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D6.3.1: First Internal Evaluation Report

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Introduction

Objective of the feasibility study (EUDURE) was to identify the potentials and experiences of the partner countries and to find adaptive elements for transfer that can best be harmonized and adapted to the respective goals, structures and cultures. The EUDURE project examined the framework conditions and transfer options of the German dual study principle in Bulgaria, Romania and Croatia. Finally, a specific recommendation for action was issued.

The DAAD study's transfer factors, which have been identified for the institutionalisation of dual study elements in other countries, serve as a basis for measuring the adaptation potential: "Dual study programmes in a global context: internationalisation in Germany and transfer to Brazil, France, Qatar, Mexico and the USA". Within the framework of the EUDURE study, the central questions based on the DAAD study have been asked on this basis:

- 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?

The study examined the transfer potential of the German dual system of study to Bulgaria and Romania with a corresponding preference. A further important condition for the transfer of the dual study programme 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, along with updated information regarding the social, economic and political situation will be exposed in the following paragraphs.

Country Inventory

The country Inventory is reflecting the feasibility study conducted in preparatory project, but also it is explaining how the programmes were selected. The existing VET and WIL inventory was updated as a result of an initiatives in Bulgaria, Romania and Croatia.

Bulgaria

Economical and Political Aspects

Although Bulgaria, with around 46 percent of EU GDP per capita, is the poorest country in EU, and still struggling with problems like alarming decrease in population, increasing emigration of well-educated young people, due to the lack of job opportunities and corruption, as well as difficult integration of the Roma population, the situation last years is changing. The new generation in Bulgaria want to open up to a Europe-compatible country strategy. Among other things, these efforts should be supported by innovative educational concepts that can help to improve competitiveness not only in the administrative and infrastructure system, but after all in the education system.

Having a look at the economic development from the last years, Bulgaria could reach its highest gross domestic product (GDP) growth in 2018 since the global financial crisis. This trend is expected to continue also in 2019. In



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the first quarter of 2018, GDP increased by 3.6 percent compared to the previous year. Private consumption is increasing thanks to the employment growth and wage rise.

Inflows from EU funds are expected to increase from 1.5% in 2017 to over 2% of GDP in 2018. Imports are rising faster than exports, and the trade deficit is widening. The policy is oriented towards introduction of the euro. According to the recent convergence, report of the European Commission the country has made a significant progress in meeting the formal requirements. Nevertheless, serious structural and institutional challenges remain and for a foreseeable overcoming of the prosperity gap in comparison to the EU and euro area, the growth rates are far from sufficient.¹

Wirtschaftliche Entwicklung Bulgariens 2017 bis 2019 (reale Veränderung gegenüber dem Vorjahr in %)

