which lead to success (Kenworthy & McMullen, 2014, pp.20-25). In an effort to boost an entrepreneurial attitude among European society, European Parliament resolution of 21 November 2013 was passed to provide top-down support mainly to small and medium-sized enterprises by promoting mentoring and advisory initiatives to help their development.

Every stage of running a business entails risk and uncertainty. Regardless of whether the company operates on the domestic or foreign market, both the owner and the employees should be continually educated on how to identify and eliminate threats. The survivability of new companies is low, which warrants a thesis that the level of recognition and reduction of potential risks remains low. At the end of 2017, entities in Poland which had been in operation for 12 months or less accounted for 8.7% of all active businesses. Two-year-old companies made up 6.4% of the total, while those operating for over six years constituted 67.4% (Dąbrowski, Pabijanek & Kotowski, 2018, pp.25). There are several key reasons for such low figures, the first being focus on price competition. Nowadays, in addition to the going rate for a product or service, the customer makes purchase decisions based also on quality, ingenuity and innovation. If the owner of a company is convinced that price is the key to success, problems with financial liquidity are on the horizon – with intensified competitive efforts on the part of stronger actors aimed at lowering the price of a particular product, smaller economic entities may be forced to cease operations or sell their shares. Therefore, the quality of services is such an extremely important element, as it can showcase uniqueness and individuality.

Another reason for the lack of survival of companies is the limited awareness among their owners of the need to have a long- and short-term strategy, or, in other words, to set goals, systematically measure and possibly correct them, and communicate this knowledge to employees. It is a roadmap for the company's activities and an analysis of its competition, helping to establish priorities and scope of business and to motivate employees as it shows them which direction the organization is heading (Pisano, 2015, pp. 44-54). Another important aspect is the ability to work in a team, especially for entrepreneurs who had for many years been self-employed, but then gained a team of employees as they grew. The role of sole decision-maker accountable only to themselves stands in opposition to taking responsibility for a team of employees, the need to manage them and the increasingly developing organization, where synergy requires consultation with the team. Being the single power-wielding party and dealing with every aspect of the company's life themselves is a habit which may cause conflict, ultimately leading to bad decisions and financial losses.

Internal factors, such as product development, sales dynamics, service levels, and prices, as well as external macroeconomic conditions, such as political decisions, interest rate fluctuations, and exchange rate fluctuations, affect the development and behaviour of enterprises on the market. All of those risks lead to payment bottlenecks, or the possibility of losing financial liquidity (Gorzen-Mitka, 2019, pp.339-349).

The purpose of this article is – based on own research conducted in the realities of the banking offer in Poland - to indicate financial services offered by the money market which enable diversification of risk onto other market participants. It is therefore about identifying financial institutions, as an opportunity to improve current financial liquidity of enterprises. Its utilitarian purpose is to demonstrate the importance of education in correct understanding and promotion of those solutions, which continue not to be the method of choice to most SMEs.

Own research was conducted on the basis of a review and analysis of data results from national statistical offices, government agencies supporting the development of SMEs, available in the years 2010 - 2019 on the Polish market the offer of financial products and surveys carried out in January 2019 among 194 SMEs by one of the commercial banks operating in the Republic of Poland, the intention of illustrating the method of risk management in small and medium-sized enterprises in Poland.

The survey consisted of 18 questions, of which four were closed and the other questions were open character, enabling respondents to choose indicated and analyzed financial solutions or giving a different answer consistent with the preferences of entrepreneurs. Then the results were grouped according to preferences and analyzed in terms of the size of enterprises, showing the importance of barriers encountered in the ongoing business activity.

RISK MANAGEMENT PROCESS BY SMES

A well-developing economy is characterized, among other things, by the fact that an increasing number of enterprises is established with international operations in mind. Owing to the virtually unlimited possibilities of trading and transmitting information provided by the Internet, the sales market can be extended at practically no cost and without disruption. In recent years, the importance of exports among micro and small enterprises in Poland has increased. Since 2010, the number of companies selling abroad has increased from 8.6% to 16.3% in 2017 (Fig. 1).

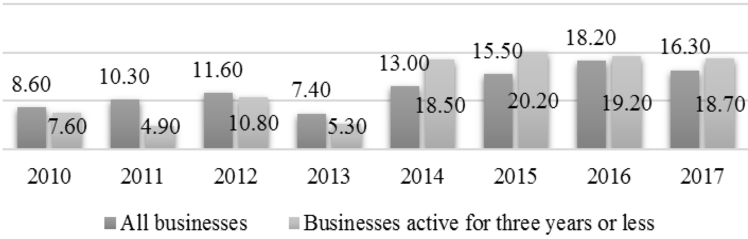

Figure 1: Structure of Polish companies involved in exports in 2010-2017 [%]
Source: Bank Pekao 2018, pp. 136

According to data published by OECD, the threats faced by entrepreneurs wishing to expand their operations into other countries include: (1) lack of capital to finance exports, (2) difficulty in identifying the business potential of the undertaking, (3) lack of or limited information about the selected market, (4) difficulty in reaching out to potential foreign customers, (5) lack of reliable foreign representation, and (6) lack of time among managerial staff to deal with the internationalization process (OECD, 2009, pp.8-9). Those factors were also indicated by Polish entrepreneurs surveyed in 2017 (Kasperkowiak, Małecka &Łuczka, 2017, pp. 309-404).
Furthermore, regardless of where a particular business operates, one of the key risks to which any economic activity is exposed is financial risk, which includes, in particular, (1) liquidity risk – where an enterprise may no longer be able to meet its debt obligations and purchase goods and services, for example as a result of its customers failing to make timely payments, (2) market risk – where losses may be experienced due to changes in micro and macro environment, (3) operational risk – where the company may not be able to meet its contractual obligations due to inadequate processes or resources (Florio & Leoni, 2017, pp.56-74).
From this point of view, the functioning of a company in an environment exposed to threats requires extensive knowledge and ability to make appropriate decisions, supported by experience and qualifications. What matters is not only the approach to the problems, but also quick implementation of solutions. Micro and small companies do not have the adequate resources (qualified personnel, professional analysis of reports, use of consultancy firms), therefore they struggle with correct identification and elimination or mitigation of factors that have a negative impact on their operations. Support from external companies is expensive and continues to be treated by SMEs not as an investment but as a cost. According to economic literature, the risk management process should follow these steps: (1) risk identification, (2) measurement and assessment, (3) determination of possible solutions, (4) control and monitoring (Florio & Leoni, 2017, pp.56-74). The last of those steps, which follows a detailed analysis, will secure the enterprise against potential consequences of a materialised risk, or, at least, will help mitigate them. Main risk-handling strategies include risk avoidance and risk acceptance. The latter accepts risks, with their financial and reputational consequences, which leads to risk reduction through implementation of appropriate mitigating mechanisms to lessen the effects of risks, both within the company and in its surroundings. One such mechanism is financing of risks through the purchase of financial

instruments, which include derivatives, insurance, trade finance products, factoring, and forfaiting (Mioducka & Małecka, 2018, pp.83-93).
Such a methodical and systematic approach to company management gives owners the opportunity to (1)more effectively control the direction of enterprise development, (2) make more accurate strategic decisions, and also (3) identify unreliable contractors, not only in the domestic, but also in the foreign market. One of the added values of properly managed risk management processes is (4) maintaining financial liquidity, which allows entrepreneurs to focus on other, equally important and possibly neglected, issues such as obtaining information on potential markets or procuring new foreign customers.

SELECTED FINANCIAL PRODUCTS TO MITIGATE THE LIQUIDITY RISK

One risk management method is to transfer it to other participants in the economic market, such as financial institutions offering modern services. Financial liquidity, which is a determinant of survival in any turbulent economic market, means timely performance of obligations, which, in turn, puts the company in a positive light in the eyes of its current and prospective business partners as well as subcontractors and associates. Unreliable or dishonest partners may cause inability to satisfy short-term liabilities on time and cause a real risk of insolvency. The financial services market offers several solutions to support the company in timely payments. Companies are not legally obliged to use the services of one bank, therefore they can use a wide range of products available on the market of financial services.
The first of these instruments is working capital facility, which is used to finance expenses related to the current operations of the company, usually granted for less than a year and available in either current or credit account (Rahman, Rahman & Belas, 2017, pp.263-285). One instrument that does not require a specific legal agreement is trade credit, which can be provided to companies with low creditworthiness at the bank. It is extended by sellers of goods or services to their customers, and involves delivering the subject matter of the transaction and deferring payment. This gives businesses an opportunity to buy the necessary products from suppliers, who often extend the credit period in relation to that offered by other suppliers to gain client loyalty (Agostino & Trivieri, 2019, pp.576-592).
Another service is factoring, which involves purchasing of non-past-due accounts receivable of enterprises (creditors) owed to them from customers (debtors) for deliveries and services by an entity providing factoring services (a factor). Several types of factoring can be distinguished:
(1) In terms of the risk associated with the debtor's insolvency:
- Full (proper, without recourse) – the creditor's accounts receivable are purchased and the risk of debtor's insolvency is transferred, which means that the factor will collect liabilities directly from the debtor.
- Incomplete (improper, with recourse) – the creditor's trade receivables are purchased without taking over the risk of debtor's insolvency, which means that should the debtor fail to pay their liability, the original creditor will have a liability to the factor.
- Mixed – a combination of full and incomplete factoring, which means that trade receivables are purchased along with the risk of debtor's insolvency, but only up to a certain amount specified in the agreement; should the debtor fail to pay their liability, the factor covers the debt up to a specific limit and the remaining portion is covered by the original creditor.
(2) In terms of the moment of receiving payment for the accounts receivable sold:
- Discount-based – the factor acquires the account receivable under a contract of assignment at the time of entering into a factoring agreement (the date of payment by the debtor is irrelevant).
- Advance-based – the factor pays the creditor a specific portion of the amount due, while the remaining portion is transferred once the debtor pays the liability.

- Maturity-based – the original creditor gets its accounts receivable once the debtor makes an actual payment (Velentzas, Kartalis & Broni, 2013, pp.757-762).

Factoring, which is also addressed to small and medium-sized companies, is an important instrument for improving financial liquidity and can be used by enterprises with poor financial standing. SMEs fail to fully exploit the potential of this service, because its cost is relatively high compared to other sources of financing (with price determined individually), which is a particularly burning issue in the management of cost decisions in small organizations. As own research indicates, recent years have seen an increase in non-banking factoring providers (from 29 in 2014 to 39 in 2017). This warrants an assumption that increased competition in that market segment will bring the prices down to acquire and retain clients. Those new non-banking firms offer a simple and fast process of selling the service, however, they are exposed to high costs because of the precariousness of collecting accounts receivable, thus they may themselves be vulnerable to liquidity risk. Such a situation may, in turn, result in the necessity to sell their shares to larger organizations, including banks, which will thus gain access to their know-how and customer base (see also: Mioducka & Małecka, 2018, pp. 83-93; Małecka, 2018, pp.246-253).

From the point of view of companies involved in international commercial transactions, forfaiting is an important instrument. Then a forfaiter (a financial institution) discounts export receivables secured by the importer's bank by making a 100% payment for the exported goods while deducing a discount rate, which can significantly reduce transaction risk (Velentzas, Kartalis & Broni, 2013, pp.757-762; Mioducka & Małecka, 2018A, pp. 64-77).

FACTORING AS A SERVICE TO SUPPORT FINANCIAL LIQUIDITY MANAGEMENT

Data provided by the Polish Central Statistical Office (GUS) show that over the last few years, there has been a growing interest in factoring in Poland. Between 2014 and 2017, the average number of customers using factoring increased by 2.182 companies, the number of invoices increased by 68%, and the value of debt purchased increased by PLN 69.472 million (Tab. 1).

Table 1: Development of factoring services in Poland in 2014-2017
Source: Own research based on Nowińska 2017 (GUS)

	Number of customers using factoring in each year			
	2014	2015	2016	2017
Total	10.242	12.336	11.273	12.424
Domestic factoring, of which:	9.300	11.383	10.230	11.332
with recourse	6.638	7.487	6.585	7.418
without recourse	2.181	2.284	2.623	2.821
Foreign factoring	942	953	1.043	1.092
	Number of invoices purchased in each year ('000)			
	2014	2015	2016	2017
Total	6.803	7.702	8.336	10.056
Domestic factoring, of which:	6.368	7.240	7.700	9.313
with recourse	3.861	4.686	4.732	5.049
without recourse	2.091	2.265	2.530	3.622
Foreign factoring	435	462	635	743
Value of accounts receivable purchased (PLN million)	**Value of accounts receivable purchased (PLN million)**			
	2014	2015	2016	2017
Total	153.018	171.640	190.032	222.490
Domestic factoring, of which:	132.766	150.086	166.049	190.076

with recourse	52.200	61.983	63.643	70.827
without recourse	71.641	80.818	89.235	104.733
Foreign factoring	20.252	21.555	23.983	32.414

The results of presented survey was conducted electronically in January 2019 to check entrepreneurs' awareness of factoring and obtain information on barriers related to liquidity risk, as well as to categorize the consequences of absent funds for their current business operations, between entrepreneurs in Poland. 194 respondents from the SME sector took part in the survey. 190 people answered the question about the number of their employees: 75.79% employ up to 10 people, 15.79% – from 11 to 50 people, and 8.42% – more than 50 people.
Having problems with late payment of liabilities by their counterparties was declared by 70.62% of entrepreneurs, which means that 29.38% of respondents had no difficulties with recovering money for their goods or services (Fig. 2).

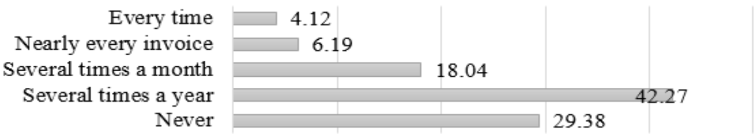

Fig. 2: Late payment of invoices to respondents [%]
Source: Own research

A significant portion of payments from counterparties (86.60%) is made by bank transfer, which means a high level of digitization in the society and an increase in trust in those forms of payment. 35.05% of suppliers pay their liabilities in cash, revealing the need for further building of entrepreneurs' awareness of electronic payment options to lower the costs of running a business (e.g. no fees for using ATMs and cash deposit machines) (Fig.3).

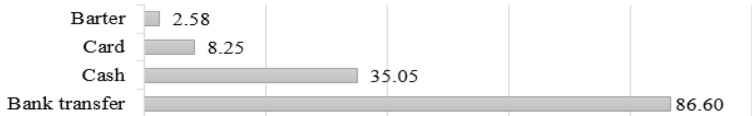

Fig. 3: Preferred form of payment among respondents (multiple answers possible) [%]
Source: Own research

The results of the analyzes have shown that almost half of the surveyed companies had no problems with payment bottlenecks (49.48%). On the other hand, this problem was faced daily by 6.70% of entrepreneurs (Fig. 4).

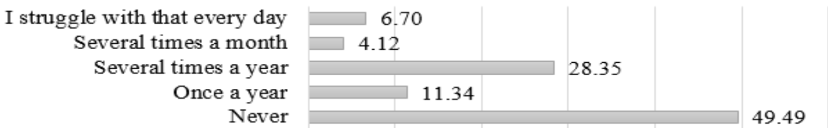

Fig. 4: Untimely fulfilment of liabilities by respondents [%]
Source: Own research

According to the entrepreneurs, the most important consequence of losing liquidity is the lack of funds to cover costs generated by contributions to the Social Insurance Institution (ZUS) and taxes (26.80%). Failure to pay those levies, in addition to accruing default interest, may have very harsh consequences, such as seizing debtor's assets or collecting outstanding debts directly from the entrepreneur's bank account. This answer was followed by 'slowdown in the company's development' (18.56%) and 'loss of business opportunity' (15.46%). Deterioration of relations with employees is perceived by 7.22% of the respondents as the most important consequence of the loss of financial liquidity. 6.19% of the respondents chose the answer "Other", while indicating (1) no liquidity problems (1.03%) and (2) the need to monitor payments (0.52%) (Fig.5). Such definition and perception of risk among the entrepreneurs, leading, as a consequence, to loss of financial liquidity indicates the necessity of reviewing the market of non-banking services in order to identify the possibility of using so-called soft debt recovery by SMEs, which includes prompting counterparties about payments, sending reminders or assisting them in obtaining writs of execution.

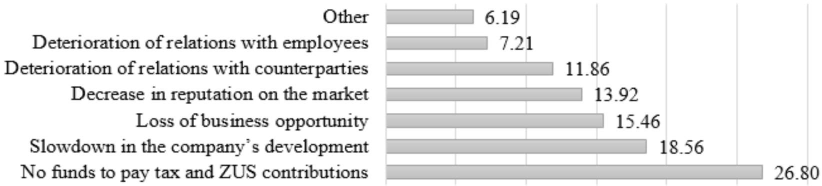

Fig. 5: Consequences of liquidity risk as perceived by entrepreneurs (multiple answers possible) [%]
Source: Own research

The obtained research results emphasize the importance of maintaining solvency at a solid level, which is a reflection of both the financial condition of the business and the competences and qualifications of those in charge of managing the diversification of the risk portfolio. Almost half of the respondents (41.75%) was not familiar with the concept of micro-factoring, and 23.71% knew it, but were not sure if they understood the principles of the service (Fig. 6).

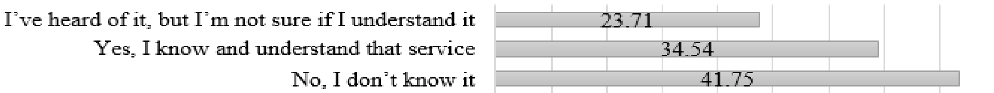

Fig. 6: Recognition of the concept of micro-factoring [%]
Source: Own research

The obtained research results indicate the importance and role of educating entrepreneurs on modern financial services, as well as the need for institutions which offer this product to ensure a clear and transparent sales process and modify the pricing to allow the offer to be extended also to small and medium-sized enterprises, for which the current pricing is simply too high. It turned out, that factoring is not used at all by 83.58%, while 4.48% declare using this service often (Fig. 7).

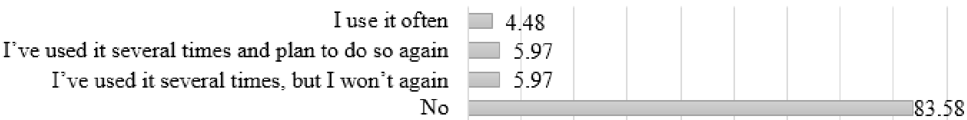

Fig. 7: Use of micro-factoring [%]
Source: Own research

A separate issue is the possibility of background-checking the institutions offering this service. It is not a circumstance which influences the decision on choosing a particular offering, but the credibility of the firm which takes over the invoice may be crucial for the business partner whose financial document has been transferred to a factor. Another important issue is the minimization of administrative and bureaucratic formalities, which are indicated by SMEs as a barrier to development in third place, indicating further direction of research.

CONCLUSIONS

The study reveals the significance of the issue of liquidity risk and knowledge of financial instruments to mitigate it. Factoring, although its history goes back to ancient times, remains a little-used instrument supporting the day-to-day management of SMEs. Half of the respondents did not know that service at all, while one-fifth have used that product.
The results of our own research lead to the conclusion that non-financial risk-mitigating products are extremely important. In this context, education, which helps understand, identify and reduce potential threats, becomes an essential and critical element of effective entrepreneurship. Educated entrepreneurs will be aware of the opportunities offered to them by factoring, and their choices aimed at diversifying the financial portfolio will be better suited to the volatile economic environment. A useful contribution would be a transparent offering written in an understandable language, clearly expressing the principles of operation and the added value of factoring. Another important recommendation to factoring providers would be to reduce the formalities and documents required for a speedy process to an absolute minimum. Moreover, the research suggests that a system to provide SMEs with support as regards non-financial services which facilitate company management, such as assistance in debt recovery (soft debt collection) or ad hoc legal help, would be highly advisable.

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SUSTAINABILITY IN ENGINEERING AND BUSINESS EDUCATION AND LIFELONG LEARNING

EXTEND Project: Systematic Approach to Curricula Development

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ABSTRACT

EXTEND project is aimed at modernizing approaches to teaching engineering disciplines in Russia and Tajikistan, increasing quality of education and possibilities of employment for young engineers, students' motivation and making engineering education attractive. Modern universities carry out not only professional training of students, but also prepare competitively capable personnel who can survive and thrive in modern free market relations, accompanied by a variety of forms of ownership and competition. International educational projects are relevant as they supply universities with international experience and job possibilities. Therefore, foreign languages competence is of key importance for engineers of future generation, and is a means of forming professional, communicative, linguistic and cultural competences. Success of teaching foreign languages depends not only on teachers' skills, but on carefully selected and elaborated didactic materials as well. EXTEND project team exchange ideas and experience that result in fruitful discussion of issues concerning elaborating new courses to improve engineering education. International teams, which include EXTEND project participants from European, Russian and Tajik higher educational institutions will carry out the task. Project EXTEND is an open kind of consortium, which implies that members from partner countries subordinate to its leader and share joint responsibility for commitments of the consortium.

Keywords: *EXTEND project, Higher Educational Institutions (HEIs), engineering education, international consortium*

INTRODUCTION

In 2017 project Erasmus + Capacity Building in Higher Education 586060-EPP-1-2017- PO-EPPKA2-CBHE JP «Excellence in Engineering Education through Teacher Training and New Pedagogic Approaches in Russia and Tajikistan» (EXTEND) was won. General impact of the EXTEND project is related to increasing knowledge through research in Russian and Tajik engineering education. It will help to bridge EU educational experience and opportunities for future employment of students in a global context.

The project is being implemented by a consortium of higher educational institutions (HEIs) from partner countries, which includes the following universities:

1) Polytechnic University of Bucharest (Romania);
2) Riga Technical University (Latvia);

3) University of Minho (Portugal);
4) University of Warwick (England);
5) Bauman Moscow State Technical University (Russia);
6) National Research Moscow State University of Civil Engineering (Russia);
7) Ogarev National Research Mordovia State University (Russia);
8) Nosov Magnitogorsk State Technical University (Russia);
9) Tajik National University (Tajikistan);
10) Technological University of Tajikistan (Tajikistan);
11) Khudjand State University named after academician B. Gafurov (Tajikistan);
12) Kulob State University named after A. Rudaki (Tajikistan).

EXTEND project is aimed at modernizing approaches to teaching engineering disciplines in Russia and Tajikistan, increasing the quality of education and possibilities of employment for young engineers, students' motivation and making engineering education attractive. The Project is designed to elaborate the system of university teachers' training according to the principles of Bologna process and European space of higher education. The Project will be open for university teachers and post graduate students, who are planning to be lecturers of HEIs (Савинова, Ю.А, & Зеркина, Н.Н., 2018).

Specific objectives of the project are the following:

1) The development of comprehensive model and descriptor of the competences of the university teacher of engineering disciplines;

2) The establishment of Network of Centres of Excellence in Engineering Education (EXTEND Centres) offering training courses, methodological research and consultations in teaching engineering disciplines in Russian Federation and Tajikistan.

3) The development of training programme for PhD students and experienced teachers in teaching engineering disciplines.

Nowadays, the following issues are undertaken by the Project team:

- creating the complex model and descriptors of competences for lecturers who teach engineering disciplines at HEIs;
- studying and mastering the best European practices in teaching engineering disciplines;
- monitoring pedagogic practices in engineering education at universities of Russia and Tajikistan;
- establishment of EXTEND Centres Network – centres which will improve engineering education, provide the base for researches, learning courses and consulting services for teaching engineering disciplines in Russia and Tajikistan;
- scientific research, publication of papers in scientific journals, which are indexed in Web of Science and Scopus databases, monographs and methodical manuals related to the project theme;
- elaboration of new curricula for university teachers and post graduate students according to modern methodology of teaching engineering disciplines within classical format and MOOC (mass open online courses);
- holding international scientific and practical conferences related to the project theme.

Therefore, we are strongly convinced that international projects improve engineering education at HEIs in general, and collaboration within the international consortium contributes to it, in particular.

INTERNATIONAL CONSORTIA AS A FORM OF IMPLEMENTATION OF COOPERATION IN THE SPHERE OF SCIENCE AND EDUCATION

In EXTEND project interaction between HEIs is implemented in the form of cooperation within the international consortium – a network of 12 universities from European countries, Russia and Tajikistan, which collaborate on in-depth educational issues with the aim to elaborate new educational programmes at the international level. In our case, consortium is a means of organizing mutual activity of 12 HEIs from different countries for a 3-year- period for successful implementation of EXTEND project activities, which unites goals, possibilities, technologies, intellectual property, traditions and experience of these HEIs. Project EXTEND is an open kind of consortium, which implies that all members from partner countries subordinate to its leader and share joint responsibility for commitments of the consortium. Undoubtedly, international educational projects implemented within the consortium result in novelties and qualitative improvement in the sphere of higher education, which bring together educational systems of various countries as much as possible, thus gradually forming unified, world educational space.

Thus, project-grant activity becomes a key component of higher education internationalization. The main tendencies of this activity include: combination of bilateral, multilateral and net projects; forming cross-cultural nets of partner universities representing different countries; transformation of projects having subject-matter basis into interdisciplinary ones; elaboration of new educational programmes, courses and techniques; holding educational seminars, workshops and conferences; internship of university teachers, students and PhD students abroad. These are the characteristic features of the consortia activities, which are implemented in EXTEND project as well.

According to experts, consortium serve as a good example of HEIs integration based on coordination and is "the most perspective form of the union, as it represents the quickest and cheapest way of global strategy implementation" (Veretennikova, O.B., Drantusova, N.V, Klyuev, A.K. et al., 2008). By mutual collaboration within the consortium educational experience is significantly increased and possibilities of students and teachers from various parts of the world become equal.

Global space of higher education erases the borders and distances, inasmuch as within the consortium specific communicative culture is established, based on new communication forms and channels, informal relations between the consortium members, democracy, mutual respect, friendly and collaborative atmosphere in the international team.

The distinctive features of the consortium are the following:

- multiplicity of participants, inasmuch as the consortium is an association of two and more organizations;
- voluntary character of uniting participants, possibility of providing maximum openness and transparency of activities, improvement of communication within the consortium and outside it as well;
- the goal of the consortium activity is elaborating new knowledge-based production having, as a rule, a distinct innovative component;
- temporary character of activity, determined by the focus on implementation of some project with the possibility of reforming on achieving the planned result;
- mutual use of united resources of participants, with the aim to overcome qualitative and quantitative resource limitation of each organization;
- shared responsibility of all participants of the consortium for the process and results of the implemented activities;
- openness of the consortium, manifested in its interaction with outer partners in the process of activities aimed at the achievement of the set goal;
- its own organizational structure with possibilities to coordinate the activity of the consortium activities and its interaction with outer agents in the process of representing the interests of the consortium in the external environment (Vasilenko, N.V., Kostenko, A.A., Nazaretyan, K.A., 2017).

ELABORATION OF NEW CURRICULA AS ONE OF THE MAIN OBJECTIVES OF EXTEND PROJECT

Within the framework of EXTEND project university self-assessment «The use of educational technologies in engineering training programs» was undertaken. The self-assessment allows determining the maturity level of the educational technologies management system, including the availability and the level of development of the teacher advancement training system in the sphere of educational technologies application. The self-assessment is exercised in accordance with the key elements of the management system.

1. Policy of educational technologies development
2. Deployment of policy in the field of educational technologies
3. Exchange of knowledge, information and the best practices in the area of educational technologies
4. Infrastructure for educational technologies
5. Monitoring of effectiveness of educational technologies implementation
6. The use of electronic (digital) educational technologies
7. The use of active educational technologies
8. Professional development in the area of educational technologies application
9. Postgraduate training.

Thus, basing on the results of university self-assessment the consortium agreed upon elaboration of courses. Within the framework of the project implementation, it is planned to elaborate the following courses:

1. *Project Based Learning (PBL).* Focus: why and how to implement PBL in engineering programs considering different approaches and contexts (interdisciplinary, cooperation with industry, etc.).
2. *E-learning and ICT Tools*. Focus: how to use different ICT tools in teaching practice and how to prepare an e-learning course.
3. *Foreign Languages for Engineering + Academic Writing*. Focus: how to introduce foreign languages in engineering programs (e.g. academic writing, intercultural contexts, etc.).
4. *Research Based Learning (PhD Students*) Focus: learning through the use of research / inquiry approaches and learning how to use research methods.
5. *Active Learning Strategies.* Focus: why and how to implement different active learning strategies to improve teaching practice (Team Based Learning (TBL) + Flipped Learning + Gamification).
6. *Curriculum Design and Development*. Focus: processes to be taken into account in order to plan, develop and deliver a curriculum (learning outcomes and competences, activities, content, resources, assessment, etc.).
7. *Assessment.* Focus: alternative methods of assessment in engineering education - "assessment for learning".
8. *Design thinking.* Focus: how to use design thinking tools in teaching and learning.
9. *Communication.* Focus: communication techniques and tools for teaching practice: storytelling, feedback, rapport, backtracking, etc.

Program principles: 1 ECTS = learning = 10 contact hours Program of Modules: 8 Modules x 1 ECTS

A Module development team: 3 persons (8 mod * 3 p = 24): one (1) coordinator per institution; two (2) participants per institution. The modules were selected according to the interest and engagement level.

It is worth mentioning that all courses in question will be elaborated by international teams, which include EXTEND project participants from European, Russian and Tajik HEIs. Each team comprises representatives from 3-4 universities, which jointly collaborate with the aim to elaborate new courses compiling with the new methods and techniques in this area. Each team is supervised by the group leader, who monitors the process, makes corrections, guides the work, and bears responsibility for the group work.

Internationalization of teams will undoubtedly contribute to enhancement of quality of the elaborated courses due to the fact that the final product will represent a combination of various educational systems, experience and existing researches. Moreover, cross-cultural communication within the international teams promotes rapprochement of cultures, team building, exchange of the best experience and, as a result, more detailed and careful curricula elaboration. "In the new third millennium, the requirements to foreign languages knowledge from the standpoint of the language classical grammar have already shifted towards the level of communication skills formation, the ability to combine the tools of native and foreign languages to solve industrial, educational and other common problems. A person must have a certain stock of knowledge on history, culture, system of national values, beliefs and traditions, in addition to knowledge of the linguistic structures themselves, even communicating at a professional level" (Зеркина, Н.Н., & Савинова, Ю.А., 2018).

There exists a practical need in engineering specialists with a good level of language proficiency, who will use it as an instrument of their future professional activity. In this paper attention will be focused on the relevance of such course as "Foreign Languages for Engineering. Academic Writing", which will enable both students and university teachers to enhance their specialization and professional, linguistic and cultural training as well.

A high demand in such courses is explained by a growing role of international contacts of all kinds, including contacts between engineering specialists. In the elaboration of this course, much attention is given to the possibilities of using foreign language as a means of studying another subject area of technical orientation and exercising future practical activity of learners in the engineering field. The course "Foreign Languages for Engineering. Academic Writing" is aimed at developing the linguistic competence of engineering students and university lecturers teaching engineering disciplines. "Bologna Process to which Russia joined in 2003, defined the direction of integration in the sphere of the higher education that caused need of foreign languages studying in general and the professionally oriented foreign language in particular." (Дубских, А.И., & Зеркина, Н.Н., 2018), (Зеркина, Н.Н., 2015).

In our opinion, the course will be efficient if:

-it meets the individual requirements of students in the field of their professional development;

-methodological framework includes systemic, competence, person-oriented and activity approaches, which enable teachers to create favourable psychological and pedagogical conditions for effective processing of information.

It should be noted that the systemic approach will be applied not only for the elaboration of these courses, but for teaching them as well, due to the fact that 9 courses represent a system and develop both "soft" and "hard" skills, which are of key importance for an engineer of the new generation. Interdisciplinary communication is exercised in the course as well, which implies integration of the basic subject "Foreign Language" with general professional and specialized courses. It is planned to elaborate such sub-courses as "Foreign Languages for Power Engineers", "Foreign Languages for Civil Building Engineers", "Foreign Languages for Mining Engineers", "Foreign Languages for Machine-Building Engineers", "Foreign Languages for Metallurgists", etc.

Course organization technology includes the use of the Internet, active methods of teaching, such as Project-Based Learning (PBL); Team-Based Learning (TBL); Research-Based Learning (RBL); Flipped learning, etc. "Active learning methods aimed at developing communicative and collaboration skills, encouraging students to take responsibility for their own work were studied for further dissemination. These methods include collaborative learning groups, student-led review sessions, games, analysis or reactions to videos, film making, student debates, analysis of case studies, etc." (Кисель. О.В., & Зеркина, Н.Н., 2018). Variation of these methods provides for building learners' communicative, professional and personal capacity; fundamentals of academic writing will be incorporated in the course for improving skills and abilities of written business communication, writing papers indexed in Web of Science and Scopus databases, which is one of the key priorities for PhD students and university teachers nowadays.

However, to achieve the set goals of EXTEND project, and elaborate a truly effective course, it is necessary to rely on some specific approaches as well.

Firstly, on the culturally sensitive approach, which considers a person as a protagonist of culture and

provides for his/her general cultural training. In other words, it develops a future engineering specialist's culture.
Secondly, on the communicative approach, which is responsible for building the learners' communicative capacity during classes, and implies the use of communicatively-oriented tasks and exercises, recreating as much as possible situations of real professional communication, rather than doing substitution exercises.
Thirdly, on the interdisciplinary approach, which takes into account inter-subject links, relevant for the future engineer from the point of view of their future profession.
Fourthly, on the cognitive approach, where attention is focused on a cognitive function of the language, and linguistic units are studied functionally, i.e. directly in the professional context.
The aforementioned approaches enabled us to identify principles, relevant for the elaboration of the course:
- principle of integration of teaching with science;
- principle of professional and creative orientation of teaching;
- person-oriented principle;
- principle of interdisciplinary integration;
- principle of practical orientation of the educational process;
- principle of integration of professional and personal orientation of educational information;
- principle of ICT application;
- principle of multifunctionality of exercises;

As far as the active methods of teaching are concerned, we are strongly convinced that they are able to intensify learners' independent activity, enable them to proceed from the reproductive level to the productive and creative one. Role and business games, "gallery walks", discussion clubs, problem question, case method provide ample opportunities for engaging learners in situations of real professional communication.
The main difference between standard Foreign Language courses and the new one concerns strategies that are used at the lessons. In the new elaborated course "bottom-up strategy" will be used instead of the "top-down" one. As a rule, at the traditional classes teachers themselves define proper goals, content, methods and techniques of teaching, while in the new course it is possible to tailor them to individual learners' needs.
The elaboration of the course will include the following three stages:
1) *Preparatory stage*. At this stage the course developers analyze authentic texts, dealing with the learners' specialties, identify their morphological, grammar, genre, stylistic and lexical peculiarities, characteristic for sub-language of learners' specialty. Authentic texts should be a key component of the course (i.e. taken from professional context and intended for professionals), with the volume approximately 2500-3000 characters. Such volume of the text is enough, in our opinion, for detailed consideration of the dealt issue. In order to facilitate perceiving a big volume of information, it is recommended to divide it into sub-texts with titles, as it is psychologically easier for learners to read, perceive and anticipate information, learnt earlier.
Selected texts should retain all difficulties of the original variants, rather than be simplified and annotated. Methodical adaptation of texts can include lexical and grammar comments before or after texts, identifying a terminological core of the text, saving schemes and illustrations.
Foreign language learning will be actual for students only in case if texts do not contain information, which has already been known to them. Inasmuch as they have a relatively high level of engineering training, the cognitive gap between the existing knowledge and new information will create motivation for overcoming this gap.

2) *Material systematization stage*. At this stage the obtained material is processed, systematized, and methodical-didactical framework is prepared. This framework includes composing linguistic units in exercises. There exists an urgent need in making a special system of exercises, based on the theory of gradual forming of mental acts and utterance creation.

Receptive, reproductive, productive and communicative (creative) exercises will be extensively used in the course, and it is worth noting that the latter exercises have a prevailing role in the educational process. They are aimed at mastering both oral and written skills, enable the learners to take the lead and, therefore, actively participate in defining goals, content, methods and techniques used at the lesson (“bottom-up strategy”).
As soon as the text perception is over, learners start dealing with linguistic units (e.g. tasks for search of equivalents in native and foreign languages), gradually proceeding to the level of meaning (e.g. answer the questions, fill in the gaps, etc).
3) *Implementation stage.* Piloting courses are implemented in the curriculum of partner countries HEIs, which later can used in EXTEND centres and other HEIs of EU, Russia and Tajikistan.

CONCLUSION

International consortia are an effective institution for excellence in higher education, being very significant in elaborating of new curricula, solving a number of issues concerning internationalization of higher education, facilitating innovative potential of universities and disseminating the best practices in the sphere of higher education.
International consortia give a unique opportunity to combine theory and practice together, and implement the achieved results for the well-being of future generation education, and give a platform for approbation and implementation of the researched results.
Organization of EXTEND centres and online access to courses will broaden the educational horizons for learners. Regardless of the place of their living, students will be able to complete the elaborated courses at any partner university of the consortium, or use their electronic databases. All this significantly increases the possibilities of future EXTEND centres, and provides accessibility of education for students from various countries, Moreover, the accessibility of education will be provided by means of distance technologies according to the international specifications and standards. Thus, a unified e-platform will be elaborated for all partner universities.
To sum it up, foreign language is a means of developing professional, communicative, linguistic and cultural competences, and is a tool, which opens up new possibilities in the professional sphere, erases linguistic barriers and promotes them to a qualitatively new level of personal and professional development.

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Employability of New Immigrants' Youth Studying in Technical Program in Taiwan

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ABSTRACT

The purpose of the study is to understand the employability of new immigrants' youth studying in technical program in Taiwan. A national survey was conducted to explore the employability of new immigrants' youth from the perspectives of teachers and students. A total of 1,500 questionnaires were distributed to students and 1,171 questionnaires were retrieved. Valid questionnaires totaled 1,098 and accounted for 73.20%; a total of 750 questionnaires were distributed to teachers and 544 questionnaires were retrieved. Valid questionnaires totaled 524 and accounted for 69.87%. The study found that new immigrants' youth performed best in emotion control ability, followed by personal management ability; new immigrants' youth performed worst in basic listening, speaking, reading and writing skills, followed by native language proficiency.

Keywords: new immigrant's youth, workplace employability, technical and vocational education

1. INTRODUCTION

Under the framework of the global system reform, enterprises expect skilled labor force for use to cope with the fast changes in working conditions and technologies (Asonitou, 2015). The government, enterprises and policy makers proceed to cultivate graduated students from higher education for the overall national prosperity, in order to link with employment rate and improve the standards of skills and competencies (Frank & Meyer, 2007). Harvey, Locke, and Morey (2002) stated that employability is the key agenda in higher education mainly because the expansion of higher education is one important factor in enhancing economic involvement in times of a knowledge-based economy.

Many researchers proposed that employability is not merely the ability to adapt to workplace but also the essential ability to be acquired. For example, communication ability (Maxwell, Scott, Macfarlane, & Williamson, 2009), reading ability (Maxwell, Scott, Macfarlane, & Williamson,

2009), and information ability (Hamid, Islam, & Manaf, 2014; Koka & Raman, 2015). The basic ability of employment for job seekers is the essential element of job seeking and such essential ability serves as the foundation to establish personal adaptability, interpersonal skills and career management to improve the opportunities for corporate interview and acceptance.
Employability is the issue that everyone faces in the career. As the government is actively developing the multiculturalism of new immigrants' children, the study aims to explore the employability of new immigrants' youth studying in technical program through the questionnaire, and the findings of the study may be provided for the competent authority in charge of education and schools to develop the employability of new immigrants' youth.

2. LITERATURE REVIEW

Employability has become the youth policy agenda and has drawn great attention from advanced countries since 1990. Employability not only means basic professional skills, but also means knowledge required to understand the potential value of an individual, the controlling position and employment in the labor market, and the important role an individual play (Tseng, 1972). It combines the attitude, knowledge, and skills, including all factors relating to individual performance in the labor market (Atkinson, 1984). Saterfiel and Mclarty (1995) indicated that employability refers to skills for individuals to secure and retain jobs, including work attitudes and habits and functional subject skills. De Grip, Van, & Sanders (2004) pointed out that employability is the ability of a willing and capable individual to attract employers and secure and retain a job in consideration of organizational constraints. Youth Development Administration (2006) indicated that employability can be obtained through learning, including (1) work attitudes and the ability to cooperate that are conducive to employment, (2) career planning and active learning, and (3) professional knowledge and the ability to apply.
Dacre & Sewell (2007) pointed out that employability should contain professional skills, knowledge and good personal attitudes, so that individuals can choose and ensure to find a good and satisfactory job. Employability requires personal expertise and knowledge to create an opportunity to secure and retain jobs (Petrongolo, 2009). Yusof, Mustapha, Mohamad, & Bunian (2012) believed that employability requires the accumulation of work experience to ensure that individuals can adapt to changes in the work environment and career development. In the discussion of employability, later scholars not only considered an individual's work ability or attitude and other related factors, but also included an individual's corporate contribution, personal learning, adaptation to the work environment, and career planning and development, showing that employability changes with the times. To sum up, the study defined employability as the knowledge, skills and attitude required for individuals in job seeking, which will assure finding the job and cover individuals career planning and development, the adaptability to work environment, and personal learning and growth.
Governments and scholars have paid attention to the employability of youths and proposed multiple core competencies for employment (SCANS, 1990; Commonwealth of Australia, 2006; Hillage &Pollard, 1998; Cotton, 2001; Brennan et al, 2001; Ministry of Higher Education, 2007; Department for Business Innovation & Skills, 2011). However, most of the researches focused mainly on students, and few researches explored the employability of new immigrants' youth. Chao, Lin and Li(2018)integrated the findings of scholars (Azevedo, Apfelthaler, & Hurst, 2012;Mastura, Imam, & Osman, 2013; Sermsuk, Triwichitkhun & Wongwanich, 2014; Castillo, 2014; Paadi, 2014; Koka & Raman, 2015; Corker & Hooland, 2015; Dean, 2016) and proposed that employability includes analytical and thinking ability, problem-solving ability, teamwork ability, communication and expression ability, interpersonal relation ability, leadership ability, time management ability, information ability, management ability, professional competence, planning and organization ability, learning ability, personal adaptability, work attitude, work attitude, innovative thinking

ability, critical thinking ability, self-marketing ability, foreign language communication ability, personal management ability, basic listening, speaking, reading and writing skills, learning will and development, learning will and development, and work independence. Through interviews and the Delphi survey, Chao et al (2018) identified 31indicators for the employability of new immigrants' youth. The study based the survey on the above indicators.
It is imperative to understand the current employability of new immigrants' youth in the future workplace. Based on the multi-culture background and characteristics, new immigrants' youth are trained with personal basic skills, workplace skills and employability to successfully connect with the workplaces in their native countries.

3. RESEARCH DESIGN AND IMPLEMENTATION

(1) Research methodology and subject
To achieve the purpose of the study, the study conducted the survey targeting new immigrants' youth studying in vocational senior high schools. According to the statistics, new immigrants' youth studying in vocational senior high schools totaled 19,322, and students for sampling totaled 1,013. To avoid lack of valid questionnaires, the number of students for sampling was multiplied by 1.5. The questionnaire was distributed to 66 senior high schools based on the percentage of new immigrants' youth. Questionnaires distributed to students totaled 1,500, and questionnaires distributed to teachers totaled 750.
(2) Research tools
Chao, Lin and Li (2018) drafted the indicators for the employability of new immigrants' youth through literature review and established 31 questions based on the Delphi survey and opinions of experts and scholars. The study based the national survey on the above indicators to explore the current employability of new immigrants' youth studying in technical program in Taiwan from the perspectives of teachers and students

4. STATISTICAL ANAYSIS

(1) Characteristics of survey samples
The questionnaire was distributed to senior high schools based on the percentage of new immigrants' youth. A total of 1,500 questionnaires were distributed to students and 1,171 questionnaires were retrieved, accounting for 78.07% of total questionnaires. Valid questionnaires totaled 1,098 and accounted for 73.20%. The characteristics of survey samples are shown in Table 1.

Table 1: characteristic of survey samples – students

Variable	Group	Frequency	Percentage
Type of School	Public	508	46.27
	Private	590	53.73
School System	Senior high	61	5.56
	Vocational senior high	1037	94.44
Gender	Male	555	50.55
	Female	543	49.45
Grade	2nd grade	642	58.47
	3rd grade	456	41.53
Father's Original Nationality	Taiwan	1016	92.53
	Vietnam	16	1.46

	Indonesia	5	0.46
	Thailand	6	0.55
	Philippines	8	0.73
	Malaysia	9	0.82
	Cambodia	0	0
	Mainland China	22	2.00
	Others	16	1.46
Mother's Original Nationality	Taiwan	66	6.01
	Vietnam	450	40.98
	Indonesia	193	17.58
	Thailand	25	2.28
	Philippines	26	2.37
	Malaysia	10	0.91
	Cambodia	47	4.28
	Mainland China	260	23.68
	Others	21	1.91

A total of 750 questionnaires were distributed to teachers and 544 questionnaires were retrieved, accounting for 72.53% of total questionnaires. Valid questionnaires totaled 524 and accounted for 69.87%. The characteristics of survey samples are shown in Table 2.

Table 2: characteristics of survey samples – teachers

Variable	Group	Frequency	Percentage
Gender	Male	188	35.88
	Female	336	64.12
Age	30years old or below	60	11.45
	31-40years old	211	40.27
	41-50years old	187	35.69
	51years old or above	66	12.60
Years of Teaching	10years or less	217	41.41
	11-20years	204	38.93
	20 years or more	103	19.66
Years of Teaching for New Immigrants' Students	5years or less	354	67.56
	6-10 years	133	25.38
	11years or more	37	7.06
Duty	Teacher and administration	100	19.08
	Mentor	365	69.66
	Subject teacher and special education teacher	59	11.26

(2) Current employability of new immigrants' youth from the perspectives of teachers and students
The study compared the survey of current employability of new immigrants' youth from the perspectives of teachers and students with the Delphi survey. The results of the comparison are shown in Table 3. Top 5indicators for the employability of new immigrants' youth from the perspectives of teachers and students were similar. Students believed that they performed well in ability of multicultural literacy, emotion control ability, personal management ability, work attitude, and work ethics and morals; teachers believed that new immigrants' youth performed well in emotion control ability, personal management ability, work attitude, work ethics and morals, and social management ability.

Both teachers and new immigrants' youth believed that they performed worst in basic listening, speaking, reading and writing skills and native language proficiency. Taiwan is a developing country with rapid information development, but new immigrants' youth believed that they were insufficient in information ability, which was different from the teachers' perspective. The perspectives of teachers and students also varied in professional knowledge in specific field and professional work skills (techniques).

The study compared the national survey with the Delphi expert survey (2 from competent authority in charge of education, 6 from colleges and universities, 6 from senior high schools, and 2 from the industry) proposed by Chao, Lin and Li (2018). According to the Delphi expert survey, top 5 employability indicators were basic listening, speaking, reading and writing skills, professional knowledge in specific field, professional work skills (techniques), time management ability, and teamwork ability, which ranked 31, 20, 24, 14, and 7 from the students' perspective. This shows that there is still room for improvement in the current employability of new immigrants' youth.

Table 3: Employability of new immigrants' youth from perspectives of teachers and students

	Indicators	Student	Rank	Teacher	Rank
Q1	Basic listening, speaking, reading and writing skills	2.43	31	2.85	31
Q2	Native language proficiency of new immigrants' youth	2.58	30	2.89	30
Q3	Ability of multicultural literacy	3.97	2	3.73	7
Q4	Emotion control ability	3.99	1	3.89	1
Q5	Living adaptability	3.81	6	3.50	20
Q6	Foreign language proficiency (language other than native language and Chinese)	2.77	29	3.08	29
Q7	Personal management ability	3.93	3	3.84	5
Q8	Professional knowledge in specific field	3.44	20	3.62	14
Q9	Professional work skills (techniques)	3.40	24	3.63	13
Q10	Problem-solving ability	3.51	18	3.61	15
Q11	Information ability	3.22	27	3.59	18
Q12	Communication and expression ability	3.53	16	3.69	8
Q13	Time management ability	3.56	14	3.57	19
Q14	Ability to focus on details	3.63	12	3.60	17
Q15	Work attitude	3.86	5	3.84	4
Q16	Work adaptability	3.71	10	3.68	9
Q17	Work ethics and morals	3.91	4	3.87	2
Q18	Social management ability	3.75	7	3.86	3
Q19	Teamwork ability	3.75	7	3.81	6
Q20	Work independence	3.55	15	3.65	12
Q21	Critical thinking ability	3.63	11	3.61	16
Q22	Ability in interdisciplinary knowledge	3.28	26	3.32	27
Q23	Planning and organization ability	3.41	22	3.38	24
Q24	Ability of involving in projects and tasks	3.60	13	3.66	11
Q25	Leadership and decision-making ability	3.40	23	3.35	25
Q26	On-the-job learning will and potential development	3.75	7	3.67	10
Q27	Comprehension on industry	3.47	19	3.32	26

	environment and development				
Q28	Job seeking ability	3.30	25	3.40	21
Q29	Career planning ability	3.43	21	3.39	23
Q30	Innovative thinking ability	3.51	17	3.40	22
Q31	Entrepreneurship ability	3.21	28	3.15	28

5. CONCLUSIONS

(1) In terms of employability, new immigrants' youth performed best in emotion control ability, followed by ability of multicultural literacy.

Both teachers and new immigrants' youth themselves believed that they performed best in emotion control ability. The performance of new immigrants' youth was similar to that of classmates, but there was no obvious reaction in emotional expression, which could correlate with their background and identity. Mothers' native nationalities were moderate, and family education affected the perspectives of new immigrants' youth and their ways of dealing with things. As a result, new immigrants' youth tended to repress their emotions; in addition, due to their identity, they were not confident in expressing their opinions, causing teachers and new immigrants' youth themselves to believe that they had a good emotion control ability.

(2) In terms of employability, new immigrants' youth performed worst in basic listening, speaking, reading and writing skills and native language proficiency.

Both teachers and new immigrants' youth themselves believed that they performed worst in basic listening, speaking, reading and writing skills, followed by native language proficiency. The degree to which the family attaches importance to the language of the foreign spouse's native language will affect the language performance of new immigrants' youth; that is, due to the low status of new immigrants in the family, it is difficult to implement native language learning; in addition, native language learning of new immigrants' youth still focuses on life dialogues and lacks specialized words or proprietary or technical terms (Wu, Ma & Lan, 2015); in addition, vocational senior high schools do not provide courses on native languages of new immigrants or basic listening, speaking, reading and writing skills currently, and few schools teach native languages of new immigrants through immigrant culture clubs. In the 2019 curriculum guidelines, the government has included native languages of new immigrants in language learning courses to improve the native language proficiency of new immigrants' youth and their basic listening, speaking, reading and writing skills

6. SUGGESTIONS

(1) The competent authority in charge of education should design the courses and teaching materials for native languages of new immigrants from Southeast Asia to develop the native language proficiency and cultural literacy of new immigrants' youth and their parents.

The Ministry of Education has planned to include the native languages of new immigrants from Southeast Asia (Vietnam, Thailand, Indonesia, Myanmar, Philippines, Cambodia, and Malaysia) in the General Curriculum Guidelines of 12-year Basic Education announced in 2014. They are required in elementary schools and optional in junior high schools (and identified as the second language in secondary education). The purpose is to develop the basic listening and speaking skills of new immigrants' youth and further improve the cultural identity and parent-child interaction. Currently, the authority in charge of education has not provided courses on native languages of new immigrants and teaching materials in senior high schools. As most of the new immigrants' youth have graduated from elementary schools and junior high schools, it is advised that the competent authority in charge of education should design the courses and teaching materials for native languages of new immigrants from Southeast Asia in secondary education to improve the native language proficiency and cultural literacy of new immigrants' youth.

(2) The competent authority in charge of education should plan the certification system for native languages of new immigrants to strengthen the native language proficiency of new immigrants' youth.

Currently, the official certification system is available for Taiwanese, Hakka, and indigenous languages in Taiwan; however, there is no such system for native languages of new immigrants, which affects the motivation of new immigrants' youth to learn native languages. It is advised that the competent authority in charge of education plan the certification system for native languages of new immigrants to promote the benefits of native language learning, pass down the heritage of native languages, and improve the willingness to work in native countries.

(3) The government may allocate sufficient budgets for improving the international horizon and employability of new immigrants' youth.

Despite the decreasing number of new immigrants' youth, nearly 300,000 new immigrants' youth attend schools every year. Therefore, education for new immigrants' youth is imperative. In the next decade, new immigrants' youth will become an important part of the workplace in Taiwan. It is advised that the governments integrate resources and allocate budgets for the education for new immigrants' youth to improve the adaptation, international horizon, and employability of new immigrants' youth based on multiculturalism.

(4) Schools should provide career development courses for new immigrants' youth.

The study found that new immigrants' youth had low career planning ability and job seeking ability, increasing the difficulty in seeking jobs after graduation. It is advised that schools plan career development courses suitable for new immigrants' youth and give positive encouragement and appropriate career guidance to help them explore their aptitudes, interests, competencies, and value and build confidence; in addition, it is advised that principals, counselors or persons in charge of new immigrants' youth visit the native countries of new immigrants' youth to understand the status of their culture, economy, and education, so that they can provide new immigrants' youth more appropriate information and improve their cultural identity.

(5) Schools should establish ways of communication to familiarize teachers with the family status of new immigrants' youth.

In terms of the current status of employability, there is a significant difference between the perspectives of teachers and new immigrants' youth. This shows that teachers do not understand the learning status of new immigrants' youth clearly. It is advised that teachers invite parents by phone or in person to participate in their youth's learning and understand the significance of school activities and the learning status of their youth. By communicating with parents, teachers are able to understand the family status of new immigrants' youth and provide appropriate teaching and guidance, so as to improve the learning status of new immigrants' youth.

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Managing Earthwork Construction Business Institutions Applying Industry 4.0 Relating Technologies – The Case of German SMEs

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ABSTRACT

The interest in Industry 4.0 relating technology in earthwork construction is increasing and continues to gain more and more in popularity. Earthwork contractors have begun to think about alternative and innovative ways to increase productivity by applying new ICT technologies. In this context they try e.g. to utilize sensors, software and information and communication tools to improve processes and to reduce workforce and total costs at the same time. However, as with many innovations, there exist companies that have not invested in these technologies yet. The objective of this paper is to investigate in technologies associated with Industry 4.0 and their potential future application-possibilities in the field of earthwork construction. Therefore, this paper conducted an in-depth literature review of relevant Industry 4.0 technology topics. Additionally, semi-structured interviews among German earthwork industry experts were conducted, which revealed several insights regarding benefits, challenges and barriers of managing relevant technologies.

Keywords: *Industry 4.0, Earthwork Construction, Technology Management, Information and Communication Technology*

INTRODUCTION

Traditionally the construction industry is not perceived as being among the most innovative industry branches. The earthwork construction sector with its excavators and bulldozers would not appear to have much in common with digitization at first glance. And in fact, earthwork construction itself has lagged in digitization for years. But they are currently undergoing the same digital disruption that has already hit several other industry branches (World Economic Forum, 2016). In becoming increasingly connected and automated, new technology should enable low-skilled operators to work more efficiently in the nearby future. Since the adoption of BIM (Building Information Modelling) is progressing and its implementation gets pushed through governments initiatives and several contracting entities, the interest in smart connected heavy machinery will accelerate (Singh, 2007; Kelp & Kaufman, 2017). However, little is known about the full role of Industry 4.0 relating technology within the application field of earthwork construction and its potential for facing future challenges in terms of increasing competition and the lack of skilled workforce. For that reason, the main objective of this study is to examine how Industry 4.0 relating technologies are capable for earthwork construction and to what extend they may affect the earthwork construction environment.

Therefore, a literature research was conducted first, using Google Scholar and several databases such as ASCE, EMERALD and ASCE, to determine the latest developments of Industry 4.0 relating

technologies in the field of earthwork construction. Therefore, search keywords like Industry 4.0, earthwork construction, earthmoving machines, earthmoving equipment, machine guidance systems, innovations, productivity, connected machines, big data, smart sensors and process optimization were involved in the articles searched. Where it was considered meaningful for reasons of plausibility some additional papers were included in the research. After collecting the latest academic contributions, an analysis was performed to classify the main areas of interest. It is acknowledged that the review focuses on Industry 4.0 technologies, having a closer look on smart technologies applied on earthmoving machines and within earthwork construction in a narrower sense.
In addition to the literature review, semi-structured interviews among German construction experts were applied. The interviews should reveal further insights regarding the companies' experiences on the technologies described and into their impacts on earthwork construction. Therefore, several questions were outworked to experience the participant's assessments. In a final step, the results from the literature review and the interviews were brought together and synthesized, to determine the future trends. The aim is to predict future developments and to provide a direction for future research.

LITERATURE REVIEW: INDUSTRY 4.0 RELATING TECHNOLOGIES

Machine Guidance Based Site Control Technology (SCT)

Today, several types of earthmoving machines are available with different automation configuration levels, allowing operators to operate more efficiently. In contrast to existing methods, conventional survey stakes are redundant, because today's machine guidance systems are based on 3D design and real-time measurement information. This automated machines, minimize the need for surveyors to stake out and continually check the grading work. This greatly speeds up the process and adds accuracy, because the machine matches the model. The current state-of-practice are systems with automatic blade or cutting-edge bucket control (Seo, Lee, Cassule, & Moon, 2015). Albeit, extensive research has been conducted, a fully autonomous system for a mobile earthmoving machine such as a bulldozer, excavator, motor-grader or roller has yet not been applied on a real construction site (Dadhich, Bodin, & Andersson, 2016). Thus, the current state-of-practice comprises just semi-automated machines, using sophisticated design software to direct the operations with a high level of precision. In this context, Dadhich et al. (2016) investigated in the key challenges of automating earthmoving machines, stating that more research and more industrial support is necessary to speed up the process towards fully autonomous machine solutions. The advantages are apparent, considering the lack of skilled operators and the impacts on productivity and cost savings. Accordingly, several case studies show, that machine guidance systems are feasible for productivity gains between 5% to 270% and cost savings in the range of 10% to 70% depending on various external contribution factors (Jonasson, Dunston, Ahmed, & Hamilton, 2000; Aoalsteinsson, 2008; Higgins, 2009; Forrestel, 2007; Caterpillar Inc., 2006; CTC & Associates LLC., 2015; Kirchbach, Zeeshan, & Tezel, 2015).

Smart Sensors and IoT

The Internet of Things (IoT) – also known as the Industrial Internet – is a technology that is likely to disrupt industry branches, enabling automatic communication and interaction among objects and the physical environment (Krotov, 2017). At a first glance, connected products are essentially not perceived as a breakthrough innovation in general, since industrial equipment has been supervised remotely in the past. However, the novelty originates from the IoT's potential of widespread application as rates for data traffic have decreased, enabling a seamless connectivity and automated surveillance at acceptable cost (Saarikko, Westergren, & Blomquist, 2017). The functionality behind this is that the IoT makes objects sensed or controlled and thus implies a network paradigm of cyber-physical systems (CPS) that allow physical objects to connect with each other and to collect and exchange data through the internet protocol and wired or wireless networks (Kang, et al.; Chen & Chen, 2016). Regarding earthwork construction, IOT can collect or exchange data acquired from smart sensors mounted on earthmoving equipment (Caterpillar Inc., 2015). It is a core technology for the realization of smart connected machines, enabling productivity analytics and predictive maintenance (Parpala & Iacob, 2017).. Machine data, generated automatically through smart sensors, allows manufacturers and customers to analyze work patterns, to anticipate changes, and to monitor and to confirm whether a machine has achieved its desired productivity. They may also be able to identify patterns in machine maintenance before a machine experiences catastrophic failure or damage (Azar & Kamaat, 2017; Parpala & Iacob, 2017).

Big Data

The term "Big Data" is an important component of any company's digitization strategy and is becoming increasingly important in civil engineering and earthwork construction. It describes datasets whose size exceeds the capacity and capability of traditional database software tools for capture, storage, processing and analysis. However, there is no exact measure to describe when a record is referred to as "Big Data". Literature describes "Big Data" based on the following 5 dimensions: data volume, data variety, data velocity, data reach and data variability. According to Kaplinski et al. (2016) "Big Data" technologies are new generation technologies and architectures which were designed to extract value from multivariate high-volume data sets efficiently by providing high speed capturing, discovering and analysis," to enhance decision making (Kaplinsky, Koseleva, & Ropaite, 2016). As a result, "Big Data" is worthless if no technologies are available to extract valuable information from the data sets and illustrate it in a meaningful way. The increasing importance of "Big Data" in civil engineering is due to the new technologies and intelligent sensors that are available in today's construction machines. They can generate enormous amounts of data, which can create significant competitive advantages when applying adequate analysis options. The manufacturing industry has followed "Big Data Analytics" approaches for many years, using data collection; processing and analysis to better understand irregularities within their production system. They range from the creation of automated daily reports to sophisticated predictive analyses requiring usage of data mining or advanced statistical tools. "Big Data" solutions are now also gaining increasing interest in the earthmoving machinery industry as an integral part of predictive maintenance management systems. (Santos, et al., 2015).

Cloud Computing and BIM

Cloud Computing builds the basis for providing access to a shared pool of configurable resources via the Internet and thus is they key enabling technology for BIM (Building Information Modelling). BIM facilitates a visualization of the construction design, allowing several project participants simultaneously to monitor the progress of a construction site (Bilal, et al., 2016). While the conventional BIM is intended for designing, creating, managing and sharing the whole lifecycle of a building, where process sequences usually can be predefined, the application of BIM technology to earthworks is a little bit more sophisticated, because irregular shapes (topography) and unforeseen object data (e.g. soil condition) must be considered (Moon & Seo, 2017). Because most construction projects entail earthwork phases, where data of both buildings and urban environment is required, there is a need in integrating both approaches, to visualize a site in its entirety (Roarty, 2015). However, BIM is usually applied in building construction and not very common in today's earthwork projects (Tanoli, Raza, Lee, & Seo, 2017). However, regarding earthwork construction, BIM integrated technology will facilitate spatial data analysis and more effective and transparent earthwork calculations in the future (Kim, et al., 2015). Regarding the smart deployment of earthmoving machines on site, the basis therefore is always three-dimensional construction drawing data (Kim, et al., 2015; Tanoli, Raza, Lee, & Seo, 2017). However, BIM researches focusing on earthworks are still in its initial stage but are currently making advances. For instance, Moon & Seo (2017) developed a 3D earthwork BIM methodology, presenting a graphic simulation that can assist machine operators during excavation work. It combines software and hardware technologies to represent the actual excavator configuration in a three-dimensional virtual environment. (Moon & Seo, 2017).

METHODOLOGY

This study applies a qualitative research method to investigate in current barriers and opportunities of applying Industry 4.0 relating technologies to the management of small and medium sized construction enterprises acting in the field of earthwork construction. A qualitative research strategy is appropriate given the fact that the study intends to gain insights on how construction professionals manage their company applying Industry 4.0 relating technologies. Therefore a set of semi-structured interviews was carried out to collect valuable data. Following that a sample of ten German construction companies focusing on earthwork construction was constituted on the criteria of the existence of a formal, public discourse regarding the use of Industry 4.0 relating technologies. Afterwards the key people responsible for the companies' management strategy were identified within these companies.

To get reliable data all interviewees were selected under the premise of the following requirements: a) to have experience in earthwork construction as a senior manager, b) to have management experience in earthwork construction of minimum 10 years, c) to be completely familiar with earthmoving machines and relating production techniques, c) have an understanding of Industry 4.0 relating technologies, d) less than 250 employees, e) to apply a minimum level of information and communication technology within their organization (e.g. CAD Software, Digital Terrain Models, Machine Guidance Systems, Mobile ICT Components, Local Area Network, Internet Access and E-Mail).

The interviews were based on the following main questions:

1. How do you estimate the relevance of Industry 4.0 related technology and its adoption to earthwork construction regarding the management of your company?
2. What are the problems and barriers of implementing Industry 4.0 related technology within your company and on site?
3. Can you describe an example of Industry 4.0 related technology which you already use?
4. Which associated technology would be promising in managing your company in the nearby future?

FINDINGS

Infrastructure Requirements

All interview participants pointed out that, before Industry 4.0 becomes relevant in earthwork, the necessary framework conditions must first be created by policymakers. In particular, access to high-speed internet also needs to be enabled on remote construction sites. Unlike in the manufacturing industry, construction sites are unique and are often located away from developed areas. As almost all technologies associated with Industry 4.0 are dependent on the internet and can only then function together as a complete system, most participants believe that earthwork will lag behind industry for a number of years. In addition, they note that the implementation of these technologies necessitates considerable capital expenses as well as the approval of employees. Since the construction sector has difficulty recruiting young talents familiar with new technology and largely has to fall back on an older personnel base, the acceptance, willingness to learn and a supposedly higher training expense for older employees represent additional limiting factors for implementation.

Construction Process Management

All interview participants already use machine guidance systems on various construction machines in their company. In line with the literature review, they also largely hold the view that these systems lead to cost savings on the construction site of between 10 and 70%. According to the participants, the introduction of positioning and sensor systems as well as their integration with modern software in the new generation of construction machines represent a promising approach for the potential adaptation of the digital factory for the construction site. Besides the potential for cost savings and the optimization of processes, the systems create increased information transparency and thereby open up new means of communication (Kirchbach, Koskela, & Gehbauer, 2014, Kirchbach, Steuer & Gehbauer, 2013).
Autonomous construction machines are also conceivable in the nearby future – due to constant system developments and the interplay of automatically generated digital information by means of sensors. Examples mentioned include earth-moving compactors for soil compaction, bulldozers for levelling work and diggers for excavating construction pits.

Supplier Side

All participants report that they have different construction machine manufacturers in their fleet of machinery and, consequently, no compatibility with respect to the often supplied and integrated fleet management systems in particular. As the practical application of these technologies is based on the ability to exchange data between different manufacturers, it is necessary for OEMs to rethink their systems and sensors in order to make them compatible with each other using open interfaces. On the whole, it can be determined that initial efforts have been undertaken by manufacturers to digitalize earthwork. In this context, however, the project participants need to enter into close dialogue with each other in order to prevent the development of isolated solutions. Continued efforts should concentrate on developing a holistic approach that encompasses all work steps (and not just some work steps, as has so far been the case). Since a construction site often involves earthwork, building construction and civil engineering, an integration into BIM should also be considered. Thus, no 'islands of automation' should be created. Instead, existing approaches are to be combined, bundled into a single solution and further developed.

Fleet Management & Predictive Maintenance

The finding that the participants have not thus far utilized telematics systems intensively for their construction machines is primarily due to the fact that each manufacturer introduced its own software and different software interfaces were used which were not compatible. This prevented consistent data transfer – meaning users of mixed fleets had to log in to multiple interfaces or integrate additional hardware to access data. In turn, this resulted in more workload and additional costs and was not communicable to users, especially as many devices are already fitted with the components ex works. Another key point mentioned by the participants in this respect is the predictive maintenance of the machine fleet. This technique is already utilized in some areas – albeit to a limited extent. Although the technical basis already exists with IoT and smart sensors, here too there is insufficient will among manufacturers to standardize for full implementation. In 2016, the US association of fleet managers AEMP, the US construction machine manufacturers' association AEM and the German representative body VDBUM agreed to a standard AEMP interface 2.0 for construction machines. Despite this positive approach, which resulted in the ISO standard 15143-3 in 2017, the current solutions on offer are not suitable for practical use. Here, the participants stated the possible reason for this is that the sales staff are only inadequately informed and largely are unaware of these agreements. This is likewise an indication that the manufacturers do not currently have the will to provide these technologies in a practicable manner.

Workforce

According to the opinion of most participants, the introduction of Industry 4.0 technologies in earthwork will also change the requirements on employee qualifications. The simplest work steps currently performed manually may be automated in future. For this reason, soft skills such as organization, communication and decision-making will be required in future. Moreover, greater knowledge of software and programming will be necessary. It is already the case that construction machine technicians must be able to resolve basic programming and code errors independently. In the future, these requirements will increase further due to system complexity. This is increasingly leading to a need for interdisciplinary knowledge (mechanics, software and programming). Suitable and tailored training measures will also have to be developed and provided to this end. However, employees will also need to be open to technologies and place the necessary trust in themselves and management. The desire for continuous learning is a key requirement to keep pace with technological progress. The interview participants believe this will represent a major challenge for many of their colleagues, and hence one of the greatest barriers to the further development of their company.

Communication

Currently, various construction machine manufacturers and parts from the supplier industry are working on online cloud solutions that aim to create a suitable information platform on which relevant project information can be shown and accessed in real time. As a result, all construction participants, surveyors and project partners with internet-enabled devices, the office as well as all construction machines with 3D machine controls fitted with an internet-enabled modem should be able to provide and access relevant information at the same time. This solution approach should thus allow the office, all construction participants and the respective construction machines to communicate with each other directly on a secure, web-based portal. CAD machine data can thereby be accessed anytime and anywhere, allowing construction progress to be monitored continuously from the office. Thanks to this two-way communication, construction managers also have access to latest planning data all time. Without question, this solution approach would significantly simplify many working processes and minimize unnecessary journeys and working hours. In turn, this would lead to a reduction in costs and an increase in machine productivity. This two-way communication to and from the machines ensures that the machinery managers are always working with the updated CAD terrain models and planning data. Consequently, all project participants with access authorization to the portal would have an easy means of accessing relevant design files and all productivity information regarding construction sites and construction machines in real time. The site managers could thus save precious time on travelling to the construction site and, as a result, effectively manage the use of machines and site coordination from the office.

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This qualitative study examines and considers Industry 4.0 technologies in terms of their application and management in earthwork construction in Germany. The aim of this study is to investigate the opportunities, possible applications and barriers. Based on the data collected from interviews, the relevant key areas from the perspective of management are identified, systematically categorized and described. Due to the nature of qualitative studies, the results cannot be generalized or universalized.

However, the results provide the basis for future research and open up new starting points. For instance, quantitative investigations could be conducted in the future to analyze the distribution of various technologies. Particularly, comparative research could provide interesting insight with respect to company size or company earnings.
Future research should also consider the construction sector as a whole and examine the extent to which the presented technologies can be suitably implemented and combined throughout the entire value chain of construction. To this end, case studies could be prepared that encompass earthwork, civil engineering and building construction.

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Collaborative Service-Learning Partnerships between Government, Community and University for Implementing Social Change

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ABSTRACT

Community Engagement, the third pillar of Higher Education, requires South African universities to engage in projects that benefit society. Service-Learning, a form of community engagement, is a powerful pedagogical tool that lends itself to the enrichment of diversity and conceptualisation of innovative curriculum activities towards the positive transformation of students, academic staff and the broader society. Meaningful government and community partnerships are assets for universities who strive for relevant engagement with communities. In Service-Learning triad partnerships, the government, university and community stakeholders collaboratively conceptualise Service-Learning projects. These partnerships are composed of representatives from diverse institutional cultures and individual backgrounds. Through Participatory Action Research (PAR), the systems approach is applied to understand and critically examine the interconnectedness between the aims and objectives of government, community and the university. Service-Learning partnerships can be viewed as a powerful tool for actualizing community development strategies; moving these from policy to implementation in communities. This paper encourages universities to build meaningful partnerships with external stakeholders through service-learning projects. By engaging actively with their partners, universities could strengthen their Service-Learning initiatives and partnerships.

Keywords: *Service-Learning, University partnerships, Systems thinking, Social change*

1. INTRODUCTION

This study attempts to understand the complexity of Service-Learning (SL) partnerships, comprised of the university, government sector and the community, towards meaningful societal change. The system of SL partnerships is explored through dialogue and engagement in the form of partnership summits. A philosophical approach to SL partnerships is epitomised below:

> *All life is interrelated. We are all caught in an inescapable network of mutuality, tied into a single garment of destiny. Whatever affects one directly, affects all indirectly. We are made to live together because of the interrelated structure of reality.* (King, 1991, p. 254).

Reverend Doctor Martin Luther King Junior's (1964) quotation from an American Dream, supports the idea that people are linked by their common humanity and all living beings are related. McMillan (2013) forwards Martha Nussbaum's argument that to cultivate humanity we must acknowledge "the worth of human life wherever it occurs" (p. 42-43). Nussbaum (2013, p. 9) views "ourselves as bound by common human abilities and problems". Significantly, societal institutions like government, communities and universities in South Africa engage in many social change projects. Often these are fragmented and unsustainable, leading to poor service delivery and lack of stakeholder collaboration. If society is a living system of individuals interacting across cultural, institutional and social boundaries, then institutional silos creates duplication and poor service delivery.

South Africa's move towards transformation changed the policy landscape for institutions, who face the challenge of translating policies into action, as communities experience poor housing, lack of access to basic services and unemployment. The 'policy to implementation' gap causes policies to lose their meaning for those it was designed to serve. Little attention is paid to the voice of the people, which acts as a barrier to the delivery of critical services to communities (Coetzee, 2010; Idasa, 2010 & Pitso, 2014). However, a new discourse of "governmentality" signals a shift from transformation policy to policy implementation, requiring an integration of "issue, policy, programme, project or context" (Kharam, 2004, p. 23-144). Merging these elements require collective problem solving. Universities are more engaged and responsive to societal needs, working with their governments to increase public participation and democracy to achieve transformation (Hartley, Saltmarsh & Clayton, 2010). SL and Community Engagement, the third pillar of higher education, is a powerful tool for actualizing social change strategies. SL projects depend on successful partnerships, therefore it is important to explore relevant theories for its sustainability (Nduna, 2007 & Fourie, 2003). Previous research on SL partnerships highlights student experiences of their learning (Nduna, 2007; Eyler et al., 2001; Eyler & Giles, 1999 & 2001; Bransford & Schwartz, 2000; Astin et al., 2000; Strange, 2000; Boss, 1994; Osborne, Hammerich & Hensley, 1998). Although Fourie (2003, p. 36-37) observes that very little evidence exists which determines the effectiveness of the SL partnership, Stanton and Erasmus (2013, p. 78) argue that Triad SL partnerships can promote "democratic participation and inclusive partnerships".

The study analyses three SL partnership sessions (summits) to understand SL partnerships and how dialogue could lead to more sustainable relationships. The discussion rests on Michael Gibbons' work on engagement and the new social contract between society and the university (Gibbons, 2005 & Forbes, 2009). These relational concepts and frameworks, together with a systems approach are applied to understand the interconnectedness between partners. Using Participatory Action Research (PAR), partnerships are critically examined by the partners.

2. THEORETICAL AND CONCEPTUAL UNDERPINNING

The White Paper on Education 1997, led to legislated community service for South African HEI's, which became a catalyst for universities to transform (CHE, 2004). In universities "service" is gaining momentum as institutions strive to align with national development priorities (CHE, 2004). Universities are required to engage and contribute to social change; not be "ivory towers" – removed from societal challenges. The interaction between curriculum and societal imperatives poses new ways of thinking for universities and "a strong motivation for developing community service programmes which include a civic component combined with service delivery and academic training" (Perold, 1998, p. 43). Uniquely embodied in developmental and transformation discourses of universities (JET/CHESP, 2006), SL develops civic consciousness, enhanced caring for others and collaborative problem-solving, "where high levels of fragmentation and alienation" exist, argues Perold (1998, p. 44). SL favours both community service and student learning equally, leading to complex partnerships. One organization cannot solve social problems but "rather synergistic efforts are required to increase the potential impact of policies" (Martin et al., 2005, p. 13). Collaborative partnerships become effective change catalysts, sites of knowledge production and exchange.

2.1 Episodes as discursive spaces for engagement

SL partnerships can create cohesive systems by aligning policies, strategies, aims and objectives of government, communities and universities, preventing duplication and wastage. Systems theory promotes the argument that humans live in an interconnected system (Hendry & Seidl, 2002; Luhmann, 1995). Partnerships can be understood as an interrelated system of diverse individuals engaging within a communication system. Luhmann's (1995) concept of the "episode" as a sequence of communication within a social system allows for engagement with others, and according to Hendry and Seidl (2002), is endemic of all social systems. Episodes are mechanisms that create discursive spaces for engagement, encouraging reflection on practice. In Luhmann's (1995) theory of change, episodes are relevant to partnerships, creating spaces for dialogue. External factors can influence or restrict the processes in episodes. Roos and Von Krogh (1996, p. 55) argue that strategic outcomes are dependent on factors like "who talks to whom, why they talk, what they talk about, and when these conversations take place". The selection of venues, topics, and time of discussion can affect episodes, as Mezias, Grinyer and Gut (2001) suggest that participant behaviour becomes less restricted in a different environment.

2.2 Emergence theory as part of Systems Thinking

Wheatley and Frieze's (2007) Conceptual Framework for Collaboration features three stages: Networks, Communities of Practice and Systems of Influence. When a network forms and becomes stronger, it evolves into a community of practice, then emerges as a new system of influence as illustrated below:

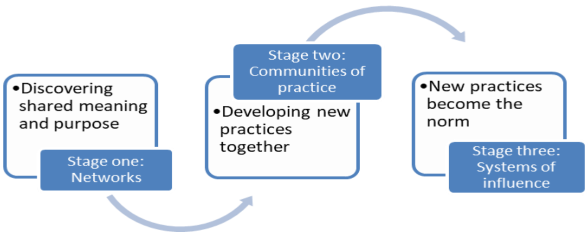

Figure 1: Conceptual Framework for Collaboration (Adapted from Wheatley & Frieze, 2007, p. 5)

Actualisation and sustainability moves away from short-term "quick fixes" towards long-term sustainable partnerships. Partnerships that evolve from a network to communities of practice experiences real impact through the emerging system of influence.

2.3 Theory of engagement as a core value in a mode 2 society

Engaged universities collaborate with society. Gibbons (2006) argues that the relationship between science and society is changing. A site of struggle, "a Mode 2 society" exists, where universities battle for their independence in setting research agendas against the "encroachment" of external groups and influences (Gibbons, 2006, p. 5). Clear demarcations between science and society existed before with the university being the "fountainhead of new knowledge" and sender of science to society (Gibbons, 2006, p. 7). Now society breaks down historically entrenched boundaries by responding to science, called "speak back", creating challenges for traditional universities. Contextualisation describes the process and resultant knowledge as "the outcome of this reverse communication", which develops into socially robust knowledge "or patterns of thinking" (Swilling,

2010, p. 271). Here society sets the agenda, influencing the conceptualisation of problems and stages of research (Gibbons, 2006).
Research becomes synergised into societal and university activities by collective and collaborative action. Universities face Mode 2 society, the "agora" where the university interacts with the public and where scientific "problems of society are deciphered, solutions are conceptualised" (Gibbons, 2006, p. 11). By shifting the metaphor from translation across boundaries to dialogue at boundaries, transaction spaces allows the access and acquisition of others' knowledge while searching for a common discourse to address a social challenge (Gibbons, 2005). Conflicts exist when there is no connection and collaboration with communities or when "these connections go too far, do not recognize our individuality, and result in boundary violations" (Cloke & Goldsmith, 2000, p. 167). Boundary objects and transaction spaces are important ingredients for authentic collaboration. Mode 1/Mode 2 debate allows for creative and systematic discussion on the role of SL (Bawa, 2003). This calls for new conversations and ways of seeing partnerships as universities shift their lenses outwardly towards new avenues of knowledge creation.

3. METHODOLOGY

This study is confined to three SL Partnership Summits hosted by a university of technology for staff, government and community partners over three years. The generated data were collected from the three summits. The summits differed in format as the concept of dialogical spaces for engagement developed as indicated in the figure below:

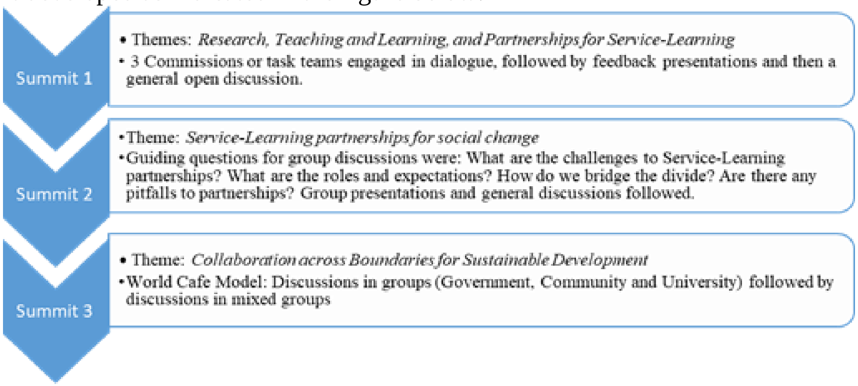

Figure 2: Dialogical spaces for engagement on Service-Learning partnerships

Summit one consisted of three commissions: *Research, Teaching and Learning, and Partnerships*. Expert commission leaders chaired sessions and presented the results, followed by open discussion. At **Summit Two** presentations on the theme were followed by group responses to the guiding questions. The Community Development Resource Association (CDRA), facilitated the World Café at **Summit Three** guided by four concepts: i) Searching; ii) Accompanying; iii) Sharing; and iv) Facilitating CDRA (2013). The Conceptual Framework for Collaboration (Wheatly & Frieze, 2007) was introduced by CDRA.

4. FINDINGS AND DISCUSSION

The discussion is based on the reflections and theory with reference to the findings. To ease the discussion, participant's responses are labelled as follows: Summit One is (S1), Summit Two is (S2) and Summit Three is (S3).

4.1 Systems Thinking: Episodes

Previous discussions mention the value of episodes for communication in networks. Participants requested more meeting opportunities, suggesting that "SL events would be ideal" (S1). Another participant said "there should be collaborative approaches for planning, implementation and evaluation of the project" (S1) and another that "there should be discussions on campus with communities" (S2). A suggestion from S3 is that there should be an "overarching body responsible for coordination between stakeholders".

4.2 Importance of Communication

SL activities can become more visible through marketing. "Communication is key: a platform for interaction by all" (S1). A question posed was: "How do you make communities aware of offering?" An S3 group mentioned that "marketing is lacking" and stressed that "Marketing /Awareness" was important and the university should develop a platform to share the learning from different projects. S2 raised the issue of multilingualism and "that there is a need to create a local language". Communication is at the heart of system theory and information should be available and accessible in an understandable medium. If the system flow is interrupted, communication gaps will result.

4.3 Life-Cycle of Emergence

The conceptual framework for collaboration represented as the life-cycle of emergence has potential for SL partnerships and articulates with Giddens' (2006) ideas on the creation of "socially robust knowledge" and with Luhmann's social systems theory of "episodes". Emergence theory advocated by Wheatley and Frieze (2007) leads to systems of influence. An S3 group participant argued that the "project lifespan should be longer: ±4 years" to create "continuity". Implementing emergence theory leads to more sustainable projects.

4.4 Prevailing contract with universities: Mode 2 society

Changing social contracts between university and society has necessitated creative and new approaches for partnerships. "Instead of a triangle system [triad partnership model] there should be a full square system in place i.e. community, government, HEI and funders [including] big businesses" (S3). Universities are not viewed as primary voices and/or voices of authority and knowledge anymore. S1 partners gave directives on partnership stages as: "Initiation of Partnerships, Implementation, Maintenance, Reflection and Evaluation Phase". This synergies with Gibbons' concept of "contextualization", where society "speaks back", reflecting a change in the prevailing contract universities traditionally had with society (2006, p. 3-5). An S2 participant suggested that the university "involve the community in policy development". Some quality systems require university to consult external stakeholders for comment on university processes. Another participant emphasized that the "community must be a critical partner". Partners should share responsibility and power to ensure that all have a voice.

4.5 Socially robust knowledge

The university "must be engaged with sharing knowledge" (S2). Participants requested that projects be "longer for continuity" (S3) to enable the measurement of project impact. "Identify existing long term, sustained community projects", suggested an S3 participant. Another advised the university to "work on sustainability/design a maintenance plan at planning stage" (S3). The S1 research commission suggested that: i) "The monitoring and evaluation stage be examined to assess outcome (impact) of project on community/stakeholders/learners/academic staff and faculty; ii) Action research was regarded as most suitable as findings could be immediately tested with community; and iii) The most suitable method would be focus group discussions and open-ended interviews with all identified research participants". The findings suggest that PAR encourages the creation of socially robust knowledge.

4.6 The Agora

Partnership summits replicate an agora where the university meets external partners. Giddens (2006) argues that conceptualisation and problem solving have moved from the domain of universities and resides within the agora. The S1 Curriculum Commission proposed that partners should have "involvement in training / assessment and evaluation", and universities should ensure that "community partners contribute to the overall learning" (S1). The World Café method generated extensive responses and discussions as participants moved freely and autonomously. Participatory decision making, inclusive problem generation and problem solving environments encourage collaboration.

4.7 Transaction spaces and trading zones

Knowledge is the currency of engagement when partners are attracted by genuine interest. A S2 participant states, "Partnerships should be on a reciprocal basis". In the trading zone, the benefits of SL should be explicit and boundary objects clearly identified. If there is no object to trade, commitment is affected. Boundary objects that S3 partners are willing to trade are: "Discuss/Educate – sharing of benefits and offerings; Create opportunities for questions (knowledge and skills development); and Access and build on knowledge and skills already present in communities". An S3 group proposed that the university "approach the community without a project brief" to encourage collaboration and let the "university get a mandate from them [and] also to contribute to the design". Universities should "engage communities at all stages (not only at onset)" (S3). Universities should recognize that changing their social contract with society, leads to a conceptual change in knowledge generation. A "new language of engagement" is led by the discourse of transaction spaces and boundary objects (Giddens, 2006, p. 20). There should be consensus and clear management of expectations in the partnership. An S3 group recommends that university staff should be "trained for social development" and that educating communities will "break barriers". The S3 group more involvement from government in SL projects and to reduce red tape. Regular engagement with partners can ensure that universities measure up; as the degrees of contextualisation are dependent on the level of reverse communication.

5. SUMMARY AND CONCLUSION

Universities should focus inwardly "to transform themselves from elitist institutions to ones significantly contributing to the creation of a more just and equitable society" (Elliot, Francis, Humphreys & Istance, 1996, xiii). In a rapidly changing world, inhabited by a plethora of social challenges, new systems of collaborative engagement are needed. SL Summits have created a space or "episode" where [university] staff and partners can strategically engage to understand, share, nurture and develop. Partners should have clear roles, responsibilities, expectations and guidelines to ensure that boundary violations do not occur, or if they do, that there is a strategy to manage it.

PAR can be used to engage further with partners on challenges and issues, towards improvement. Future partnerships could benefit from this broader comprehension of engagement. Universities should heed the call from partners to increase the creation of dialogical spaces for knowledge exchange. Triad partnerships should expand to embrace diverse stakeholders provided they are willing to engage with the university and community. Partnerships could be strengthened by understanding individual contexts and realities.

Universities should promote the sharing and exchange of knowledge in collaborative government partnerships and the third sector (Pitso, 2014). There is an emphasis on the individual within an interconnected system and the ability to reflect and adapt to other ways of seeing. Du Plessis and Van Dyk (2013) promotes the person-centred approach by integrating the community voice into SL partnerships. This focusses and releases "participatory processes and methodologies" so that SL "would then never be service to or on behalf of others, but would be learning and serving together" (Du Plessis & Van Dyk, 2013, p. 66). The creation of dialogical spaces across multi-stakeholder boundaries is effective for understanding partnerships. Dialogue provides opportunities for developing powerful systems of influence which contribute to positive social change.

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Cross-Sectional Competences For 4.0-Mindsets In VET

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ABSTRACT

The present world of work and the private life world are constantly changing. This digital transformation is due to Megatrends, to manure in buzzwords like Industry 4.0, computerization or digitization. Although this developements are slowly becoming apparent, it seems to be clear that future work environments are also becoming more complex. In order to be able to act and shape competently, it is necessary to strengthen the cross-sectional competences of current and future workers and VET-students. This article is a plea for the didactic design and implementation of such cross-sectional competences in the educational practice: Netcompetence can be a sustainable construct for the holistic strengthening of VET students, skilled workers and the human being in a 4.0-world.

Keywords: *VET, Digital Transformation, Digitalisation, Industry 4.0, Future Competences, Netcompetence, Skilled Worker*

INTRODUCTION

Internet of Things (*IoT*), *Cyber-physical systems* (*CPS*), *Work 4.0* or *Industry 4.0* (for a better reading the german term *Industrie 4.0* is translated to *Industry 4.0*) are known as the abstract-looking superscripts of the high-tech visions of a digitally networked working world and society. In the early days of the 4.0 debate, this kind of design primarily was based on a more technology-centric feasibility with still polarizing theses on the influence on the working world (BMWi 2017). In the meantime, we increasingly need to focus more on the human-centered implementation and education possibilities. During times of an increasing complexity of access to information and academization, this contribution designs a perspective on requirements for future work, displays the effects on the sustainable strengthening of the vocational educated skilled workers in Germany in terms of businesses and the dual-system of *VET* (Gebhardt et. al. 2015, 119-120).

A scenario, that is created on the findings of own surveys and observations of the Institute of Vocational Education, Work and Technology (shortform: biat, at the Europa-Universität Flensburg), within the same research projects in the fields of *Requirements for skilled workers in Industry 4.0* from 2015-2019*:*

With the company-owned smart-tablet, the Industrial Electronics Technician (skilled worker, non-academic) puts an eye on the work process during commissioning during an assembly operation while she is working in the Ukraine. In addition to digital circuit diagrams, she reads the data from the logo-control, interprets it, responds to possible problems, and sends a real-time feedback to the IT-engineer at the main company headquarters in Germany via a messenger app. In this decentral and networked way they discuss possible actions, alternatives and the further proceeding. The Ukrainian colleague is also informed about the status of this working-case, in a reduced English language, sometimes supported by a translator. To the evening of the event in the hotel, the company server is logged on quickly, materials are ordered, and the status of operational safety instructions required by the company are checked. This can be done by the electronics engineer, if necessary, decentral and according to his own managed time-periods. Then he will still be with the family before he goes to dinner, to which her Ukrainian colleague has invited.

At its core, the scenario shows that profession related work of skilled workers is an interaction that is constantly changing, especially in comparison to the pre-digital ages. In privacy as well as in the all-day business, interaction and communication become increasingly digitized via mobile data networks and ICT (information- and communication technology), notably in former non-classical IT-spheres. On the path of digital transformation, to the Industry 4.0, this interaction will increasingly be not only a communication between humans, but also between human beings and machines, as well as between cross-linked machines it selves. The spatial boundaries will dissolve as well as working-contents, which have been once transparently defined. All processes and contents in the work-world and privacy will be more connected and may influence itself in different ways. This fact will happen on- and offline by the means of IT-network-technologies. What will be the requirements of the digitized world and what kind of impact will they have on the working world and society? And how can the non-academic skilled workers keep and expand their competences. The main goal need to ensure the working- and design-ability of humans in the context of *digital-transformation* and *Industry 4.0*. This contribution gives and compressed introduction of requirements of the future work and the necessity of system thinking and communication, like the *Netcompetence* as solid impulse for education. There is a crucial correlation of education and the use of digital technologies in business (Baum & Lukowski 2019).

THE NEED FOR CROSS-SECTIONAL COMPETENCES

Formerly and apparently clearly defined responsibilities for occupational and / or qualification-related work and professional contents and interests are going to be weakened. The content of various disciplines and vocational actions will be mutually dependent on the present and further developments. Those contents will diffuse into each other. Reconstructing and classifying these contextual overlaps of different subject and professional areas as well as reflecting their own handling and design options going to be enhanced by the increased information-technological fusion and networking of processes. Over many years, linear, hierarchically structured workflows with precisely defined work requirements and clearly defined task areas had proved themselves in many areas of the company's specialized work. The developments towards a digitized world of work are the result of cyclical, interdisciplinary, openly participatory work organizations and workflows. The fusion of individual and collective life worlds with comprehensive ICT has long been a reality (Filk & Grimm 2015).

I learned this while working, basic programming is explained at YouTube. [...] The process with the software provided by the manufacturer took too long and I developed something myself. Now everybody can access the query at the same time in the process. [...]Then I presented my program and it was found for good by the team and factory management and then I gave even the instruction for the employees. (Skilled Worker; an Electronic Technician for Telecommunications Systems, but no IT-qualification; own surveys 2016 and freely translated)

The above statement by a skilled worker without IT-qualifications represents the substitute for the weakening of traditional professional boundaries by self-responsible work and design in online networks at the workplace. In this case, *Do-it-Yourself at work* autodidactic of programming-languages was provided to optimize an existing business-process by his own motivation of solving the problem. In biat's investigations and surveys, with the look through the technological *4.0-glasses*, it can be figured out that digitalization and networking have arrived in real life work processes of skilled workers, but in different ways and not in a holistic diffusion of operational processes.

The world is becoming more complex, so there is a need for hybrid-mixtures of different types pf empirical research methods. The Flensburg investigations intended to document the performance of the skilled work in their authentic everyday business as well as to recognize and assess the current and future demands of the working world (Drescher et al. 1995, 17; Becker und Spöttl 2008, 70ff.; Mayring 2000, 3ff.). The participatory work observations of the skilled workers at the operational implementation partners proved to be a promising instrument in the course of the project. The digitalisation, internationalization, developments of Industry 4.0, IoT, the current demographic evolution through escape-migration, as well as the respective operational context are included in the daily work observations of the working place (see fig. 1).

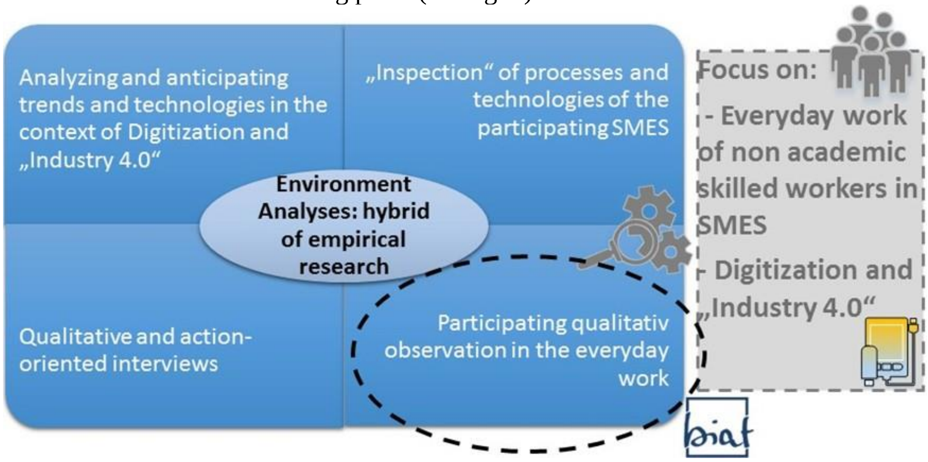

Figure 1: Hybrid research method

This hybrid qualitative survey form is particularly useful for gaining a practical insight views of the reality of the work processes, it`s technology and the professional competences. The intercourse is fostered by interpersonal communication during the work process of the skilled workers. The logging participation in everyday work tasks of the observed skilled work is to be evaluated by the direct proximity of authentic and more purposeful, in contrast to work-process "blank" -Online surveys of the employees or even only at the management level.

The use of digitally networked technologies is sometimes less the result of a trend reference or the operational intention of self-attribution by the labels *IoT* or *Industry 4.0*. In the observed labor practices, skilled workers are still the decisive agency, especially outside of routine work activities. In the case of problem solving, the non-documented or implicit experience of the skilled work is still successfully accessed, yet non-systematically but purpose-oriented. The operational use of IT-technologies extends from IT-supported documentation systems, communication via mail programs on smartphones or computer workstations, software operation and programming, right down to the location-dependent decentralized control, maintenance and commissioning via IP networks of clients and PLCs. The findings on the technological status quo in the investigated SMEs are extended by the fact that differences in the degree of IT-fusion and use of digital technologies and / or software in the working day are still to be determined by skilled workers from different professions. In some cases, the growing IT-Fusion has already been shifted into new occupational reference frameworks.Digital user interfaces for process control and optimization are going to be implement in the current operating practice along the objectives and with aspects of usability. Even skilled workers from the field of electrical engineering, during external work processes, are now using smart terminals, e.g. via the mobile network and VPN tunnels to the company server. The digital and decentral coordination and information procurement for the goal-oriented execution of their job assignment. In this way, they procure circuit diagrams or instructions from operating servers or via telephone in a problem-solving dialogue and professional exchange. This communication is carried out in the investigated work groups via private smartphones of the skilled workers. In this case, safety-related concerns do not play a role for the users. Some of the local operational infrastructure observed so far does not see any use of smartphones integrated in the work process, but the positive effects and experiences of the rapid exchange through the use of smartphones in the private sphere diffuse into the workplace. As a kind of coping strategy, its function is used to ultimately optimize the work process of the skilled workers by themselves. With their own smartphones, for example, shooting digital images of the current installations, in order to visualize and record the current state: free according to the specially interpreted motto *Bring your own device.* These images then form the basis for a fixed, real-time communication, in order to exchange process and problem-oriented messages via messenger applications (such as WhatsApp), with company-internal as well as company-oriented colleagues, and to weigh up handling options in the work process.