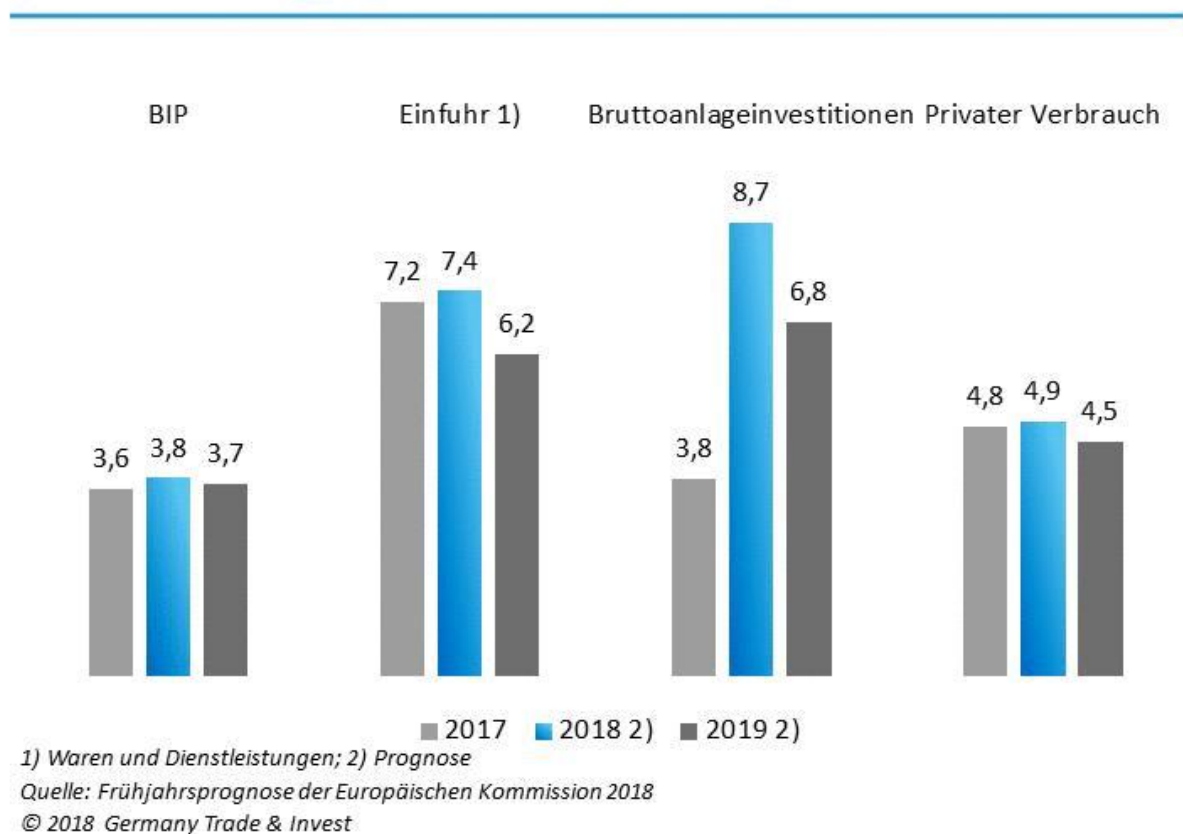


Figure 1: Economic Development in Bulgaria for the period of 2017 until 2019 (real change compared to previous year in %)

Source: Germany Trade & Invest

¹ GTAI Wirtschaftsausblick - Bulgarien (Juli 2018)

<http://www.gtai.de/GTAI/Navigation/DE/Trade/Maerkte/Wirtschaftsklima/wirtschaftsausblick,t=wirtschaftsausblick--bulgarien-juli-2018,did=1950050.html#Wirtschaftsentwicklung-Bulgarische-Wirtschaft-ist-weiter-auf-Wachstumskurs->



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It is also predicted an increase in production capacity and a trend towards mechanization or automation of production and the introduction of new technologies. Through the settlement and willingness to invest above all German companies or companies with German participation such as:

- KITTNER
- Liebherr
- Grammer
- Lufthansa Technik
- PiH Industry
- Casting technology bulgaria
- Winterhalder
- Steca electronics
- METRO Cash & Carry
- Penny Market

Bulgaria can build on an already existing solid economic foundation to its own economic portfolio. German companies operating in Bulgaria are giving the country good marks in many areas. In 2015, German-Bulgarian trade reached a new record. The country is supported by the increasing dynamic of economic output and foreign trade with Germany. The initiated change process in Bulgaria with regard to the willingness to reform, especially in the education sector, is already remarkable in the vocational training sector. The Bulgarian Minister of Economy said that the efforts in implementing dual vocational training in Bulgaria should continue. The desire to introduce dual vocational training in Bulgaria arises from the general skills deficiency. The main reason is the education system, which does not produce adequate graduates sufficiently. Vocational schools using the German example do not exist. Emigration and shrinking population contribute additionally to the skills shortage. Particularly, German companies try to solve the problem of skilled workers with their own in-house training.

According to the Constitution of the Republic of Bulgaria, the state creates conditions for organizing and conducting Vocational Education and Training (VET) and the Higher Education Act regulates the structure, functions, management and financing of higher education. The study on economical and social aspects in Bulgaria revealed the following:

- The trend of disproportion between demand and supply of the labour market qualifications is deepening.
- The tendency of discrepancy between the required labour market skills and the quality of the practical and theoretical training of young people in the education system is also persistent
- Admission of students to vocational education and training does not meet the needs of the economy
- The vocational training is the only way for now to solve the problems in vocational education.

There are a lot of benefits from an apprenticeships inside a company such as hands on practice and contact with real world of the company professional experience in such a way facilitating the transition from school to work.²

On the other hand enterprises gain in the terms of strong integration of students in the company environment and fosters the identification of the apprentice with the company's values and required skills as apprenticeships can identify and train potential candidates for higher qualified jobs.

Education Structures

The desire to introduce dual vocational training in Bulgaria arises from the general skills deficiency. The main reason is the education system, which does not produce adequate graduates sufficiently. Vocational schools using the German example do not exist. Emigration and shrinking population contribute additionally to the skills shortage. Particularly, German companies try to solve the problem of skilled workers with their own in-house training.

² Marks, M., Germany TRADE&INVEST (2014): „Wirtschaftstrends Bulgarien – Jahreswechsel 2014/2015“.