In biat's investigations it was observed that skilled workers do work in self-government, auto didactically, high-level information technology during their working hours and favored through the opening from intranet to internet at the workplace. This is a singular observation, but its significance is sufficient for a common sense of the quality of the VET-System, regarding technological changes of the *digital transformation*. Because the increasing IT fusion in the workplace reinforce the assumption that a competent handling of IT also becomes a significant part of the future competency of non-pure IT-professionals. In one observed case, it is not a trained IT specialist with no formalized IT qualifications. His frustration over the self-experienced faulty work process, served as a drive for the optimization of the same and his autodidactic process. In this case, a software-based logistic system was supplemented and optimized by a specially programmed software. Self-paced learning took place via YouTube-tutorials at work, but unstructured and unformal. His results were communicated to the top and explained by the skilled worker and consequently also integrated into the process. The internationalization of value chains means that the introduction of new technologies or facilities in the observed factories is accompanied by further trainings and introductions in English language. Thus, English now avoids a former transport language of the international exchange of engineers and now also in isolation from the traffic language of the middle employment level and specifically from further education. In order to prevent communication and translation problems, some cases get support of a translator. In addition to the English courses in further VET, the employees also learn English instructions from international manufacturers or suppliers. It was observed in some SMEs, that the present instructor translated English manuals into German. Online translation tools and technical dictionaries English-German were used in-house in addition to the growing interdisciplinary professional on-demanding and the internationalization of operating networks and corporate languages. There is also a change and hence a need going round an awareness of different cultural and linguistic areas of future work and society designed of the skilled workers. On the one hand against the background of work assignments of skilled workers and skilled workers abroad and on the current through the migration and integration of fugitives into society and through the training and in the workplace. In the field surveys of the biat also took place during teaching measures in the Chamber of Crafts with young refugees. The aim of the measure is to provide young refugees with a technical and linguistic basis, with the aim of achieving the capability to train in the dual vocational education and training system. In this specific case, masters and training officers are thus confronted with new heterogeneous requirements of daily work, in terms of sensitization of other cultures and languages, as well as the difficulty of the lack of linguistic base-skills and the development of *DAZ* (*German as a second language*).

NETCOMPETENCE FOR A SUSTAINABLE EDUCATION

The construct of the *Netcompetence* (german: *Netzkompetenz*) is explained by examples from the observed working practice of the specialized work. These circumstances provide an orientation for the above-mentioned individual design of educational measures, in the course of a competence management for the training, further training and operational personnel development, as basic prerequisites for innovations in the environment of 4.0. The concept and implementation of the prototype of the educational manual for the *Netcompetence-Learning-Unit* and *4.0-Sensitization* are based on the findings of the of biat. These are subsequently made comprehensible by the necessary construct Netcompetence. The concept of *Netcompetence* was already marked in 2000 by Peter Wordelman. He used this in the context of the internationalization of the dual vocational training system and the growing challenges of internet use and globalization in working practice (Wordelmann 2000). The term *Net-* refers to the networking of worlds, on the one hand in the working place and on the other in the whole of society and privacy. This networking takes place within and between organizations (divisions, departments) and systems: technical and social. The increasing interdisciplinary processes of ICT-use, which have been previously isolated from each other, are going to grow together during the work process now. Machines and products can be communicated on a physical or logical level, on- and offline, interpersonal, interdisciplinary, international and intercultural. This complex development of work and society leads to the need the Netcompetence. The construct of Netcompetence is open to developments and intended to develop an individual positioning, whereby people will find orientation and support in a digital-networked society and working world (Grimm 2017, p. 195). To develop and establish this Netcompetence as a cross-sector competency is the core for the design of future-oriented and sustainable education and personnel development measures. It`s intended to promote human capacity for action and development (Grimm et al. 2017, 150f.). These forms and actions of skilled workers and employees in general are also directly linked to the innovative and competitiveness of companies and of the whole *VET-System*. The people in a democratic knowledge society and in the working world, which are increasingly influenced by shortened technological innovation cycles, must be able to empower and support competences sustainably. The development of *Netcompetence* is accompanied by effects that can strengthen the resilience of the human being. This resilience is achieved through the development of Netcompetence, in the sense of a safer and more secure location against the fast-paced nature of current and future innovations and the growing access to on- and offline information. The learning person has to be the focus of innovation measures and organizations. Its position can be maintained competently in conceivable and inconceivable scenarios of the work of tomorrow, as man-made mental relations are created and always renewed, so that networked processes can be comprehended.

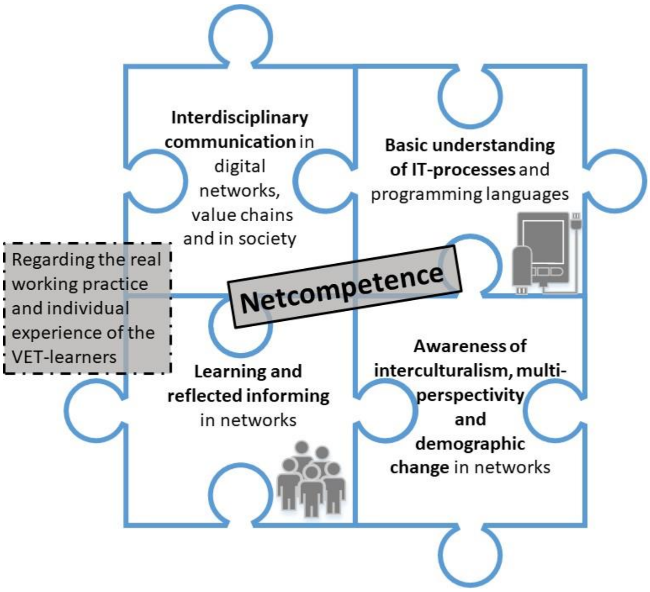

Figure 2: Netcompetence (Gebhardt & Grimm 2019)

For *Netcompetence* can be categorized individually configurable content fields. The contents are not to be treated in isolation for Education, especially within this *Netcompetence-teaching-learning-arrangement*, but for the learners comprehensibly to each other. In this way, a sensitization can be achieved for the growing networking and requirements of the future working world and society - this fact applies to all person-centered education measures. The contents are oriented to the VET-learners and thus practice-oriented in education and further training measures to integrate, with regard to a competent lead to the requirements of the working environment of the future in the environment of *Industry 4.0*. In this case, four open-linkable content fields / categories of Netcompetence are mentioned (see fig. 2):

• Evolve professional competence through interdisciplinary on- and offline communication in virtual and real networks and value-added networks
• Evolve learning and reflected information in networks
• Raising awareness of interculturality, multiperspectivity and demographic change
• Evolve a basic understanding for information technology processes (also for non-IT professions).

In order to establish *Netcompetence* through educational measures for innovation processes, the aforementioned *Netcompetence-Learning-Unit* (aka: *Netcompetence-teaching-learning-arrangement*) will be conceived and carried out as a short-term measure to prepare for the upcoming developments in the sphere of *digital transformation* and megatrends, such as *Industry 4.0*. This measure is designed to further evolve *Netcompetence*, as an educational and vocational need. *Netcompetence* serves learners as a kind of compass for the human being and professional actions, in this case, the skilled workers. It strengthens the orientation for their own professional actions during the speed of *digital transformation* with the intention of securing their future action and design-ability. The stressed reference and instrumentalization of real technological elements and work placements are the bearers and multipliers of this practice-oriented framework of the Netcompetence-Learn-Unit developed by biat. The evaluation of this *Netcompetence-Learning-Unit* points to a promising development of critical and innovative reflexively in context-adaptive contexts of one's own profession, operation and everyday life, with regard to the content of Industry 4.0: Focused on the settings of the vocational schools of VET.

Figure 3: Stations of the Netcompetence-Learning-Unit

The implementation and execution of the *Netcompetence-Learning-Unit* in German vocational schools *(lasts about 5hours / unit on one day at three different vocational schools in Flensburg, Berlin-Spandau and Recklinghausen, with over 150 TVET-students from 2017-2018, mainly mechatronics)*, is to be assessed as useful and purposeful. The basis for an innovative competence and change management can thus be created, if the idea of innovation of the *4.0-developments* is thought by humans and an active participation of the learners and employees is guaranteed. The concept of this sensitization training with the cross-linked content of *Industry 4.0*, is an adaptable educational-instrument for the first reflected preparation for the future change in the working world and society. Provided that the content is appropriately didactized and recognized and assessed as relevant by the participating learners and their perceptual milieu, the development of future-relevant and cross-sectional competence can be successful. This is additionally offered by a pass-accurate, short-term and low-threshold form, against alienated technology voyeuristic excursions and manufacturer qualifications in smart factories or 4.0 simulations in laboratory atmosphere. The VET-participants learned a stationery on the subject of Industry 4.0 by dealing with the 4.0 context in groups independently. Two technological components, virtual and physical, of the 4.0-Sensitization-Measures also enter *Netcompetence-Learning-Unit* (see fig. 3). The virtual component is a web-based ordering system. It is designed as a development-oriented information platform for the introduction into the networked context of terms and relations of Industry 4.0. This form is a basic framework for an expandable ontology management. The learner can explore the virtual and graphical information platform with his or her private smartphones or the provided laptops or smart-tablets. In addition, they are dealing with a *4.0 compact trainer* from *Festo-Didactic* - this is the physiological / technological component. This compact system presents the idea of an individualized Industry 4.0-production line with a lot size of one and practical technology components of all-day work. The 4*.0 compact trainer*, thanks to its technological rearrangement, the combination of the PLC, the RFID transponders and the smartphone control, provides an accessible insight into a possible operational situation of 4.0 implementation: a hybrid of physical and virtual elements. The web-based information platform and the *4.0 compact trainer* promote self-directed discussion and at the same time consolidate the role of the participants as acquiring customers in the context of networking in Industry 4.0.

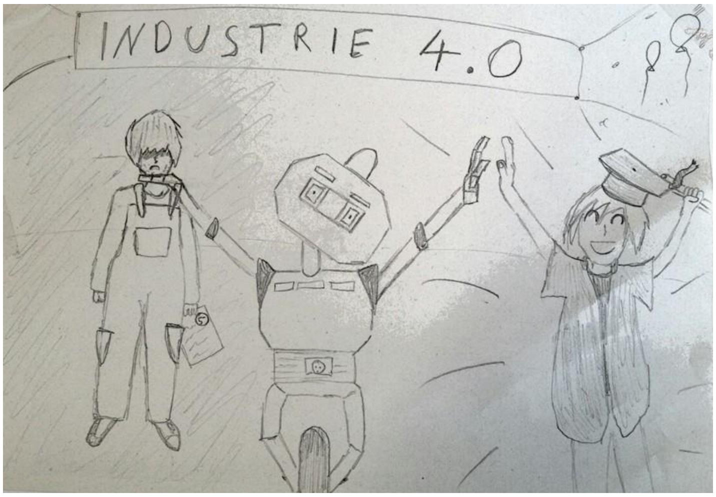

Figure 4: Caricature by the participating TVET-students of the *Netcompetence-Learning-Unit* (Gebhardt 2019)

The following subsuming hypotheses present summary findings of the overall evaluation of the *Netcompetence-Learning-Unit*:

1) VET Participants call for ongoing practical and business-oriented education in the context of *Industry 4*.0 and future work.
2) Participants reflect the future viability of their company and their profession. (They have the design-desire for the innovation of business and work processes.)
3) *Digital Native* is not an integral quality feature for the competent handling of digitized and

virtualized processes (*using vs. understanding*).

4) A fear of the increasing of academic qualifications and a dequalification of VET- qualifications of the skilled workers (see Figure 4: Caricature by the participating TVET- students of the Netcompetence-Learning-Unit)

The *Netcompetence-Learning-Unit*, as a product of the Flensburg biat, is to be assessed as useful and purposeful. It forms the basis for an innovative 4.0-education in the sphere of lifelong-learning during the digital transformation. Thus, can be created, if the idea of innovation of the 4.0-developements are going to be thought of by humans to guarantee their active participation. The concept of a sensitization training in the environment of *Industry 4.0* in the VET, is an adaptable educational instrument for the reflected preparation for future change in the working world and society. Provided that the used content is appropriately didactized and recognized and assessed as relevant by the participating learners and their perceptual milieu, the evolvement of the future-relevant *Netcompetence* can be successful. This is additionally offered by a pass-accurate, short-term and low-threshold form. The participants learn stationery about some subjects of *Industry 4.0* by dealing with the *4.0-context* in groups independently and individually. The resolutions of the Conference of Ministers of Education on the necessary competences for the digital world, which were published at the end of 2016 (KMK 2016), are to be quickly translated into educational practice, which will still be too slow in 2019. The successfully tested concept of network competence as a sustainable cross-sector competence offers an already proven implementation for the VET-sector.

NETCOMPETENCE FOR A REFLECTIVE 4.0-MINDSET

If all men had green glasses instead of the eyes, they would have to judge, the objects which they see thereby are green, and they would never be able to decide whether their eyes show them what they are, or whether they do not To add something to them which belongs not to them, but to the eye. So it is with the mind. (Kleist 1801; lyricist, writer, dramatist; freely translated)

Economic and rationalizing interests primarily promote innovative change management in companies and in politics and the VET-system. Ensuring sustained employability is increasingly based on the insight of VET-educators and entrepreneurs to actively promote the development of cross-sectional competences, such as *Netcompetence* from the regular school through VET or academic education to company HR. Most recently, to prepare the work for future innovations and cross-sectional processes offline and online, and to strengthen skilled workers is the base for the innovation and competitiveness parallel to the trends of academisation of the professions. The active implemented and people-oriented construct of *Netcompetence* could reach to be a meta-term for cross-sectional competences in the general education of humans, children and adults, in link to the need of an increasing reflexivity and lifelong learning in enlightened, democratic and diverse societies. Linked to the timeless quote of Kleist above, virtual and real networks in work and privacy and internationalization provides the need to be able to look out over glasses, earlier formed by rigid and traditional frames of the professions, qualification an VET-system as well of culture and society.

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School Governance in the European Cultural Area

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ABSTRACT

This article brings forward aspects of governance in the school education systems and it starts from the idea of approaching the governance in a culture of active participation democracy in which the decisional process presents more steps, a reevaluation of governance influencing the thinking and the perception. The matrix of democratic principles interaction with the scholastic fields takes us to the conclusion of the inversion of the proportion between responsibility and assuming, restriction and freedom.

Keywords*: school governance, decision influence, the process of taking decisions, limits in governance, interactions in governance*.

WHAT IS GOVERNANCE?

The concept of governance is not new. It is as old as the human civilization. “Governance“ means: “the process of taking decisions and the process in which decisions are put into practice”. *Governance, in its wide meaning, refers to the way in which any organization functions, including a nation.*[1]
Governance consists in “the traditions and the institutions in which an authority from a country acts.”[2]
The three key dimensions are: (1) the process during which the governments are chosen, made responsible, checked and replaced; (2) the ability of the governments to efficiently manage the resources and to state, put into practice and impose solid regulations and politics; and (3) respecting the institutions which govern the economical and social interactions.[3]
The Worldwide Governance Indicators (WGI) project analyses six dimensions of governance: 1. Voice and responsibility, 2. Political stability and the absence of violence, 3. The government efficiency, 4. The quality of regulations, 5. The democratic state, 6. The control of the corruption.

Why is Governance Important?

During the governance, the citizens are in a right way preoccupied by the government reaction to their needs and by their rights protection. Generally, the problems of governance refer to the capacity of

[1] United Nations Economic and Social Commission for Asia and the Pacific
[2] Daniel Kaufmann, Natural Resource Governance Institute (NRGI) and Brookings Institution
[3] http://info.worldbank.org/governance/wgi/#home

the government to develop an efficient and responsible process, which is open towards the citizen participation and which strengthens rather than weakens a democratic system of governing. (USAID)

According to the Institute of Governance, the need for governance comes whenever a group of people get together so that they make up an activity with a certain purpose. Basically, "it's about power, relationships an responsibility: the one who has influence, the one who decides and the way in which those in charge with responsibility assuming are taken into consideration."[4]

Pierre de Senarclens presents the idea that governance suggests the solution between a balance of agents under the conditions of major changes of games, endings and rules. For him, "governance interprets the idea that the governments of states don't hold the monopoly of legal power, that other institutions and actors who contribute to the order maintenance, taking part to social and economical adjusting"[5]. "The governments are in the situation of negotiating with these networks those solutions for the main regional problems for own civil societies"[6].

"The governance of one single nation, of one institution and one physical person is not possible, through economical and administrative regulations only through legislation … the societies can't be ruled from a certain point, the government"(Foucault, [1976}1994; Dean,1999)

The multiplication of the relationships between people, as an effect of global union, the technological progress, the urbanization and polarization[7] (Dowbor, 1990)– the four changes that affect contemporary society – will make the ways of living and thinking of people come together. Andrei Marga draws the attention towards the fact that "globalization"…is more than "international movement" and it doesn't lead to solution standardizing [8] (Marga, 2005).

"The governance is seen as an alternative to the governmental classical action, it aims the redistribution of power in the public area through renegotiating of authority and decision taking within partner networks."[9] (Mănţăluţă & Blendea, 2013)

Is Governance Unlimited?

This rhetorical question belongs to Andrei Marga and his conclusion is that it is not. He uses both Moses Mendelssohn ' s evidence who said that: "there is no power on Earth to be able to rule people's beliefs" and Charles S. Pierce shows that no institution can control all the opinions of the people, and on the other side he tells us that " not all the interactions within society belong to the governance" only the rules which assure the management[10] (Mănţăluţă & Blendea, 2013).

"MULTI –LEVEL"GOVERNANCE INSIDE THE EUROPEAN UNION AREA

The White Book of the European Governance suggests "collective negotiating in decision taking and lays the basis for a new point of view upon power, a sharing of public authority through interactive networks and it is based on the control of collective action without compulsory interference of member states, the involvement of the institutions and actors that do not belong to governmental

[4] https://iog.ca/what-is-governance/
[5] Adrian Ivan. Guvernanță și teorii ale integrării în Uniunea Europeană. http://www.cse.uaic.ro/_fisiere/Documentare/Suporturi_curs/I_guvernanta.pdf
[6] https://www.academia.edu/18420534/Guvernanta
[7] Dowbor, L. Decentralization and Governance, *Latin American Perspectives,* Vol. 25, Jan ,1990, pp. 28-44, Sage Publications, Inc., URL: http://www.jstor.org/stable/2634047
[8] Andrei Marga, „University Reform Today", Cluj University Press, 2005, pp.386-380
[9] CS. Ovidiu Mănţăluţă, CS. Paul Blendea,Cercetări, modele de intervenție, bune practici. Introducerea unor noi sisteme de guvernanţă în învăţământul preuniversitar, Revista de Pedagogie • LXI • 2013 (3), http://revped.ise.ro/wp-content/uploads/2017/08/2013.-3.-Full-issue.pdf , pg.60
[10] Idem.

sphere, the involvement of networks of local actors, especially to civil society, business and beneficiary environment."[11]
"The participation of the citizens to the decisional process supposes the opening of the process for creating politics to any kinds of changes in the sphere of interests and actors' preferences, the acceptance of deliberation and persuading as ways of speech creation of their opinion and will and reconsideration of the decision legitimacy from the majority democratic or parliamentary patterns, towards deliberative democratic shapes."[12]
The most important consequence of the new perspective of deliberative process is the movement of decisional competencies "downwards" and the creation of the mechanisms of production of "synergy"[13] (Marga, 2013).
Wallace and Pollack show that the researchers in the field of multi-level governance field are preoccupied not only by authority distribution between the national state and EU, but generally by the authority transfer from the national governments to super-national and under-national actors.[14]

THE SCHOOL GOVERNANCE

The final report of ET2020 WGS of the European Commission "Ideas for better learning: the governance of school education systems"[15] (Moss, 2009) states the main principles of the process of governance in school systems based on: "clear vision, common values, approaching focused on the pupil, cooperative decision taking processes, faith and dialogue, interested parts, co –decisional feeling, responsibility and assuming, efficient decision process, the teachers as key change agents, promoting leadership, cooperation and improvement, investing in continuous professional development, generating and using of different types of data, identification of strong points and improvement fields, the stating of strong politics at the level of schools.
We notice a high frequency of the word "decision – making", central process of making of new educational politics not only in the previously mentioned article, but also in all the documents regarding educational politics of OECD.

We will get help in our study from the research made by Leif Moss in the examination of the governance of school process starting with "decision making" as process of influence.

L. Moss places the process of decision –taking in an environment of communication which begins with premise building, continues with decision taking, ending with the way in which communication is perceived, understood, interpreted, dealed with or connected with "the other agent" (Moss, 2009)[16], underlining in all the phases of the process – premises, decisions, connections – the important aspects of the "soft governance" and "hard governance" pattern.

During the phase of building the premises, *influence* is present due to the way in which decisions are *defined, produced and also by who*. Who defines the situation or the problem? How is the speech or action on which decision is based built or how is the *definite reality* built ("definition of reality" appeared in March & Olsen,1976; DiMaggio & Powell,1983).

[11] Monica Munteanu, Guvernanța europeană și dinamica formulării politicilor publice în România, http://revistasferapoliticii.ro/sfera/125/art06-munteanu.html
[12] Idem.
[13] Marga, Andrei, Guvernanță și guvernare. Un viraj al democrației?, Bucuresti, Compania, 2013, pg. 50
[14] The final report and thematic outputs of the ET2020 Working Group Schools, https://www.schooleducationgateway.eu/downloads/Governance/2018-wgs6-Full-Final-Output.pdf
[15] Leif Moss, Hard and Soft Governance: The Journey from Transnational Agencies to School Leadership, https://www.researchgate.net/publication/250151802_Hard_and_Soft_Governance_The_Journey_from_Transnational_Agencies_to_School_Leadership
[16] Idem.

The taking decisions phase is a procedure which involves selection and acceptance of some premises which are important and influential enough to be taken into consideration: decisions can be taken by persons or group of agents. Moss sends us to Dahl who called this phase –“direct power“[16] (Moss, 2009). Sometimes decisions can take to a new “agenda” for discussing or taking decisions, or to“ the description or regulation of new behaviors“[17] (Moss, 2009). The actual decisions build patterns for new decisions.

The connection phase, the third step of the process of influence as process of decision and communication is influenced by Thyssen‘s theories regarding communication. For him, communication is efficient if it “irritates“ another pole in a certain measure so that this one chooses to interfere, to stop and to reflect and eventually to change the actual way of reflection and practice. Some reactions may appear long after the ”irritancy“, but it is “useless to speak about influence without effects”, “if the law doesn’t change anything in what regards the behavior of the citizen“[18] (Moss, 2009).

In the ET2020 Working Group Schools report on 2018, the idea of institutional transparency and of set of democratic basic values as the beginning of governance of schools for which organizations should assume responsibilities, occur.

Schools should answer a series of different responsibilities, Moss tells us: responsibilities imposed by the rules of the market, formal responsibility, political responsibility, professional responsibility and moral responsibility.
Schools should answer simultaneously to all these responsibilities, creating in response numerous dilemmas for schools and school leaders. OCDE and European Commission were not forced to use direct forms of power in what concerns education and governance but national politics are influenced by super- national politics of EU “which creates, filters and sends the globalization process“ (Antunes, 2006, p. 38).

Both agencies distinguish between “hard governance“ and “soft governance“. The choice of the terms is interesting, as “hard rules“ means rules that “influence the people’s behavior“, while “soft rules“ “i*nfluences the way in which people perceive and think about themselves and their relationships with the exterior world“.* Soft governance influences the agents in more profound ways.

“An optimal educational governance, stimulated by its functioning, but especially of a superior quality, would be built not only from restrictions: constraints, but also from liberties: permissions, openings containing pro- quality responsibilities, under an ethical emblem. First of all from the simple reason of production through involvement: *the core of school governance is the inversion of the actual relationship between obligation and assuming”*[19] (Marga, 2013).

The term of governance is used to express the opening of the school and of the educational system – Halas said that we govern those things or human beings whose behavior we cannot foresee on the whole[20] (Gabor, 2003).

[17] Idem
[18] Idem
[19] Andrei Marga, Guvernanță și guvernare. Un viraj al democrației?
[20] Halász, Gabor: Governing schools and education systems in the era of diversity: A paper prepared for the 21st Session of the Standing Conference of European Ministers of Education on “Intercultural education”. Budapest 2003.

L. Moss, at the beginning of his article, notices that “isomorphic forms“ of governance appear at all levels, as we can see a tendency of substitution of “hard“ governance forms, compulsory from the legal point of view, with “soft” forms based on persuasion and advice.
Elisabeth Bäckman and Bernard Trafford, authors of “Democratic Governance of Schools“, conclude that school “instead of censorship and restrictions, which are useless anyway, develops the critical thinking better“[21] of students (Bäckman, Elisabeth, Trafford & Bernard, 2014). Other analyst’s idea is that “governance“ is a “guide of future behaviors orientation in social relationships.”

THE MORPHOLOGICAL MATRIX OF IDEAS

We intend to study the interactions between the **principles** of school governance using the technique of matrix – *rights and responsibilities, active participation and the revaluation of diversity* – and the key **fields** of school – *education based on values, cooperation, communication and involvement, and students’ discipline.* We will use these elements in a matrix chart [22] (Lijphart, 2006).

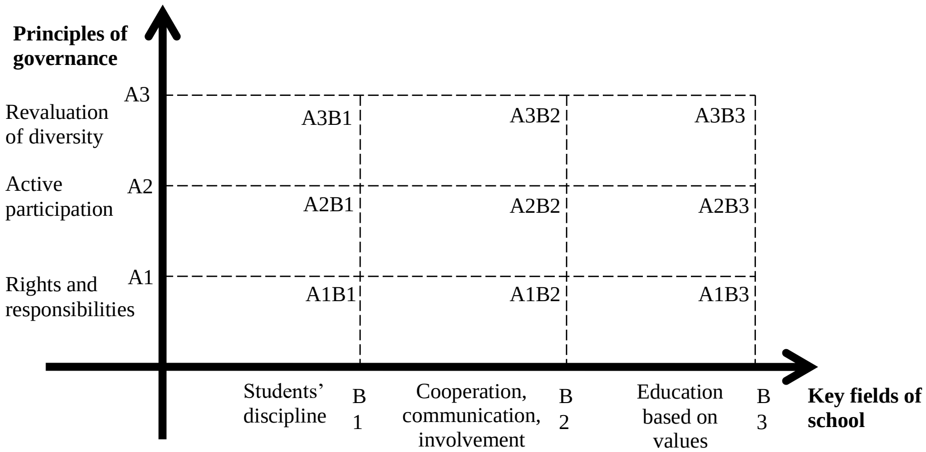

Figure 1: The interaction between democratic principles and the fields of school life

The relationship between **rights and responsibilities – students’ discipline (A**1**B**1). We notice positive results in the development of the pupil as an individual and of school as an organization where the discipline is treated as a real problem of school and the creation of the behavior of the responsible student, owner of a critical thinking is being studied. The consciousness, responsibility for his own actions, the influencing of the motivation have great success in the development of the student rather than imposing. Such an education in which determination replaces strictness, the power of the example and the way of treatment and solving situations of rights violation becomes a way of profound influencing with an educational message, in which the worry and the respect for the other are present. The pupils and Pupils’ Council are trained in this way of participation learning rules in an active way, understanding their meanings and their deep reason beside their perception as simple interdictions.

The relationship between **active participation – cooperation, communication, involvement (A2B2).** The lack of democratic values leaves a too large space in the middle of the scene. In the

[21] Bäckman, Elisabeth, Trafford, Bernard, *Guvernanța democratică a școlilor*, Editura Universitară, București 2014, pg. 11
[22] Arend Lijphart, Modele ale democrației, ed. Polirom,2006

logical mechanism of the speech which influences the decision taking, we need a guide, a fair judgement, a “piece of advice from the wise men“ to correct, to slow some ideas. The advantages of interaction stand in practicing inter-human competencies, experimenting democratic values, encouraging cooperation and the evaluation of the results, auto - reflection, creatively solving the problems, getting over difficulties, strengthening the self - confidence, gaining respect from the other one and knowing each other. Lack of examples and illustrative activities lead to poor or modest results, to a cautious behavior, to lack of confidence, isolation and rejection.

The revaluation of diversity –Cooperation, communication, involvement (A3B2). In a culture of democracy, school governance is placed today under the European slogan ”Unity in diversity!“. The convergence and the isomorphism of the school governance placed under the sign of values take forms which can be discovered in all systems that assume education as a mission. The various phases, games of role, suggested solutions and tested through practice, the discovery of the truth under various aspects, the validity of the simultaneous solutions lead to reevaluating of the basis, the revaluation of the results and responsibility through action. In this survey we can come across problematic situations due to some damaged values but deeply rooted, destroying the meaning, overlapping of the values, the double meaning with negative impact, lack of valuing endings.

Rights and responsibilities – Education based on values (A1B3). The school is a laboratory in which active citizenship is being experimented, practical example of democratic values are based and consolidated. Where the school governance functions guided by democratic values, the intern regulations which is normally assumed in total agreement, without difficulties in putting it into practice. The advantages of this interaction are the setting of the unity starting from meaning and significance, the inversion of the relationship utility/value, proving the necessity of overlapping the axiological over practical in checking the solutions leading to the idea of transparency, responsibility, auto-reflection capacity, the deceleration of the influences and strategic thinking. The dangers can be the keeping of the supremacy of knowledge without ethical value, the replacement of social values with own values usually narrow and limited.

Active participation - Education based on values (A2B3). The change of cultural vision can be obtained only through active involvement of the person, in his own becoming and grounding of the values using continuous practice. Democratic education is a preparation for getting over obstacles and for finding “good“, “correct“ answers for crisis situations. We know there are states with strong democratic tradition which were in the situation of stopping their democratic way during their modern history[22]. Qualities such as perseverance, determination, daring, sincerity, impartiality, firmness, not negotiating the law, setting the quality standards lead to social visibility, cohesion of the group and the action of transparency. Not being sure, doubt, discontinuity, stopping, giving up, lack of the ending in actions and activities lead to lack of agreement, blaming of the action, damaging of authority, getting over time limits for a successful activity or project, lack of transparency.

The revaluation of diversity - education based on values (A3B3). The process of revaluation of diversity starts with the other one’s tolerance and ends with the overcoming of conditionings and differences in a normal way and without prejudices. School should offer the students the freedom to choose what kind of projects they find more suitable and which seem to be more challenging in the way of training the mind and the soul. The visible influence during the decision taking process involves widened agreement, a feeling of membership, satisfaction and fulfilment. The real dangers are redundancy, lack of vision and agreement, the atomization of the whole building anti-social and discriminating attitudes, intolerance, radicalization, hatred and contempt.

CONCLUSIONS

Analysing all the interdependences created one can notice starting from the point A1B1 going to A3B3 an action of school governance from "hard" forms – imposing as a compulsory specification, noticeable in written rules and standards – to a "soft" action – built on larger basis and founded on assumed values and ancient unwritten laws. Positive aspects, but also aspects that should be avoided due to their unfortunate consequences are included in the analysis. The polarization of the values is not a bad thing as long as we have a balance based on integrating knowledge and a culture of scientific type. Dangers occur when the lack of knowledge, cultural experience and reflexive exercise are not shields to take the pressure that appear during the phase "direct power" in the taking decision process. The objectives of the research suggested are:
- the determination of the level of development of consulting culture, of dialogue and of assuming public responsibilities for getting results at school level;
- the optimizing and the efficiency of taking decisions process through the involvement of all interested factors and a better usage of experts' recommendations;
- the identification of some examples of good practice in school governance and their practice.

The creation of educational politics in a culture of governance would raise their efficiency and success, these could be measured with the help of some indicators regarding access in deliberative processes, the transparency of taking decision act and the public access to information, such as including the majority of requirements and preferences of all actors involved in the process of stating the alternatives.

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HCI (HUMAN COMPUTER INTERACTION) APPLICATIONS FOR EDUCATIONAL PURPOSES

Neural Networks in the Educational Sector: Challenges and Opportunities

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ABSTRACT

Given their increasing diffusion, deep learning networks have long been considered an important subject on which teaching efforts should be concentrated, to support a fast and effective training. In addition to that role, the availability of rich data coming from several sources underlines the potential of neural networks used as an analysis tool to identify critical aspects, plan upgrades and adjustments, and ultimately improve learning experience. Analysis and forecasting methods have been widely used in this context, allowing policy makers, managers and educators to make informed decisions. The capabilities of recurring neural networks—in particular Long Short-Term Memory networks—in the analysis of natural language have led to their use in measuring the similarity of educational materials. Massive Online Open Courses provide a rich variety of data about the learning behaviors of online learners. The analysis of learning paths provides insights related to the optimization of learning processes, as well as the prediction of outcomes and performance. Another active area of research concerns the recommendation of suitable personalized, adaptive, learning paths, based on varying sources, including even the tracing of eye-path movements. In this way, the transition from passive learning to active learning can be achieved. Challenges and opportunities in the application of neural networks in the educational sector are presented.

Keywords: *neural networks; recurring networks; learning paths.*

INTRODUCTION

Learning useful representations from raw data means extracting relevant information in a compact form and removing redundant information as well as noise. In other words, constructing a simplified model that explains observed data. Analysis of the obtained representation can highlight latent factors, disclose previously unseen relationships among variables, and ultimately help gaining useful insight into the phenomenon being observed. Finding a good representation is crucial in multiple research fields, where data come from several sources and are characterized by high complexity. Neural networks are a widely used and successful representation learning technique.
Neural networks, as their name suggests, are inspired by the structure of the cortex in the human brain. They consist of a number of units arranged in a directed graph (undirected for the Boltzmann machines) by means of connections. A unit takes as input a weighted sum of the outputs of the units connected to it and produces its output by applying to that sum a nonlinear activation function—typical such functions are the hyperbolic tangent and the logistic sigmoid. The neural computation model has some nice theoretical properties and neural networks can be shown to be universal approximators (Goodfellow *et al.*, 2016).

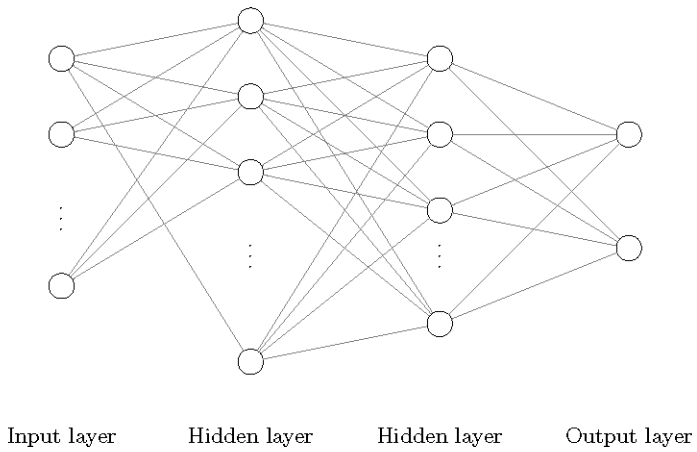

Figure 1: A deep neural network

Neural networks learn from a collection of training samples. Training a neural network is usually done by means of Stochastic Gradient Descent, with the calculation of the gradient of the loss function (quantifying the prediction error) with respect to the network parameters being obtained through the backpropagation algorithm. To keep the architecture simple, restrictions are applied to the topological structure of networks: Units are arranged in layers, with connections only between units in adjacent layers (Fig. 1). Intermediate layers are called hidden layers. Neural networks with at least two (three for some authors) hidden layers are called deep learning networks. It is this hierarchical structure that provides deep network with the ability to build powerful representations. Subsequent layers work on intermediate representation constructed by previous layers, so that internal representations are at an increased level of “abstraction”.

RECURRING NEURAL NETWORKS

Like other models, neural networks work on the assumption that the examples are independently and identically distributed according to an (unknown) distribution. Thus, the order in which examples appear is unimportant. Sequential data raises unique challenges for neural networks, because order-based dependences among data need to be captured. Even though networks can be designed to cope with fixed—length sequences, dependences may extend over variable–length intervals, with possibly long gaps. An architectural change is therefore required. While a conventional neural networks has connections only between units in adjacent layers, a Recurrent Neural Networks (RNN) may have cycles in its graph structure. In this way, a *state* can be constructed and maintained that contains information—Goodfellow *et al.* (2016) effectively called it a “lossy summary”—about the whole sequence observed so far. Upon observing new sequence elements, RNNs update their current state vector to reflect changes. The problem becomes how to isolate important changes and discard irrelevant ones.

LSTM networks

In theory, RNNs are able to treasure on dependences of any length. In practice, however, very long chains of gradient propagation when the network is unrolled in time will lead to vanishing gradients (Bengio *et al.*, 1994). A mechanism to control the accumulation and propagation of state variations is needed. To cope with this problem, gated RNNs were introduced, including for the Long Short-Term Memory (LSTM) networks (Hochreiter & Schmidhuber, 1997) and for the Gated Recurrent

Unit (GRU) networks (Cho *et al.*, 2014).
These networks have the ability of controlling the amount of information about past inputs that is be preserved at each stage. The self-loop is regulated by additional units—gates—that introduce the ability to forget old state information.

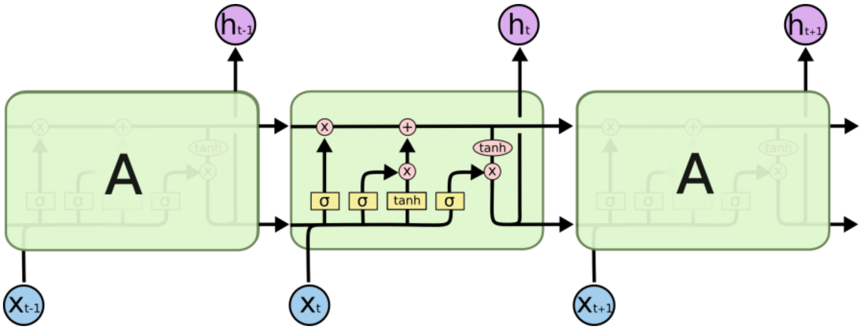

Figure 1: An LSTM cell (Olah 2015)

Figure 1 (Olah 2015) shows the structure of the repeating module in an LSTM network, highlighting the cell state (upper part), the output (lower part). From left to right, the forget gate block, the input gate block, the candidate state gate block, and the output gate are shown. The symbol σ stands for the logistic sigmoid, which squashes its input in the interval (0,1), where the multiplication sign indicates the Hadamard product. Differently from an LSTM networks, in a GRU forgetting and the updating of the cell state is delegated to a single gate. GRUs, being simpler, have shown improvements over LSTMs in computational performance. The two models are otherwise competitive on a wide range of problems.

APPLICATION TO THE EDUCATIONAL SECTOR

It is worth mentioning that psychological studies on human and animal learning have been conspicuous sources of inspiration in developing machine learning paradigms. Machine learning, in its general meaning of automatically deriving knowledge from experience—crystallized in data—is particularly attractive in the educational sector. There are two reasons for this. Firstly, the educational environment is so complex that little assumptions can be made about the data distribution. Secondly, vast amounts of data are available for exploration.
Useful applications of machine learning in education include a variety of objectives (Coelho & Silveira, 2017). Accurate monitoring student's states during learning can support personalized, flexible, and adaptive learning, with direct benefit for students and an increased retention rate for providers. Student modeling can be based on several data sources, including for interaction logs, facial features, and eye movements.
The application of deep learning models to educational data gained momentum in 2015 (Guo *et al.*, 2015), when a prediction system for student performance was introduced. An interesting benefit of such a system is its capability of providing early warnings so that students at risk could be identified where there is still time for corrective actions. While applying deep learning and RNN models to an educational context is obviously desirable, the scenario creates some unique challenges that need to be addressed. In particular, inhomogeneity and redundancy often characterize data in educational analysis, especially in detection of student boredom, and they should be handled properly. Designing handcrafted feature to represent student behavior can be challenging (Bosch & Paquette 2017). Unsupervised autoencoders are trained to find data embeddings, mappings to low-dimensional spaces that (a) improve the performance of classifiers, and (b) have the potential of showing interesting insights in data, highlighting previously unseen connections. Despite being

useful as building blocks in modular architectures of complex neural networks, the embedding themselves can be analyzed and studied separately, looking for clues about unexpected associations evidenced by spatial closeness in the simplified representation.
In a personalized and adaptive learning environment the learning path, instead of being fixed, is continuously adapted, based on student's individual characteristics and knowledge state, to help students achieve their learning objectives in the shortest possible time. Personalized recommendation systems enable the realization of customized learning path for different individuals, treasuring on the experience of others. Recommendation systems should be optimized in terms of diversity, novelty and interaction intensity. In early recommendation systems, content based filtering derived recommendations for a learner on the basis of what was preferred in the past by learners with similar tastes. In order to aggregate learners with similar preferences in Collaborative Learning, it is natural to think to clustering algorithms based on various similarity metrics (Pelánek, 2019).
Sparsity and volume of the data volume call, however, for different solutions that can scale in a better way. Kim *et al.* (2017) combined Probabilistic Matrix Factorization with a Convolutional Neural Network (CNN) to model contextual information and consider Gaussian noise. Features used to represent learning resources need to keep some fundamental assumptions into account (Zhou *et al.*, 2018). In particular, some knowledge is regarded as essential in a learning plan and it ought to be included in any path relative to that plan. Zhou *et al.* (2018) used an LSTM predictor for learning paths, in particular because of its ability to handle sequences of different length. In contrast, Kim *et al.* (2017) preferred a CNN to a LSTM or GRU, because of the faster training times offered by the former. In fact, CNN's, due to their fixed structure, can use simple backpropagation, whereas recurrent networks have to resort to backpropagation through time in order to keep long-term dependencies.
The relationship between learners, items, and tags can be represented by means of a tripartite graph, which was originally static and based on historical information. Recently, an approach where the interaction tripartite graph—modeling the ternary relation among learners, interaction behaviors, and learning content—is made dynamic has been proposed (Hu *et al.*, 2019). In this way, trendy topics attracting much attention may easily propagate among learners. The weights in the dynamic interaction tripartite graph are initialized and then through an attention-driven CNN.
In online platforms, a large number of exercises are prepared and loaded to assess the degree to which a learner has mastered a topic. The ability to find similar exercises, *i.e.*, exercises sharing the same purpose, can substantially improve the richness of learning. Automatically grouping exercises on the basis of similarity is not at all trivial, because exercises usually contain heterogeneous data such as text and images, and similarity at word level—and even at notion level—can easily lead to erroneous grouping. For this task, a CNN and an Attention-based LSTM have been combined (Liu *et al.*, 2018). The CNN processes images, an embedding layer creates representations for notions, while the Attention-based LSTM produces the final, semantic, representation.
Such combination of components is telling of a research trend that is in progress. In future developments, subnetworks will either continue to be juxtaposed in a modular way, each component dedicated to the portions of input it handles best, or we might witness the development of new, hybridized architecture designed specifically so that it will be natively able to process all the data.

CONCLUSIONS

Discovering hidden structure and patterns in data originated from online learning systems is valuable in education, as it permits to gain a deeper understanding and to devise a highly flexible, adaptive, and personalized offering. Deep learning networks and their capability to untangle previously unanticipated connections are very promising tools in this endeavor.
Choosing the most appropriate deep network architecture for a given task is still a problem requiring skill and expertise. The main architectures offer advantages and disadvantages, in terms of

capabilities and performance, and careful weighing is needed when making a selection. Once the choice has been made, the next step is to determine suitable architectural hyperparameters, which also requires extensive experiments to find the level of inductive bias that improves generalization capability.

The availability of public datasets to experiment new ideas and evaluate their performance is a critical factor for the research in this field. Currently available datasets for education, for instance the Edx or the WorldUC datasets, are a starting point but cannot completely cover the requirements for some experiments (Hu *et al.*, 2019). Extensions of publicly available data would therefore be welcome.

Perspectives for future research are wide and auspicious. Regarding improvements to the RNN architecture, several attempts have been made, among which the most exciting appears to be attentional interfaces (Vaswani *et al.*, 2017), where an RNN can focus, depending on the context, on salient parts of its input that are relevant for the prediction of the next target; a specific module regulates the decision. For example, an RNN can control the output of another RNN. All of the proposed improvements seem to be conducible to a relaxing of the topological constraints in network layout, an idea which has started to yield interesting results with skip connections in residual networks (He e*t al.*, 2016), and hypernetworks (Ha *et al.*, 2017).

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An innovative game-based approach for teaching urban sustainability

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ABSTRACT

This paper is based on SUSTAIN, an ERASMUS+ project with an innovative perspective on urban transportation, and its target is to promote the importance of sustainability on the everyday problem of urban transportation among the students of higher education (and not only), who are the policy makers of tomorrow. In order to achieve its goals, the research team is currently developing a course that will be based on an interactive serious board game with an analytical style of education. SUSTAIN's purpose is to create a game that will allow students to learn about transportation sustainability and societal metabolism through playing. The project partners develop small and illustrative simulation models, which will make the definitions more concrete and allow students to experiment largely in a consequence-free environment. The simulation models can be used to identify scenario exemplars on how we can achieve sustainable urban transportation and *consequently a balanced societal metabolism, while on the same time taking into account formal decision making processes. In this paper, we are going to explain a Stocks & Flows Diagram for the above mentioned model, with a system dynamics approach.*

Keywords: *urban transportation, sustainability, serious game, decision making, system dynamics*

INTRODUCTION

Sustainability and sustainable development have been recognized as the major challenges of the 21st century and to achieve this objective there is the need to think of education not as the traditional, analytic way of transferring knowledge, but as an experience that is centred on the student. Its purpose is to assist them in acquiring the necessary material/tools that will help them comprehend and tackle complexity that is inherent in sustainability.
The objective of the current paper is to present an effort in the context of an E+ project on Higher Education to use serious games as a means to teach sustainability. To achieve the objective a board game will be designed and developed that will utilize the principles of Systems Thinking for the game mechanisms and design.

The SUSTAIN Model

The board game that will form the center of the new type of education, will be based on a simulation model that helps to contextualize and make more understandable the abstract notion of sustainability. The simulation model, named the SUSTAIN model, is developed with the principles of Systems Thinking and more specifically, using the methodology of System Dynamics. The following paragraphs, illustrate the basic aspects of the simulation model.
The SUSTAIN model that we are going to describe is a Stocks & Flows Diagram (SFD) (Forrester, J. W.,1971) without the definition of variables (Auxiliaries and rates) and constants. Over the following weeks, we will develop further the model by "quantifying" it, so that it can be simulated and experimented with. However, this delivery intends to convey the structure of the overall model, from which the SUSTAIN board game can be designed. Of course, we do not expect that all aspects in the model be implemented/accounted for also in the board game, but we have developed this model by keeping in mind the elements that were already considered in our preliminary designs as well as those found in the literature, so that we are not expecting big differences. What we would suggest now, to the game designers, is to review the model and carefully check especially the dynamics of stocks accumulations/decrease (with related timing) and the aspects of delays between actions and results (both very important aspects also for the game experience).
The model is divided in several sections:

- Investment-general variables
- Urban planning
- Waste management
- Water management
- Transport
- Environment
- Energy

Each of them has its own variables and internal dynamics, but, from a systemic point of view, they can be seen as a whole big system which represents the concept of "city". In fact, there are many links and interconnections between variables belonging to different sections. For example, building a new school have impacts not only at urban planning level (because it occupies a portion of available land), but also on waste and water management and energy (new activities, additional consume of resources, additional waste).

The majority of them are not visible in the image because otherwise the model may become unreadable, but every time the visible link is missed, there is a shadow variable (in grey inside brackets <…>) that represents the link. For the right and effective understanding of model, we want to explain some very brief and easy concept about System Dynamics, in particular S&F modelling. The S&F model is a simulation model that represent the system under study from a quantitative point of view, allowing user for policy experimentation in free-consequence environment. Furthermore, using computer simulation models is much cheaper in terms of cost and time, rather than experimenting with the actual system, to know if the targeted objectives could be achieved when a certain policy is implemented.

S&F symbolism (figure 1) consists of:

- the stock (represents things in the model that can accumulate, the stock will rise and drop depending on its flows and will remain constant while in equilibrium),
- the flow (is the rate of change of a stock. Inflows add to a stock; outflows take away from the stock. Equilibrium occurs when inflows to all stocks are equal to the outflows),
- and the information link (blue arrow in the model represent the direct influence of the current value on another).

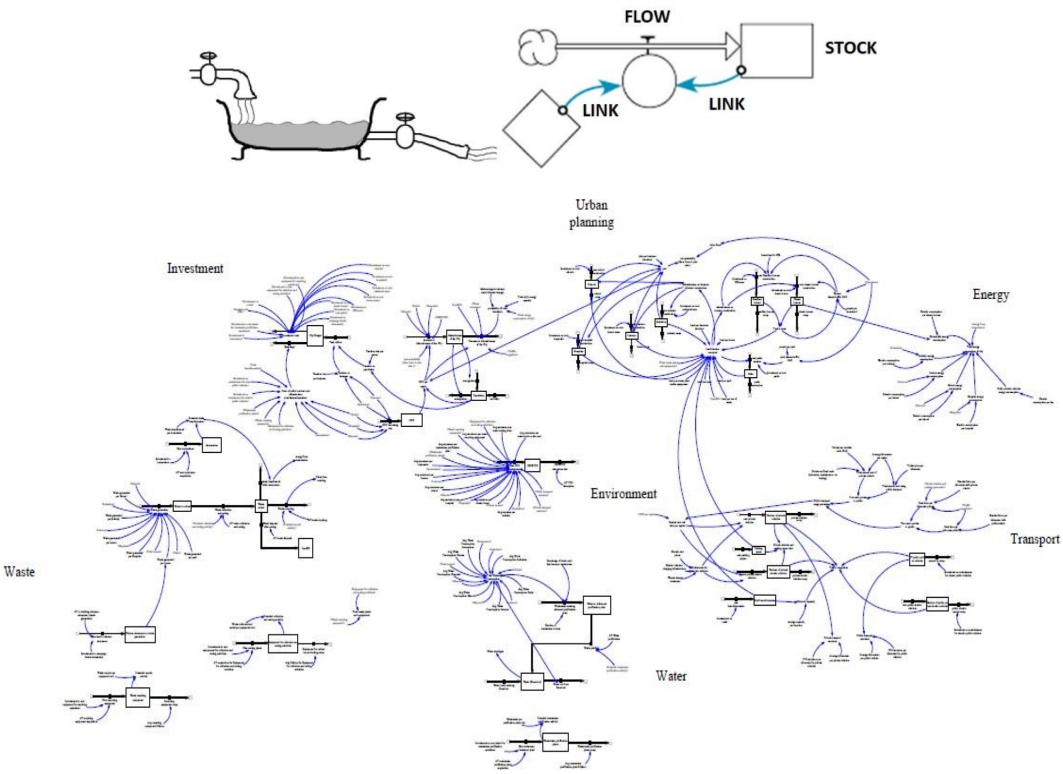

Figure 1: S&F symbolism

Investment-general variables

This first part of the model can be seen as the core of the model, because in this section there are the principal stocks that affect deeply the entire model, namely:

Population. A city exists when there are some persons that live in it. Every aspect of the city is affected by the number of persons that live in the city. The more the persons, the more the resources consumed, activities carried out, waste generated.

Attractiveness of the city. This stock represents the "wellness" and the satisfaction of the citizens and is led by many variables (e.g. job availability, schools, hospitals, GDP, etc.). Also, this level influences the people migration rates in and out the city, that define population level (Sanders, P., & Sanders, F., 2004)(Schroeder, W. W., 1975)(Haller, R., Emberger, G., & Mayerthaler, A., 2008).

GDP. GDP is a monetary measure of the market value of all the final goods and services produced in a period of time by a country or a city. It is guided by the economic wellness of the city, due to business activities.

Liquidity. This last stock represents the liquid assets for the city administration. Taxes from people and business activities increase the level, which is then (based on the availability) reinvested in different city sectors (e.g. new roads, more efficient facilities for waste and water, etc.)

Transport

The transport sector in the model reflects a high-level description of transport dynamics inside a city (Jifeng, W. A. N. G., Huapu, L. U., & Hu, P. E. N. G., 2008). There are two transport choice for citizens: private vehicles or public vehicles. Based on the usage of one or the other mode there is a variation in number of private vehicles (i.e. new cars purchase), and therefore the car fleet in the city. There are also other variables outside the transport section which affect this variation (i.e. population and GDP per capita). The variation of private vehicles which circulate inside the city produce important feedback at section level as well as at overall model (Armah, F., Yawson, D., & Pappoe, A. A. (2010).
The modal choice is the core aspect in this section, for the reasons explained before, and is defined by two essential factors: Cost and Time. The cost factor is represented by cost ratio between annual cost for private transport and public one. Each citizen has an annual average kilometer per capita. Private transportation cost results from private car fixed costs (insurance, maintenance, car purchase) and variable cost (fuel) times annual kilometers. While public transportation cost results easily from price per kilometer and annual kilometers.
The time factor is represented by the ratio of time needed to arrive to the destination with both modes. Each of them results from standard time of transportation and traffic congestion, but only the private one is affected by time for finding parking, this latter is defined by the ratio between vehicle fleet and parking space.
Public transport fleet could be developed by investing both on traditional (e.g. petrol busses) and electric vehicles (e.g. trams). Each of them has its different costs of purchase and maintenance, also they have different impact in terms of GHG/CO2 emissions. Such sector is controlled by Urban planning sector through the planning of new parking spaces and new lane-kilometers. Another important factor is represented by traffic congestion, which is due to the number of private vehicles, public vehicles and network capacity. The congestion negatively affects the attractiveness of the

city, and the related traffic emissions influences the sector Environment (then, again the attractiveness of the city).
Finally, such sector is controlled by Urban planning sector through the planning of new parking spaces and new lane-kilometers (Xu, Z., 2011), at the same time investment on roads and parking space have impact also at urban planning level, because they consume the city's land availability for other buildings and activities.

Waste management

The Waste Sector is modelled as a long supply chain representing the whole cycle of waste from its generation to the landfill. In detail, the supply chain makes clear that waste is first generated (it depends on the number of the various activities in the city and the Average waste generated by each class of them) and needs to be collected subsequently. Therefore, the process entails phases (i.e., rate variables) of collection, sorting and recycling). The waste that cannot be treated is sent to Landfill or the Incinerators. Investments in this area can be carried out acquiring (or building) new equipment and plants needed for the whole supply chain.
The Water sector of the model is based on the main idea that any activity in the city consumes water and generates wastewater. Water consumption is modelled multiplying each category of stock for a constant, representing the average consumption of water for that specific class: for example, the total number of industries is multiplied by the "average water consumption industries" to define the Water Consumption for this specific class. Part of the water that is used creates waste (i.e., the "total water consumption" multiplied by the "percentage of water used that becomes wastewater" gives the wastewater that needs to be purified and is subsequently treated in an advanced purification plant). Wastewater going through advanced purification plants is therefore purified and represent an inflow to (pure) Water in Reservoirs. Reservoirs are also increased by Rainwater naturally entering in it. Investments in this area can be carried out acquiring (or building) new wastewater purification plants.

Energy

Cities consume energy based on the number of schools, hospitals, leisure structures, industries and households (Feng, Y. Y., Chen, S. Q., & Zhang, L. X., 2013). The total energy consumption of the city is an important factor to consider (Naill, R. F., 1992), because it defines the capability of the city to meet the need for energy of its citizens and business activities. In fact, concurrently with meteorological extreme event (due to climate change), there could be some local blackouts. The probability of this kind of phenomenon is due to the fact that the meteorological event "cut" the city's energy delivering capacity and a high level of consumption causes the blackouts which have impact on city's attractiveness. This kind of problem could be softened by the use of incinerators during the waste management process. In fact, incinerators provide city with additional energy, lowering the total level of consumption.

Urban planning

The urban planning sector concerns the consumption of free soil for functional areas, dedicated to specific purposes or uses. The functional areas, for housing (NearZero houses and Classic houses), health services (Hospitals), leisure and recreation (Leisures and Parks), parking (Parking space) and education (Schools), and production or job creation (Industries) increase the attractiveness of the city, while they exhaust the available surface (Fong, W. K., Matsumoto, H., & Lun, Y. F., 2009). Each area or function also implies negative consequences on the quality of the city itself, in terms of waste, emissions, energy and water consumption, as well as influencing the transport sector. These negative consequences are modelled by other sectors such as Water, Waste and Environment. The distinction between NearZero houses and Classic houses allows to choose different type of buildings with different costs and associated consumptions (e.g. for cooling/heating). Such difference could be embedded in the board game using different weights such as “costs of building” or “environmental costs of functioning”.

Conclusions and Future Research Directions

The purpose of the paper was to present the methodological aspects behind the design of a board game that will be used as a teaching tool in order to promote “sustainability literacy” in higher education.
The model uses the principles of Systems Thinking and Causal Loop Diagrams to create the system of a region/city and illustrate how the various elements are connected causally, how feedback loops are created and how these loops give rise to non-linear and complex behavior.
The next steps include the development of a quantitative model and the translation of the model’s variable to mechanisms and elements of a board game.

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University's digital transformation: A case study for providing e-services via Moodle

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ABSTRACT

The evolution of digitization reaches a new stage with a focus on the overall transformation, where the so called "Intelligent Environment" such as "Smart City", "Smart Campus" is in the heart. Today's institutions, which have not yet started the transformation towards a Smart Campus, are capable to exploit untapped ICT resources that could potentially lead to the optimization of the processes and services. In order to verify that a new service can be offered with the available ICT resources, a method of finding a subset satisfying some condition is used. The paper reports approach where elements of the main set include own resources and their functionalities, while needed resources to provide a new service build the subset elements. This work presents examples of developed e-services by using the open source Learning Management System (LMS) Moodle. The study demonstrates that Moodle and advanced ICTs are just as so an alternative for improving personal management and information systems in the means of e-services offering. The paper analyzes the results and evaluate the benefits from the digital transformation point of view. The conclusion summarizes features of the applications will contribute the way university interacts with students and staff.

Keywords: *digital transformation, university management, e-services, IoT*

INTRODUCTION

The evolution of digitization reaches a new stage with a focus on the overall transformation, where the so called "Intelligent Environment" such as "Smart city", "Smart campus" is in the heart of the idea. The effective Information and Communication Technologies (ICT) are a competitive advantage of higher education institutions, and an ability to identify, consume, create and manage complex information in- and outside of the university. In the recent years, Bulgarian universities have invested mainly in ICT related to the educational processes optimization. Popular learning management systems (ILIAS, Moodle) have been used to provide free access to e-learning resources, interactive materials, distance learning. Side-by-side, resource and administrative management, typical for the traditional universities (face-to-face), lag behind in the integration of modern ICT technologies. The causes are not necessarily financial. There is a need of recognition the benefits from the implementation of such technologies as well as utmost applications of the available ICT technologies. Today's institutions, which have not yet started the transformation towards a smart campus, are capable to exploit many untapped ICT resources that could potentially lead to the optimization of the processes and services. This work presents examples of developed e- services by combining available ICT resources with free web applications.

DIGITAL TRANSFORMATION

Integration of digital technologies is a powerful tool for resource optimization and improved data collection and analysis which creates the conditions for informed decision-making. Regarding the educational field, a number of authors have associated this digital transformation with the establishment of the so-called ‘Smart’ campuses, which is a terminology that dates back to the beginning of 21 century (Kaneko, A., Sugino, N., Suzuki, T., & Ishijima, S., n.d.). Initially, this transformation included the implementation and use of various digital technologies together, such as videoconferencing systems, smart cards usage (Halawani, T., & Mohandes, M., 2003). The idea constantly evolved into an overall concept in which the ‘Smart’ campus enables the community to design, develop and use innovative services (Pistore, M., 2013). ‘Smart’ campus is presented as the intersection point between "Smart Homes" (new experiences for "digital citizens" entering higher education) and "Smart Cities" (new operational efficiency for saving money and improving safety) (Nedwich, R., 2018). Large corporations offer state-of-the-art ICT solutions that address the challenges faced by universities - inefficient management systems, lack of quality of service (QoS) experience, serious resource losses, poor security and high operational costs (Smart Campus Technology - Connected Campus, Digital Campus, Cisco Education., 2019), (Campus Network Solution, n.d.)

The bases of all developments are “Internet of Things” (IoT) as a global infrastructure which connects (physical and virtual) real-time data carriers that provide information for analysis and decision-making. The IoT is about creating an ecosystem that enables experiences more efficiently, and with more intelligence than individual point solutions (Friess, R., & Watt, I., 2016). The concept of building a smart campus implies that the institution will adopt advanced ICT for automatic monitoring and control of every facility in the university (Wang, H., 2013).

METHOD FOR EXPLORING THE POSSIBILITIES OF NEW SERVICES PROVIDING

The optimization of the working processes and set up of new quality services are priorities of the Technical University of Varna. Furthermore, these concerns are the basis of the integrated quality management system EN ISO 9001: 2015 (Quality management systems. Guidelines for the application of ISO 9001:2015., n.d.). Migration to a Smart Campus infrastructure is a costly process, hence the stage ICT integration is an option for universities with budget limitations. Therefore, a method to gain greater benefits from available ICT and scenarios for new services providing is urgently needed. The aim of this work is to present alternative options to enrich the university’s e-services using the available ICT resources.

In order to find the solution two sets of distinct objects has been considered. The available ICT resources at the university (the infrastructure, the available software, etc.) collectively form the first set A and the necessary ICT resources for establishment of a system for e-services- set B. The comparison of the two sets shows that B is a proper subset of A ($B \subset A$) and most elements of set B are existent tools and functionalities integrated into the Moodle platform.

NEW E-SERVICES THROUGH MOODLE

Moodle is a web-based open source learning management system (LMS) with multiple tools and functionalities, making it a preferred platform among a number of universities. The LMS is mainly used for educational purposes, such as uploading teaching materials, e-learning courses, conduction of exams. Research in this field has shown that LMS have not been used for facilitating the administrative work at university organizations in Bulgaria. There are possibilities that integrated tools may become a useful assets for providing such e-services. With appropriate settings, Moodle's learning activities can create solutions used in students status management. The proposed 3 cases are aimed at shortening the time consuming processing of paper applications shown in Figure 1.

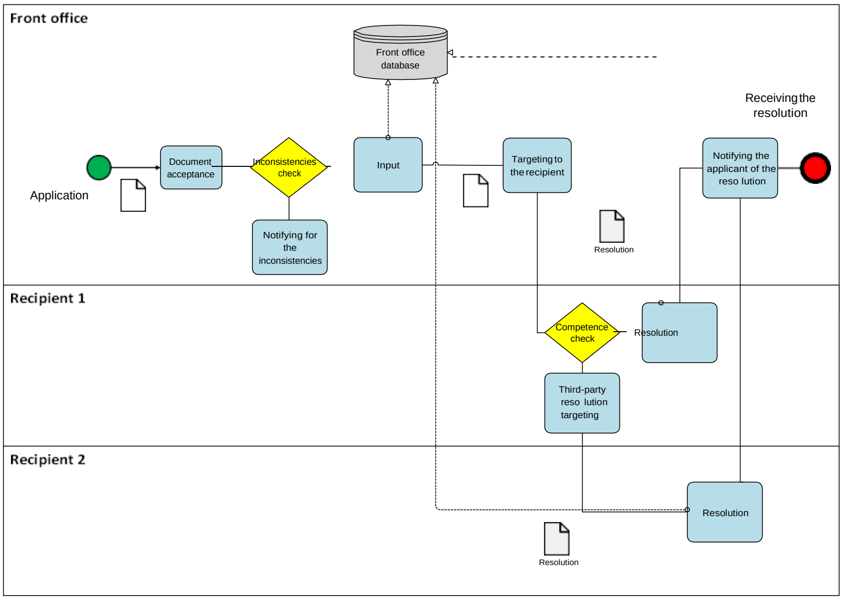


Figure 1. Processing a paper application.

Case 1. Moodle Tools

"Feedback" is a Moodle tool that allows survey creation. Request forms have been generated with the tool and added to the newly created "E-services" section, accessible for students by username and password. The tool functionality to create relations between questions is an advantage. Thus, there is no need to compose multiple applications, but only one form in which the logically related questions are loaded. The following code shows part of the feedback form building:

```
</ul></div></div></div><div class="box feedback_item_box_left"><div class="box box
generalbox boxalign_left"><div class="feedback_item_label_left">Считано от
предстоящия:<span class="feedback_required_mark">*</span></div><div
class="feedback_item_presentation_left"><ul>            <li class="feedback_item_radio_v_left">
<span class="feedback_item_radio_v_left">
<input type="radio" name="multichoice_19[]" id="multichoice_19_1" value="1" />
</span>
            <span class="feedback_item_radiolabel_v_left">
         <label for="multichoice_19_1">
            зимен семестър
 
            </label>
            </span>
</li>
<li class="feedback_item_radio_v_left">
            <span class="feedback_item_radio_v_left">
            <input type="radio" name="multichoice_19[]" id="multichoice_19_2" value="2" />
</span>
            <span class="feedback_item_radiolabel_v_left">
            <label for="multichoice_19_2">
```

летен семестър
</label>

Figure 2 shows a generated with Moodle "feedback" tool request form.

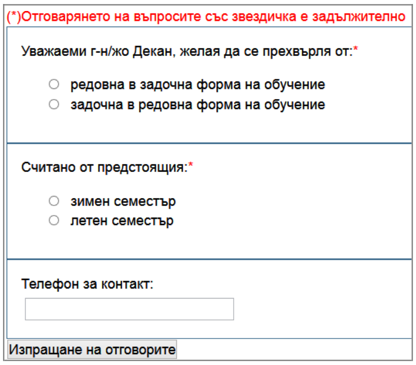


Figure 2. Screenshot of generated with Moodle "feedback" tool request form.

Staffs processing the students' requests are granted role and permissions as a "lecturer", giving them access to the requests received. The tool has no features such as form printing, autoresponder, downloading data in excel, CSV or other convenient for processing format. Possible actions are visualization of the requests received and generation of statistics.

Case 2. Moodle with external tool

The web application "Google forms" has been used to create university's request forms. When designing forms, limitations have been set to minimize errors while completing application. Forms have been added as URL resources in the newly created "E-services" section. When select an application, the relevant fill form with required fields is invoked (Figure 3). For applicants' convenience, the major part of the forms is pre-filled, as only check mark and drop-down menu choices are required for selection. If the form is correctly filled the message "*Your application is accepted*" is displayed. In case of an error, entered data must be corrected.

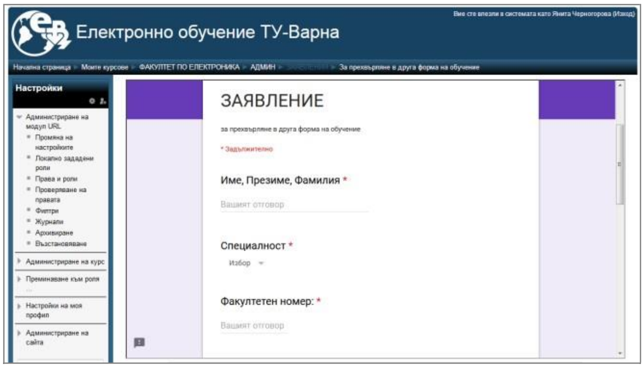


Figure 3. Screenshot of a request form created with "Google forms" app.

Requests are submitted to the form creator’s Google Drive. There are two options for visualization - either individually or in summary. The first review choice visualizes the form as it is filled out by the applicant and could be printed. The second one - summary, provides statistical data regarding answers with selection (Figure 4). The ability to examine the situation objectively is a must for a flexible management style. The analytics favor persons running the organization in decision-making in order to increase students’ satisfaction.

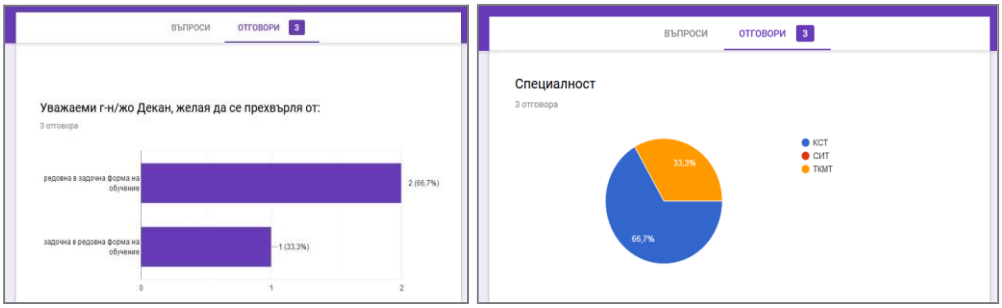
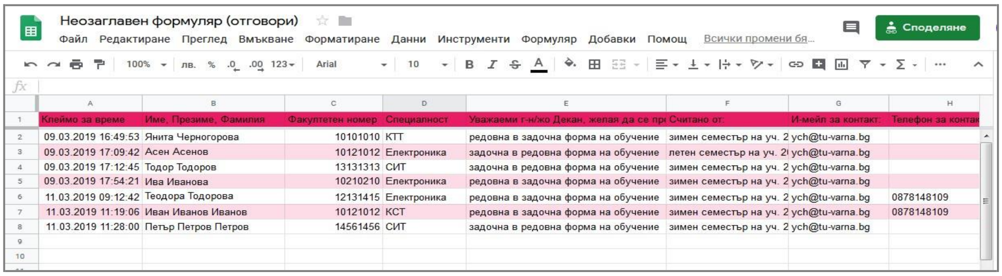


Figure 4. Screenshots of statistical data.

In addition, table with received applications data can be shared with a link (Figure 5), avoiding the need of having a Google Account. The information is updated in real time. Each column has a filter that allows selections by variety criteria.



Неозаглавен формуляр (отговори)

	A	B	C	D	E	F	G	H
1	Клеймо за време	Име, Презиме, Фамилия	Факултетен номер	Специалност	Уважаеми г-н/жо Декан, желая да се пр	Считано от:	И-мейл за контакт:	Телефон за контак
2	09.03.2019 16:49:53	Янита Черногорова	10101010	КТТ	редовна в задочна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	
3	09.03.2019 17:09:42	Асен Асенов	10121012	Електроника	задочна в редовна форма на обучение	летен семестър на уч. 2	ych@tu-varna.bg	
4	09.03.2019 17:12:45	Тодор Тодоров	13131313	СИТ	задочна в редовна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	
5	09.03.2019 17:54:21	Ива Иванова	10210210	Електроника	редовна в задочна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	
6	11.03.2019 09:12:42	Теодора Тодорова	12131415	Електроника	редовна в задочна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	0878148109
7	11.03.2019 11:19:06	Иван Иванов Иванов	10121012	КСТ	редовна в задочна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	0878148109
8	11.03.2019 11:28:00	Петър Петров Петров	14561456	СИТ	задочна в редовна форма на обучение	зимен семестър на уч. 2	ych@tu-varna.bg	

Figure 5. Screenshots of the table with received applications data.

In the proposed case, the applications cannot be electronically signed by authorized person, so the need to maintain a paper archive (for the purpose of tracking the process) is not eliminated.

Case 3. Plugin

The interoperable design of Moodle allows creating plugins and integrating external applications tailored to individual needs. Plugins enable inclusion of additional features and functionality to Moodle, such as new activities, new quiz question types, new reports, integrations with other systems and many more (Moodle plugins directory., n.d.). The authors of this paper has found approximately 1,600 plugins in the Moodle plugins database, which plugins although categorized suggest that they are designed for improving teaching and learning environment. This large amount of plugins is impossible to fully investigate, therefore with no claim for originality, this work suggests development of plugin for administrative e-services. The goal is to automate most of the administrative services related to student status verification and application processing in real-time by linking Moodle to the university database. The abstract model of communication is presented in Figure 6.

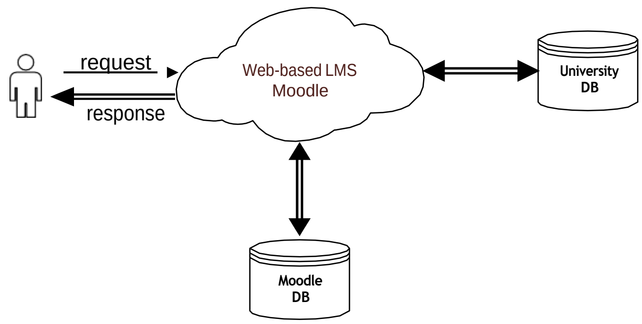


Figure 6. Abstract model of communication.

To log in and submitting a request form from the students, they only need user names (their faculty numbers) for access to the Moodle platform. Created plugin searches require information in the university database by username and set criteria for executing the request. For each request, different criteria for acceptance have been set. Some criteria require documents attachment, a feature unavailable in the first two cases, but with the third. For instance, transferring application from external form of education to regular education, which process‘ block diagram is shown in Figure 7.

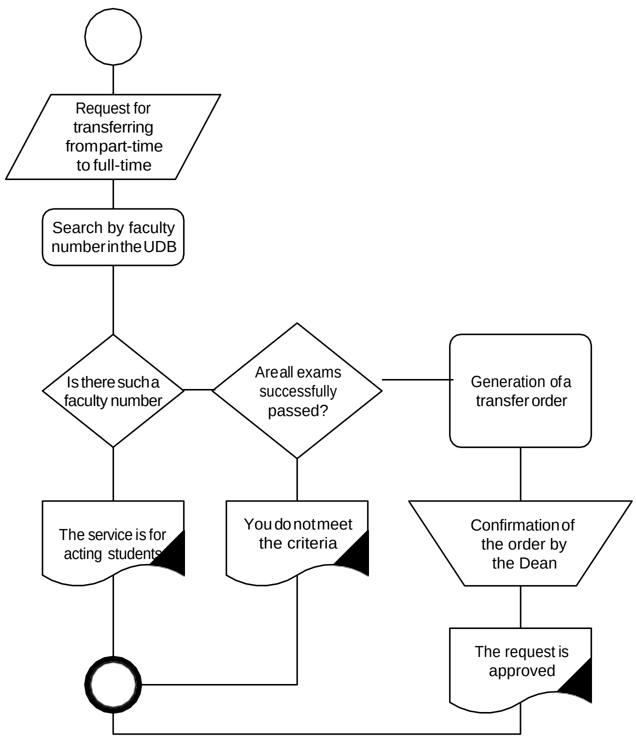


Figure 7. Block diagram of the process.

The plugin provides system processing of a standard request and electronic signature of the document. The authentication of the applicant and the person who accepted / rejected the application is verified by log in the platform with username and password. Embedded reports allow traceability of the entire process – by whom, from where and when a particular activity has been performed. Automated processing is not applicable in the case of applications with attachments.

A comparison of the proposed three cases has been made and the result is shown in Table 1. The evaluation criteria determine to what extent the proposed case: reduces the processing time of the application; creates the possibility of automatic processing; provides statistics for analysis.

Table 1: Advantages and disadvantages of the three cases

	Advantages	**Disadvantages**
Case 1	From face-to face to e-services Use of available ICT (Moodle) Statistical data Sending message to user's profile Familiar environment	Not provided files attachment No connection with university's database Manual processing Application processing requires staff, working with two databases Does not allow downloading data in a database-friendly format Applicable to standard applications only
Case 2	From face-to face to e-services Use of available ICT (Moodle) Familiar environment Statistical data Extracting information in suitable format	Not provided files attachment No connection with university's data base Manual processing Applicable to standard applications only
Case 3	From face-to face to e-services Use of available ICT (Moodle) Familiar environment Statistical data Provided files attachment Requests system processing Electronic signature Traceability of activities Applicant automatic notification Data store in the Moodle database	System processing is applicable to standard requests only

The three cases offer an administrative service of varying degree of digitization. The second case requires self-authentication of the applicant by filling in known personal data that does not meet the conditions for secure electronic identification. Both first and second cases require manual processing even for standard request, while the third case performs system processing. The attachment of additional documents is a feature applicable only in the third case.

CONCLUSION

The study demonstrated that Moodle open source software and advanced ICTs are just as so an alternative for improving the management and administrative environment. Therefore, future work will be expanded to increase the platform applications in the means of e-services offering. Digital transformation in higher educational institutions is associated with integration of technologies for establishment of Smart Campus. Technological corporations bring solutions for rapid migration to digitization, but they are costly and not always easy to adapt to the institutional specific needs. Enhancing performance of own ICT resources along with stage transformation is an accessible approach for university's growth.

The benefits of deploying e-services through Moodle are: enhancing student satisfaction; relieving document turnover in the administration; implementing a new service request channel; shortening the deadline for the provision of an administrative service; enhancing employee satisfaction.

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A Novel Design of the Pre-Processing Stage of Data Mining for Educational Purposes

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ABSTRACT

As data sets, in education too, change in size and structure, an appropriate design of the pre-processing stage of data mining for the implementation of data mining for educational purposes is becoming a hot research topic. The aim of the present research is to carry out interdisciplinary analysis of scientific literature on pre-processing in data mining and to design a pre-processing stage of data mining for educational purposes underpinning elaboration of a new research question. The present research employs both theoretical and empirical methods. Theoretical methods include analysis of scientific literature and theoretical modelling. The theoretical findings allow identifying sub-stages of the pre-processing stage for the implementation of data mining for educational purposes. The empirical study was carried out in 2018. The study was a case study The empirical results emphasize the main areas of analysis of teachers' behaviour in an international project. The empirical study validates the model of the pre-processing stage of data mining for educational purposes. The practical application of the model allows drawing a conclusion that the model is valid. The novel contribution of this paper is the design of the sub-stages of the pre-processing stage for the implementation of data mining techniques for educational purposes.

Keywords: *Data mining, pre-processing stage, data set, teacher behaviour, international project, exploratory research, case study.*

INTRODUCTION

Educational data mining is a developing research area that assists in decision making for educational purposes as educational data mining has emerged as an independent research area in recent years (Baker, 2010). Educational data mining often differs from the broader data mining literature, in explicitly exploiting the multiple levels of meaningful hierarchy in educational data (Baker, 2010). For example, methods from the psychometrics literature are often integrated with methods from the machine learning and data mining literatures to achieve this goal (Baker, 2010). Implementation of data mining implies the design of the pre-processing stage. However, the pre-processing stage of data mining for educational purposes has not attracted a lot of research efforts.

Further on, quality assurance in education expands the understanding of teachers' behaviour and changes data sets in size and structure. Hence, an appropriate pre-processing stage for the implementation of data mining for educational purposes has to be designed. The aim of the present research is to validate the designed model of the pre-processing stage of data mining for educational purposes through interdisciplinary (education and data mining) analysis of scientific literature underpinning elaboration of a new research question. The present research employs theoretical and empirical methods. Theoretical methods include analysis of scientific literature and theoretical modelling. A case study has been applied to the empirical study as "case studies [...] are generalizable to theoretical propositions and not to populations or universes. In doing a case study, researcher's goal will be to generalize theories (analytical generalization) and not to enumerate frequencies (statistical generalization)" (Yin, 2003, 10). The case study has a qualitative design (Kohlbacher, 2005). Moreover, an exploratory type of the case study has been used (Zainal, 2007) in the empirical study as case studies have an important function in generating new research questions, hypotheses and building theory (Kohlbacher, 2005). Exploratory case studies are set to explore any phenomenon in the data, which serves as a point of interest to the researcher (Zainal, 2007). The exploratory methodology proceeds from exploration in Phase 1 through analysis in Phase 2 to generating a new research question in Phase 3 (Melnikova, Zaščerinska, Glonina, 2015). The interpretive paradigm used in the empirical study is characterized by the researcher's practical interest in the research question (Cohen, Manion, Morrsion, 2003). Researcher is the interpreter.

THEORETICAL MODELLING

The proliferation, ubiquity and increasing power of computer technology has dramatically increased data collection, storage, and manipulation ability (Dermino, Fortingo, 2015). As data sets have grown in size and complexity, direct "hands-on" data analysis has increasingly been augmented with indirect, automated data processing (Dermino, Fortingo, 2015). Automated detection has been already aided by other discoveries in computer science, such as neural networks, cluster analysis, genetic algorithms (1950s), decision trees and decision rules (1960s), and support vector machines (1990s) (Dermino, Fortingo, 2015) including data mining techniques. It should be noted that data mining is defined as the process of uncovering hidden patterns in large data sets (Dermino, Fortingo, 2015). In its turn, patterns such as groups of data records (cluster analysis), unusual records (anomaly detection) and dependencies (association rule mining) based on data collection support decision making (Goyal, Vohra, 2012). Consequently, data mining refers to secondary data collection from a diverse source of documents or electronically stored information (Stewart, 2009) as data mining being an area of methods has an extended history going back to exploratory data analysis (Tukey, 1977) and has established methods for determining validity and generalizability (Slater et al., 2016). Data mining is carried out in three stages (Rogalewicz1, Sika, 2016): 1. Pre-processing: proper preparation of data for modelling, especially elimination or minimization of gross errors through dealing with missing values, and removing outliers and unreal values. 2. Main processing: software is mostly used; specific data mining methods are implemented in order to perform the exploration tasks. 3. Post-processing: interpretation of results obtained at the stage of main processing. Different designs of the pre-processing stage in data mining have been proposed:

- pre-processing as data cleaning and preparation to modelling (Faayad et al., 1996);
- pre-processing implies selection (of a data set), data cleaning and preparation to modelling, transformation (converting data for application of a specific method) (Rogalewicz1, Sika, 2016);
- pre-processing proceeds from sampling (Input Data Source, Sampling, Data Partition) through Exploration (Distribution Explorer, Multiplot, Insight, Association, Variable Selection, Link Analysis) to Modification (Data Set Attributes, Transform Variables, Filter Outliers, Replacement, Clustering, SOM/Kohonen, Time Series) (Marban, Mariscal, Segovia, 2009);

- pre-processing consists of problem identification, transformation of raw and inchoate data streams into applicable forms and formats (Berry, Linoff, 1997; Berry, Linoff, 2000).

Analysis of different designs of the pre-processing stage allows the paper's authors to model four sub-stages of the pre-processing in data mining implementation for educational purposes: 1. Formulation of research question and/or problem for the implementation of data mining. 2. Sampling (selection and size). 3.Selection of data sets. 4. Data preparation (partition, localisation and cleaning). It should be noted that data partition proceeds (Brinkman, 2009) from identification of main functions or main objects to determination of measurable items of main functions or main objects. Depending on teachers' behaviour, the teacher can formulate each function and/or item (Bartolini, Ahrens, Zaščerinska, 2018). Another issue is order of questions in secondary data collections from a diverse source of documents or electronically stored information: when people answer a question, there is a risk that they might have been influenced by the previous questions in the questionnaire (Brinkman, 2009). The order of the questions can be controlled by maximizing the number of different topic transitions between questions (Brinkman, 2009).

EMPIRICAL STUDY

Validation of the model of four sub-stages of the pre-processing stage in data mining for educational purposes via input parameter values and distributions has been chosen as the most reliable and preferred way to validate a model (Govindarajan, 2014). The model validation was carried out in 2018 within the Nordplus Adult 2018 project entitled "Adult educators' competence training for development of immigrants and asylum seekers' digital entrepreneurship" to be implemented in Estonia, Latvia, Lithuania and Sweden as efficiency of process including international projects remains the key issue in adult education (Ahrens, Zaščerinska, Melnikova, Andreeva, 2018). It should be noted that the terms "teacher", "adult educator" and "instructor" are used synonymously in scientific literature. Efficient implementation of international projects implies not only effective use of project's recourses such as intellectual property, human workforce, funding, etc. Efficient international project implementation is targeted to increase the project's impact. Impact is defined as the influence on the decisions (regardless of outcome) that shape people's lives, communities, governance, the environment, and elsewhere can be defined as having impact (Federation for the Humanities and Social Sciences, 2014). The project impact, in its turn, has to be sustained beyond the project lifetime. Impact of a project in education is often connected with teachers enrolled in in-service training. In order to strengthen the impact and sustainability of an international project in education, teachers have to be properly selected for in-service training. Teachers are the key to the quality assurance in education as teachers assist learners in the improvement of their learning outcomes as well as raise educational standards (William, 2012). For the selection of right teachers, data mining techniques aimed at predicting teachers' performance or, in other words, behavior are to be employed. Behaviour is the way an individual acts towards people, society or objects (Guez, Allen, 2000). Behaviour is something that a person does that can be observed, measured, and repeated (Bicard, Bicard, the IRIS Center, 2012). When we clearly define behaviour, we specifically describe actions (Bicard, Bicard, the IRIS Center, 2012). Actions and behaviours can be measured through performance dimensions (Berkeley, 2018). Therefore, the term "performance" has to be defined. Analysis of scientific works reveals such a term as "teacher/instructor performance evaluation" (Asanbe, Osofisan, William, 2016; Ola, Pallaniappan, 2013). However, more often the term "teacher evaluation" (William, 2012) is used in scientific literature. In the present research, both terms, namely "teacher/instructor performance evaluation" and "teacher evaluation", are used synonymously. The overall aim of teacher evaluation is to create a knowledge-rich teaching profession in which teachers develop a research role alongside their teaching role, with teachers engaging more actively with new knowledge, and benefiting from support structures to generate improvement (OECD, 2009). Teachers' participation in international projects impacts the development of knowledge-based teaching profession. Consequently, teacher evaluation includes such a dimension as teacher participation in international projects. Teacher evaluation performs two main functions (OECD, 2009): the improvement function and the accountability function. The improvement function is centred on performance improvement (initially at the level of the individual workforce, and ultimately at the level of the institution) (Denisi, Pritchard, 2006). The performance improvement also enables teacher's activities to personalize the educational process in the classroom. Training is often recognised as a key to improved performance (Manasa, Reddy, 2009). The accountability function includes basis for employment decisions (e.g. promotions, career advancement, performance reward, sanctions, etc) (Ola, Pallaniappan, 2013). Additionally, performance evaluation can aid in the formulation of criteria and selection of individuals who are best suited to perform required organizational tasks (Manasa, Reddy, 2009). It can be part of guiding and monitoring employee career development and improvement (Ola, Pallaniappan, 2013), too. Our "performance" definition is of bimodal nature. By bi-modal phenomenon, a phenomenon that obtains or exhibits two contrasting modes or forms is meant (Zaščerinska et al., 2014). On the one side, our "performance" definition is based on the term „linguistic performance" used by Noam Chomsky in 1960 to describe "the actual use of language in concrete situations" (Chomsky, 2005). In these terms, performance means the act as the whole. On the other hand, performance is a set of individual activity (Winston et al., 2014). In these terms, performance is a set of activities. By teacher performance, teacher's individual combination of his/her actual use of professional knowledge in concrete situations as well as a set of his/her professional activities is meant. It should be noted that the development of such a system as cooperative self-adapting Activity Recognition (AR) (Jahn et al., 2018) applied to run-time teacher evaluation will change the scenario of teacher evaluation as well as the landscape of teaching profession. Cooperation of Activity Recognition (AR) systems will take place at several levels of an Activity Recognition (AR) chain (Jahn et al., 2018): at the level of recognised motion primitives (e.g. arm movement) over the level of detected low level activities (e.g. writing) to the level of identified high-level activities (e.g. participating in a meeting or activities of daily living). Performance evaluation is defined as a systematic process of evaluating an individual worker's job performance and effectiveness in relation to certain pre-established criteria and organizational objectives (Abu-Doleh, Weir, 2007; Mardikyan, Badur, 2011). According to Nakpodia (Nakpodia, 2011), evaluation is an intervention strategy that has received significant attention in academic, business and political circles for information gathering process, ascertaining the decision to be made, selecting related information, collecting and analysing information in order to report summary data useful to decision makers in selecting among alternatives. Currently proper evaluation of teachers' performance is built on the establishment of reference standards and criteria (OECD, 2009). The main reference standard for teachers' evaluation typically is their academic and professional qualifications (i.e level of education, experience, certification and licensure) (Goe, Bell, Little, 2008). The key element and fundamental precondition of these must be clearly and concisely stated to know what is expected from teachers at different levels (Goe, Bell, Little, 2008). Instructors' profiles often express levels of performance appropriate to beginning teachers, experienced teachers, and those with higher responsibilities (Goe, Bell, Little, 2008). It is important to note that professional profiles provide the common basis to organize the key elements of the teaching profession such as initial teacher education, teacher certification, teachers' ongoing professional development and career advancement (Goe, Bell, Little, 2008). These four key elements of the teaching profession also serve as performance dimensions for analysis of teacher behaviour (Goe, Bell, Little, 2008). Another essential basis for good practice in evaluation is the existence of clear and measurable criteria which must be consistently applied by competent (trained and experienced) evaluators (Drake, 1984; TDA, 2007). This requires the development of explicit guidelines about what is expected from professional practice (Ola, Pallaniappan, 2013). UNESCO's analysis of the European and Latin American teacher evaluation system emphasizes the content knowledge, the pedagogical skills, the abilities to assess instructors and the professional responsibilities vis-à-vis the school and the students as key domains to evaluate teachers (Ola, Pallaniappan, 2013). However, the analysis does not include the engagement in professional development as a common teaching standard in European systems, with a subsequent risk to undervalue the teacher's engagement and willingness to enhance his or her own practice (Ola, Pallaniappan, 2013). The present part of the paper demonstrates the application of the four sub-stages of the pre-processing designed within the present research. The first sub-stage of the pre-processing includes formulation of research question and/or problem for the implementation of data mining for educational purposes. For problem identification, the tasks of the Nordplus Adult 2018 project are analysed. The Nordplus Adult 2018 project aims to carry out pilot implementation of training programme for adult educators and to assess its effectiveness. Training programme is to be delivered during 3 days. The organisers of the training programme intend to invite target group representatives (adult educators especially those who work with immigrants and asylum seekers). During the pilot implementation not less than 30 adult educators from different institutions (working with immigrants and asylum seekers in Lithuania) will take part. The project partners may invite representatives of the target group from their countries (Estonia, Latvia and Sweden), too. Evaluation of adult educators is carried out by the project management only. Consequently, the problem is selection of teachers for the training programme. As data mining assists in uncovering hidden patterns in large data sets (Dermino, Fortingo, 2015), the research question is as follows: What are proper teachers for the training programme?

Table 1: Performance dimensions' design for analysis of adult educators' behaviour within an international project

Performance Dimensions		
Main area	***Sub-area***	***Level***
Personal information	Name	Nominal
	Gender (male, female)	Nominal, Dichotomous
	Position (teacher, manager, etc)	Nominal
	Language(s) of course delivery	Nominal
	Country of origin	Nominal
Initial education	Initial education (BA, MA, PhD)	Ordinal
Involvement in digital entrepreneruship	Entrepreneurship	Ordinal
	Digitalisation	Ordinal
Teacher education certification	Teacher education certification (BA, MA, PhD, non-formal education)	Ordinal
Ongoing professional development	Informal and non-formal education	Ordinal
	International projects	Ordinal
	Publications	Ordinal

The second sub-stage of the pre-processing focuses on sampling (selection and size). In educational research, the best procedure for selecting such a sample is to use probability sampling as non-probability sampling does not ensure the construction of a parameter for a population (Ahrens, Zaščerinska, 2014). The sampling size is limited by the adult educators available in the Nordplus Adult 2018 project's partner countries. The third sub-stage of the pre-processing deals with the selection of data sets. The selection of data sets is also limited by the secondary data collection from diverse sources of documents or electronically stored information available in the Nordplus Adult

2018 project's partner countries (Estonia, Latvia, Lithuania and Sweden). The fourth sub-stage of the pre-processing serves as data preparation (partition and cleaning). As discussed before data partition proceeds from identification of main functions or main objects to determination of measurable items of main functions or main objects (Brinkman, 2009). The Nordplus Adult 2018 project is focused on three main areas such as adult education, immigrants and asylum seekers' and digital entrepreneurship. These key areas of the Nordplus Adult 2018 project expand the main functions/ main objects/ main areas of the adult educators' performance dimensions such as initial teacher education, teacher certification, teachers' ongoing professional development and career advancement with language(s) of course delivery and country of origin. The main areas of the adult educators' performance dimensions are extended as plurilingual adult educators with a different country of origin can assist immigrants and asylum seekers in learning digital entrepreneurship in a more efficient way as they obtain and are able to apply their multicultural experience in teaching. The same refers to adult educators' initial education: some of adult educators before starting their career in adult education studied other areas than education science. This initial education experience can be integrated into their teaching digital entrepreneurship to immigrants and asylum seekers. Table 1 based on the analysis carried out within the present work and by Asanbe, Osofisan, William (2016) presents the performance dimensions for analysis of adult educators' behaviour. In comparison to the performance dimensions worked out by Asanbe, Osofisan, William (2016), the performance dimensions designed within the present research do not focus on teacher ranking at adult education organisation, teacher appointment status and extension of teaching experience. The authors of the present work consider that for adult educators in order to be selected for in-service training within an international project, teacher educational background, teacher ongoing professional development as well as teacher involvement in digital entrepreneurship are important.

CONCLUSIONS

The theoretical analysis carried out within the present research contributes to the conclusion that teacher participation in international projects is an area/domain of teacher evaluation. The findings of the theoretical investigation of the definitions of „performance“ allow defining "performance" as a bimodal phenomenon. The analysis of scientific literature results in the model of four sub-stages of the pre-processing of data mining for educational purposes. The findings on data preparation for analysis of teachers' behaviour allow determining the dimensions as well as main areas of teachers' performance within an international project. The practical application of the model allows drawing a conclusion that the model is valid. The present research has limitations. Theoretical basis of the pre-processing stage of data mining is based on the inter-connections between data mining and stages of data mining. The bi-modal definition of „performance“ has been set. Another limitation is that the model of the pre-processing of data mining for educational purposes is validated only within one international project. Therefore, results of the study cannot be representative for the whole education area. Nevertheless, results of the research –four sub-stages of the pre-processing in data mining and performance dimensions of teachers' behaviour within an international project - may be used as a basis for analysis of teachers' behaviour through the implementation of data mining techniques in large datasets. The following research question has been formulated: What data mining techniques support decision makers in selecting proper teachers for the training programme within an international project? Further research intends to focus on implementation of data mining techniques to support decision makers in selecting proper teachers for the training programme within an international project. Future work will imply validation of the designed model of four sub-stages of the pre-processing in data mining for educational purposes via expert evaluation. Comparative analysis of the pre-processing stages in data mining for educational purposes could be also carried out. Investigation of inter-relationships between efficiency of teacher participation in teacher in-service training as well as teacher ranking at adult education organization, his/her appointment status and extension of teaching experience could be interesting for the scientific community. Investigation and gradual incorporation of Activity Recognition (AR) into run-time teacher evaluation would be of a great research interest, too.

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Conceptual Overview of an Anthropocentric Training Station for Manual Operations in Production

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ABSTRACT

The paper presents a conceptual overview of a human-centred training station for manual operations (ATASMO). It identifies the main users of the system but also the long-tern targeted features of ATASMO. Moreover, the current implementation, its limitations and future work on ATASMO is synthetically presented.