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As part of the global Chambers of Commerce network with 130 locations in 90 countries, The German-Bulgarian Chamber of Commerce (AHK) is also involved in the field of dual vocational training. The AHK offers **different measures and services** for dual vocational training to companies taking part in the cluster:

- Consulting on training occupations
- Coordination with vocational schools to organize the theoretical training part
- Translation and adaptation of German training framework plans to the needs of the company
- Training of trainers
- Conducting marketing and information events
- Workshops for the trainees
- Support during the training period

Another key institution for dual education in Bulgaria is the National Agency for Professional education and training (NAVET).

Status of cooperation

- Project DOMINO "Swiss support for the introduction of dual training principles in Bulgarian education 2015-2019"
- Project "VET" of Advantage Austria in 5 regions of Bulgaria with 6 vocational schools
- Project "APPRENTICESHIP CLUSTER for INDUSTRY-READY ENGINEERS of TOMORROW" with project coordinator Technical University Gabrovo, co-funded by the Erasmus+ Programme of the EU
- Different VET projects of private companies such as Liebherr-Hausgeräte Marica, Kaolin, Kittner Anlagen- und Maschinenbau etc.
- The AHK Bulgaria starts in 2018 a pilot project in the field of VET in cooperation with ABB Bulgaria

Social aspects

- The trend of disproportion between demand and supply of the labor market qualifications is deepening.
- The tendency of discrepancy between the required labor market skills and the quality of the practical and theoretical training of young people in the education system is also persistent.
- Admission of students to vocational education and training does not meet the needs of the economy.
- The vocational training is referred to as a "panacea" to solve the problems in vocational education.

Romania

Economical and Political Aspects

Romania remains on course of growth. It is expected that the Romanian economy will grow significantly in 2018, albeit not as strongly as it did the year before, when private consumption fueled the economy. The contribution of investments is likely to increase if the government uses the opportunities offered by the 2014-2020 funding period and pursues economic policy. Romania remains interesting for Germany as a partner for foreign trade and investment.³

³ GTAI - Wirtschaftsausblick - Rumänien (Juli 2018)

<http://www.gtai.de/GTAI/Navigation/DE/Trade/Maerkte/Wirtschaftsklima/wirtschaftsausblick,t=wirtschaftsausblick--rumaenien-juli-2018,did=1951816.html#container>

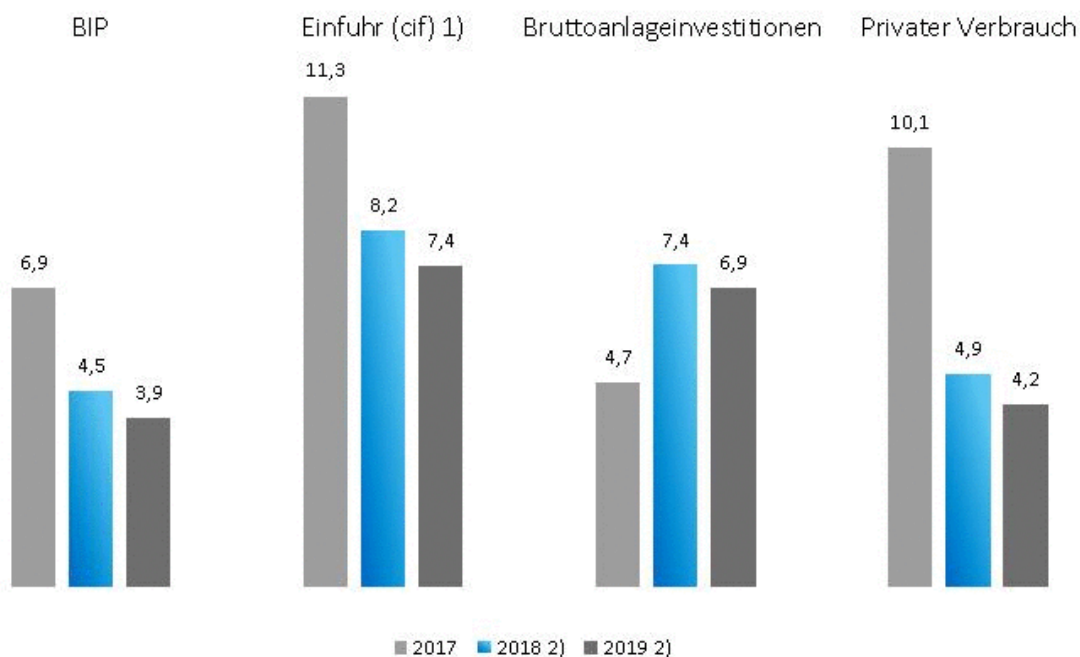


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Wirtschaftliche Entwicklung Rumäniens 2017 bis 2019 (reale Veränderung gegenüber dem Vorjahr in %)