Keywords: *training system, adaptive instructions, manual operations, human-centred.*

INTRODUCTION

To successfully embrace the Industry 4.0 paradigm in a socially sustainable way, manufacturing enterprises need to accompany their technological developments with new tools and technologies by which the human operators are affected. A special focus is to support humans with assistive technologies to easily train and fulfil correctly their work in current and future factories. This becomes even more critical in the context of an aging workforce in manufacturing (Niessen, Swarowsky, Christine, & Leiz, 2010). Thus, anthropocentric approaches applied throughout the design and exploitation of any tools, technologies and systems for manufacturing is required.
Due to global competition and a diminishing number of available workforce (e.g. migration, aging workforce etc.), approaches for training unskilled people, unfamiliar with the production processes and technologies are critical for manufacturing companies to remain profitable. Various training systems to support learning of the correct manual manufacturing process before effectively working in production exist (Gorecky, Schmitt, Loskyll, & Zühlke, 2014) (Aehnelt & Wegner, 2015). Progress in IT, promises to offer solutions for custom job experiences, keeping into account a 4-dimensional space (i.e. worker, machine/ workstation, HMI interface and context – operations, tasks etc.). Although approaches for designing human-centred manufacturing systems exist e.g. (Peruzzini & Pellicciari, 2017), (Pirvu, Zamfirescu, & Gorecky, 2016), one of the main difficulties is to adjust ad-hoc the assistance keeping into account a specific worker (e.g. impaired, normal, young and old) and its current state (Kosch, Abdelrahman, Funk, & Schmidt, 2017), (ElKomy, et al., 2017). Assistive systems are at best only rely on predefined profile (age, skills etc.) and are not keeping into account one's state (e.g. tired, distracted, neutral, angry etc.) despite advancements in human behaviour research and psychophysiology (Park, 2009), (López-Gil, Virgili-Gomá, Gil, & García, 2016).
In this paper a conceptual overview of an anthropocentric training system for manual operations (ATASMO) is presented, targeting to support an interactive adapted training experience relying on ad-hoc adaptive instructions.
In the first section the user profile as well as the hardware and software requirements are presented. In the second section, the current implementation is presented. In the third section the outlook and the concluding remarks are synthesized.

SYSTEM CONCEPT AND MAIN REQUIREMENTS

The main goal of ATASMO is to enable a large spectrum of adaptive training scenarios for various operator profiles, from the simplest ones (i.e. predefined instructions) to complex ones (i.e. adaptive instructions based on context-awareness and real-time data from biosensors). Thus, both hardware and software modularity are essential.
Hardware modularity is essential to ensure that ATASMO can: a) enable appropriate set-up of training environment (e.g. sensors, position of parts, sub-assemblies and instruments etc.), b) read all the relevant artefacts/actions through sensors (i.e. parts, instruments, semi-finished product and trainee actions) on the training station in order to c) output the training instructions for the user to correctly assemble a broad spectrum of products. A modular software architecture is essential because besides the robustness to unexpected malfunctions of an individual service, it enables fast customizability regarding the training scenario by simply enabling and disabling services from a main application. Thus, the best training station usability for various target groups and industry use-cases can be achieved (e.g. younger trainees might be satisfied by having new features, while the elderly ones would prefer rather more established ones).

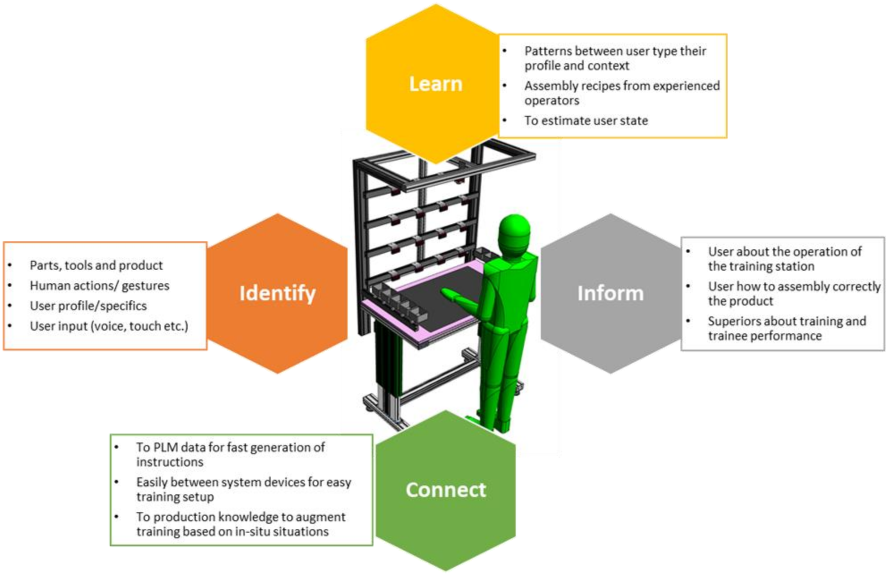


Figure 1: Overall features of ATASMO

ATASMO's overall hardware and software should allow a broad spectrum of system functionalities to (see Figure 1):

- Identify or recognize components and tools relevant for the assembly as well as human actions, interactions and profile;
- Learn during operation or calibration phase of the system about patters or correlations related to the human operator and context, human state (e.g. neutral, angry, joy etc.) and regarding the assembly recipe;
- Inform users how to use the training system and to correctly assemble a product. The training manager should also receive information about trainee and training performance (e.g. how many errors were executed in production after the training scenario X);
- Connect to relevant data systems for easy generation of instructions and support plug & play of devices for easy training set-up.

The system's users are manufacturing operators in industries which execute manual work to create final or semi-finished products. Data gathered from manufacturing companies located in the Centre Region of Romania, from automotive to industrial equipment suppliers, employing more than 3000 operators, revealed that the most common users of such a training system would be women, aging between 26-35 years old, with professional school or high-school education having 2-5 years of experience in the field of manual work. The general profile of operators is summarized in Table 1.

Table 1: Operator's profile overview

Gender	Education	Age	Work experience
Male: 44%	Primary: 24%	< 25: 26,5%	< 1 year: 18%
Female: 56%	Middle: 74%	25-35: 40%	1-2 years: 21%
	Higher education: 2%	>35: 33,5%	2-5 years: 25 %
			> 5 years: 36%

CURRENT ATASMO DEPLOYMENT

The current implemented training in ATASMO focuses on the assistance of unexperienced users to correctly assemble of a customizable modular tablet (CMT, see Figure 2). The tablet's components can be chromatically (e.g. black, blue, red, yellow) and functionally customized (i.e. power bank, flashlight and speaker modules in various numbers can be selected). Each individual module (i.e. 3.1, 3.2 and 3.3 types from Figure 2) is mountable in any mainboard location. More details about the modular tablet design can be found at (Stanciu, Petruse, & Pîrvu, 2018).

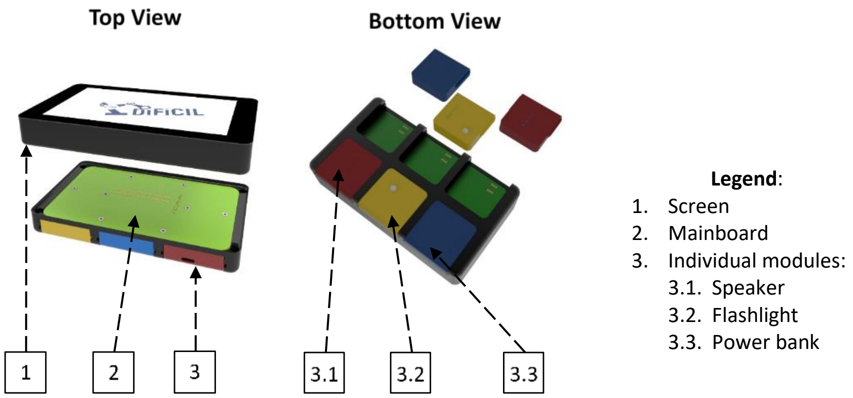


Figure 2: Customizable modular tablet (CMT)

The tablet design enables four main recipes for the correct manual assembly without using any tools or support instruments:

- R1: 1) Screen + 2) Mainboard + 3) Six individual modules;
- R2: 1) Mainboard + 2) Six individual modules + 3) Screen;
- R3: 1) Mainboard + 2) Screen + 3) Six individual modules.
- R4: 1) Individual module + 2) Mainboard + 3) The other five individual modules + 4) Screen.

The training is executed on ATASMO (see Figure 3), a physical training station, where human users are aided in order to learn the correct assembly process of a product (i.e. the CMT). The table

surface is approximately 0,84 [m²], with 0,7 meters wide and 1,2 meters long, having an overall height of 2 meters. Thus, the system can be used for a large spectrum of trainings for small to medium sized products.
Sensors to detect objects and recognize human features (e.g. 3D depth camera and Kinect respectively) can be easily placed and adjusted thanks to standard aluminium profiles. Moreover, wearable and non-invasive biosensors with wireless functions are used (e.g. galvanic skin response, eye tracking etc.) to optimise the training experience. Finally, to assure ergonomic working conditions, the table enables 400 [mm] height adjustment through electrical motors actuation.

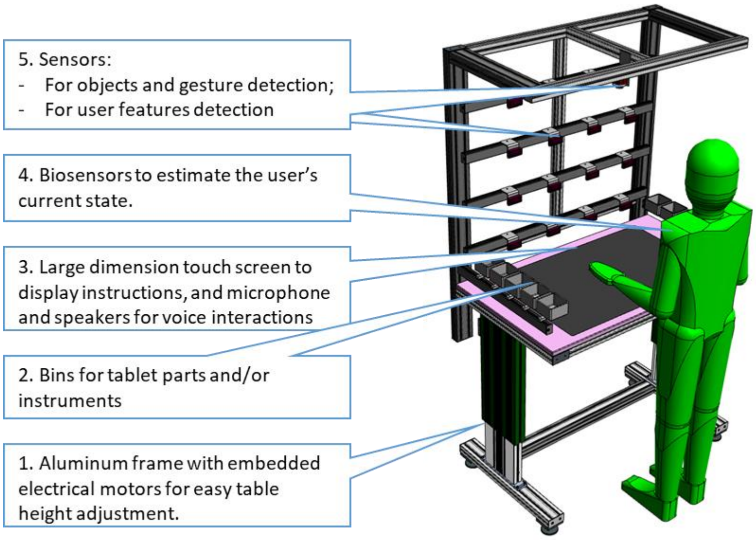
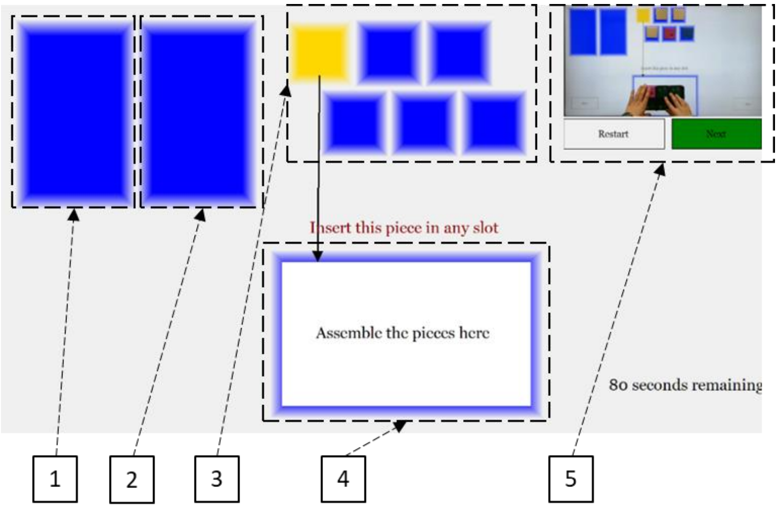


Figure 3: ATASMO system current design

The current training implementation has the following main steps:

1. Training start. A voice command "Start Training" from the user triggers the execution of the training application.
2. Height adaptation and user identification. Once the training application has started, based on the Kinect data, the table is adjusted to allow an ergonomic position for assembly of parts. For this, the user initially sits in a predefined position to correctly determine its height. Moreover, user features such as gender, age are also extracted from Kinect to link user profiles with their training performance.
3. Introduction to the system and manual assembly guidance. To familiarise with ATASMO, a video with sound explaining the system and the product is played before the actual training starts.
4. Step-by-step assistance. The subcomponents of the CMT are placed on predefined areas on the training table, before training begins (see Figure 4, table areas 1-3). The user must follow instructions displayed on the upper right area to complete the assembly recipe. After completion of each step, the user must press next to trigger the following instruction; if not pressed in a predefined time, the next instruction is automatically triggered. If the user executed each step faster than the predefined maximum time, it is considered a successful step. Finally, in the background, the system measures how much time the user spends for each assembly step as well as the overall training time per user.
5. Training end. After the product is assembled, a voice command "Stop Training" closes the training application. If the user executed all steps faster than the predefined maximum

time, it is considered a successful training. After the training, the user is informed about its performance, i.e.: a) successfully passed the overall training or, b) failed, with recommendation to follow a new training focusing on the unsuccessful assembly steps.



Main table areas:

1- Screen storage.
2- Mainboards storage.
3- Modules storage (battery, flashlight, speaker).
4- Product assembly area.
5- Training instruction area (video) and touch area to trigger the next instruction.

Figure 4 Current user-interface of ATASMO

Five microservices orchestrated by a main application enables the training execution. These are:

- A voice service to start and end the training. The commands are received in the tablet's microphone (embedded in the table) and detected from a local data base;
- A human features extraction service, which uses Kinect input data to extract human user features among which is also the user's height;
- A height adjustment service, which based on the user's height actuates the electric motors to raise or lower the training table;
- Object recognition service, which based on the information from a 3D camera, the position and types of CMT sub-components is determined.
- Training application service, which displays the introduction and step-by-step assembly instructions. It enables also touch interaction to select the next instruction.

CONCLUSION AND OUTLOOK

The long-term features of an anthropocentric adaptive training station concept as well as a first implementation version of ATASMO were presented. Among ATASMO's key features are real-time adaptation of training content keeping into account the user's actual state, its general profile and the product assembly recipe.
The first demo has limited adaptivity features implemented, having only user height adaptation to enable an ergonomic assembly position. In the next iteration the following upgrades are targeted:

- Adapt the training instructions considering which part was selected by the user based on 3D stereo camera data. Thus, the instructions will depend on the touched subcomponent of CMT. Moreover, finalized assembly sequences (e.g. screen assembled with mainboard) will be detected to automatically trigger the next instruction without pressing the "Next" button;

- Identify the most relevant training characteristics in order to adapt user-interface and instruction content. Moreover, analysis to identify if a clustering of user-groups based on them is possible. This information will result after discussions with industrial training experts and laboratory experiments;
- Adapt the training instructions and user-interface based on image processing for automatic approximation of gender, age and experience.

On the mid-term, real-time assessment and integration of real-time data from biosensors into training adaption is targeted. Next, algorithms will be “trained” to recognize assembly patterns of various products executed by different user groups in order to generate automatically adaptive training instructions. Finally, ensuring easy adaption of training content based on PLM data or real-life knowledge back into the training are long-term goals of ATASMO. Only after coupling PLM data to ATASMO, with less time-consuming training content creation, industrial organizations could be easily convinced about the training productivity of the system.
From an educational perspective, ATASMO offers an excellent use-case for involved students to experiment and use advanced biometric hardware (e.g. Shimmer GSR/EMG, Tobii glasses, etc.) and software (iMotions) to analyse and improve their skills in human-machine interfaces designs and interactions for adequately engineer the human factors in manufacturing system. Moreover, ATASMO derived applications will be embedded in courses dealing with the design of systems requiring multi-disciplinarily (e.g. design thinking, human factors engineering etc.).
Moreover, for regional companies ATASMO offers a flexible training system concept that can be used from a specific products training towards a one-stop training system, where e.g. frequent production problems and appropriate solutions can be explained, and their comprehension verified through simple tests. ATASMO developments can be showcased to outside organizations as part of Sibiu Smart Systems digital innovation hub (Connected Intelligence Research Center, 2019).

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The Spatial and Temporal Properties of eLearning: an Exploratory Study Regarding the Students' Perspective

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ABSTRACT

The paper aims to analyze and comment the current eLearning environments considering the space and time characteristics in order to better understanding of certain antecedents' factors for eLearning system acceptance and effective use by students. The current paper illustrated the eLearning platforms – from the differences between online and traditional face to face learning to the spatial thinking and learning process – using as a case study the minds of students from a technical University of Romania.

Keywords: *eLearning, traditional learning, students' perception, spatial thinking, temporal cognition*

1. INTRODUCTION: COGNITIVE FACTORS IN ELEARNING VS. TRADITIONAL LEARNING

Recent days, more and more schools promote or have an alternative in hosting online courses. They have become more and more popular due to the flexibility they have – a student is able to consume the content at his/her paper(s), anytime and anywhere, pause, rewind, take notes and review the material however they choose. However, a good part of the populations stays away from this kind of 'entertainment', mostly due to misconceptions or incomplete information/documentation beforehand. Due to this rise of eLearning adoption, traditional courses must come up with new ways to keep its students engaged and active in class. So, the viewers interest is retained for the entire duration of the lecture, for instance. Overall, there are two types of persons – the ones more engaged by physical classes and the ones for whose eLearning factors are a game changer. In the following paragraphs we'll analyze and compare the two techniques.

Online Learning

This type of learning was initially oriented towards professional consumers i.e. those looking to expand their skills, get accreditations or even host online classes, e.g. the modern-day employee – working 9 to 5, five days a week, the only time he's able to attend classes is late afternoon and even then, it's not always possible (due to incompatibilities with school schedule or overtime overlaps). In such a case, the solution can be the Online Classes. He can attend those, learn and apply itself from

the comfort of his own couch, during the weekend when he's relaxed and has a couple of hours to spare. He's investing these hours into his future, after all (Bylieva, D. *et all*, 2019).
From the other way around, through online classes, the teacher cannot directly interact with its students. That means that, if someone has a question, it's harder for him/her to get the answer fast. It might be needed to further search online or contact the Online Course Owner – that takes time. Some courses could offer some sort of live chat or an additional forum, where attendees can engage and help one another. This form of chat-rooms might bring the extra edge that online courses needed.
Staying on the same principle, some people believe that interacting with the trainer is the best way to learn, to confirm their ideas. Spontaneity is key here and for those kinds of people, live or synchronous trainings would be the way to go. They might be a bit more cover some to set up, but the benefits outweigh the disadvantages.
Another form of online knowledge gathering might be considered the old-fashioned web search. This kind of tackling the situation brings both advantages and disadvantages. The advantage might be that we can quickly dismiss articles and topics that are not necessarily related to their point of interests – this mainly relies in the capability to understand how these online search engines work, so people can exploit them to their fullest potential. The main disadvantage is that, after the search, people still left with thousands of articles and news and web results that might be related to what they need. It's their duty to go through them, validate their accuracy and perspective and only afterwards trust them. This is an extra step to perform that not all students might be willing to take. The majority just blindly believe whatever is written online… All and all, online learning is more suitable to adults or grownups that are familiar with the domain taught and are able to discern between false information and the correct one.

Traditional Learning

As stated before, traditional classes are more suitable in teaching young children, adolescents or new entries in the workforce. Periodic and checked attendance in class help them in getting a sense of belonging, being a part in something bigger. Making them feel like they matter helps in creating a sense of security that engages and should make them want to perform better. A competitive nature is sometimes benefic towards the formation of the human character. Also, a strict, predefined schedule, helps form the kids – they end up more responsible, disciplined and improve the mental alertness.
The traditional method contributes in helping both pupil and teacher get acquainted in a more in-depth matter. This empowers the professors to know their student on a more granular level, to adjust their assessment methods to a per-person-basis and better apply their experience to the overall classroom needs. Hence, a professor should be a mentor, a guide and an enabler to the student's future and possibilities.
In a more traditional context, students can directly engage with the conversation, creating a more personal approach to the feedback loop. The entire classroom can immediately participate in the debate, share new ideas, discuss personal or other nonobjective points of view and so on; in the same time, the professor can act like a moderator to the conversation – making sure that the conversation stays productive or even launching new concepts in order to stimulate the overall context.
As for the exam documentation, most often than not, the classroom notes and the course books are the best source of preparing for a test. The topics discussed are the most likely to appear in the test (some of this might even be controlled by the professor – he could create both the study-material and the test itself). Understanding Q&A patterns, possible question suggestions, or just going through the topics one more time could give the students just the extra help they needed in order to better

comprehend the given topic. Basically, the online resources students might find are in a more generalized form than the direct interactions that can occur in class. Also, open discussions help alleviate the pre-exam fears one might had – this can rarely occur through using online courses.

2. SPATIAL THINKING & SPATIAL LEARNING

As it is presented (Al-Busaidi, K. 2012), the concept of "spatial thinking" is relatively new in the literature. Some of the authors associated it with spatial intelligence, that intelligence of "pictures and images" that implies the ability to correctly perceive the surrounding world by visual, as well as the ability to recreate their own visual experiences. People with increased spatial intelligence have the ability to perceive with extreme sharpness the colors, lines, shapes, space, can perceive the relationships between these elements. They also can visualize, can graphically represent images in space, can understand their own position in a matrix space. They transfer mental images to an object they are create or improve it. Visual perception is combined with a set of previous knowledge, emotional reactions, preexisting images to create a new vision offered to others as an experience.
In another approach, spatial thinking is the ability to identify, analyze, and understand position, location, scale, patterns, distances, spatial relationships and time between objects, phenomena, to interpret data related to them.
Spatial thinking is an important factor in the learning process because students use certain spatial analogies to learn new things. The spatial thinking, according to cognitive psychology (Dawson, G. and Fernald, M., 1987), has two components: *thinking about space* and *using space to think*. Moreover, the component *thinking about space* may be seen from two different perspectives, respectively *the scale of environments* and *the scale of objects*.
Spatial learning is an effective learning method that is based on spatial thinking. Students who use spatial learning prefer to use images, colors, maps / schemes, video demonstrations, to organize their information and communicate better with others. They also have a good spatial sense, which gives them a good sense of directions in space. They can easily navigate to new places using maps and are rarely lost. For these students e-learning is much more suitable than traditional learning to learn quickly. Students who study engineering, architecture, and medicine have especially much more developed spatial thinking and they can learn spatial easily.
The fundamental concepts with which spatial thinking operates are found, in all activity domains, in all spheres of social and private life. The main aspects of life, how systems work, how and why there are certain relationships, how to address and solve certain problems can be analyzed in terms of "Spatial thinking".

A perspective approach

As it is presented (Bueti, D., Bahrami, B., and Walsh, V. 2008) the perspective approach refers to the ability to see and understand a visual object or scene from different points of view; it involves the ability to imagine them - in your mind - from a different perspective than yours. It may also involve physically looking from another point of view at a visual object or scene. Perspective approach has long been an area of interest for psychologists who have studied its various aspects (Moss, J., *et all*., 2016), especially visual, cognitive and affective (such as empathy). Until recently, however, educational research in the field of mathematics has given relatively limited attention to the spatial

approach in perspective, or the ability to imagine us elsewhere or to physically change the place to see from a different angle.
Essentially, the perspective approach is a cognitive ability that we use daily in our lives to give meaning to the physical world. Recent studies also show that the skills developed in the perspective approach are significantly linked to the general mathematical skills.
There are two main ways of approaching perspective. One involves the movement of the body or an object to experience a different view; it is sometimes called "embodied perspective taking" - the embedded perspective approach. Meantime, information distributed through a 3-dimensional representation lies at the core of any efficient learning technique. This sort of learning pattern can apply to any kind of data – from mathematical formulas and the way one can influence another, to the way IT engineers' sort and access information regarding a software infrastructure. This kind of learning is scalable and puts each piece of information in a specific place, individually distinct from any other piece of information.
This kind of special skills are important for a student. It allows him to memorize large amounts of information in a reliable way. In the current academical environment, students are required to understand information in a spatial way. This is usually achieved through abstract visualizations or presentations. Initially, this kind of thought process may come as a barrier, but overtime, through exercise, things will get better.
Every individual uses spatial thinking to an extent as he / she interacts with the world around them. One of the first steps to develop such a way of thinking comes through ones youth. Quality resources and examples will assist with the learning process. The more "at the core" the learning material is, the better. The instinct is to use fun but superficial software or games, but that's not the recommended way. The kind of resources refers to the mapping of concepts and abilities needed in an interesting and captivating way.

3. TIME MODELS & LEARNING PROCESS

The sense of time is an essential capacity of humans, with a major role in many of the cognitive processes expressed in our daily lives. Perception of time is among the first abilities that have evolved in biological systems and thus, have affected the subsequent evolution of almost all cognitive modalities (Hinton S. C., Meck W. H., 2004).
The meaning of time and temporal knowledge is largely absent from robotic systems, and this has a clear negative impact on integrating autonomous artificial agents into human environments. This is because the basic idea of the human-robot symbiotic interaction involves the close, synchronized and temporal coupling between people and machines. It is important to focus on efforts considering how time perception can be used with other rational or behavioral abilities (Maniadakis, M. and Trahanias, P., 2014).

Time processing mechanisms in the brain

Over the past decade, a number of different brain areas have been implicated as key parts of a neural time-keeping mechanism in the milliseconds-to-a-few-seconds time range and discussed together with assumed functional properties: notably, event timing in the cerebellum, generalized magnitude processing for time, space and number in the right posterior parietal cortex, working memory related

integration in the right prefrontal cortex (Hegarty, M. and Tarampi, M.R., 2015), coincidence detection mechanisms using oscillatory signals in front-striatal circuits etc.
It is important to focus on efforts considering how the perception of time can be used in conjunction with other cognitive or behavioral skills (Ivry R, Spencer R. 2004).
The participation of many areas of the brain in the processing of temporal information proves the key role of time in several aspects of reasoning, such as decision-making, memory storage / recall or action planning.

4. A STUDENT`S PERSPECTIVE TO ENHANCE THE ACQUISITION OF SKILLS THROUGH eLEARNING

To check the opinions of the students regarding the spatial and temporal properties of eLearning, a case study about the student's perspective to enhance the acquisition of skills has been implemented. The case study comes under the form of a questionnaire in which 93 students were asked 27 questions. Those questions were classified in 5 categories, each category representing a point of view of the learning aspects and those are:

- ✓ Curricular area
- ✓ Spatial analysis of the courses
- ✓ Evaluation and corrections
- ✓ Temporal analysis of courses
- ✓ Social Opportunities

Also, each answer of the questions represents a number from a response scale with values between 0 to 5, each number representing: 0 = not important; 1 = very low importance; 2 = low importance ; 3 = medium importance ; 4 = high importance ; 5 = very high importance

Firstly, we will check the total number of the answers in the questionnaire, grouped by their value (from 0 to 5) and represented in percentages, to have an overview of the results, given in Figure 1:

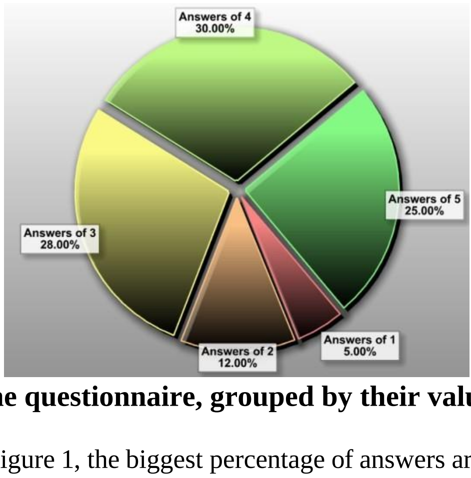

Figure 1 - Answers of the questionnaire, grouped by their value (from 0 to 5), in %

As it can be seen from the Figure 1, the biggest percentage of answers are of value 4 (30%), followed by number of answers of 3 (28%) and then by 5 (23%). But even if we have these percentages, we can't say that the questionnaire result is that eLearning is better, because not all the questions or their context refer to that.

Further, we will take each category and discuss its percentages of answers, and what each question refers to. For the category, referring to *Curriculum area*, the percentage (%) of the question answers are represented in the Figure 2. This refers to how the learned lessons domain, homework's, projects and teaching methods are corresponding with what the students were expecting from an eLearning course.

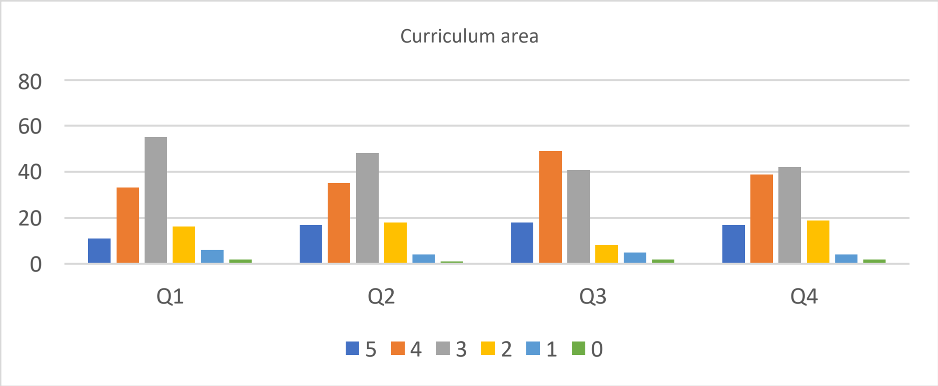

Figure 2 Curriculum area

As we can see from the Figure 2, most of the students are at least satisfied with the learned curriculum area, most of the answers being of medium (3) and high (4) importance.
Meantime, for the spatial analysis of the courses (presented in Figure 3), the questions refer to spatial learning, the visual elements from the courses, the way in which online learning use spatial analysis in the presented courses, and if this is helpful for the students.

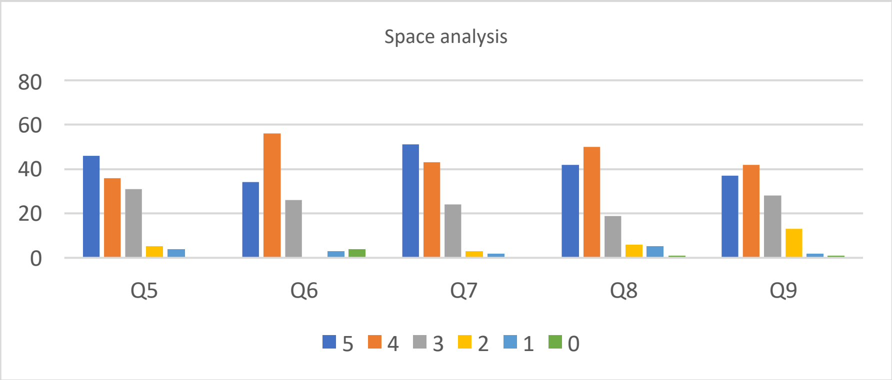

Figure 3 Spatial analysis

In the same way, the next categories are represented. Those categories refer to ways of evaluation like tests and quizzes and if those evaluation methods present the information's in a clear way, if the structure of exercise is conforming the course, if the evaluation is verifying the capacity of the student to solve problems, not only memorize information, the answers being seen in Figure 4.

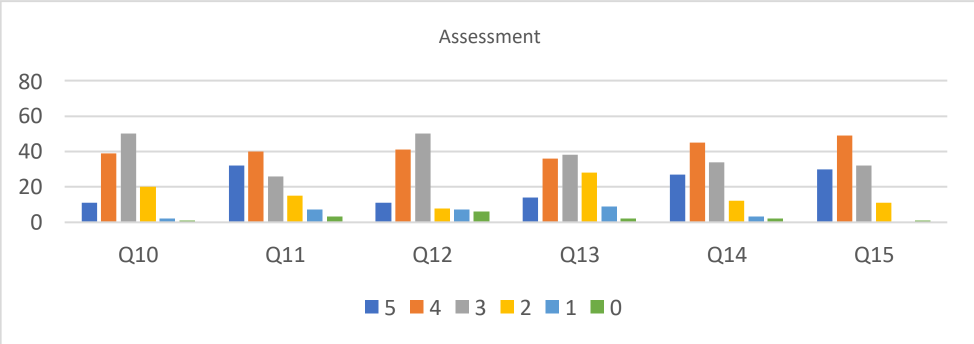

Figure 4 Assessment of the course

In the temporal analysis of courses category, the answers are also pretty good, online study having more advantages in this area than the classic learning methods and this can be seen in the answers from Figure 5. High (4) and very high (5) importance are mainly reported.

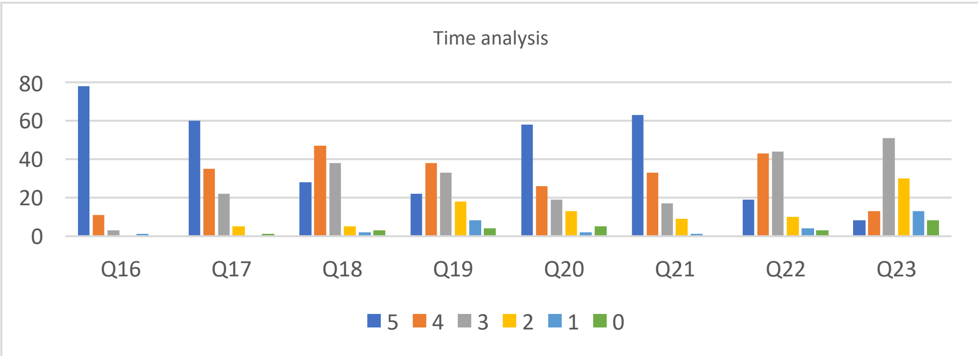

Figure 5 Temporal analysis

Also, in the Figure 6, even if the last category is referring to social opportunities and one might think that there are not so many ways to socialize, one may be wrong; in online learning you can interact with at least the same number of students, even if not more than in the classic learning methods, and that is seen very well in Figure 6, where most of the answers are above average about this subject.

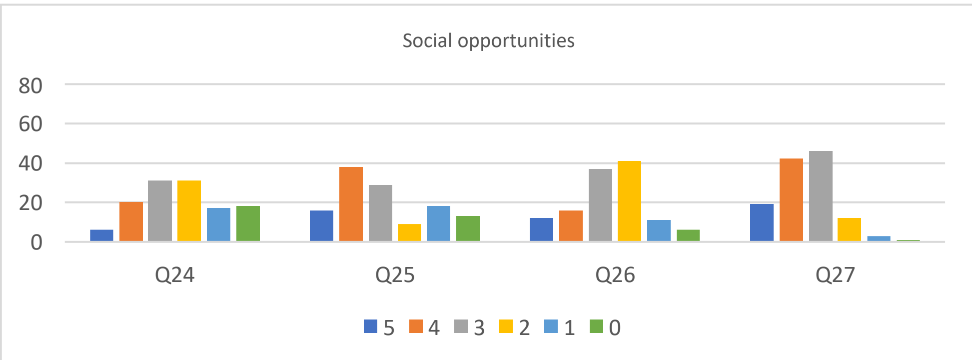

Figure 6 Social opportunities

5. CONCLUSIONS

Hence, it can be concluded that not all students are agreeing perfectly with all the aspects of modern ways of learning, but even so, the most answers are above the average level of importance and that means that most of the students already take into consideration the modern learning methods, and even if there are also some negative answers, maybe in the future this will change and online learning will be seen better by more and more students.
In order to sum things up, the current paper illustrated the eLearning platforms – from the differences between online and traditional face to face learning with both its' respective advantages and disadvantages; to the spatial thinking and learning process – using as a case study the minds of students from a technical University of Romania. Regarding the spatial area of cognition, it is necessary to maintain a close relationship between human space concepts and spatial concepts which is used for artificial agents / distance learning. As follows, the development of spatial' component of an eLearning system must be reinforced, in order to complement rather than replace human cognitive abilities.
On the other hand, time is ubiquitous in the functioning and knowledge of the brain. The present study reveals that time management is a strong reason for those that choose online learning. Most of the students consider the flexibility of online learning as a positive thing.
Finally, the teacher is no longer the one who verbalizes with the students, but rather is a guide in the learning activity everyone wants to follow. Teaching is done using active and participatory methods that ask for students' interest, creativity, imagination, involvement and participation to acquire knowledge to use them.

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A Novel User Interface for Knowledge Base Browsing

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ABSTRACT

Intuitive user interfaces have been of great concern for GUI developers. The current research, who deals with their designing, faces the term ***intuitive*** *constantly. The main question is how can the Interface be intuitive? For the moment, the researchers try to provide a very intuitive generic user interface that can be used in a variety of applications. In this paper we provide a solution that can model any applied ontology into a honeycomb menu. The hexagonal shape of the honeycomb has attracted the attention of humans for centuries. As a relevant consequence, the final user can browse any knowledge base very easily with the aid of this interface. Another useful feature is that programmers can take full advantage of semantic web technologies which can tailor results based on any knowledge base that is feed as input, without any need for code change, thus leading towards a panacea system.*

Keywords: *HCI, knowledge-based system, GUI, semantic web.*

INTRODUCTION

Because the honeycomb structure is considered the strongest, yet, the lightest in various domains we considered it very useful in the ontology presented here. Moreover, it has inspired a lot of human innovations in architecture, transportation, mechanical engineering, chemical engineering, nanofabrication and recently, biomedicine (Zhang et al., 2015).
Lyon and Colyvan (2008) discuss the role that the honeycomb proof in geometry plays in explaining the hexagonal structure of hive-bee honeycomb.
The work of Steve, Gangemi and Pisanelli (1997) introduce the metaphoric concept of ONIONS, in which the “onion leaves” symbolize interpretants in a local definition of an expression, linked to various paradigms.
Thus, the challenge that remains is to develop a common ground for all the information that a knowledge-base holds, in order to map it into a discoverable source of information.

PROBLEM DEFINITION

The problem of optimum user interface design can be solved by considering the public that the interface addresses. It cannot be developed a universal interface that would suite both the younger and the older audience at the same time.
The work of Almendros-Jimenez and Iribarne (2005) suggests that use case model can help a GUI designer identify the needs for a user interface for a specific application.
Solutions design were proposed by Samp and Decker (2010), as an optimization for decreasing the time needed for selection in displayed menus. Their paper suggests that radial layout is more intuitive for humans than the linear layout.
Thus, the solutions that currently exist do not provide a panacea for GUI design.

SOLUTION PROPOSED

The honeycomb menu that we propose enables the final user to browse any knowledgebase very easily with the aid of its **optimum** interface design. Moreover, programmers also can benefit from this approach as the need for further expansions is not done by writing additional lines of code, but rather, by extending the underling ontology. Thus, can be taken advantage of semantic web technologies, that interrogated correctly, can tailor results based on any knowledgebase that is feed as input, without any need for code change.

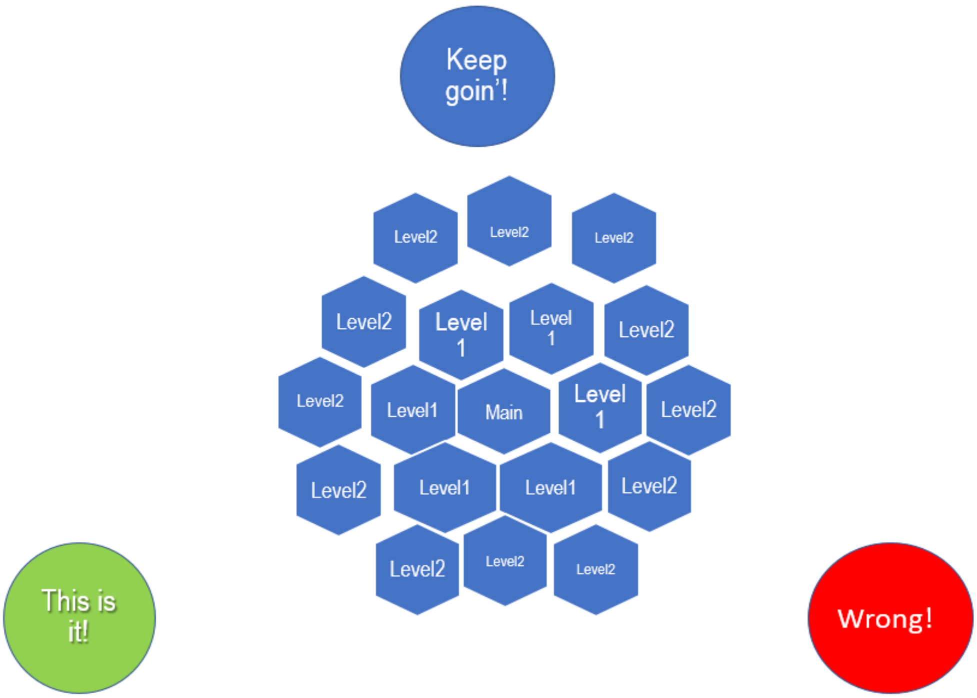

Figure 1: A Generic Honeycomb Interactive Menu.

As figure 1 shows the menu unfolds from the center root hexagon, towards its outer border. It is hierarchically structured in concentrically laid layers, starting from the central root and going step by step towards the outer layer/level of the knowledge-based system mapped.

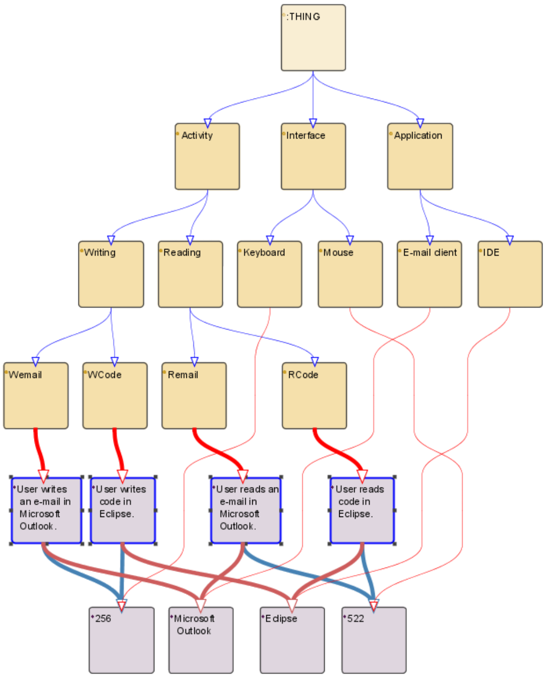

Figure 2: A Small Sample of the Ontology Graph (Ciora 2009).

This solution can be considered a panacea per say as it is data independent, meaning that it can be applied on any data sets that it is tested upon.

In order to provide an example of how the ontology graph that sits behind a honeycomb menu would look like, we generated a small graph in Protégé. This is illustrated in Figure 2. Here, classes are represented by yellow boxes, whereas the actual instances are represented by grey boxes. The graph contains two sample applications and two possible inputs from the user and their corresponding interpretation – in the non- rounded squares as one can see in the ontology diagram. The applications are Microsoft Outlook and Eclipse and the inputs are the actual scan codes generated by the user input for mouse scroll and key down events: 522 and 256 scan codes respectively.

In order to prove our concept, we used an existing ontology called *Context*, developed by Ciora (2009). It was used for assessing students using the newly introduced honeycomb menu. It models the human computer interaction. The taxonomy of the most basic categories of particulars in our ontology is depicted in Figure 3. The categories are supposed to be mutually disjoint and to cover the whole domain of particulars (Monaghan et all 2019).

The ontology has three main branches (Figure 3):

- The application branch – which creates a hierarchy of applications based on the application type (ex. integrated development environment (IDE) – Eclipse, e-mail client – Microsoft Outlook);
- The interface branch – which maps the input events raised by the input devices (mouse & keyboard); for example, we map the 522 and 256 interrupts which correspond to mouse scroll and key down events in Windows;

Figure 3: Context's Top Categories.

- The activity branch – is the main branch in the ontology, it maps the activities of a user based on both the active application and interface currently being used for a certain task. For instance, if the Microsoft Outlook application is active and the 522-mouse scroll event occurs then we can create associated triples to add to our graph to log the application - Microsoft Outlook and the event - mouse scroll. The resulting graph provides a picture of the user's activities over time and allows interesting queries to be performed on it using SPARQL to provide views from numerous angles. For our special case the resulting graph contains just one node with the value: "User reads an e-mail in Microsoft Outlook".

The solution proposed was implemented in Python and tested on a Windows system. We took advantage of the operating system's APIs: the OLE automation interface, that is based on the Component Object Model (COM).

When people discuss COM objects, they are often talking about only one side of COM – using automation objects. Automation objects are objects that expose a programmable interface that can be used by another programme or environment.

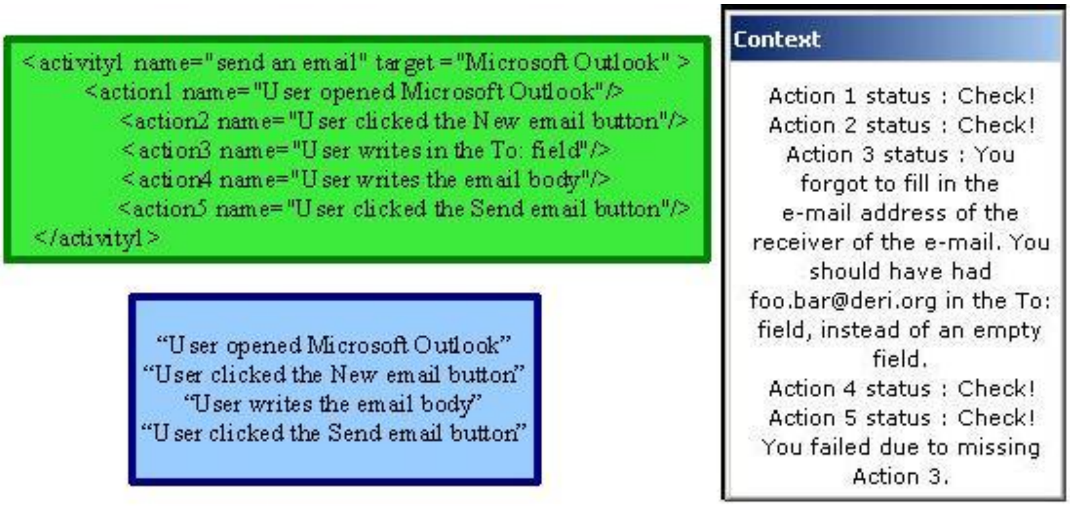

Figure 4 Assessing the student

The OLE automation interface's primary goal is automating applications. We don't focus on this part of the interface, but rather on the information that it can provide about the applications it connects us to. This information goes from the Word document's author to the subject or the content of an e-mail.

A second interface we used was the hooking interface. A hook is a point in the system message handling mechanism where an application can install a subroutine to monitor message traffic in the system and process certain types of messages. The system supports many types of hooks, but our interest was limited in hooking the mouse and the keyboard. This interface gave us access to the raw input of the input devices; this was useful at some extent - meaning that we could find out what, where and when the user clicked something, but it would not give us the information which UI element was activated, is any, by a mouse or keyboard event.

In order to able to tell which UI element was activated we needed the aid of a third API called Active Accessibility. The Active Accessibility is meant to help accessibility aids, here our application, interact with UI elements of other applications and the operating system. Therefore, this interface allowed us to retrieve which UI element a user activated at a given time.

With the aid of these three interfaces we can capture all the actions a learner performs on a computer. We extended the tool with a logging functionality, so we could keep a history of the student's actions. On top of this low-level tracking tool we started building an assessment tool, which has as input an XML document. The XML document contains the description of a task that a student must solve. A sample of such an XML document can be seen in Figure 4.

Our program sits in background and monitors the student's actions. When the student closes the application, we present him the outcome. If he or she executes the tasks correctly – meaning if he completed all the necessary steps in the required order, the system tells the learner that he successfully completed the test. If he or she failed to do so, the system provides him or her with feedback on the errors he or she committed. It shows him or her, the steps where he or she has failed and provides an explanation why he or she has failed and shows him or her, the correct solution.

RESULTS AND CONCLUSIONS

The testing of the system was made on a live environment, where several applications were launched, like: Skype, Word, Outlook. We evaluated the system using several use cases from several points of view. The first angle was the accuracy of the system and the second angle was the exception testing. The evaluation from the accuracy point of view refers to how well our system can assess a student on a task. We verified if it gives a failure result to the student even if the student successfully performs a task. We recorded and performed several assessment tasks, some of them described in the previous section, to see whether the system assesses us correctly. The system gave us positive feedback and it did not report any incorrect results. The accuracy is given by its simplicity, as it is anchored deep into the operating system's APIs.

The exception testing verified the stability of the application. With exception testing, all the error messages and exception handling processes are identified, including the conditions that trigger them. A test case was written for each error condition. We aggregated these tests in an exception test suite.

Finally, we looked at the optimality/intuitiveness of the interface, where were compared the speed of completing a task using the honeycomb interface versus a linear interface. The conclusion was that the user completed the given tasks approximately 30% faster using the honeycomb interface then the linear one. From the results the main conclusion is that the honeycomb optimality does prove to be the most suitable for user interfaces.

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Simulation-Based Learning, an Essential Tool for Control Process in Food Engineering Education

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ABSTRACT

Simulation-based learning has become an essential tool for food engineers in education and industry. The students from food engineering higher education usually have difficulties to understand abstract concepts of the process control, to make links among microbiology, biochemistry and automation of the technological process from food industry. The present paper describes a methodology for teaching the process control by developing a control level process using simulation-based learning. The used of this metode highlighted that the students developed competence toward "thinking like a scientist", developed argumentation and critical decision-making skills and reinforced research-planning and experimental design skills.

Keywords: *simulation-based learning, virtual technological system, teaching process control*

1. INTRODUCTION

Recently, a worldwide emphasis for global competitiveness in the 21st century has been to educate individuals in science, technology, engineering and computers technology to produce a competitive future workforce (Sevgi, A.G., Aysegul T.C., Elif, S.K., & Betul, E.K., 2018). However, it was revealed that employers in industry have difficulty in finding such employees who have the capability of identifying, adapting, and utilizing scientific and technological knowledge for developing unique technologies (Kennedy, T., & Odell, M., 2014).
A new, promising branch of science was born at a specific meeting point: *bioengineering*. Bioengineering especially has developed in connection with biotransformation processes (biosynthesis-biodegradation), in order to obtain antibiotics, enzymes, vitamins, amino acids, organic acids, bicarbonates, biopolymers, as a result of the cooperation among microbiologist, biochemist, chemical, food industry and mechanical engineer, process control engineer and computer engineer, in a domain which is called *Microbial Engineering* and *Biochemical Engineering* (Jordão, A.M., & Cosme, F., 2018).
The students from food engineering higher education usually have difficulties to understand abstract concepts of the process control, to make links among microbiology, biochemistry and automation of the technological process from food industry. Thus, the process control teaching became an integral and indispensable part of the active assimilation of theoretical and practical knowledge.
A new methods for engineering higher education is the inquiry-based approach or simulation-based learning. Inquiry-based learning can be defined as a process of discovering new causal relations, with the learner formulating hypotheses and testing them by conducting experiments and/or making observations (Belton, D.J., 2016). Simulation-based learning has become an essential tool for food engineers in education and industry. Various studies examining the teaching and learning of process

simulation are available, although no clear theoretical frameworks for process simulation pedagogy currently exist. Simulation-based learning offers the students many advantages: performing individual and team student work, originality and practical usefulness, interdisciplinary fields.
Inquiry-based learning is a central form of teaching and learning in engineering higher education. It is an activity-oriented, student-centered and collaborative learning approach that has gained more and more prominence in recent years (Kaiser, I., Mayer, J., & Malai, D., 2018). In inquiry-based learning students become actively involved in knowledge construction by following an idealized hypothetico-deductive method. Inquiry-based learning courses can take different forms, but have two principles in common: deep active engagement and opportunities to collaborate.
The work presented here describes a methodology for teaching the process control by developing a control level process using inquiry-based approach or simulation-based learning. Three laboratories have deal with the construction and simulation of the level control process. The students were grouped in three teams and each team realised the feedback system of the reservoir's level in MATLAB-Simulink. Tutor supervised the process construction and intervened only on demand. For tuning the controller's parameters has been used the method of the stability limit, the Ziegler-Nichols' method. At the end, the students' teams discussed and analysed the results.
The proposed method covers different pedagogical purposes:
a. to develop competence toward "thinking like a scientist";
b. to promote argumentation skills and critical decision making;
c. to improve students' research-planning and experimental-design skills.

2. METHOD FRAMEWORK

2.1. Modelling

The main equation of the mathematical model is the total mass balances:

$$A\rho \cdot \frac{dh}{dt} = F_i \cdot \rho_i - F_e \cdot \rho_e \tag{1}$$

where h is the level of the liquid from the reservoir, A the transversal section area of the reservoir, F_i and F_e represent the feeding flow and relief flow and ρ_i respectively ρ_e are the densities of the liquid in the feeding and relief flows. Because the process is taking place in isothermal conditions, can be considerate that $\rho_i = \rho_e = \rho$.

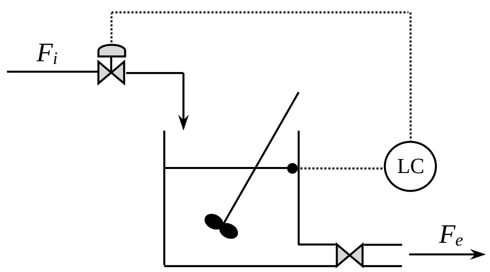


Figure 1. The level control in a reservoir

Under the influence of the liquid level variation the relief flow is inconstant. It will be written the *Bernoulli* equation for the relief flow of the reservoir (Pavlov, C.F., Romankov, P.G., & Noscov, A.A., 1981):

$$\rho g(h + H) = \frac{v^2 \rho}{2}\left(1 + \frac{\lambda L}{d_c} + \sum \xi\right) \tag{2}$$

where H is the level difference between the reservoir bottom and the relief point, λ is the friction coefficient on the pipe, L is the pipe length, d_c is the inside pipe diameter and $\sum \xi$ represents the sum of the local resistance of the fixtures assembled on the pipe. Using this equation it can be written:

$$F_c = v \cdot A_c = A_c \cdot \sqrt{\frac{2g(h+H)}{1+\frac{\lambda L}{d_c}+\sum \xi}} \tag{3}$$

where A_c is the transversal section area of the pipe.

The friction coefficient λ for the steel pipes has the following equations:

- for the laminar flow - $Re \leq 23000$:

$$\lambda = \frac{64}{Re} \tag{4}$$

- for the turbulent flow - $Re \geq 2300$:

$$\lambda = 0{,}014 + \frac{1{,}056}{Re^{0{,}42}} \tag{5}$$

equations where the Re criterion is calculated with the equation:

$$Re = \frac{v\rho d_c}{\eta} \tag{6}$$

where η is the liquid viscosity.

For the mathematical model has been build a S-function in MATLAB in order to simulate the dynamic behaviour of the reservoir.

2.3. Simulation

In MATLAB-Simulink computing software the feedback control system of the reservoir's level has been realised by the each group of students. Then, has been used the method of the stability limit, the Ziegler-Nichols' method, for tuning the controller's parameters (Agachi, P.S., & Cristea, M.V., 2014). The process has been brought to instability with the method of successive trials in order to obtain the oscillation value of the gain factor K_u (or oscillation value of the proportional band PB_u) and the ultimate period P_u.

The block diagram of the process level control is presented in figure 2.

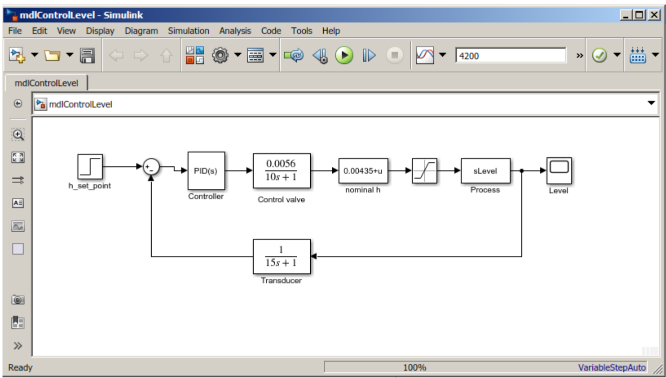


Figure 2: The Simulink block diagrama of the reservoire level control

With the values of K_u and P_u experimentally determined, Ziegler and Nichols proposed the optimal controller parameters given in table 1.

Table 1: Optimal controller parameters proposed by Ziegler and Nichols [7]

Optimal controller parameter	Controller structure		
	P	***PI***	***PID***
PB [%]	2 PB_u	2.2 PB_u	1.7 PB_u
T_i [min]	-	0.83 P_u	0.5 P_u
T_d [min]	-	-	0.12 P_u

The students groups have been simulated three cases of the level control: the first group for the initial step perturbation of level form 3 m to 1.5 m, the second group from 3 m to 5 m and the third from 3 m to 2.5 m. Each group has established the optimal parameters for the adequate controller in accordance with Ziegler-Nichols' method.

3. RESULTS AND DISCUSSION

With the method of successive trials the process has been brought to instability. The students' groups have been simulated the process by increasing the gain factor K_u of the controller until has been reached the limit of the stability. In figure 3 is presented, in the left, the variation in time of the level with 80 value of the gain factor and in the right is the level variation with 100 value of the gain factor. It can be observed that in the second case the process presented permanent oscillations with the same amplitude. Then, the students have been measured the ultimate period as is shown in figure 4.

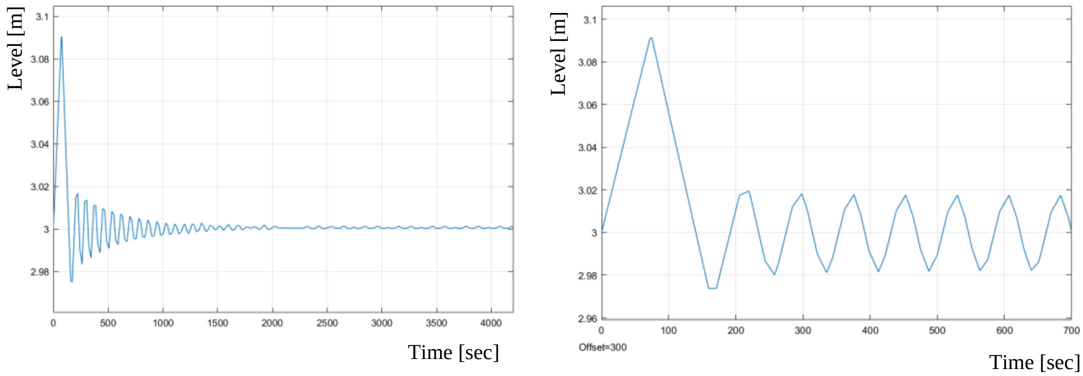


Figure 3: The process response at the increasing of the gain factor

The optimal settings of the controller, according to Ziegler and Nichols are given in table 2.

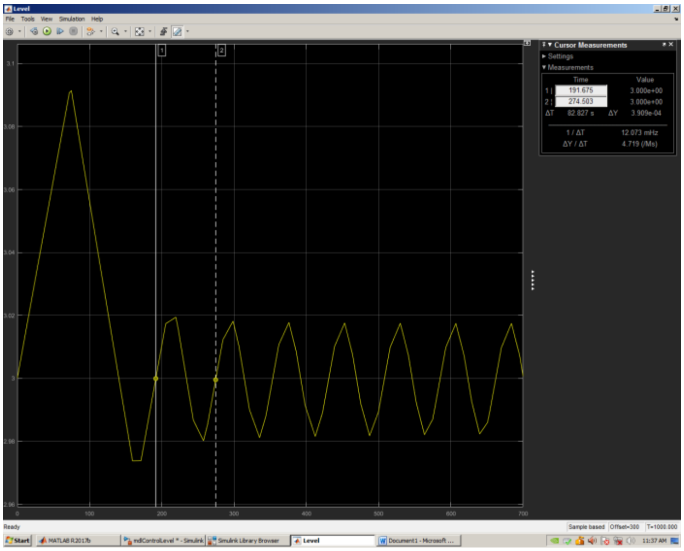
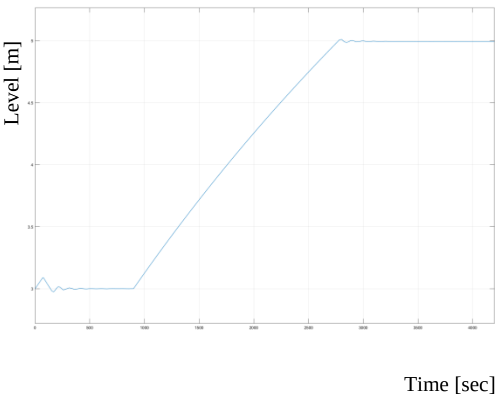


Figure 4: The ultimate period calculation

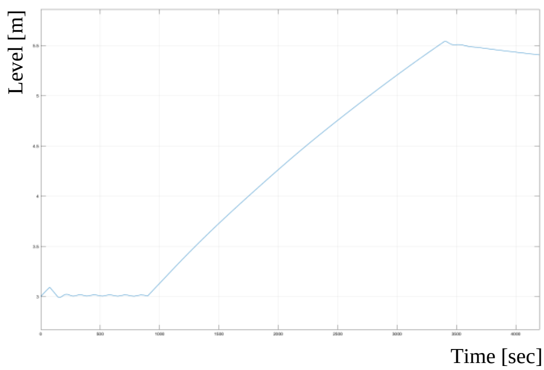
Table 2:The optimal controller settings in the fermentation process control loop

Optimal controller parameter	**Controller structure**		
	P	***PI***	***PID***
K_u	50	45.45	58.82
T_i[se]	-	68	41
T_d [sec]	-	-	9.84

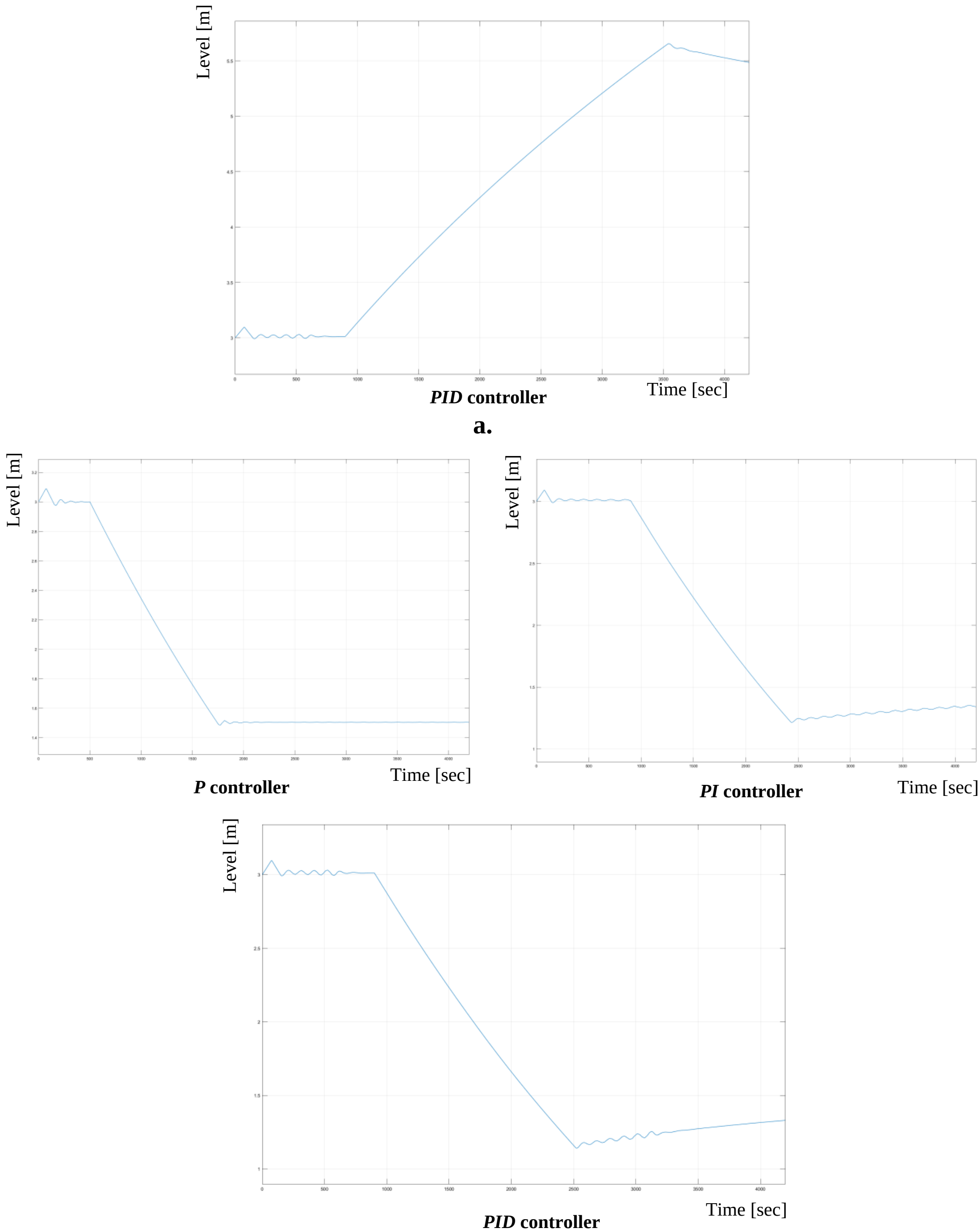
In figure 5 are given the behavior of the control loop for the *P*, *PI* and *PID* controllers considering the table 2, in two cases of the level step perturbation.



***P* controller**



***PI* controller**



b.

Figure 5: The behavior of the level control process for *P, PI* and *PID* controllers with the step perturbation of level at 900 seconds: a. form 3 m to 5 m and b. form 3 m to 1.5 m

As it could be noticed from the figure 5, the most stabile control of the level process is with *P* controller because when the integral component is introduced, a plus of instability is added. As well, considering the *PID* controller, all controller parameters are a little enhanced to counterbalance the "laziness" of the process but, the level control in a reservoir isn't a "lazy" process, it hasn't a great inertia.
The above described method became in the last years, in the technical universities from Romania, a good practices in teaching process control in engineering. By simulation-based learning students can construct more easily and quickly a virtual technological system with the feed-back loop control corresponds to a real one. In this way the physical realisation of a micro-plant of the technological system that take more time is possible to be eliminated. As well, for the students from food engineering the simulation-based learning become a way to design the virtual technological system, to simulate more situations as are the extreme situations concerning the parameters' setting of the controller, the controller structure. Food safety and its quality is a primary field in European and global policy and legislation of the 21st century because it concerns the required conditions for a healthy population. The key issues for improving the biochemical and micro biochemical safety and the quality of food resides in to understand not only the bioprocess from food technology, but also the way the process can be made operational in real time and economically efficient.

4. CONCLUSIONS

This paper describes an implementation of simulation-based learning method in teaching the process control in food engineering higher education. Three laboratories have deal with the construction and simulation of the level control process. It has been constructed a mathematical model for the level dynamic variation of a reservoir and the students, grouped in three teams, realised the feedback system of the reservoir's level in MATLAB-Simulink. The Ziegler-Nichols' method has been used for tuning the controller's parameters. At the end, the students' teams discussed and analysed the results.
The method used in a process control laboratory highlighted that the students achieved the following pedagogical objectives:
a. they developed competence toward “thinking like a scientist”;
b. they developed argumentation and critical decision-making skills;
c. they reinforced research-planning and experimental design skills.
Furthermore, the present paper may serve as a simple guide to developing other laboratory practices based on process control in food industry.

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ENTREPRENEURSHIP EDUCATION AND RESEARCH

Immigrants and Asylum Seekers' Digital Entrepreneurship Competence: Evaluation of the Theoretical Framework

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ABSTRACT

The article reveals the concept of digital entrepreneurship and its framework for education of immigrants and asylum seekers in Baltic Sea countries. The research has been carried out in the boundaries of the Nordplus Adult project with participation of partner organisations from Estonia, Latvia, Lithuania and Sweden. As stated in the article, digital entrepreneurship is supposed to be one of the opportunities in promoting successful integration of immigrants and asylum seekers into labour market. Therefore, by supporting the development of entrepreneurship as an integral part of adult education, and modelling new methods of combining new digital technologies and entrepreneurship education it is intended to help both immigrants and asylum seekers to acquire relevant competence for successful integration into labour markets. The article's purpose is to disclose the relevance of digital entrepreneurship as a new competence of immigrants and asylum *seekers with respect to their needs for successful integration into the socio-economic situation of a host country. The method of data collection was interview with experts. The experts found the efficiency of the framework important to some degree. In the experts' opinion, educational goals based on the framework are achievable. However, diversity of the target group could be a risky factor.*

Keywords: *Digital entrepreneurship, education of immigrants and asylum seekers, competence, Baltic Sea countries.*

INTRODUCTION

As countries in Europe and beyond have faced a large influx of immigrants and asylum seekers, social and integration services have to take the immediate response and to provide sufficient support to integrate newcomers into the host society and get them on a path to economic self-sufficiency. The investments in labor market integration policies are especially compelling in countries facing demographic decline and skills shortages. Baltic countries face unbalance in their labour markets. On the one hand, there is unemployment (Estonia – 4.2.0%, Latvia – 7.3%, Lithuania – 6.2%, Eurostat 2019). On the other hand, many industries, in particular in the field of ICT, experience a shortage of skilled workforce. Another tendency is that immigrants in these countries continue to face great difficulties in finding employment, and are also more likely to be found working on short-term, low-paid jobs which fail to fulfil their skills potential, moreover, entrepreneurial capabilities of immigrants are not sufficiently developed (Eurofound, 2017). Given the fact that immigrants and asylum seekers' employment potential in European countries is rather low (McHugh, & Morawski, 2017) the new ways of integration should be developed especially those of fostering entrepreneurial competence. Advances in digitisation and developments in ICTs create opportunities for new types of entrepreneurial activities. One such type of entrepreneurial activity is digital entrepreneurship, defined as a new business creation opportunity generated by ICTs – internet, mobile technology, social computing and digital platforms. Digital entrepreneurship is supposed to become in future one of the opportunities in promoting the successful integration of immigrants and asylum seekers into labour market. Therefore, by supporting the development of entrepreneurship as an integral part of adult education, and by modelling new methods of combining new digital technologies, entrepreneurship education in Baltic countries it is intended to help both immigrants and asylum seekers to acquire relevant competence for successful integration into labour markets.
The aim of the article is to disclose the relevance of the digital entrepreneurship as a new competence of immigrants and asylum seekers with respect to their needs for successful integration into the socio-economic situation of a host country.
The methods applied: theoretical analysis, experts' evaluation (interview in a written form); interpretative content analysis.

THEORETICAL BACKGROUND

Digital entrepreneurship is defined as a practice of pursuing "new venture opportunities presented by new media and internet technologies" (Davidson, Vaast, 2010). It is similar to traditional entrepreneurship. Entrepreneurship is the capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit. The most obvious example of entrepreneurship is the starting of new businesses. Entrepreneurial spirit is characterized by innovation and risk-taking, and is an essential part of a nation's ability to succeed in an ever

changing and increasingly competitive global marketplace. It involves recognizing and seizing opportunities, transforming those opportunities into marketable goods or services, assuming risk, and realizing rewards, and may occur in a variety of settings, including new and old ventures, non-profit institutions, and the public sector (Man et al, 2002). Digital entrepreneurship - is a subcategory of entrepreneurship that leverages new technologies in novel ways such as the Internet Communications Technology. A digital entrepreneur is an individual who uses the Internet as a tool to create commercial opportunities, disseminate information, and collaborate with clients and partners (Nuthall, 2006). In the sense that “digital ventures aim at generating a financial profit and are directly inscribed into the economic realm, such as creation of a new company or commercialization of an innovation” (Davidson, Vaast, 2010). In digital entrepreneurship “some or all of the entrepreneurial venture takes place digitally instead of in more traditional formats” (Hair et al, 2012). Digital enterprises are different from traditional entrepreneurial ventures because they have different business models and can pursue their products, marketing and distribution activities using digital platforms.
In the article, we follow the “mild digital entrepreneurship” approach provided by Henry et al. (2007). Mild digital entrepreneurship means venturing into the digital economy as a supplement or complement to traditional setting. Digital ventures can use computerized technologies as the main means of communications within their organization, between the organization and their key stakeholders (for example, suppliers and customers), or both (Valenzuela, 2000). Entrepreneurial competencies have been identified as a specific group of competencies relevant to the exercise of successful entrepreneurship. Such entrepreneurship is often associated with the development of small and new businesses (Heilbrunn, Kushnirovich, 2007; Nuthall, 2006). Digital entrepreneurship competencies have been defined as the total ability of the entrepreneur to perform a job role successfully using a range of ICT means. There is a general consensus that entrepreneurial competencies are carried by individuals, who begin and transform their businesses.
The set of entrepreneurial competencies has been identified by different researchers (Man et al. 2002; Hull et al. 2007). The classifications usually include opportunity, relationship, conceptual, organizing, strategic, and commitment competencies. The studies of digital entrepreneurship (Heilbrunn, Kushnirovich, 2007; Nuthall, 2006) allowed the authors of the article to add the framework with digital-based entrepreneurship competencies. As the result the theoretical framework of immigrants and asylum seekers’ digital entrepreneurship competence has been developed. The framework includes:
1. The opportunity competencies are related to identifying, assessing and seeking market opportunities: identification and definition of a viable market niche; development of products/services appropriate to chosen market niche/innovation; idea generation; environmental scanning; recognising and envisioning taking advantage of opportunities; formulating strategies for taking advantage of opportunities.
2. The organizing competencies are related to managerial functions such as planning, organizing, leading and controlling: development of the management system necessary for long-term functioning of the organisation; acquisition and development of resources required; business operational skills; involvement with start-ups; financial and budgeting skills; management style; marketing skills; industry skills; the ability to implement strategy (develop programmes, budgets, procedures, evaluate performance); market analysis skills; business plan preparation skills; goal setting skills.
3. The relationship competencies embrace the ability to build, keep and use networks with stakeholders: development of organisational culture management system; delegation skills; collaboration skills; the ability to motivate others (individuals and groups); personnel management skills; human relation skills; leadership skills.
4. The conceptual competencies refer to creative thinking, innovative behaviour, assessment of risk etc.: creative thinking; innovativeness; organisational skills; interpersonal skills; emotional intelligence; the ability to manage customers; coordination skills; written communication skills; oral

communication skills; decision making skills; analytical skills; logical thinking; critical thinking; deal-making skills.
5. The strategic competencies deal with setting, evaluating, and implementing strategies of a venture: strategic management skills; vision and goals setting skills; research and analysis skills; data management; decision making skills; developing of the monitoring systems; quality assessment skills.
6. The commitment competencies are the abilities that drive the entrepreneur to work hard and face the difficulties involved in sustaining the business: sustainable leadership skills; team building; coaching and mentoring; personal development; commitment to excellence; persuasive techniques; trustworthiness; change management.
7. The digital-based entrepreneurship competencies: using the potential of network-based business; care about technological developments and market dynamics; maximum use of information technologies and supply management improvement; innovation management and implementation.

EMPIRICAL STUDY

The present part of the contribution demonstrates the design of the empirical study, results of the empirical study and findings of the study.
The empirical study has been carried out in the period between 2018 09 – 2018 11, by project "Adult educators' competence training for development of immigrants and asylum seekers' digital entrepreneurship" (funded for Nordplus Adult programme) team. Project partners from Estonia, Latvia, Lithuania and Sweden have carried out expert evaluation of the theoretical framework of the digital entrepreneurship competence. 5 external experts, who have an experience in working with and educating immigrants and asylum seekers (2 form Lithuania and 1 from each other country), analysed the developed framework and evaluated it according to the following criteria (developed by project team):
Authenticity - the degree the competence is needed by the target groups in the future workplaces.
Meaningfulness – the degree the framework will have some value for both teachers, learners and future stakeholders.
Fairness – the degree the framework will give the opportunity for future target groups' students to demonstrate their abilities and maximise their potential.
Transparency – the degree the framework if clear and understandable to all learning participants.
Generalisability – the degree the framework could be generalized to broader student domains.
Cognitive complexity – the degree the thinking processes will be applied by future target group students in the learning process.
Educational consequences – the degree the framework complies with the goals of education and is adjusted to learning and teaching activities accordingly.
Directness – the degree the framework will allow to assess the learning outcomes of the future students.
Comparability – the degree the teaching and learning activities based on the framework could be conducted in a consistent and responsible way with respect to other educational practices.
Efficiency – the degree the teaching learning goals based on the competence framework could be achieved.
Respondents' cultural and educational experience emphasized the significance of each participant's opinion on research question (Luka, Ludborza, Maslo, 2009) within the present empirical study. It should be noted that opinion is determined as individual's view based on awareness and attitudes (Lūka, 2007). The group of research participants was considered to be homogeneous.
The exploratory type of the comparative study (Phillips, 2006) was applied within the present empirical study. The exploratory type of the comparative study aims to generate new hypotheses and questions. The exploratory methodology proceeds (Phillips, 2006):

- 'conceptualisation' in Phase 1,
- detailed description of educational phenomena in the countries to be investigated features in Phase 2,
- the data collection in Phase 3,
- explanation through the development of hypotheses in Phase 4,
- re-consideration of the initial questions and application of the findings to other situations in Phase 5.

The method of data collection was interview in a written form (Mayring, 2004).
The interpretive paradigm was used in the empirical study. The interpretive paradigm aims to understand other cultures, from the inside through the use of ethnographic methods such as informal interviewing and participant observation, and establishment of ethically sound relationships (Mayring, 2004). The interpretative paradigm creates an environment for the development of any individual and helps them to develop their potential (Lūka, 2008, 52). The core of this paradigm is human experience, people's mutual everyday interaction that tends to understand the subjectivity of human experience (Lūka, 2007). The paradigm is aimed at understanding people's activity, how a certain activity is exposed in a certain environment, time, conditions, i.e., how it is exposed in a certain socio-cultural context (Lūka, 2007). Thus, the interpretative paradigm is oriented towards one's conscious activity, and it is future-oriented. Interpretative paradigm is characterized by the researcher's practical interest in the research question. The researcher is the interpreter. After the answers were received the content analysis has been carried out.

RESULTS OF THE EMPIRICAL STUDY

First, it was sought to learn the authentic experience of experts in the field of immigrants and asylum seekers' education.

1. What is your experience in working with immigrants and asylum seekers?

All 5 experts have an experience of working and educating immigrants and asylum seekers. Estonian expert represents one of the leading competence centres on forced migration and refugee integration in Estonia. The centre offers various support for the integration of immigrants and asylums seekers by training, sharing and bringing good practices to Estonia, improving the Estonian reception and integration systems through advocacy, and sharing fact-based information to the broader public. In addition to providing trainings to education workers, the centre is also regularly improving the capacity of other specialists working with refugees, such as support persons, social workers and youth workers.
Expert form Latvia is involved in educational programmes for immigrants and asylum seekers provided by the centre for life-long learning that belong to the University in Latvia, Riga.
Experts from Lithuania represent the infocentre for support of migrants located in Klaipeda. Both experts are involved in various programmes that are aimed at rendering various kind of support (social cultural, educational etc.) for migrants.
Expert form Estonia represents the adult education organisation that has long experience working with migrants and asylum seekers and have different activities and programs for this target group. Moreover, the centre arranges lectures, exhibitions, cultural events, study circles and workshops and have created a meeting place where target groups can find possibilities to learn more about Sweden's society and to learn the Swedish language.

2. In your opinion, is the digital entrepreneurship competence relevant for immigrants and asylum seekers in your country?

All 5 experts agreed that digital entrepreneurship competence is relevant for immigrants and asylum seekers in order to enter the labour market more effectively. As the Swedish expert mentions: "to become an active citizen you need to have these skills". However, as Estonian expert emphasizes:

"It's certainly relevant but one needs to consider the fact that digital skills of refugees are extremely different. Some of them start to get acquainted with computers here; some have previous experience of social media and Internet, and a few are even more skilled. Anyhow, there exists always a need for improving digital competences". As Lithuanian exerts mention "adult educators should bear in mind these differences and design the courses respectfully".

3. Does the development of digital entrepreneurship skills take place in educational programmes for immigrants and asylum seekers in your country?

Lithuanian experts also stress that new skills of the digital entrepreneurship could be beneficial in order to foster the integration of immigrants and asylum seekers into labour market, however they suppose that educational programmes in this field are quite new and should be developed methodologically. The expert from Latvia also considers this field as a new one. To the mind of Latvian expert "the development of digital entrepreneurship skills is at a start point". Estonian expert mentions: "We offer assistance for starting with enterprises (at the moment we initiate a new social enterprise where the refugees have a leading position). On the other hand, we provide support for acquiring digital skills. But we do not combine these two fields explicitly. So far, nobody has indicated any interest towards this field of entrepreneurship. All business ideas have been from more traditional areas (food industry, cosmetics etc.)".
The evaluation of the competence framework according to the criteria listed above is presented in the table 1 in which "X" means how many experts supported this particular choice:

Table 1: The evaluation of the competence framework according to the extracted criteria

Criterion	To a high degree	To some degree	To a small degree
Authenticity	x	xxx	x
Meaningfulness	xxx	xx	
Fairness	xxxx	x	
Transparency	x	xxxx	
Generalisability	xx	xxx	
Cognitive complexity	xxx	xx	
Educational consequences	x	xxxx	
Directness		xxxxx	
Comparability	xxx	xx	
Efficiency	xx	xxx	

The authenticity of the framework was at the average defined by experts as being "to some degree" important. In the opinion of informants "the importance of the framework will increase as soon as training programmes in this field appear". Research participants stressed that "presently nobody offers such kind of training therefore it is rather difficult to predict its added value for future workplaces".
The meaningfulness of the competence framework was assessed as important "to a high degree". Experts emphasized that the value of the framework will increase in the learning process directly.
The fairness of the competence framework was evaluated to a higher degree. To the mind of respondents, the framework is highly up-to-day and relevant for target groups. Therefore, adult educators might expect high interest from the target groups.
The transparency of the framework was assessed as average. Respondents mentioned that "the framework and its advantages and disadvantages will become clear in the process of teaching-learning". According to experts "It is clear that something new will be proposed. Anyhow, it is tricky to predict future".

The generalisability of the framework was assessed as average. Respondents emphasized that the target groups if very diverse. Therefore, it is a great challenge for adult educators to develop courses respectfully to the differences of the target groups participants.
The cognitive complexity was evaluated as rather important. “From the students’ point of view, it seems rather challenging. Everybody can benefit but it may be also challenging to everybody. Both entrepreneurship and digital competences are highly important fields in education but one needs to combine those adequately”.
The aspect of educational consequences was defined as average. In the opinion of the research participants “it is hard to predict but, perhaps, it gives some tools for such assessment educational outcomes”. The framework could be compared with study programs that already exist. “In principle, it seems promising field but as no such programs have been implemented earlier, we cannot really tell”.
The aspect of directness was evaluated as “important to some degree”. In the opinion of informants, the competence framework could be applied to the needs of another target groups for instance: unemployed, university and college graduates etc.
The comparability was assessed as very important. As mentioned above, experts emphasized the possibility to apply the developed framework in the development of training courses for another target groups.
The efficiency of the framework was determined as to some degree important. In the opinion of the experts, educational goals that are based on the framework are achievable, however, educators should bear in mind that the diversity of the target group could be a risky factor and some means for avoiding risks should be anticipated.

IMPLICATIONS

Digital entrepreneurship is defined as a new business creation opportunity generated by ICTs – internet, mobile technology, social computing and digital platforms. Digital entrepreneurship is supposed to become in future one of the opportunities in promoting the successful integration of immigrants and asylum seekers into labour market. Therefore, by supporting the development of entrepreneurship as an integral part of adult education, and by modelling new methods of combining new digital technologies, entrepreneurship education in Baltic countries it is intended to help both immigrants and asylum seekers to acquire relevant competence for successful integration into labour markets.
The “mild digital entrepreneurship” approach provided by Hull et al. (2007) is followed. Mild digital entrepreneurship means venturing into the digital economy as a supplement or complement to traditional setting. Digital ventures can use computerized technologies as the main means of communications within their organization, between the organization and their key stakeholders.
Entrepreneurial competencies have been identified as a specific group of competencies relevant to the exercise of successful entrepreneurship. A set of entrepreneurial competencies that includes opportunity, relationship, conceptual, organizing, strategic, commitment competencies and digital-based entrepreneurship has been highlighted.
The competence framework has received rather positive evaluation from experts, who are involved in immigrants and asylum seekers’ educational programmes. The framework was assessed on the basis of certain criteria that allowed to evaluate its value and appropriateness for the educational processes.

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A Training Needs Assessment for Teaching and Educating Sustainability

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ABSTRACT

Education for sustainable development (ESD) is a strong debate subject that push education stakeholders of all levels to consider actual challenges of sustainability. The main objective is to re-shape the young generation behavior into an active and participatory one in order to face the actual challenges of climate change, scarce resources use, consumption efficiency, lifecycle thinking, social equity and other topics related to sustainable development dimensions and objectives. In this context, the article aims to present the research for the training needs assessment (survey based on a questionnaire applied internationally in Romania, Hungary, Slovenia and Portugal) that has contributed to the TeachSUS project development and implementation. The research results have been considered as valuable information for the innovative solution of the training programme design, in the context of the TeachSUS project.

Keywords: *Education, sustainable development, training needs, assessment, TeachSUS.*

1. INTRODUCTION IN THE EDUCATION FOR SUSTAINABLE DEVELOPMENT

The research and organizations' practice have proved that the concept of sustainable development has gained global importance over the last 15 years. From the education providers perspective, the main problem is HOW the education process should inform and train learners to approach and solve the sustainable development questions (reflecting our Common Future regarding environment, social and economic dimensions of our life) imbedded in political and ethical interpretations (Draghici, 2019). The content and main objectives of education for sustainable development (ESD) are very well reflected by the United Nations Decade for Sustainable Development (2004-2014, www.unesco.org). "The overall goal of the UN Decade of Education for Sustainable Development is to integrate the principles, values and practices of sustainable development into all aspects of education and learning. This educational effort will encourage changes in behavior that will create a more sustainable future in terms of environmental integrity, economic viability and a just society for present and future generations".

Furthermore, ESD must be accompanied by a positive perspective and view of mankind and planet future and it should be supported by a broad consensus of the population, including all categories of educators. ESD involves provoking respect for life, caring for the planet and caring for the whole life community. These aspects are closely related to the sharing of fundamental values, as well as the life ethical principles and knowledge in the field of sustainable development (respect for the planet Earth and life in all its diversity, care for the life community with understanding, compassion and love, building democratic societies that are just, participative, sustainable and peaceful). The ESD should be a focal point for the future of the entire educational system (Gadotti, 2008).

Generally accepted in scientific literature, the community of practitioners and policymakers, ESD focuses on developing and strengthening individual competencies, which facilitates the individual's positive intention, contribution, and active participation in various sustainable development processes. It is clear from this statement that all types of skills and competences, including basic skills such as reading, writing, mathematics, are included. Therefore, ESD is about educating for a sustainable lifestyle, being fundamental to sustainable development and creating a more sustainable future for all. In accordance to the above mention consideration of (Gadotti, 2008) he considered that the most important topics to be taught for ESD are those described in Figure 1. In terms of the level of education, there must be adopted different strategies for the ESD as depicted in Figure 2.

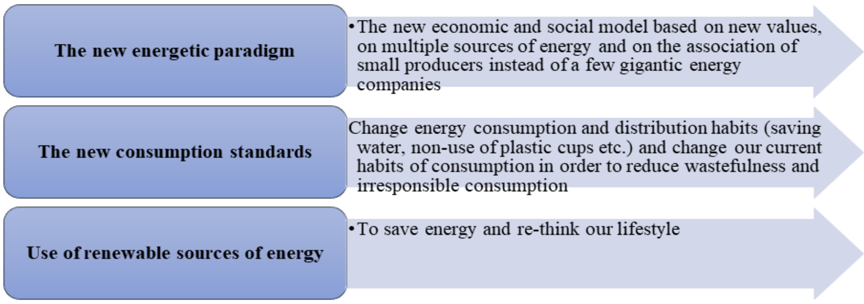


Figure 1: Topics to be taught for ESD (Gadotti, 2008).

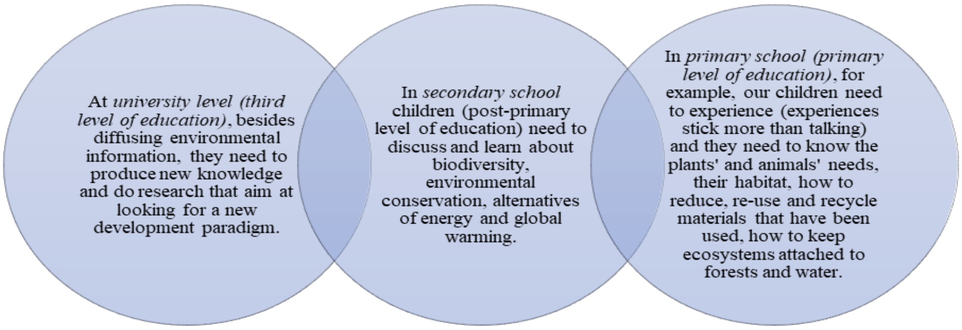


Figure 2: ESD at different levels of education (Draghici, 2019).

Most of the research studies in the literature and international organizations initiatives in the field of ESD have underlined the importance of transferring the existing needs and frameworks (as competencies maps, skill cards, curricula etc.) into practice by trying to adapt them to the local

context (Johnston, 2013; Marcus et al., 2015; Soini et al., 2018; Tejedor et al., 2018; Backman et al., 2019). Furthermore, the debate in the literature has proved that there is a diversity of contexts where ESD takes place but there has been recognized the "power of experience" (life experiences as site visits, internships and service learning in communities, project-based learning, place-based learning, field trip and experience) is of great impact and efficiency (Medrick, 2013; Perlstein et al., 2017; Draghici, 2019). The most frequently found issues in the ESD programmes are related to climate change, the use of natural resources, justice, human rights and democracy, lifecycle thinking. Usually, after the ESD programme, the knowledge acquisition should allow trainees to act in the future with respect to the sustainable principles and values (Annan-Diab and Molinari, 2017; Mircea et al., 2019). A broad and interdisciplinary obligation is mention frequently in the frame of sustainable development teaching and learning approaches (Scott and Gough, 2003).
Considering these brief aspects presented above there have been created the basis of the TeachSUS project development (TeachSUS_2018-1-RO01-KA204-049253) which is the context of the article, too. The paper refers to two main topics (after the introduction part): (1) the presentation of the TeachSUS project and (2) the description and the research results for the training needs assessment in the field of ESD.

2. TEACHSUS PROJECT DESCRIPTION

The general objective of the TeachSUS project is to create a common new non-formal education structure for sustainable development to enable professional development of institution and organizations involved in education and adult training, from all over Europe to plan learning experiences that empower their trainees to develop and evaluate alternative visions of a sustainable future and to work creatively with major stakeholders from economic sector in order to assure the practical link between education for sustainability and real economy and the community needs. The proposed partnership has the appropriate mix of competencies and networks to design and implement a new teaching model for teaching and educating sustainability in the case of lower level institutions than universities (pre-university area) and to establish a coherent practical oriented structure for Sustainable Excellence Centers (SEC) in Romania, Hungary and Portugal (TeachSUS, 2018). The excellence centers will create a country/region customized structure to sustain collaboration between stakeholders from various fields of sustainability. Each center will provide information, guidance, coaching and counseling activities made with trainers and tutors coming from private company areas and NGO's. Sustainability Centers will organize LivingLab (von Geibler et al., 2014; Mirccea et al., 2018) events on sustainability issues and presentations of new technologies and green businesses examples together with live training for new learners (TeachSUS, 2018).
The specific objectives and results of the TeachSUS project are (according with them the project activities are defined and schedule from 1st of December 2018 to 30th of November 2020) (TeachSUS, 2018):

- A new learning methodology for sustainability, developed through cooperation and exchange of practice between teachers/trainers and the staff responsible to support services at different educational levels, in that way that suite the most for the market needs, made available as open, digital resource;
- A new course, and related learning materials and tools for adult learners, that will bring more insights for those which train sustainability or only specific concepts thought their education series in English languages for broad dissemination (translated in Romanian, Slovenian, Hungarian and Portuguese); more than 60 trainees will be trained online during the project implementation period;
- Creation of flexible digital resource, which could add value to any type of training in the field that took place in universities or high schools (pre-university level) and which should integrate topics about sustainability;

- Capacity of project partners to address education for sustainability increased trough train of trainer's common session, with 20 beneficiaries;
- A network of tree SEC created in Romania, Hungary and Portugal, where coaching methods and tools for adult learners will be brought into a suitable place for the non-formal education by experts coming from private companies to coach, tutor other trainers from other institutions/organization;
- More than 15000 persons informed using broad dissemination of project vision/objectives and future results assured at local, national and European level through different media (web-based, conferences, interviews, social medias, events etc.) and more than 20 company representatives involved in the first SEC workshop.

The considered target groups to which TeachSUS project activities are addressed are: (1) Adults - teachers, trainers, mentors - from institutions/organizations involved in education, in adult / professional / youth training – they need a larger perspective about education, to understand the simplicity and complexity of sustainability; (2) Students from universities who aims to become teachers, human resources (HR) specialists/managers; they need new methodology /tools to help them become in future efficient professionals in education and HR/ management professions; (3) Employees from non-governmental organizations (NGOs).
In the context of TeachSUS project there have been adopted a coherent working methodology (associated with the project work packages) in order to achieve the proposed objectives. Figure 3 shows the main steps adopted to develop the TeachSUS training programme (training materials and the examination pool of questions).

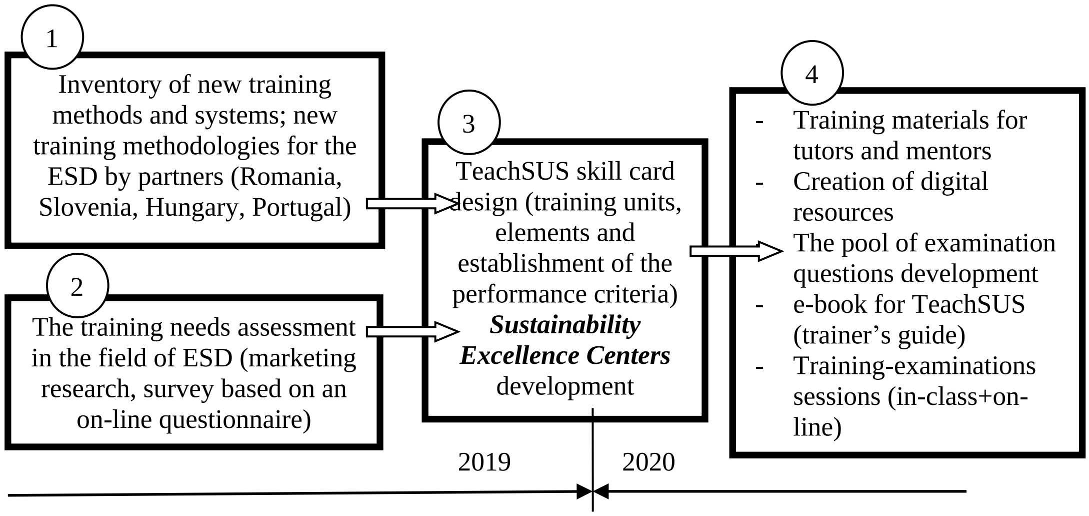


Figure 3. The main steps of the TeachSUS training programme development.

The core of the TeachSUS training is the skill card (learning units and elements with performance criteria), which clearly fit the competencies required for becoming an efficient and effective trainer/teacher for ESD. The preliminary work done by the members of the international partnership has been considered as the basis for the methodology design, including the questionnaire that has been developed to collect potential trainees' opinions on their training needs in the field of ESD and pedagogical methods to be used during the training sessions (in class and on-line).

3. RESULTS AND DEBATE ON THE TRAINING NEEDS ASSESSMENT

The preliminary research that has been conducted in January – February 2018, when the TeachSUS project has been developed, refers to the training needs assessment in the field of ESD. The following sections will present the research methodology and the results together with a debate on lessons learned that have been considered for the TeachSUS project implementation.

3.1. Methodological aspects

For the training needs identification there have been developed a survey based on an on-line questionnaire. Based on the process of the data collection from the potential trainees (investigated subjects included in the target group) there have been created a global image on the training needs in the field of ESD. The research sample has been defined together with the creation of a database with potential persons of the projects target group (name, address, phone, e-mail). Subjects in the database have registered themselves on-line using the TeachSUS project web page facilities (https://www.teachsus.eu/). Snowball principle was applied in order to enlarge the research sample (and project's target group); a series of news were sent to the target group via social media (https://www.facebook.com/teachsus/) and the project's web page to touch potential trainees that have been asked to answer the questionnaire, too. Finally, the sample (demography shown in Figure 4), consists of 111 subjects mainly from Romania, Hungary, Slovenia and Portugal.