1) Waren und Dienstleistungen, nominale Veränderung, 2) Schätzung bzw. Prognose

Quelle: Frühjahrsprognose der Europäischen Kommission 2018

© 2018 Germany Trade & Invest

Figure 2: Economic Development in Romania for the period of 2017 until 2019 (real change compared to previous year in %)

Source: Germany Trade & Invest

Thanks to its geographically favorable location and its 21 million inhabitants, Romania is a highly interesting market for business and research - even for small and medium-sized companies from Germany. The Federal Republic of Germany is the most important trading partner for Romania and numerous German companies or companies with German participation are already successfully active such as:

- Continental Automotive SRL
- Bosch Rexroth SRL
- Bremer Werk für Montagesysteme GmbH
- Dürkopp Adler Masini de cusut SRL
- Siemens SRL
- ThyssenKrupp Materials International GmbH

The expansionary fiscal policy and especially the wage increases for the public employees lead to an increasing budget deficit. While at 2.9 percent of GDP in 2017, it was just below the threshold, the deficit will be exceeded in 2018 and 2019 at 3.4 and 3.8 percent respectively. Public debt, however, remains manageable at 35.3



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percent (2019: 36.4 percent).

Improving infrastructure and removing barriers to entrepreneurship are some of the major challenges that governments and economies face over the next few years.

The unemployment rate continues to decline towards 4.5 percent. Skilled workers are in short supply, especially in the west of the country. Legal and budgetary issues have the potential to bring Romania into conflict with the European Union. In January 2019, the country is to take over the EU Council Presidency.⁴

Education Structures, Status of Cooperation & Social Aspects

The German foreign trade promotion association, designate as risks in the SWOT analysis deficits in vocational education and skills shortages due to demographic trend and migration. It is expected also that Romania will remain a moderately growing market for mechanical engineering equipment and, traditionally, the automotive supply industry. A demand also comes from infrastructure construction and environmental technology as well as from the energy sector. With the support of the country in education and research with a high economic relevance, this growth can be driven forward as predicted. There are currently more than 80 public and private higher education institutions in the Romanian higher education system. The implementation of the Bologna system in Romania from the academic year 2005-2006, was associated with a major change in the organizational strategy and, consequently, new challenges for the higher education system. The Romanian Quality Assurance Agency for Higher Education (ARACIS) exists since 2005 as a result of Emergency Ordinance no. 75/2005, as approved by Law no. 87/2006.

The ARACIS Agency is one of the main national institutions that has been created for monitoring and control in terms of compliance with the Bologna requirements. ARACIS is a public institution of national interest and responsible for the development of standards and methods necessary for the admission of undergraduate or graduate academic degree programs. Starting with the school year 2014/2015, the dual education and vocational training system was reintroduced into the education system in Romania with Sibiu as a pilot city. Supported by the association of the Romanian-German training, the "Independence Technical College" from Sibiu, in partnership with several multinational companies, is working on the introduction and implementation of the dual vocational training system according to the German model. The school system is called a "dual system", in short, this means that students who, for example, aspire to a trade or future professional activity, such as mold toolmakers, CNC operators or electrical specialists, complete the cycle of theoretical and practical changeover theory within the 3 years of training in a professional company like Marquardt.

Together with other German companies, Marquardt is a member of the Association of Romanian-German Dual Vocational Training. In cooperation with the city and the district inspectorate, these companies - inspired by the model of German vocational training - brought the concept of the dual training system to Sibiu. The Sibiu region is one of the most developed in the field of industry and services, which positively influences the development of LBUS.

Similarly, to Bulgaria Romania also faces the problem of skills shortage and difficulties in finding the appropriate candidate for work position. There is especially a demand for skilled engineers since it is expected that Romania will remain a moderately growing market for mechanical engineering equipment and, traditionally, the automotive supply industry. A demand also comes from infrastructure construction and environmental technology as well as from the energy sector. The German foreign trade promotion association, designate as risks in the SWOT analysis deficits in

vocational education and skills shortages due to demographic trend and migration. With the support of the country in education and research with a high economic relevance, this growth can be driven forward as

⁴ Wirtschaftsausblick - Rumänien (Juli 2018)

<http://www.gtai.de/GTAI/Navigation/DE/Trade/Maerkte/Wirtschaftsklima/wirtschaftsausblick,t=wirtschaftsausblick--rumaenien-juli-2018,did=1951816.html>



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predicted. There are currently more than 80 public and private higher education institutions in the Romanian higher education system. The implementation of the Bologna system in Romania from 1999, was associated with a major change in the organizational strategy and, consequently, new challenges for the higher education system. The Romanian Quality Assurance Agency for Higher Education (ARACIS) exists since 2005 as a result of Emergency Ordinance no. 75/2005, as approved by Law no. 87/2006.