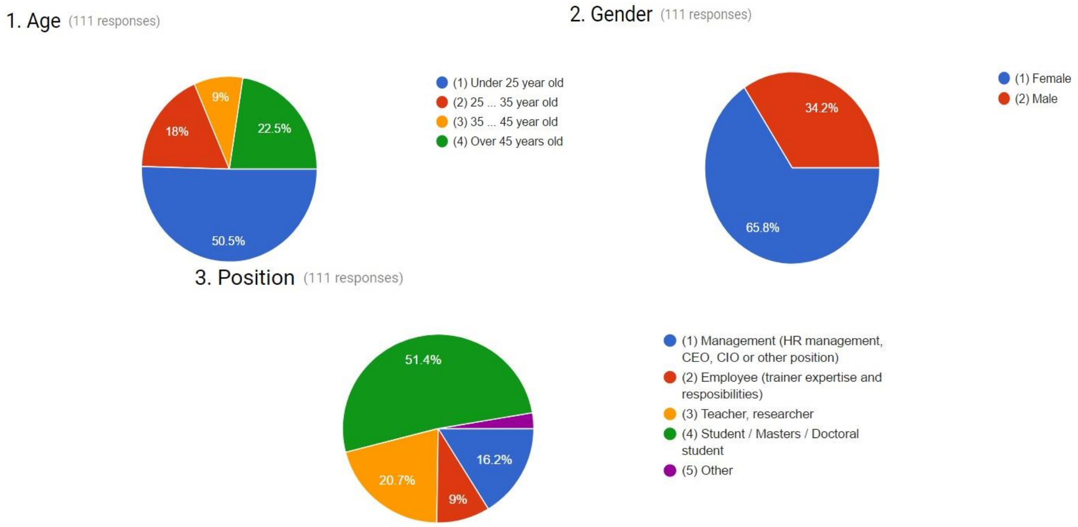


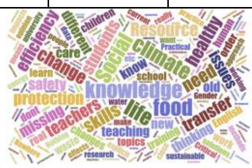
Figure 4. Demographic aspects of the sample characterization.

The designed questionnaire structure consists of three parts. First part was dedicated to collect opinions about several suggested training topics and their implications for ESD; the opinions were collected using a Likert scale of 5 points. In the second part, subjects have been asked about the most suitable train the trainers' method to be exploited in the TeachSUS project. The third part was dedicated to the collection of the demographic variable of the sample. The questionnaire was distributed on-line in Romania, Hungary, Slovenia and Portugal and the responses were processes using the Excel software application.

3.2. Research results and comments

The cumulative research results are shown in Table 1. As can be seen most of the respondents have been expressed their strong and very strong needs for all the statements in the questionnaire. There is a concern of all respondents about ESD and the future of our Planet. Consequently, they saw TeachSUS programme as an opportunity for improve their skills on ESD.

Table 1: Cummulative research results (first part of the questionnaire used)

Question related to ESD aspect that has been assessed	**Responses distribution (using Likert scale)**				
	1	2	3	4	*5*
	No need	Weak need	Average need	Strong need	*Very strong need*
1. How important is for schools to cover sustainability topics?	1 0.90%	2 1.80%	11 9.90%	30 27.00%	*67* *(60.40%)*
2. Do you think that teachers in schools need proper knowledge and understanding of today's challenges?	0 0.00%	1 0.90%	6 5.40%	26 23.40%	*78* *70.30%*
3. Do you think that changing attitudes and growing new skills to shape new characters for youngers could drive a better future?	0 0.00%	0 0.00%	4 3.60%	24 21.60%	*83* *75.88%*
4. What kind of knowledge are missing in ESD:					
5. Do you think that teachers need to adapt the trainings in an innovative way, to assure better understanding and acceptance of new information?	0 0.00%	2 1.8%	8 7.20%	34 30.60%	*67* *60.40%*
6. Would you appreciate the creating a non-formal education center for sustainability?	2 1.80%	1 0.90%	13 30.60%	34 30.60%	*61* *55.00%*
7. Do you think that international knowledge transfer from other experienced organizations is beneficial to increase consistency in the sustainability topic trainings?	1 0.90%	2 1.80%	13 11.70%	38 34.20%	*57* *51.40%*
8. Do you think that sustainability topics must be addressed in trainings in close relation with the economic interest, environmental and social impact?	2 1.80%	1 0.90%	19 17.10%	33 29.70%	*56* *50.50%*
9. Do you think that the economic sector would improve if we address sustainability topics in early schools' classes?	2 1.80%	1 0.90%	10 18.00%	33 29.70%	*55* *49.50%*

Regarding the most suitable training method, orientation or tool that suit most to their needs, a large majority of respondents agreed that a combination of theoretical knowledge, best practices examples, multimedia/gamification and coaching-tutoring techniques suits best to ESD.

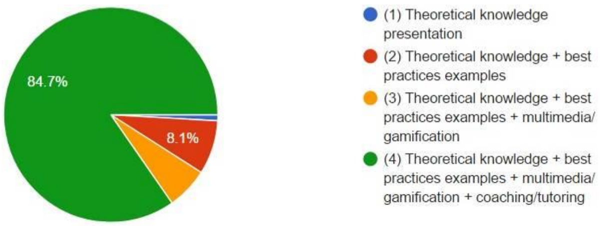


Figure 5. The responses about the most suitable training method, orientation or tool.

CONCLUSIONS

The research on the training needs assessment in the field of ESD has underlined several important aspects for the TeachSUS project development and implementation. Most of the respondents were under 25 years old, females, teachers and students that will be future teachers for different subjects at pre-university level of education. According to the research results, ESD is of strong need but it should be supported by very well-trained teachers/trainers; 83% of the respondents strongly agreed that changing attitudes and growing new skills to shape new characters for young generation could drive a better future.

The research has underlined a gap of teachers' knowledge in the field of ESD. The knowledge that are most needed are (related to teacher's skills): social dimension, lifestyle and health issues, climate change, safety protection and efficiency consumption (with respect to resources, food, energy, water etc.). 67% of the respondents strongly agreed that teachers need to adapt the trainings in an innovative way, to assure better understanding and acceptance of new information in the context of the ESD. This aspect is related to the strong expressed need for efficient and effective ESD methodologies. Furthermore, 61% of the respondents strongly agreed on the utility of a non-formal education center for sustainability. Because of the high costs involved and the need of an international network, only 57% of respondents strongly agreed that the international knowledge transfer from other experienced organizations could be beneficial to increase consistency of in the ESD. In addition, 56% of the respondents strongly agreed that sustainability topics must be addressed in trainings in close relation with the economic interest, environmental and social impact (probably they do not know the dimensions of sustainable development and their inter-relation) and only 55% of the respondents strongly believe that the economic sector would improve if we address sustainability topics in early schools' classes.

The collected opinions are limited to the research sample that consists of respondents of each partner's region or area of interest. Future work in the field will be dedicated to the analysis of the methodologies for the ESD that could be implemented successful in each partners' country (Romania, Slovenia, Hungary and Portugal) and the digital training resources development (training materials that should be ready to be used by teachers/trainers, case studies and lessons plan).

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A Critical Reflection on Relationship between ICT and Change Management in Enhancing Teaching and Learning Performances

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ABSTRACT

Numerous studies have pointed out direct positive impacts of Information Communication Technology (ICT) on education quality. From just tool, ICT is being viewed in itself as quality or as catalyst for quality improvement. These findings have led universities worldwide to adopt ICT regardless of uncertainties. Consequently, not all of them succeeded. Proofs from cases around the world show that ICT produces positive impact only in the environment that fits. Such environment is fostered by an effective change management approach. The main aim of this paper is therefore to present the symbiotic relationship between ICT and change management, zeroing on how changes are managed to attain a proper ICT ecosystem for education quality improvement. It also aims to understand, through the conducts of extensive bibliographical research, along with critical content analyses, the roles of ICT in education, its design and impacts, and what constitutes effective change management approach for ICT inclusion. Key findings include: that the integration of ICT alone does not necessarily produce direct positive impact on teaching and learning, but its design; that a good design requires a proper change management process, driven by ICT, and that the involvement of all stakeholders, particularly functional managers, is critical to attain better performances.

Keywords: *ICT, Change Management, Enhance Teaching and Learning, Symbiotic Relationship*

INTRODUCTION

In past decades, much research focused on the role ICT played in the betterment of education. While some debated that students learned better with the presences of the ICT (Hewitt-Taylor, 2003; Khan, Hasan, & Clement, 2012; Jacobsen & Forste, 2011; Pajo & Wallace, 2001), others disagreed. Kirkwood and Price (2014), for instance, raised the concern on the limited understanding of the benefits of technology in education, questioning the effectiveness of the long-held discussions that technology as tool had a direct positive impact on learning and teaching outcomes. This came after a "negative relationship" was found between the two variants—ICT and teaching and learning enhancement. To Jacobsen and Forste (2011), technology per se could not do much, but its design that shaped the direct influences on teaching and learning performances. As questions intensified, research focus has been shifted away from the role of media technologies per se, to the design of the

technology in education. In an article on Technology-Enhanced Learning and Teaching in Higher Education, Kirkwood and Price (2014) cited the introductory statement of the Director of TELRP who put “Does technology enhance learning? It’s not unreasonable to ask this question, but unfortunately it’s the wrong question. A better question is: how can we design technology that enhances learning…?” (p. 7).
The main objective of this paper is to present the symbiotic relationship between ICT and change management, zeroing on how changes are managed to attain a proper ICT ecosystem for education quality improvement. Along side, this paper also aims to underscore the roles of ICT in education, its design and impacts, and extending to what constitute effective change management approach for ICT inclusion. Given the nature of this topical substance, which will later be used as part of a bigger literature review for ICT and change management, the conducts of extensive bibliographical research, together with critical textual analyses will be used as methodology to achieve the above-mentioned objectives.
For better understanding, the paper is organized as follows: the introduction, the general view of ICT in education, the change in educational landscape, the changing views, symbiotic relationship between ICT and change process, different theories in the field of change management, approaches to managing effective change, and findings and discussions. This paper ends with a conclusion, as other papers do.

ICT IN EDUCATION

There is no contest that “current college student population is more digitally active than any previous generation” (Jacobsen & Forste, 2011, p. 275). Their activeness is partly contributed by the advancement of modern technology per se, and more importantly, by its influence on their daily lives. From businesses to public works, media technology has made things easier, more convenient, and even more productive.
In the field of education, media technology has revolutionized the way things are taught and learnt, and to a greater extent, replaced the old school of practices. Hawkridge, Jawoski, and McMohan (1990) suggested the use of ICT could improve performance, teaching, and administration. ICT has a positive impact on education as a whole, and it could also develop relevant skills in the disadvantage communities—helping in liberation and transformation. Though warning of heavier demand from the side of teacher, Keengwe, Onchwari, and Wachira (2008) confirmed concrete benefits of employing ICT in educational field, stressing that technology allows students to work more productively than in the past. Pajo and Wallace (2001) stand on the same premise by agreeing on the importance of ICT in education, seeing its growing power and capacities in triggering change in the learning environment available for education.
McLoughlin and Lee (2007) also confirmed the sophistication of employing media technology to enhance learning through which learners used various tools and multiple forms of interaction to create collective activity, supported by technology affordances. The authors acknowledged the benefits of using information technology in education as it could widen access, decreased need for onsite teaching accommodation, and enhanced explanations by the use of special electronic effects. To the institutional level, including the International Society for Technology in Education (ISTE), the need for technology-based learning is even more obvious (Hamidi, Meshkat, Rezaee & Jafari, 2011).
The perceived benefits of the positive influence of media technology use in education have propelled for quick adoptions and integrations of the ICT into higher education by many educational leaders and governments around the world (Edmunds, Thorpe & Conole, 2012). In 2002, UNESCO launched “the Asia-Pacific ICT in Education” programme in 2002 with partner-countries in order to prepare them for a comprehensive and informed approach to integrating ICT into education (UNESCO, 2002).

THE CHANGING EDUCATION LANDSCAPE

Not long ago, theorists like John Dewey, Jean Piaget, and Lev Vygotsky, proposed the student-centered approach to education. Though there are nuances of explanation and expectation, one common thing exists, that is, students learn better amongst themselves, according to the proposed practice. Constructivist Learning Theorists casted no doubt on this, stressing that the approach relinquishes some teacher’s responsibilities in providing in-class instructions, but yet giving students more autonomy and independence in choosing for themselves both the contents and approach for learning. This approach has later been materialized as ICT comes in full swing for harness.

Khan, et al. (2012) stressed the role of ICT in shaping a new learning process whereby a more collaborative learning environment was made possible, when previously not. Media technology has given ways for classes to be conducted from a far corner of the world using a sophisticated chat-room, and/or teleconferences where teachers and students could comfortably interact with one another. The new tools have genuinely altered the instructional methods and materials, providing simulated practical experiences, and enhancing visual explanation and online discussion between teachers and students (Hewitt-Taylor, 2003; Kirkwood & Price, 2005).

With no surprise, ICT has ushered in a new way of learning and teaching, transforming the so-called correspondent studies into a new e-learning style where classrooms are assisted by new communication technologies systemically connected for content exchanges. Teachers are no longer leading the classrooms, but mere facilitators who direct students to a new type of learning that is, in many ways, assisted by media technologies (Hewitt-Taylor, 2003). Not only does that indicate a sophisticated move from a total teacher-directed instruction to that of a more relaxing student-tailored contents and format, the impact of the change is much greater than one could expect—it requires a change in both classroom format and supports. Soon afterward, the fashion has been adopted worldwide, as a complementary mean to the old teacher-centered approach, and even harsher, replaced it almost completely in many education systems.

With the fast expansion of media technologies, and the sounding proofs of their usefulness in education, governments in many countries have made it imperatives for educational institutions to adopt and integrate ICT into every aspect of school lives, making it even compulsory for staff in certain higher educations to master certain basic skills for their jobs. Cambodia is of no exception. In December 2015, the government has, during its annual national budget adoption, laid out solid planning to address the development of physical infrastructure, highlighting the ICT policy priorities within the fifth legislature and a set of planned actions by various MDAs to implement the prioritized policies (KnowledgeConsulting, 2015).

THE CHANGING VIEWS

Despite the widespread growth in practice, concerns continue to be expressed about the extent to which effective use is being made of technology to improve the learning experiences of students (Kirkwood & Price, 2014). In a search for correlation between media technology use and class grades, Jacobsen and Forste (2011) raised their concern on the limited understanding of the benefits of technology in education, questioning the effectiveness of the long-held discussions on the topic. The concern came after the “negative relationship” was found between the two variants. Jacobsen’s finding supported Schramm’s take, which concluded the absence of evidences to proof the role of technology in enhancing education. According to Schramm (1977), more variances within than between media were found, and hence there was no evidence to suggest that any particular media or technology could in or of itself account for enhancing learning outcomes.

The above findings were also the testaments to what has been highlighted by Alexander and McKenzie (1998) who confirmed a similar thing found now. According to the authors, the use of a particular information technology did not, in itself, result in improved quality of learning or productivity of learning…. Rather, a range of factor was identified which was necessary for a successful project outcome, the most critical being the design of the students' learning experiences" (Alexander & McKenzie, p.3). The argument was very much in line with Hewitt-Taylor's finding who valued more on methodology over technology. According to Hewitt-Taylor (2003), the students could only realize the maximum benefits from technologies when they were properly made.

In a recently published article on "To Improve Education—Focus on Pedagogy, not Technology", Sharples (2019) reconfirmed the role of pedagogy in enhancing education, putting, "it's not what you use; it is how you use it. We need to focus on how teachers use technology, not just the technology alone. The key to this is pedagogy" (Sharples, 2019, p. 1).

It could thus be drawn from the above arguments that to understand what contributes to the effective ICT's design, (or one may call it as pedagogy —how you use technology or ICT environment), one should: first, understand the symbiotic relationship between ICT's integration and organizational change, and second, what change approach to be adopted for effective ICT design.

SYMBIOTIC RELATIONSHIP BETWEEN ICT AND CHANGE PROCESS

As ICT is increasing its influences on our daily lives, and impacts many aspects of contemporary organizational change (Barrett, Grant, & Wailes, 2006; Love, Gunasekaran, & Li, 1998), any discussion about it draws in discussion about change, and vice-versa. At one point, ICT is being adopted as just tools to assist in some change aspects, at the other time they are the prerequisites for effective change, given the enormous and unpredictable size and pace of change at stake.

Needless to mention earlier takes which gave weigh on the importance of technology as tools (Hawkridge et al., 1990; Keengwe et al., 2008; Hamidi et al., 2011), other researchers went otherwise into details of technology designs for better teaching and learning performances. Khan et al. (2012) discussed the importance of understanding pedagogical, psychological and cognitive barriers to the successful use of information technology. McFazdean (2001) suggested the process of knowledge acquisition, which required students to participate passionately in order to succeed fruitful outcomes. Other researchers including Kirkwood and Price (2014), Hewitt-Taylor (2003), McLoughlin and Lee (2007), Candy (2000) called on discussions about how technologies are used, in line with appropriate teaching and learning methodology. Byrne, Flood and Willis (2002) acknowledged the technology's benefits on the condition of the administrator's knowledge of the student body, and of the environment they learn.

The above rhetoric clearly suggests a different angle of ICT in the change process, particularly at time when subsequent new findings alert change agents to look at ICT beyond its material status; one of the very findings was from Orlikowski and Yates (2006) who argued for the need to see technology out of its contingent determinism box. This later finding supported Gardner and Ash's take (2003), which suggested that the low benefits obtained thus far from ICT's integration was mainly because of the absence of concrete understanding of the nature of change in the complex organization. "A clear understanding of dynamics of change at the people/technology interface, and the symbiotic relationship between information systems and strategy, is a prerequisite for the successful business benefits realization" (p. 18).

In an attempt to show the relationship between technology and people, Andersen (2018) views technology as operational work mechanism, linking all people's actions at all levels of the business. Barrette et al. (2006), while also agreeing to the argument, acknowledges the scarcity of relevant studies on the interconnectedness of ICT and organizational change, saying when there were, such studies tend to ignore or downplay the role of human agency. Nevertheless, what dictates a common frame for all the researchers was the fact that ICT has enormous influence on people, but yet the later is the one to decide (Orlikowski & Barley, 2001).

In sum, integrating ICT needs to be done with high caution as it may change the way we think about work (Zuboff, 1988). While on one hand ICT is required as communicative tools to manage bigger institutional outcome within this increasingly complex organizational environment (Savage, 1996), on the other hand, ICT integration impacts organizational work culture that needs to be appropriately addressed. To this end, human role is important to mitigate such culture change so that a chance of failure is minimized. To attain success, technology could not be left alone to determine success, but how change agents, including top supervisors, functional mangers, staff alike, use them accordingly to project the wanted outcome.

CHANGE MANAGEMENT THEORIES

Much research has been conducted on how to manage change for success. In businesses, the process of adopting effective changes ranges from a number of strategies; these include the initial step of quality assurance (QA) which cares more on procedure of attaining the best quality, to continuous improvement (CI) which places more emphasis on customer satisfaction and employee participation, towards adopting a continuous change approach to ensure quality, known as total quality management (TQM). At a radical change phase to attain market leadership, companies adopt a radical change to be part of its procedure, called Process Engineering, and to the most, to the whole business process, known as Business Process Reengineering (BPR) (Love et al., 1998).

By (2005) categorized change in three different type—change based on 'the rate of occurrence', in which the researcher included continuous change adopted from Burnes (2004), discontinuous change (Grundy, 1993) and incremental changes (Burnes, 2004); change that is based on 'how it comes about', in which he observed if the change was planned or emergent, and last, the 'change based on scale', which included fine-tuning, incremental adjustment, modular transformation and corporate transformation. Other researchers went down even further into planned internal and external change, and unplanned internal and external change.

Nevertheless, all these were centering around two main approaches. One was Kurt Lewin's 'planned approach', and another was the 'emergent approach'. According to Lewin (1951), effective change required detailed plans and projection made by top managers. Change had to start from a clear objectives supported by detailed planned actions, and with projectable results. Change was attainable through the process of freezing, unfreezing and refreezing, or termed differently as displacing, reregulating and rearranging (Heifetz, Heifetz, Grashow, & Linsky, 2009; Sporn, 2001). Bamford and Forrester (2003) however challenged the concept casting doubt mainly on the role of top managers. A good change management had to be a bottom-up, and cross-sectional. Changes took place at functional offices governing by functional managers. Senior managers might dictate general policies, but it was the middle managers who were directly "influenced" by events, who liaised with important customer contacts and spent time with both internal and external auditors (Bamford & Forrester, 2003).

Bamford's challenge gets subsequent supports from researchers who witness the uncontrollable nature of change, which is in most way influenced by advancement of ICT. The notion of emergent is particularly relevant in today's setting where organizations are greatly affected by the unprecedented environmental, technological and organizational changes which cannot be explained, and prescribed by priority plans and intention (Orlikowski, 1996). Technology has gone too far to make things predictable, and hence effective organizational change must expect the change per se. And change in their views is non-linear, emergent, dynamic and situated in nature (Gardner & Ash, 2003; Orlikowski, 1996).

Though debate is still going, particularly on how to effectively manage the 'unpredictable', it seems a common ground was built on the fact that first, the pace of change have never been greater than in the current business environment, and second, change, being triggered by internal and external factors, comes in all shapes, forms and sizes (By, 2005).

APPROACH TO MANAGING EFFECTIVE CHANGE

Although numerous variables have been identified as factors to be keyed in for managing a proper change, three groups of change factors are common to almost all researchers. These include strategy, technology, and human. Orlikowski and Yates (2006) term them in phrase as making system workable, dealing with materiality, and focusing on practice. Developed from Wagner and Newells' (2006), Orlikowski refered 'making system workable' to a strategy that focused on setting common goals for all change stakeholders in the institution. As for 'dealing with materiality', it was referred to the ability to see technology as more than just tools; a notion shared by Bridgman and Willmott (2006) who put it that the challenge was how to articulate a view of technology's material properties without reifying them through a form of contingent determinism. And 'making system workable' touched more on what people did with technologies in practice (what actors at various level within and across organizations are doing with the technology on the ground and over time).
Gadner and Ash (2003) also pointed to a three unifying theme for effective change to take place. To exemplify, emergent change, although difficult to manage in a conventional sense, could be shaped and harnessed under certain conditions which included shared stakeholder goals, a clear understanding of the business model, its objectives (strategy), the role of technology within the process, creation of common "IT change management" protocols and conventions, and on-going use of facilitated forums required to support knowledge integration. Marchesoni, Axelsson, Faltholm and Lindberg (2016) also drew the needs to focus on the aspects of strategy, human, which the authors coined as 'usability needs' and technology.
While Muluneh and Gedifew (2018) packaged the change process following adaptive leadership, and design thinking, Milis and Mercken (2002) highlighted the roles of top managers in the design process. Top manager's decision was in many ways influencing the level of support provided by the functional managers. This supports had a great impact on the behavior of the users. Their idea was however, challenged by Bamfort and Forrester (2003) who saw the roles of top manager as less important, compared to the middle managers. Top managers, though having the overall responsibility for effective change, were not supposed to plan or implement change, but only to create an environment that was conducive to experiment and risk-taking, and to develop a workforce that would take responsibility for identifying the need for change and implementing it. Though issue among these findings was constraint on the definition of human roles in an organization, a great thing of it was a common understanding of the criticality of management involvement in change process.
On part of technology, there is a need to look at it beyond its materiality and deterministic nature. Since 1980s, technology is no longer seen as a material cause, but social shaping agent (Markus & Robey, 1998; Williams & Edge, 1996). Orlikowski (1996), for example, pointed to a mutual relationship between human and technology, stating that ICT was both a concrete artifact and an actor which influenced and was influenced by the cognition and actions of its users. Andersen (2016) similarly acknowledged the reciprocal relation between ICT users and organizational change that increased autonomy and control power of organizational norm and routine could be made by ICT. Short-term results would be achieved, while increasing instability instead of reducing it, if there was a one-side intervention on any of these two variables (Genus, 1998; Hartley, Benington, & Binns, 1997; Senior, 1997). Several attempts have been made to develop conceptual framework that treat technology as both materials and a social object at the same time (Orlikowski & Barley, 2001), but a unified one has yet to be adopted. What dictated a common frame for all the researchers was the fact that ICT has enormous influence on people, but yet the later is the one to decide.

With great people at work, and sophistical technology in hands, one must not forget to make the system workable—the strategy. Though this seems complicated, an understanding that change is emergent, non-linear, and continuous is certainly a prerequisite to develop good institutional strategies (Gardner & Ash, 2003; Andersen, 2018; Bamford & Forrester, 2003). According to Bamford and Forrester (2003), organizational change was a continuous process of experimentation and adaptation intended to match the organizational capabilities to the needs of the changing environment, and hence any view of strategy as a linear process, following a particular set model, and done within a specific timeframe, was doomed to fail (Gardner & Ash, 2003).

Even with these change factors, effective change relies heavily on the process. In summary of Kanter, Stein and Jick's Ten Commandments for Executing Change (1992), Kotter's Eight –Stage Process for Successful Organizational Transformation (1996), and Luecke's Seven Steps (2003), Muluneh and Gedifew (2018) proposed the following steps to implementing change in people's working culture by first developing deep investigation and opening discussion of challenges, and next, proposing the use of adaptive design as tool, and last, introducing collaborative thinking for creative solutions. Though the researchers stressed on the need to equip necessary ICT skills for staff at a later stage, clear communication between and among all stakeholders had to be ensured for the whole change process. Muluneh's proposal shares mostly with Andersen's proposal (2018), though stressing more on managerial responsibility, which suggested (1). the identification of challenges prior to choice of ICT solutions; (2). training; (3). revision of organizational routines, and (4) negotiations to develop commitment to the new ICT.

FINDINGS AND DISCUSSIONS

Information Communication Technology (ICT) and organizational change are reciprocally interrelated. When we talk about ICT's integration, one must not avoid discussion on changes needed for a successful integration. In the same token, when one talks about change, one must also not forget to consider ICT, given the size and the current pace of change. Effective ICT's integration requires an in-depth understanding of relationship between the ICT per se and the environment in which they operate. Getting to know this would give the change agents a better chance of exploiting them where they see fit. To best use them, technology shall be viewed beyond its materiality, that is, not to let technology dictate the results, but using them to determine the wanted results. As for the change agent, they also need to understand the nature of organizational changes.

Change is proven to be emergent, continuous, fast and drastic in nature. This requires the change agents to reconsider its change approach. Latest findings have proved that planned change is no longer relevant given the nature of change, and hence all change agents shall expect the unprepared nature of change. Rather than following a set of rules or models, what is needed in managing organizational change is an operational style that is more reflective and less reactive (Bamford & Forrester, 2003). Functional managers, not top ones, are claimed to be the most important change agents as they are the ones to face directly with changes. Though top managers are still responsible for overall objectives of change intent, it is critical for simultaneous and interactional involvements of all change stakeholders. Their involvement, which is facilitated by a free flow of useful information, would contribute to best work practices that integrate new work procedures, which also include new technology (Andersen, 2018).

Although the pace of change, at a point in time, is radical, change aspect should be in small-scale, incremental, and bottom-up. Over time, these can lead to a major reconfiguration and transformation of an organization (Bamford and Forrester, 2003). To attain this, however, a convincing plan has to be devised, incorporating Muluneh and Gedifew's (2018) and Andersen's (2018): (1) create awareness of the change among all key stakeholders, pointing to the motivation for change, including both individual and institutional benefits; (2) give them ownership of the

change by involving them throughout the change process; (3) explain them possible consequences of not having changes, but at the same time, ensuring them of possible benefits, such as training, incentives, or new job placement etc. (4) explain the stakeholder roles in ensuring success.
Regardless of field, the adoption of technology has to be well considered with good change management approach. In education, change has to be made for almost all aspects of teaching and learning, at the onset of ICT's integration, should one expects better teacher-student performances. The need for the inclusion has to be first supported by managers as they have roles, and it shall be then involved others who have stakes. Change is non-linear, and emergent in nature, and according the earlier research, could be dealt with best by functional manager who know the issue well at the ground. The approach to change shall be incremental, flexible and goal oriented. Any attempt to mitigate planned change from top managers may risk a big problem. As ICT could be both tools and process, key stakeholders need to know what function it plays at a particular time.

CONCLUSIONS

A conclusion could thus be drawn that the integration of ICT alone does not necessarily produce direct positive impact on teaching and learning performances, but the overarching process, which requires a proper change management approach. Though ICT is viewed as an inevitable part of the change process, it shall in no way be considered as a determinant for change result. The human indeed has this role and hence, involvement of all key human actors in the change process is deemed critical. Though this paper doesn't conquer more substantial findings on relationship of ICT and change management, it serves as an important reminder to all who have stakes, and are venturing into the unknown supposition of ICT's supernatural power. In furtherance, its thorough literature reviews shall form a strong base for future researchers in understanding more in-depth of this same focus in a number of ways, one of which is the symbiotic relationship of ICT and change, that is, ICT is relevant, but not determinant for change.

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Comparison of Entrepreneurial Attitudes – a Polish and Ukrainian Case Study

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ABSTRACT

The definition of entrepreneurship is interdisciplinary. Its attitude-describing component alone incorporates many areas, including, primarily, social sciences such as psychology and sociology, followed by economics and law, while taking into account local institutional and legislative environment. Its multi-faceted nature is, however, not only about attitudes but, above all, measurable behaviours, the effects of which can be illustrated in the form of measurable results and balance sheets of enterprises. One of its most important aspects is the fact of influencing the economic environment and economic conditions of countries. Hence, any research in the field of entrepreneurship of social groups, or even nations, should focus on diagnosing the forms of economic activity and describing those environmental elements which will enable certain alleviation of the barriers to development, or even their complete elimination, which, in turn, will contribute to the growth of entire socio-economic systems.
The article attempts to investigate the conditions that affect the willingness to carry on economic activity by analysing the entrepreneurial attitudes of Polish and Ukrainian citizens whose common denominators are: (1) having an engineering degree, (2) being professionally active, and (3) willingness to keep improving their qualifications.

JEL classification codes*: L26, L25, L11, F02, F13*

Keywords: *entrepreneurship, internationalisation, market management, entrepreneurial attitude*

INTRODUCTION

The definition of entrepreneurship is interdisciplinary. Its attitude-describing component alone incorporates many fields, including, primarily, social sciences such as psychology and sociology, followed by economics and law, while taking into account local institutional and legislative environment. The multi-faceted nature of entrepreneurship is, however, not only about attitudes but, above all, quantifiable behaviours, the effects of which can be illustrated in the form of measurable results and balance sheets of enterprises. One of its most important aspects is the ability to influence the economic environment and economic conditions of countries. Until 1950s there had been a conviction that large enterprises played a predominantly important role in that respect. The crisis in 1970s, however, verified this view, with focus shifting again to the role and importance of micro, small and medium-sized enterprises. Turbulent economic environment had led to an approach in which the idea of business risk has been significantly expanded – it is no longer a question of bankruptcy, but safety, both in terms of responsibility for employees and in terms of political conditions. The cultural aspect may have as weighty an impact on development as the source of financing, which has eternally been a barrier to entrepreneurship, widely discussed both in the literature on the subject and empirical research (carried out both by state institutions and by private consulting companies). Regardless of the surrounding background, entrepreneurship is conditioned by the entrepreneur himself, that is his qualifications, motivations, as well as the size of the social and cultural capital of the owner himself. Socio-economic development is determined by activities based on knowledge and human capital, regardless of the level of industrialisation or innovations. Therefore, in addition to land, capital and labour, the issue of accumulated knowledge and entrepreneurship pops up in scientific considerations as a production factor which determines the entire process. Hence, any research in the field of entrepreneurship of social groups, or even nations, should focus on diagnosing the forms of economic activity and describing those environmental elements which will enable some alleviation of the barriers to development, or even their complete elimination, which, in turn, will contribute to the growth of entire socio-economic systems.

The article attempts to investigate the conditions that affect the willingness to carry on economic activity by analysing the entrepreneurial attitudes of Polish and Ukrainian citizens with the following common denominators: (1) having an engineering degree, (2) being professionally active, and (3) being willing to keep improving their qualifications.

1. METHODOLOGY

The pilot study included 60 persons (30 from Poland and 30 from Ukraine) to verify the importance of the research problem, namely the possibility of differences in the approach to entrepreneurship between the examined nations, perceived as a scientific issue. The selection was intentional because it addresses European Union membership and enables an analysis of the entrepreneurial attitudes of young people aged 18 to 35 who are actively working on the labour market and are willing to take up their own economic activity. Initial analyses showed that both the importance of motivation and business creation were different in a number of analysed aspects.

To obtain the results presented in the article, mathematical analysis tools were used, which enabled the calculation of shares, determination of sets of common features, and description of the choice-making trends among the respondents. The tool used to collect data was a group-administered questionnaire containing both open and closed questions with a seven-point Likert scale. To present the results, tables and graphs were used to distinguish between the shares of each nation with respect to each research criterion.

2. CONDITIONS FOR ENTREPRENEURSHIP IN THE LITERATURE

Considerations about entrepreneurship, as moral, philosophical and political reflections, can already be found in Aristotle or Xenophon. The classical approach of A. Smith assumes the presence of production factors (land, capital and labour) (Smith, 2000; Smith, 2016). However, one should not forget about the crux which had led to such conclusions, namely morality, which according to a dictionary definition is “the entirety of behaviours and attitudes of an individual or a group, assessed in accordance with a certain socially functioning system of assessment and moral norms” (PWN, accessed on 25.01.2019). Therefore, the problem of an individual is an overriding element which, as far as entrepreneurship is concerned, is the entrepreneur himself.

The praxeological nature of economies has been emphasised by T. Parsons and N.J. Smelser, who pointed to the importance of social systems, which affect the economy, as well as the conditions related to the cultural values represented (Parsons & Smelser, 1957). According to their concept, an analysis of internationalisation processes with respect to the awareness of individuals should be taken into account in research on economic activity. They emphasise the role of social and cultural processes as well as sociological and psychological conditions.

Let us, therefore, define entrepreneurship as a set of personal qualities, which are expressed through the entrepreneur's attitude and his willingness to set up, manage and lead the development of his own enterprise. This omits the element of efficiency, referred to as success in business. However, it concisely defines an attitude that is open to the economic environment and is willing to take the actions and risks associated with the establishment of a business and, furthermore, to take responsibility for possible economic implications. The dominant feature is the attempt itself to face the challenges of starting and running a business, or, precisely, the attitude. Is this the evolution of *homo œconomicus*, a rationally economising man striving to maximise income through economically efficient management in the conditions of a free market economy (Smith, 2000; Smith 2016; Bentham, 1789: 19-25; Mill, 1969: 99; see also: Wiśniewski, 1996)? Is pursuit of a sense of happiness through economic benefits what currently drives entrepreneurial people? The goal of a commercialised society is seeking to increase money resources to the highest possible degree, and, therefore, accumulation of money should be the main overarching goal of economic activity. Is this the motivation of people who become involved in economic activity today? Or should the answers be looked for in the theories of J. Schumpeter or H. Leibenstein, in which innovation, as improvement in the efficiency of production, plays an important role (Schumpeter, 1989; Leibenstein, 1968; Leibenstein, 1987: 191-205)?

M. & R. Friedman believe that the perception of the market in A. Smith's theory, narrowed down to economics only, has created an image of *homo œconomicus* whose "exclusive concern [is] with immediate material rewards" and who "responds only to monetary stimuli" (Friedman & Friedman, 1980: 27). Those authors claim that such an assumption is erroneous because "self-interest" cannot be equated with "myopic selfishness" and it should rather be judged through the prism of individual values, regardless of the person's field and profession.

J. Supiński, who is considered to be the father of Polish sociology, believed that the highest productivity should be expected from entrepreneurs. He described labour as effort and toil which should be guided by knowledge (Supiński, 1872: 215-218; see also: Małecka: 2018: 485-493; Łuczka, 2018: 476-484). According to him, the most important element of production growth was the activation of small and medium-sized enterprise owners, while stressing the Polish problem of lack of capital as a social resource. Growth, however, can be achieved through trade, which enables the propagation of social contacts and shaping of relationships, which, in contrast to A. Smith, he believed to be the human's own creation (Szymański, 1999: 74-76). At the same time, he spoke about the free market in the classical convention – as an element conducive to the economic activity of individuals, which is the basis for the socio-economic development of economies.

The article presents the results of research on the respondents' motivation to become self-employed. The paradigm of rationality, which is the basic principle underlying all human actions, was posed against motives such as the need for achievement and self-fulfilment, the desire to become independent, EU membership, risk-taking, example of parents, other family members or friends, and higher income, but also favourable market conditions and unemployment, or fear of it. 'Rational' means based on logical reasoning, and the indicated factors are certainly associated with logical conditions and civilisational and cultural connotations. Thus, they refer to M. Weber's theory on ideal types – functions that facilitate learning about reality. The concept was based on four types of social action: (1) traditional, (2) affective, (3) value-rational, and (4) instrumental-rational, with degrees of involvement (Weber, 1920: 12-13; Weber, 2018: 68-78; see also: Lange, 1974: 218; Kotarbiński, 1973: 121). In creating the ideal social type structure, M. Weber accepted the necessity of its interdisciplinary character – the existing dependencies between economic systems, prevailing cultural norms and ideological determinants (Table 1). The religious aspect, so important to the theory of the German sociologist, philosopher, lawyer and economist, is also present in the studied area, because Poland is a Catholic country, and the respondents are professed on this issue, while the respondents from Ukraine are Greek Catholics or Orthodox. However, the present research does not take this aspect into account.

Table 1. Social action according to a classification by M. Weber

TYPE OF ACTION			
TRADITIONAL	**AFFECTIVE**	**VALUE-RATIONAL**	**INSTRUMENTAL-RATIONAL**
Example of parents	Higher income	Need for accomplishments and self-fulfilment	Independence
Example of other family members	Improved material status	EU membership	Unemployment or threatened unemployment
Example of friends	Risk appetite	Favourable tax options	Favourable market situation

Source: Own materials based on own research

Presence on the free market, in the era of globalisation, requires constant handling of ubiquitous competition. The issue of location, with a properly and effectively operating distribution system, no longer plays the same importance as in pre-Internet times. Online activity is, however, possible if one has the adequate package of qualifications, and, above all, competences, enabling effective communication between business entities. One thing is certain: the existence of such wide-ranging competition basically forces one to acquire knowledge and skills in the process of continuous education. This is how we arrive at issue of the entrepreneur and his personality traits, which, as it turns out, directly affect economic systems and shape the environments and social attitudes of national economies (see: Małecka 2018a: 265-272).

The macroeconomic perspective proposed by J.M. Keynes and the theory of the consumption function has, thus, determined another aspect of business activity and entrepreneurship at the same time. The supply side, which forms the basis for the development of economic activity, discussed in the literature by J.B. Say or D. Ricardo, has replaced the income-spending process by individuals representing individual communities (Keynes, 1920: 236; Keynes, 1956). The persistent nature of imbalance in economies is caused by the continuous circulation of money earned and spent by the society. J.M. Keynes's absolute income hypothesis distinguishes eight main motivations for consumer savings: (1) entrepreneurship, (2) prudence, (3) predictions, (4) calculations, (5) improved standards of future consumption, (6) independence, (7) ambition, and (8) avarice. Entrepreneurship is, therefore, an inherent part of the claim regarding the essence of the economic balance in the surveyed society. The relationships and dependencies between individual decisions have implications for entire economic systems (Keynes, 1956). J.M. Keynes's criticism of M. Friedman in the field of intervention further emphasises the role and importance of private entrepreneurship (Friedman & Freidman, 1980: 75-85).

The introduction of the concept of 'entrepreneur' in literature is, however, is attributed to R. Cantillon, who, being a French economist, was examining the supply side of business operations. According to his theory, an entrepreneur is a person looking for an opportunity to sell their goods at a profit. However, he sees the risk associated with a seemingly simple purchase and sale transaction, namely the risk associated with the uncertainty of the sale price, which distinguishes an entrepreneur from an employee living on a certain income – their salary (Cantillon, 1755). The view of an entrepreneur as a person for whom profit is the most effective motivator to start a business was also represented by I. Kirzner or F. Knight (Kirzner, 2005:75-81; Kirzner 2017: 855-868).

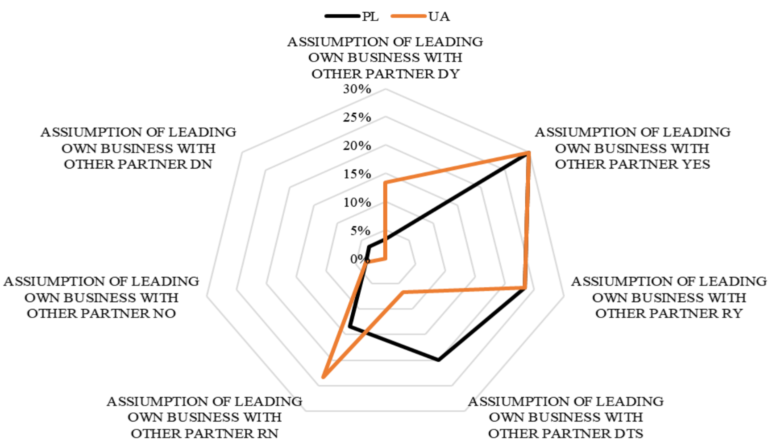
The article attempts to examine the differences in the perception of economic activity by Polish and Ukrainian respondents, and the implications of barriers to the future development of enterprises.

3. ENTREPRENEURSHIP ACCORDING TO THE RESPONDENTS

Entrepreneurship, which is definitely an interdisciplinary concept, contributes to the development of individual national economies. This is certainly facilitated by the free movement of goods, the ability to provide services without demand or supply limitations, as well as the fiscal and legislative environment. The issue of an effective source of financing, which thanks to the membership in the EU provides additional opportunities to raise capital for development, is not without significance. New economic structures, shaped by openness to trade, create a favourable environment that should be noticed by enterprising individuals. For this process to be complete, entrepreneurs should raise their qualifications through a continuous improvement process, which contributes to the growth of human capital (Małecka, 2018: 485-493; see also: Łuczka & Małecka: 2017: 375-387). The issue of their cultural environment and centres of communing and collecting experiences, which directly affect the value of the social capital, is also not without significance.

The pilot study, aimed at determining the scope and importance of the research issues, included 60 persons (30 from Poland and 30 from Ukraine) with an degree in engineering, actively involved in gainful activity while participating in a master's programme and raising their management skills. The group-administered questionnaire included 47 questions, 16 of which used a seven-point Likert scale. The willingness to set up one's own business within the next three years was declared by 83% of respondents from Poland and 90% from Ukraine, while the use of foreign capital was contemplated by, respectively, 37% and 40% respondents. When asked about competencies associated with independence in the analysed area, only 3% in both groups gave a negative answer (Diagram 1).

The answer 'DY – definitely yes' was chosen by 3% of Polish respondents and 13% of Ukrainians. As regards the remaining responses on the left side of the scale, the choices made by both groups of respondents were convergent ('YES' – 30% and 'RY – rather yes' – 23%). There were differences in other aspects, however. While 20% of respondents from Poland are not sure about their choice, such uncertainty was declared by only 7% of respondents from Ukraine. This means that the Poles had definitely less certainty about their possibilities, both in terms of their competencies and sources of financing, because the qualifications in both groups are on the same level (engineers, future holders of a master's degree from a state university).



DY – definitely yes, YES, RY – rather yes, DTS – difficult to say, RN – rather no, NO, DN – definitely no

Diagram. 1: Participation of third parties in the establishment of one's own enterprise (Source: Own research)

The respondents were also asked about barriers to the development of entrepreneurship. They were provided with 15 most common obstacles which effectively limit growth and expansion, analysed in OECD reports (Kasperkowiak & Małecka, 2018: 811-822; OECD, 2018). The respondents could also indicate a different, individually perceived obstacle, however none of the questionnaires was completed in this section. As a result, the role and weight of particular phenomena limiting entrepreneurship were established, by share of its value and importance determined by the respondents (Diagram 2).

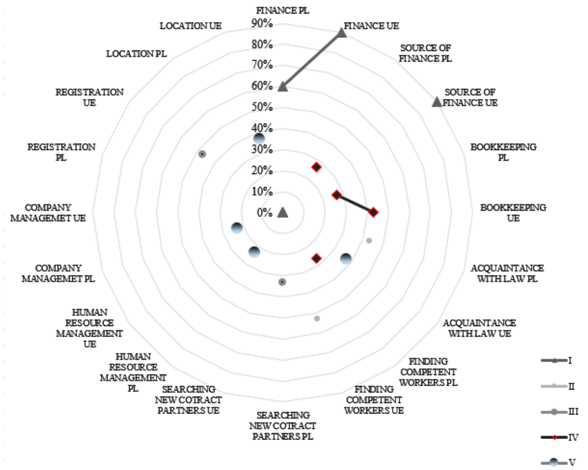


Diagram 2: Weight of each barrier to entrepreneurship development (Source: Own research)

It was observed that the main problem is financing, which has always been the major barrier mentioned both by practitioners and in the relevant literature (first weight for PL and UA) (Galbright, 1957: 124-133; Galbraight, 1977: 189-199; see also: Małecka, 2015: 91-122). Fourth weight was assigned to the issue of bookkeeping, although the intensity of perceiving this issue as a threat varied (fourth weight: 27% PL; 43% UA) (Table 2).

Table 2. Role and importance of perception of barriers to the development of entrepreneurship

WEIGHTS - NUMERICAL FACTORS	FINANCE		SOURCE OF FINANCE		BOOKKEEPING		ACQUAINTANCE WITH LAW		FINDING COMPETENT WORKERS		SEARCHING NEW COTRACT PARTNERS		HUMAN RESOURCE MANAGEMENT		COMPANY MANAGEMET		REGISTRATION		LOCATION	
	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA	PL	UA
I	60%	90%		90%								VII		VII		VII	VII		VIII	
II							43%			53%										
III											33%							47%		
IV			27%		27%	43%			27%											
V								37%					23%		23%					37%

Source: Own research

The criteria which received the third and fifth weight are completely divergent. The research has shown that both Poles and Ukrainians attribute the same importance to seeking new contractors and registration (33% PL; 47% UA), while indicating both of these issues as handicaps, but outside the basic scale (seeking new contractors has the seventh weight for UA, similarly to registration procedures for PL, which also ended up with the seventh weight). It was also noted that all respondents always indicated several limiting factors.

The perception of development opportunities in terms of trade was also tested. The countries indicated by the respondents with which they would establish cooperation in terms of both export and import included Poland, Czech Republic, Slovakia, USA, Germany, France, Italy, UK, and North America. However, the two nations indicated those countries with very different intensity and shares. While for respondents from Ukraine, Poland is always the number one partner, the reverse is not true. The result regarding the decision to remain a domestic company only is also interesting. In terms of export, the results are similar: 17% of respondents from Poland and 20% from Ukraine do not want to sell their goods or services abroad. The issue of import shows a different distribution: 40% of Poles and 27% of Ukrainians do not intend to purchase anything from other countries. Furthermore, none of the respondents intend to cooperate with Japan, which is the only country listed in the questionnaire that was not indicated by respondents (Figure 1).

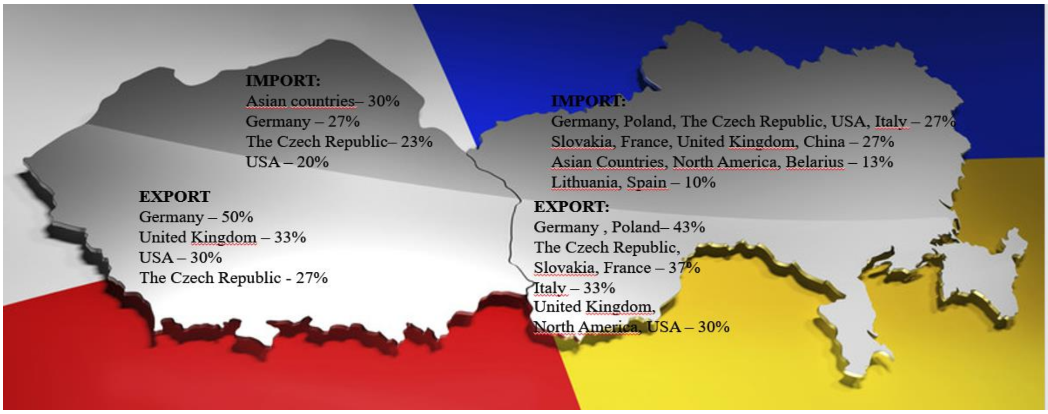
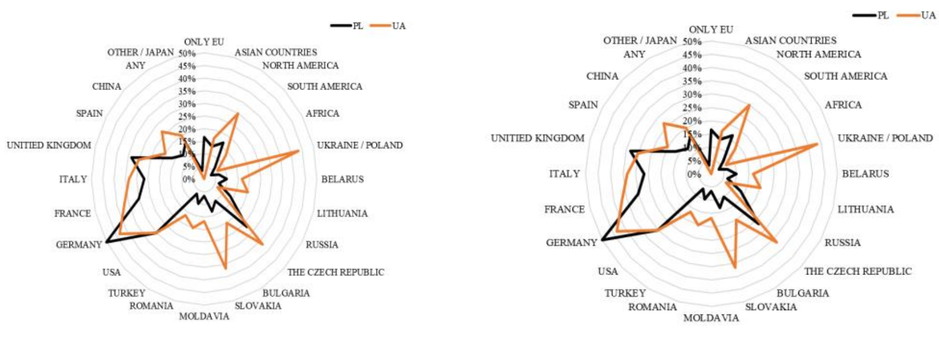


Figure 1. Main directions of trade (Source: Own research)

Moreover, the research results point to another academically interesting issue: diversification of the purchasing and the sales portfolios, which, from the point of strategic management, has a much more diversified structure among respondents from Ukraine (see also: Ansoff, 2007). Poles tend to select individual countries, significantly elevating the value of their share, while respondents from Ukraine attribute the same value weights to a much larger number of potential partners. On the other hand, the distribution of import and export directions looks almost identical for both countries (Diagram 3).



EXPORT IMPORT

Diagram 3: Distribution of countries' shares in trade (Source: Own research)

4. CONCLUSIONS

According to the authors, entrepreneurship, while being a complex issue of an interdisciplinary nature, is definitely a set of personal qualities, expressed in the attitude of the entrepreneur. That is why the conditions in which current and potential business owners are growing are so important.
It seems that the major barrier over the centuries to the development of entrepreneurship – namely finance – should nowadays have other connotations. However, this is not the case. It continues to be the main issue faced by those wishing to start, run and develop an enterprise, regardless of its size. However, one major difference can be observed in the surveyed group: while 90% of surveyed respondents from Ukraine see raising capital for development and sources of financing as a barrier which is as important as finance itself, only 27% of respondents in Poland indicate finding a source of financing as a limitation.
This points to another direction of research, taking into account the opportunities that respondents see in this respect, as well as the legal and registration-related conditions that may be the basis for such responses (knowledge of the law has been indicated by 43% of respondents from Poland and 37% from Ukraine).
Also, the results concerning the decision to start internationalisation and trade exchange seem interesting. Not a single person chose to make a debut on the market on a born global basis, but respondents from both countries expressed their preference to be a domestic business. These decisions, especially on the part of the respondents from Ukraine, could have been influenced by the perception of risk, especially in political terms, which are a separate subject of research that arose from conducting the present group-administered questionnaire.

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Selected Problems of an Entrepreneurial University - a Theoretical Perspective

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ABSTRACT

The aim of the paper is to identify university's activities and characteristics that enable it to reorient itself towards the idea of an entrepreneurial university. In the modern world, universities have an additional important role, that is, the need to adopt entrepreneurial strategies without disrupting the quality of teaching and research. First of all, the authors discuss the idea of entrepreneurship and focus mainly on academic entrepreneurship. The idea of entrepreneurship is becoming more and more desirable in a modern organization thus also in a university. The new role of the university is to create the entrepreneurial ideas and attitudes among students and all university employees, as well as to initiate entrepreneurial activities in academic institutions. It is also necessary to plan entrepreneurial university architecture. The article focuses on presenting the theoretical foundations of the academic entrepreneurship process to finally make a synthetic comparison of the features of a traditional university and an entrepreneurial university. The main research question of the article is: In which dimensions the idea of an entrepreneurial university can lead to the development of the university?
The result of the research is a new combination of attributes and characteristics of an enterprising university and new directions of university's development. By this paper the authors take part in the discussion about the implementation of the idea of entrepreneurship in contemporary university management.

Keywords: *entrepreneurship, academic entrepreneurship, entrepreneurial university.*

INTRODUCTION

Nowadays, changes in the area of education and higher education into new forms of cooperation between science and economy are related to the process of globalization, dynamic economic and social changes, as well as the development of a knowledge-based economy. In many countries and regions, opening up to business and building capacity to launch entrepreneurial potential among research workers, students and doctoral students is a beneficial and important way to develop universities. The University of Humbolt is a university model based on education and research. It has been extended to include preparation for entrepreneurship, which means shaping active behaviors that enable independent action on the market (the so-called enterprising academy third generation university) [OECD, 2012; Wisema, 2005, p. 31].
The concept of entrepreneurship university focuses on promoting the transfer of academic knowledge into companies and supporting the socio-economic development. The first implementations took place at pioneer universities in the United States, such as MIT and Stanford, defining a university-

wide patent policy, establishing a technology transfer policy, setting up university-industry partnerships and introducing new companies. Then the concept became popular in Western Europe, and ivory universities were transformed into enterprising institutions supporting academic entrepreneurs. Another wave of interest in this issue occurred in newly emerging economies, where the promotion of academic entrepreneurship occupies a high place in their political programs. The actual pioneering phase has already started, but for now it is not known what policies or structures are needed to support the effective transfer of academic knowledge and the incubation of new companies, and ultimately contribute to socio-economic development.

THE ESSENCE OF ENTREPRENEURSHIP AND ENTREPRENEURIAL ORGANIZATIONS

Entrepreneurship is variously interpreted, in one approach entrepreneurship is understood as a set of personal characteristics describing a particular way of acting of certain individuals. In this sense, a person is entrepreneurial when characterized by following features: initiative, creativity, imagination, ability to take risks, independence, ambition, and leadership skills. This approach to entrepreneurship is close to the common understanding of the term, meaning ingenuity, breadth, resourcefulness [Bratnicki, 2002, p. 25].

Entrepreneurship is determined by [Czerniachowicz, 2012]:

- personality,
- individualism,
- professed value system.

Entrepreneurship is much more conducive to traits associated with nonconformist personality.

In another approach, entrepreneurship is interpreted as a process of creating and building something new that involves innovative elements. So that the entrepreneurship is inseparable from the risk.

H.H. Stevenson and J.C. Jarillo argues that entrepreneurship is a process that is to motivate individuals to create additional value and indicate that entrepreneurship should be treated as an important element of strategic management [Stevenson & Jarillo, 1999]. R. W. Griffin interprets entrepreneurship as "entrepreneurship is the process of organizing and running a business and taking related risks", while an entrepreneur is someone "who takes actions covered by the name of entrepreneurship; someone who organizes and runs a business and takes risks" [Griffin, 2002, p. 730]. In terms of process, entrepreneurship is also interpreted by R.D. Hisrich and M.P. Peters who say that "entrepreneurship is the process of creating a new value by making the necessary time and effort and adopting financial, mental and social risk, which results in obtaining results in the form of monetary profit and a sense of personal satisfaction and independence" [Hisrich & Peters, 2004].

P. F. Drucker interprets that entrepreneurship as a way the entrepreneur and his company behave. It means the willingness to undertake and solve new problems in a creative and innovative way. It also means the ability to use emerging opportunities and threats, and flexible adaptation to changing conditions. Drucker emphasizes that an innovation is a specific entrepreneurial tool that gives a chance to use resources in a new way and create socio and economic wealth [Drucker, 1992, pp. 34-39]. In essence, this author distinguishes three concepts: entrepreneurship in the meaning of the personality traits, "entrepreneurial enterprise and entrepreneurial management", indicating that the personality itself is insufficient and must be supported by the principles and practices of entrepreneurial management. Otherwise the company instead of looking forward and being creative, becomes passive and looks back.

T. Listwan considers entrepreneurial action to be the one that is "primarily related to project initiation, creative problem solving, risk taking, creation and exploitation of opportunities, and flexible adaptation to the environment" [Listwan, 2004, p. 201]. He adds that these behaviors are inextricably linked to the competences of an entrepreneurial person.

The meaning of entrepreneurship involves an entrepreneur who takes an action to make a change in the world. Whether startup entrepreneurs solve a problem that many struggle with each day, bring people together in a way no one has before, or build something revolutionary that advances society, they all have one thing in common: action. It's not some idea that's stuck in your head. Entrepreneurs take the idea and bring it into alive. Entrepreneurship is about ideas' implementation.
Today in large organizations there are no classic entrepreneurs who would spread the idea of entrepreneurship. Manager and specialists took their place. The phenomenon of corporate entrepreneurship is to spread the "spirit" of entrepreneurship both inside and outside the company. Entrepreneurial organizations are those that are[Targalski, 1999, pp.134-140]:

1. Focused on maximizing the value of the client, which means their inclination and readiness to change the field of operation.
2. Characterized by high flexibility and adaptability, thanks to which they quickly adapt to changing market conditions.
3. Based mainly on human capital and knowledge. They prefer a more participatory, participatory management system, thanks to which they release the initiative and integrate employees with the company.
4. Focused on maximizing the use of opportunities and minimizing threats, which means, among others, that they constantly modify their domain of activity.
5. To create value added and appropriate as much as possible.
6. Looking for new products of balance as a result of permanent search for and implementation of both product and process innovations, they infringe.
7. Characterized by freedom of action, flat structure.
8. Those which reward for the initiative.

Entrepreneurial organizations are those oriented towards change and innovation. The change is perceived as an opportunity rather than a threat. What is more the common belief is that that a company that does not introduce innovations cannot develop itself. In the period of rapid changes, this means losing competitive advantage on the market. Entrepreneurship can be considered in the context of a management approach, which means seeking and using opportunities, and not limiting oneself to the currently owned resources [Korpysa, 2016].

ENTREPRENEURIAL UNIVERSITY

"Entrepreneurial university" is a characteristic of social systems, that is of entire universities and their internal departments, research centers, faculties and schools. In the conceptualization, universities tend to be entrepreneurial in two main ways. Firstly, academic entrepreneurship focuses on the commercialization of knowledge and research findings. In this way universities are perceived as knowledge hubs with aim to transfer a technology. A second way of becoming an entrepreneurial university is through entrepreneurial education (the university's teaching mission) to create entrepreneurial competencies among students and employees. Despite of an increasing number of publications on university entrepreneurship scant attention has been paid to the role of context in the emergence and development of entrepreneurial universities. Basing on an extensive literature review, authors of the article conclude that research on university's entrepreneurship lacks a complexity that is needed to better understanding interdependent processes across different actors, agents, and institutions [Gibson & Foss, 2017].
There are several definitions of an Entrepreneurial Universities and different authors do not show a consensus on the theme (see Table 1).
The entrepreneurial university is a result of complex processes by which institutional forces both shape, and are shaped by organizational and individual actions. A main contribution of this approach is to offer a greater appreciation for the history and unique nature of the entrepreneurial university's development and operation, in relation to its institutional context, interrelationships, and interdependences [Sperrer et al., 2016].

Table 1: Principals definitions of Entrepreneurial Universities
(Source: Guerrero-Cano et al., 2014; Etzkowitz, 1983; Chrisman et al., 1995; Dill, 1995; Clark, 1998; Röpke, 1998; Subotzky, 1999; Kirby, 2002; Etzkowitz, 2003; Jacob et al., 2003)

Year	Author	Definition
1983	Etzkowitz	"Universities that are considering new sources of funds like patents, research under by contracts and entry into a partnership with a private enterprise"
1995	Chrisman, et al.	The Entrepreneurial University involves "the creation of new business ventures by university professors, technicians, or students"
	Dill	"University technology transfer is defined as formal efforts to capitalize upon university research by bringing research outcomes to fruition as commercial ventures. Formal efforts are in turn defined as organizational units with explicit responsibility for promoting technology transfer"
1998	Clark	An Entrepreneurial University, on its own, seeks to innovate in how it goes to business. It seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. Entrepreneurial universities seek to become "stand-up" universities that are significant actors in their own terms"
	Röpke	"An entrepreneurial university can mean three things: the university itself, as an organization, becomes entrepreneurial; the members of the university - faculty, students, employees- are turning themselves somehow into Entrepreneur; and the interaction of the university with the environment, the "structural coupling" between university and region, follows entrepreneurial patter"
1999	Subotzky	"The entrepreneurial university is characterized by closer university-business partnerships, by greater faculty responsibility for accessing external sources of funding, and by a managerial ethos in institutional governance, leadership and planning".
2002a	Kirby	"As at the heart of any entrepreneurial culture, Entrepreneurial Universities have the ability to innovate, recognize and create opportunities, work in teams, take risks and respond to challenges"
2003	Etzkowitz	"Just as the university trains individual students and sends them out into the world, the Entrepreneurial University is a natural incubator, providing support structures for teachers and students to initiate new ventures: intellectual, commercial and conjoint"
	Jacob, et al.	"An Entrepreneurial University is based both commercialization (customs made further education courses, consultancy services and extension activities) and commoditization (patents, licensing or student owned star-ups)".

Nelles and Vorley have developed the university's entrepreneurial architecture in terms of five key dimensions [Nelles & Vorley, 2009]:

1. Structures: Includes technology transfer offices, incubators, technology parks and business portal.
2. Systems: Focuses on networks of communication and the configuration of linkages between structures and administration.
3. Leadership: Emphasizes the qualification and orientation of key influencers including administrators, board of directors, department heads, and "star scientists".
4. Strategies: Refers to institutional goals elaborated in institutional planning documents, incentive structures, and policy.

5. Culture: Refers to institutional, departmental and individual attitudes, and norms [Nelles & Vorley, 2010].

Organizations are made up of rules, laws, formal policies as well as groups or communities from elite networks to civic associations and neighborhood teams. It is therefore important how national and regional institutions work together to build policies, attitudes and actions to change entrepreneurship inside and outside the university. It is also important how the university affects its regional context [Foss & Gibson, 2015].

Gibson and Foss pointed out how institutional changes should be assessed at three levels of analysis [Gibson & Foss, 2017, p. 2]:

1) The Regulative Pillar contains authorized specifications, including regulations, management and monitoring systems. It comes from economics and describes a rational model of behavior, including sanctions, rules and compliance. Therefore, it answers the question: How or to what extent national or regional rules and regulations encourage or discourage entrepreneurship?
2) The Normative Pillar - concerns values, expectations and standards (including roles, repertoires of activities, conventions and standards). University cultures and surrounding contexts can encourage or discourage entrepreneurship, this pillar is important in understanding motivation for or resistance to, behavioural and institutional changes toward entrepreneurship.
3) The Cognitive Pillar - includes predispositions and symbolic values as models of individual behavior regarding individual acceptance of entrepreneurship within universities and their contexts. Are some actors e.g. lecturers, staff, students more willing to support entrepreneurship on the university?

The analysis of the significance of the five architecture dimensions for the entrepreneurial change the take into account the following factors: the number of lecturers and students, the size of research budgets, whether the university is a relatively new institution, whether the university is located in a large city or village. Although no significant patterns have emerged, it is clear that the analysis of each dimension of architecture helps to understand the return of entrepreneurship in each university in terms of: How universities interact with their institutional context in developing entrepreneurship and what actors and forces are the most important in motivating institutional change in development architecture entrepreneurship of the university?

The significance and impact of the regional and national context in which the university is set, regarding the launch, development and sustainability of programs and activities supporting the return of entrepreneurship. As the institutionalists emphasize the continuous influence of the old on the new, all case reports provided examples in which new strategies and entrepreneurial programs entered the existing contexts to which they had to adapt and which supported or impeded the return of entrepreneurship. The institutional change can be initiated "from top to bottom" and "bottom up" by formal and informal leaders and action [Gibson & Foss, 2017, p. 3-12].

Cross-sectional analysis shows that there are different ways to implement the entrepreneurial mission and that every dimension of architecture can be used in many ways. However, in all cases there is a general consensus that these dimensions were important for the entrepreneurial rotation of the academies and regional entities. While context is seen as the overriding determinant, we suggest the importance of identifying the hierarchy of influences in the five dimensions of architecture. The culture is seen as the dominant force that strongly affects the regulatory pillar as well as norms and cognitive orientations of leaders (influences) that are key to implementing effective and sustainable entrepreneurial systems, strategies and structures [Guerrero & Urbano, 2010]. However, it is well known that there are important recursive and interactive loops in all architecture dimensions, Figure 1.

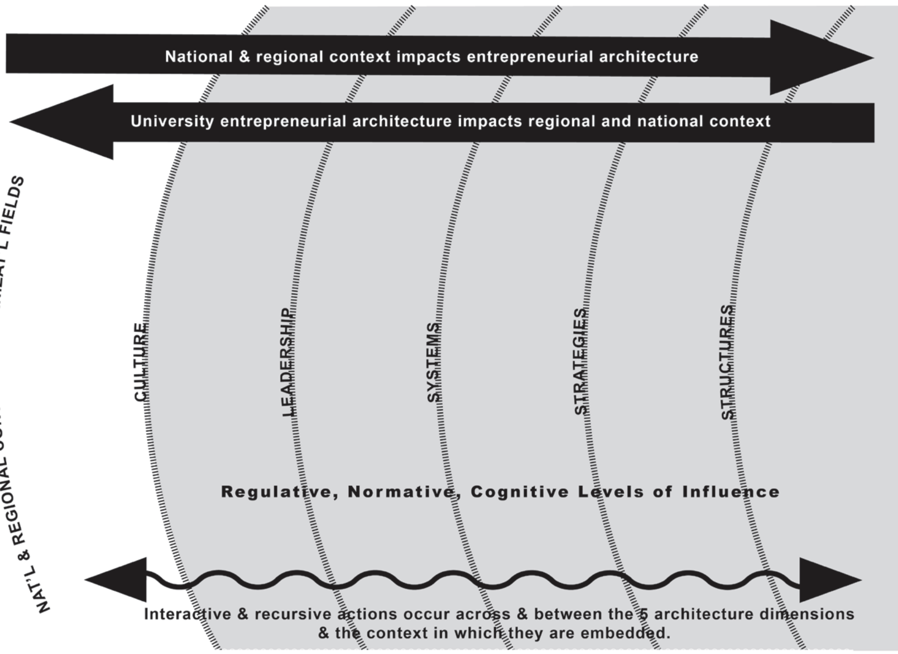

Figure 1: Interactive and recursive actions occur across the five architecture dimensions and the three pillars of influence as well as the context in which they are embedded.

Source: Foss & Gibson (2015), p. 271; Gibson & Foss (2017), p. 12.

Therefore, building the "structure" in the first place - without taking into account and involving university and regional leaders, systems and strategies - is not the most effective way to motivate to change entrepreneurship. The development and functioning of such structures is beneficial due to the awareness of the impact of existing attitudes on entrepreneurship at key levels or sectors of the university, as well as the region in which the structure is embedded. There are countless examples of top-down government-planned and funded structures around the world (e.g. science parks, incubators, research galleries) built as a visible and important commitment to a creative and innovative economy that ultimately does not contribute to entrepreneurship in a meaningful and sustainable way or to create wealth , jobs and new technologies [Peris-Ortiz et al., 2017]. At the national level, there is also a need to structure policies for innovative research and for creating entrepreneurial capacity that recognizes and rewards established excellence. The challenge is that many institution do not have well-known research traditions. The process of academic entrepreneurship shows table 2.

Younger universities have an important role to play in stimulating the culture of entrepreneurship and activity in the region. By contrast, older universities often use established research excellence and more prominent publications achievements and the acquisition of competitive financial rewards. In addition, the financial impact of knowledge transfer from universities varies depending on the regional context. Within one university, there can now be significant professional and cultural differences within colleges and research units, as well as levels of authority among lecturers and administrators, as well as students who realize the return of entrepreneurship [Gibson & Foss, 2017, pp.11-13].

Table 2: The process of academic entrepreneurship
(Source: Brennan & McGowan, 2006)

Analysis level	**Searching for advantage**	**Searching for news**	**Searching for opportunities**	**Type of knowledge**
Entrepreneurial system	Triple helix. University, industry, government	Innovative systems	Entrepreneurial systems	Coded
University	Creation of knowledge	Production of knowledge	Entrepreneurial university	Embedded, rooted
Academic school	Organization of knowledge to achieve advantage	Absorption capacity	Organizational learning	Educated
Routines, procedures	Informal networks	Learning	Individual areas and opportunities	Incorporated
Researchers	Differences in individual styles	Climate and creativity	Domain, field of opportunity	Rooted in mind / intelligence

Given diverse political and market contexts of universities worldwide, there is a clear need for a theoretical lens that addresses this multilevel phenomena in a diverse range of environmental settings [Oberman-Peterka & Strossmayer, 2012]. Theory should emphasize that universities are both creatures of their institutional environments as well as active players in these processes. A comparison between a traditional university and an entrepreneurial university is shown in Table 3.

Table 3: Traditional university and entrepreneurial university – comparison
(Source: own study based on Alvarez-Suescun & Salazar, 2014; Olearnik & Pluta-Olearnik, 2016)

Dimensions		**Traditional university**	**Entrepreneurial university**
Research	Orientation	Science-driven and researchers interest. Monodisciplinary	Basic and applied research. Science and market-driven
	Diffusion of results	Open: publications and conferences	Open: publications and conferences Restricted: patents, licenses, confidentiality agreements
	Incentives	Based on publications and scientific breakthroughs	Based on publications as well as on patents, royalties and creation of new firms
	Innovation	Great strength of tradition and attachment to conventional solutions	Openness to innovations in education and science, creative impact on the external environment, investment dynamics
Teaching	Objective	To create scientists and professionals	To create scientists, professionals and entrepreneur
	Orientation	Monodisciplinary. Focused on scientific fields, according to faculty's background	Transdisciplinary/Interdisciplinary. Focused on scientific fields and industry needs
	Levels	All – undergraduate, graduate and doctorate	Focused on graduate and doctorate

	Profile of an academic teacher	Master, authority, sage, independent proclaimer, mentor	Knowledge relay, trainer, advisor, efficient lecturer, academic manager
Third mission	Vision	Searching for truth, disseminating knowledge, educating elites, creating humanity and universal cultural values, serving society	Adaptation of scientific research and education to the requirements of the real economy, market, business environment and local, regional, national and international administration
	Orientation	Development of society's knowledge repository through research and training	Development of society's knowledge repository and economic and social development through knowledge exploitation
	Contribution to social development	Improvement of national/regional advantage. Cultural diffusion	Source of intellectual fields and engine of regional transformation through firm formation
	Linkages	Bilateral cooperation: universities - government	Triple helix: universities – industry – government
	International environment	The large role of scientific contacts, team cooperation, transfer of knowledge and experience	Striving for broadly understood internationalization of the university, openness to comprehensive international contacts
Governance	Model	Local government model, the decisive role of academic staff and university bodies	Managerial model, separation of academic self-government and professional management
	Financing	Focused: State and/or tuitions (to a much lesser extent, donations)	Diversified: State, private, donations and knowledge commercialization
	Strategy	Limited capacity of response to changes. Institutional isomorphism	Flexibility and adaptation to changes. Differentiation
	Leadership	Transactional	Transformational
	Structure	Bureaucratic, rigid. Closed	Flexible, autonomous. Open through intermediary structures
	Culture	Closed. "Ivory tower"	Open, goal-oriented, competitive, entrepreneurial

The entrepreneurial university can be seen from the perspective of research, teaching, third mission and management. The entrepreneurial organization should implement basic and applied research for the purpose of the science and the market. Dissemination of results could be open for publication and participation in conferences, but limited in patents, licenses and confidentiality agreements [Alvarez-Suescun & Salazar, 2014]. Such an organization should be characterized by openness to innovations in education and science. It should also influence on the external environment and on investment's dynamics.
The entrepreneurial university focuses on creating scientists, specialists and entrepreneurs. Teaching orientation is related to transdisciplinary and / or interdisciplinary education, focusing on the fields of science and industry needs as well as on graduates and doctorates. The profile of an academic teacher at an enterprising university is very specific. It is a person who transfer the knowledge, ia a trainer, an adviser, an effective lecturer and an academic manager. The vision of the entrepreneurial university focuses on development of society's knowledge and economic and social development through knowledge exploitation [Olearnik & Pluta-Olearnik, 2016]. Cooperation on the basis of a triple helix is very important: universities - industry – government, regional transformation through firm

formation and the pursuit of broadly understood internationalization of the university, openness to comprehensive international contacts [Alvarez-Suescun & Salazar, 2014].
An enterprising university characterized by managerial model, separation of academic self-government and professional management [Olearnik & Pluta-Olearnik, 2016]. The financing of the activity at the entrepreneurial university should be diversified (state, private, donations and knowledge commercialization). The strategy of the entrepreneurial university is characterized by flexibility and adaptation to changes. Leadership must be transformational, not transactional as in a traditional university. The structure of an entrepreneurial university is flexible, autonomous and opened thanks to intermediary structures. Whereas the culture of an entrepreneurial university is open, goal-oriented, competitive and entrepreneurial [Alvarez-Suescun & Salazar, 2014].

DISCUSSION AND FURTHER RESEARCH DIRECTIONS

To sum up, it should be noted that an additional element has joined the traditional elements of the university's mission, education and research, cooperation with the socio-economic environment. This is an important feature of an entrepreneurial university. The university environment includes stakeholders: individual persons, groups of people, other universities, social and administrative institutions as well as market entities with which the university has various relations. The university should identify individual entities in this environment, shape the desired relationships with these entities, maintain and develop these relationships - all in the interest of the university itself and in the interest of the local environment. Universities must respond to contemporary economic and market challenges, they should have the power to adapt to these challenges [Olearnik & Pluta-Olearnik, 2016].
Internationalization is another important determinant of the entrepreneurial orientation of universities [Pluta-Olearnik, 2012]. For universities in developing countries, this is a fundamental criterion, since the internationalization of universities is perceived as the developing ability of its cooperation with entities from other countries. The measure of success are international agreements concluded, the participation of students and employees in international exchange, expenditure on projects in this field, foreign employees and students visiting the university, international conferences, the number of international publications, and international research teams.
In Poland, the idea of an entrepreneurial university is gaining popularity, especially during constant economic changes, new social processes, and huge transformations in the education system [Kozłowski, 2001; Pluta-Olearnik, 2009; Gorzelak, 2009; Burawski, 2013].
However, implementing an entrepreneurial university concept takes time and is not easy or simple. It depends on the changes in the consciousness, attitudes of employees, mainly university authorities in Poland. There is a demand to give up traditional way of action in favor with modern entrepreneurial university which is opened to the external environment. Changes in the law in Poland should also be introduced. It would be important to reform the centrally enacted law in the country, which is a very strong indicator, and sometimes a limitation of the university's activities. The process of transformation an university into an entrepreneurial one requires many significant and deep changes. One the most important demand refers to modification of academic self-government which should be based on substantiveness and professionalism.
Further work and research can be carried out in terms of identifying internal and external conditions for creating an entrepreneurial university. An important direction of research also refers to the creation of a university model and management of an entrepreneurial university, especially in the context of adapting the organization to new changing trends and a more complex world. Particular emphasis should be placed developing university strategy, public policy and start-up support system. Those are instruments of supporting the entrepreneurship among students, graduates and university staff. Different perspectives related to the entrepreneurial concept of the university and its role in stimulating economic growth through cooperation with business and government are also important. Additionally, you can search for answers to the following questions:

What are the key features of entrepreneurial universities?
How to change the attitude of employees, students, stakeholders to build a coherent concept of an entrepreneurial university?
What tools, processes and activities should universities use to successfully implement the idea of an entrepreneurial university?
What opportunities and threats exist when implementing the idea of an entrepreneurial university?
All above questions define further research field.

CONCLUSIONS

In conclusion, it should be noted that promoting entrepreneurship and creating an entrepreneurial university is very important in these times. The concept of the entrepreneurial university aims to promote the transfer of academic knowledge to different organizations and lead to socio-economic development.
The growing importance of knowledge in the everyday life is a challenge for an entrepreneurial university. The concept goes far beyond the traditional understanding of the role the university plays in the society. It is not any more just teaching and conducting basic research. Nowadays it is important that universities are well prepared for technology transfer, implementing marketing ideas and registering patents, creating spin-offs that contribute to industrial innovation, job creation and economic growth [Meissner et al., 2018]. The enterprising university is also focused on the didactic activity and offers training programs in knowledge-based fields.
There is no just 'one the best way' or a kind of 'set of best practices' to establish an entrepreneurial economy. The university-oriented policy is also often interpreted and applied in various ways within and between colleges and university departments. Different universities have different orientations toward the dimensions of entrepreneurial architecture that reflect the context in which they are embedded. Developing entrepreneurship is a complex process that take place on different levels of hierarchy, and is strongly influenced by wider institutional and organizational environments.

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Engineering Studies in Poland: Gender Pattern

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ABSTRACT

Modern economy requires knowledge and skills, which are acquired by future employees mostly in the fields of education including science and engineering. The increase in the number of graduates in this type of studies can be achieved in different ways, one of which is to create conditions and increase the propensity of women to obtain this type of education. The aim of the research presented in the article is to analyse long-term trends in the number of students and graduates in Poland, with particular emphasis on engineering faculties and the participation of women. Authors using dispersion and structural similarity measures and dynamic models showed that the total number of students and graduates and the number of students in engineering studies are characterised by different patterns. At the same time, in both cases a different structure of total students and engineers by gender was observed, as well as a growing share of women.

Keywords: *tertiary education, engineering programmes, gender equality*

INTRODUCTION

One of the most important gender equality is related to access to education. We can recognize also other kinds of gender segregation like: horizontal occupational segregation, vertical/hierarchical segregation, pay segregation and segregation in values and preferences (Pološki Vokić, Sinčić Ćorić, Obadić, 2017). Many studies and research confirm that the gender disparity observed in the education sector has a direct link to poverty (Appleton, 1996), as well as to child survival, health and education (Schultz, 2002). According to The World Bank gender equality, whether in education or other areas is very important for increasing productivity and higher women's integration in the labour market (World Bank, 2012). The study of Licumba *et al*. based on a panel data of five Southern African countries between 1970 and 2010, suggests that there is a positive and significant effect of gender equality in education on economic growth (Licumba, Dzator, Zhang, 2015). This relation was proved by Klasen (2002) who based on sample of 109 countries between 1960 and 1990 indicated a positive and significant coefficient of gender equality on economic growth. Some authors provided evidence that the effect of female education on economic growth depends on the country's degree of industrialisation (Dollar, Gatti, 1999), while other shows that countries with high levels of female schooling will have higher levels of labour productivity and growth, regardless of the degree of industrialisation and/or level of human capital (Knowles, Lorgelly, Owen, 2002). Lagerlof (2003) explains how changes in gender equality in education are likely to affect the process of growth of human capital. In his model as equality in education goes up, women's time becomes expensive and couples tend to substitute quantity for quality of children. Fertility rates decline and investment in human capital and income *per capita* rises (see also: Kalaitzidakis et al., 2001). According to (OECD, 2017) OECD members should adopt practices that promote gender equality in education by: making the study equally inclusive and attractive for women and men, raising awareness among young men and women, parents, teachers and employers about the likely consequences of educational choices for employment opportunities, career progression and earnings as well as encouraging more women who have completed STEM (such as science, technology, engineering and mathematics) studies to pursue professional careers in these areas. Such practices are also implemented in other countries. Tahir and Yaqoob (2018), based on a sample of 600 alumni of universities in three districts of the Southern Punjab in Pakistan concluded that university education sensitizes women regarding gender equality and its role is visible in increased girl enrollment and women labor participation. Diversity education, focusing on different forms of difference implemented without providing clear definitions and policy goals to achieve gender equality, increases the risk for diminishing the transformative intent of broader social justice goals and overlooking gender equality completely (Forbes, Öhrn, Weiner 2011; Loots, Walker, 2015). That's why many studies still report on the persistence of deeper seated inequalities between the genders in all spheres of higher education (e.g. Francis, Burke, and Read 2014). Women in both developed and developing countries continue to experience inequality in terms of education, employment status, hierarchical positions, compensations and career advancement (Burke, Singh, 2014; Kalayci, Hayirsever, 2014). Although in a modern world women are more represented in the workforce, caught up with men in the rates of higher-education graduation, increased their training and representation in formerly male-dominated professional fields in STEM, and they entered many previously male-dominated occupations (Costa *et al.*, 2014), still even in more gender egalitarian national cultures, women and men continually occupy highly differentiated gender roles, resulting in the greater likelihood of women taking the primary responsibility for home and family in addition to paid work/career (Seierstad, Kirton, 2015). Tertiary education plays a crucial role in economic growth and social progress. Higher education drives research and innovation that fosters positive economic and social change at the local, regional, and national levels. In 2018 in the EU according to Eurostat 40.7% of people aged 30-34 hold a tertiary degree. The EU has thus effectively reached the 40% target set by the Europe 2020 strategy to promote economic growth and employment, while 45.8% of women, and only 35.7% of men, held a tertiary education qualification, although we can observe high variation in these attainment rates across countries mostly due to different labour migration or learning mobility patterns (Education and Training Monitor 2018, 2018). In the EU countries, more women complete their studies than men, while in the case of newcomers this proportion is the opposite (Silander, Haake, Lindberg, 2013). In 2016, women accounted for 54.1% of tertiary students in the EU, being a majority among tertiary students in all of the EU Member States except for Greece (48.5%) and Germany (48.2%). It is worth noting that these proportions are considerable different between academic disciplines. Across the EU-28, almost one third (32.0%) of all students in tertiary education were studying social sciences, journalism, information, business, administration or law in 2016. The second most common field of education was engineering, manufacturing and construction-related studies which accounted for 15.7% of all tertiary education students. In this field, almost three quarters (74.1%) of all students were male. Within natural sciences, mathematics, statistics, and information and communication technologies (ICT) the share of men in the total number of tertiary students was 61.1%. In 2016, an analysis of the number of graduates in the EU-28 by field of education shows that 14.8% of all students had graduated in engineering, manufacturing and construction-related studies and 11.0% in natural sciences, mathematics, statistics and ICT. Within the EU-28, close to three fifths (57.6 %) of all graduates in 2016 were women. An analysis by programme orientation reveals that this share was equal to 42.5% for natural sciences, mathematics, statistics, and information and communication technologies, and close to one quarter (27.7%) of the total for engineering, manufacturing and construction-related fields. In the same time we can observe diversified gap between the number of male and female graduates relative to the size of the population aged 20-29 across countries as well as field of studies (Tertiary education statistics, 2018). The main objective of the research is to present long-time tendencies for propensity of women to enrol engineering studies in comparison to men in Poland. In the paper a problem of regional differences of STEM graduates was also undertaken. To achieve these goals authors have used different methodological approaches like dispersion and structural similarity measures and models. The data covers period 2005-2018 for students and period 2004 do 2018 for graduates. The authors have verified the research hypothesis that we can observe the growing participation of women in engineering higher education.

RESEARCH METHODS

The analyses of changes in the number of students and graduates, as well as in the gender structure were based on chosen statistical measures and econometric models of dynamics. The authors used for this purpose: relative changes, the coefficient of variation, trend models:

$$\hat{y}_t = \beta_0 + \beta_1 t + u_t \qquad (1)$$

where:

y_t – dependent variable,
t – time variable, $t = 1, 2, \ldots, n$,
β_0, β_1 – coefficients,
u_t – error term,

and the distance measure of structures (city metric), calculated according to the following formula:

$$v_t = \sum_{i=1}^{k} |\alpha_{it} - \alpha_{it-1}| \qquad (2)$$

where:

k – the number of components in the analysed structure,
α_{it} – share of i–th component in the analysed structure in period t,
α_{it-1} – share of i–th component in the analysed structure in period $t-1$.

EMPIRICAL ANALYSIS

The data comes from Statistics Poland (2019) and concern students of Polish higher education institutions as of 30 XI in the given academic year between 2005 and 2018 and graduates of Polish higher education institutions in the given academic year (2003/2004 – 2017/2018). The structure of the obtained data made it possible to perform analyses by gender and taking into account engineering studies. Figure 1 presents the total number of students of Polish higher education institutions in Poland 2005–2018.

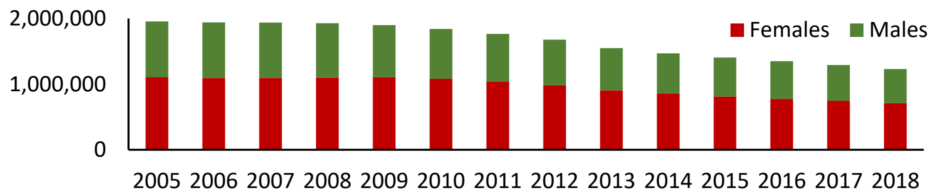

Figure 1: Students of Polish higher education institutions as of 30 XI in the given year (2005–2018) – grand total

During the whole analyzed period there is visible strong decreasing tendency in the number of students of higher education institutions. In 2005-2008 the changes in the number of students (both females and males) were very small whereas in 2009-2018 the changes were greater (faster fall for males than for females). The number of female students is greater than number of male students in all years.

Figure 2 presents the number of students of first–cycle programmes with the title of Engineer in 2005–2018 in Poland.

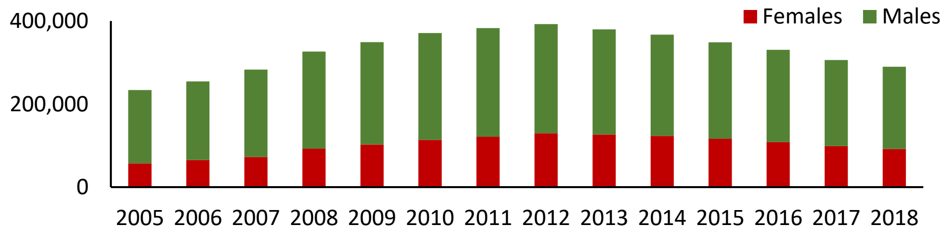

Figure 2: Students of Polish higher education institutions as of 30 XI in the given year (2005–2018) – first-cycle programmes with the title of Engineer

The number of students of first–cycle programmes with the title of Engineer increased in the first part of examined period (2005-2012) and decreased in the second part (2012-2018). The fall in the first period was slower than growth in the second period. The share of female students in students of first–cycle programmes with the title of Engineer is about three times smaller than share of male students. Table 1 presents parameters of linear trend models and relative changes for 6 examined variables in the research period.

Table 1: Parameters of linear trend models and relative changes for students (2005-2018) and engineering students (2012-2018) of Polish higher education institutions

Variable	β_0	β_1	R^2	Relative change (2018/2005)
Students grand total	2131648.93*	-62905.22*	0.95	-37.03%
2 students grand total females	1214900.46*	-34311.98*	0.91	-35.37%
3 students grand total males	916748.47*	-28593.24*	0.98	-39.20%
4 students engineers total	415169.29*	-17545.61*	0.99	24.14%
5 students engineers total females	139858.86*	-6560.71*	0.97	60.72%
6 students engineers total males	275310.43*	-10984.89*	0.99	12.29%

* – parameters statistically significant on the level 0.01

All estimated parameters in all trend models were statistically significant and goodness of fit was very high. All estimated slopes were negative what means that values of examined variables decreased systematically during analyzed periods. Comparing values in the first year (2005) and in the last year (2018) one can observe that for 3 variables (grand total) level in the last year was lower than in the first year of study whereas the situation for students engineers was different. Although there was a drop in the second part of analyzed period the level in 2018 was still higher than in 2005. Figure 3 presents the total number of graduates of Polish higher education institutions in 2003/2004 – 2017/2018 in Poland.

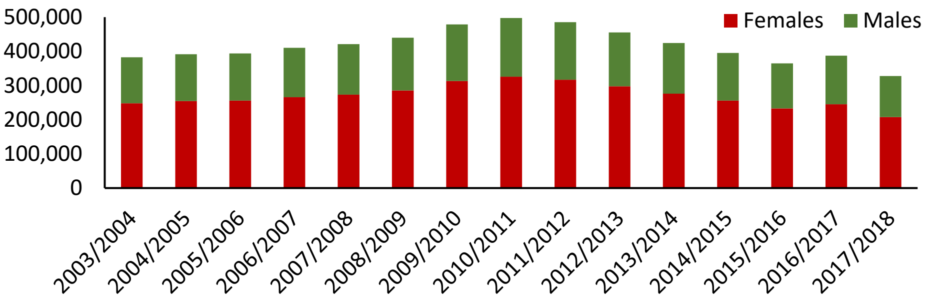

Figure 3: Graduates of Polish higher education institutions in the given academic year (2003/2004 – 2017/2018) – grand total

The number of graduates of Polish higher education institutions increased in the first part of examined period (2003/2004-2010/2011), decreased in the second part (2010/2011-2017/2018) apart from one academic year – 2016/2017. The decrease in the second part of analyzed period was so fast that the number of graduates (both females and males) was much lower in 2017/2018 than in 2003/2004.
Figure 4 presents the number of graduates of first–cycle programmes with the title of Engineer in 2003/2004 – 2017/2018 in Poland.

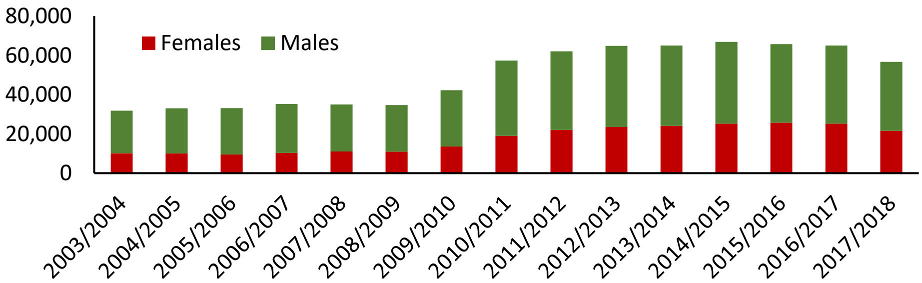

Figure 4: Graduates of Polish higher education institutions in the given academic year (2003/2004 – 2017/2018) – first–cycle programmes with the title of Engineer

The number of graduates of Polish higher education institutions (both females and males) in the first part of analyzed period was about twice lower than in the second part. It is a positive phenomenon but in the last academic year the value of analyzed variable again dropped although not in the high degree. Table 2 and 3 present distances between gender structures of students and graduates in the selected years of the research.

Table 2: Distance between gender structures of Polish students of higher education institutions in 2005 and in 2018

Grand total	0.0299
First–cycle programmes with the title of Engineer	0.1442

The shares of females and males in students of higher education institutions were almost the same at the beginning and at the end of analyzed period – distance between structures in 2005 and 2018 was very close to zero. Such distance was greater in case of students of first–cycle programmes with the title of Engineer – the share of females increased from 24.5% in 2005 to 31.7% in 2018 what is a positive phenomenon.

Table 3: Distance between gender structures of graduates of Polish higher education institutions

Academic years	Grand total	First–cycle programmes with the title of Engineer
2003/2004 – 2017/2018	0.0278	0.1232
2003/2004 – 2010/2011	0.0137	0.1165
2010/2011 – 2017/2018	0.0415	0.0067

Because of different tendencies for graduates in the first and second part of analyzed period the distances were calculated for three pairs of academic years. The smallest distance characterized structures in the second part of analyzed period so the changes in shares of females and males in the first academic years were responsible for the value of distance of structures in the whole period. The share of females increased from 31.95% in 2003/2004 to 38.1% in 2017/2018 what is again a positive phenomenon. Figure 5 presents the number of graduates of first–cycle programmes with the title of Engineer by gender and voivodships in the academic year 2017/2018.

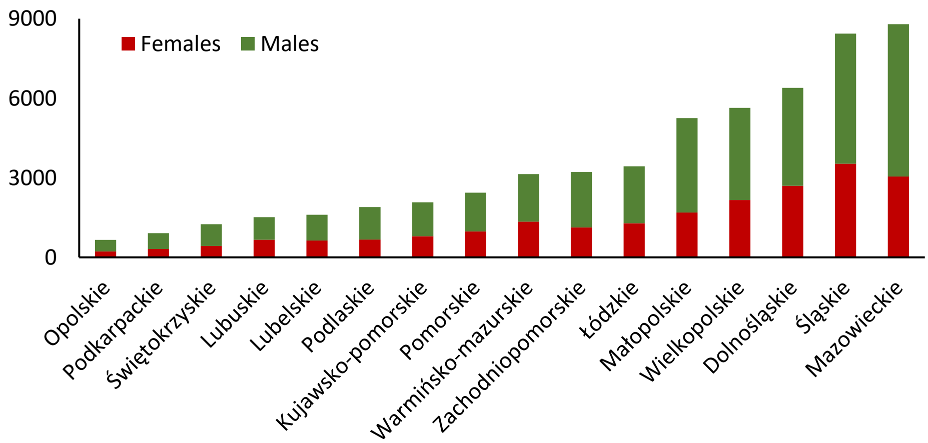

Figure 6: Graduates of Polish higher education institutions in the academic year 2017/2018 by voivodships– first–cycle programmes with the title of Engineer

In comparison to academic year 2003/2004 the number of graduates of first–cycle programmes with the title of Engineer grew substantially in all regions although the number of technical universities in all voivodships did not change. The greatest increase was in Mazowieckie (capital voivodship) – from 6,000 until almost 9,000 graduates and also in voivodships: Śląskie, Dolnośląskie, Wielkopolskie and Małopolskie. We have noticed also the growing share of women among graduates in all regions. Figure 7 presents coefficients of variation (CV) of share of females in graduates of first–cycle programmes with the title of Engineer in voivodships in 2003/2004 – 2017/2018.

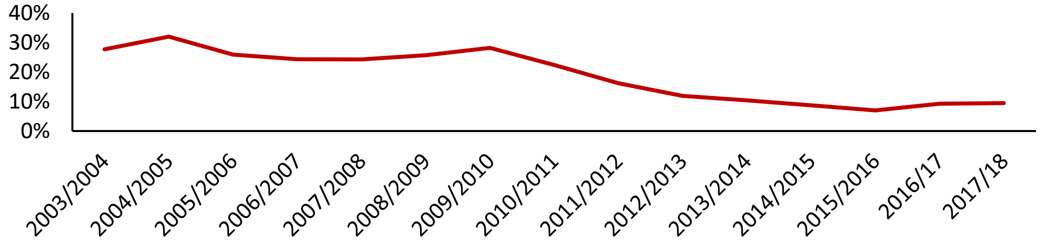

Figure 7: Coefficients of variation of share of females in graduates of higher education institutions in voivodships in 2003/2004 – 2017/2018 – first–cycle programmes with the title of Engineer

We can observe diminishing values of CV beginning from 2010/2011 academic year, which is evidence of higher homogeneity of analysed regions according to gender structure of graduates in engineering fields of study.

CONCLUSIONS

In Poland there has been a decrease in the number of students in recent years. This applies mainly to master's and part-time studies. A significant decrease in the number of students started in 2010 and could be caused, among other things, by a better situation on the labour market, as graduates of Bachelor's studies could find employment relatively easily and their wages are similar to graduates of Master's studies. Among engineers, this trend was different and was characterised by an increase in the number of students until 2012 and a subsequent decrease. Different patterns over time and different gender structures were also characteristic of total and engineering graduates. In the analysed period, an increase in the share of women both among students and graduates was also observed, mainly in engineering studies. This phenomenon is connected with the change of cultural and social patterns – women gain more independency and prefer career over motherhood. At the same time, the results obtained indicate that regional differences in the share of women in engineering studies are levelling out. Unfortunately, other studies being conducted indicate that the participation rate of women in the Polish labour market is still characterized by strong differentiation at the regional and sectoral levels, and there still exists significant gender wage gap (Batóg, Batóg, 2018). Removing these differences requires more effective implementation of state policies in these areas.

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