The dual education in Romania is officially stated at the level of professional schools. There are no dual studies at university level. In the university curricula it can be introduced a minimum of 2-3 weeks of practical phases during the university year, beginning with the second year. For the practical phases, the university have to establish a learning and practical plan for the students. The companies should also provide mentors for students and after the practical phases, they have to conduct the evaluation. In order to be able to introduce more practical phases in the university curricula. There are some legal aspects that must be taken into consideration:

- Study programs in Romania are accredited by ARACIS
- Study programs are reaccredited every 5 years and only 20% of curriculum can be undertaken
- A study program should include certain number of general fundamental courses, domain courses, special field courses and complementary courses, which can be included from a list, published by ARACIS.
- One ECT is 25 hours
- The study programs should have 26-28 hours of didactical activities per day

Croatia

Based on the report provided from PTP deliverable D.T.4.1. the legal perspectives on country specifics and internal university regulations in country Croatia are reported and summarized below for a broad overview over the same topic in comparison to other two partner companies – Romania and Bulgaria

Social Aspects

Due to the skills gap, i.e. the skilled labor shortage among the young people, currently in Croatia there is an insufficient amount of vocational learning in real work environment in enterprises, according to a 2014 survey of employers. One of the reasons pointed out by the employers is that the competencies required for successful performance cannot match with the competencies, acquired in the traditional educational system. This might be one of the reasons for the low levels of young employment in Croatia. A possible solution for this problem can be enhancing of the attractiveness of the VET in Croatia, so that the students can gain practical experience in real working conditions.

Education structures

Key institutions for higher education in Croatia are Ministry of science and education and Agency for science and higher education. Universities, polytechnics, and schools of professional higher education (colleges) represent the Higher education in Croatia. This is performed through university studies at the universities and professional studies at the polytechnics and colleges. A dual education within Croatian education system is still not implemented. The University study programmes qualify students to work in science and higher education, private and public sector and society in general, as well as to develop and apply scientific and professional



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University study programmes have three levels: undergraduate (180 ECTS/240 ECTS), graduate (60 ECTS/120 ECTS) and postgraduate. Professional study programmes are split into: short professional studies, undergraduate professional studies, and specialist graduate professional studies.



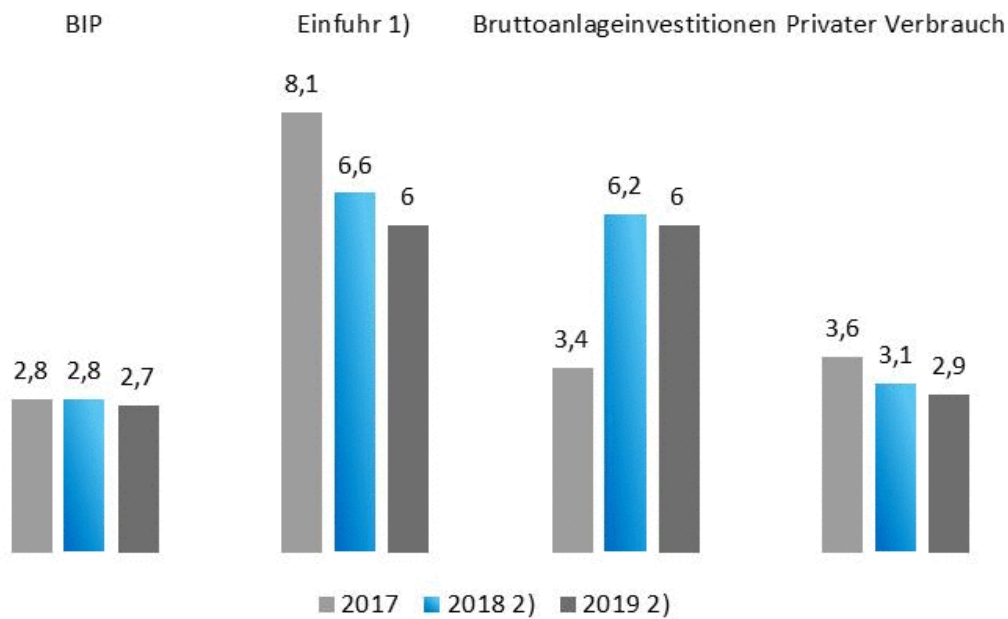
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Economical and Political Aspects

Wirtschaftliche Entwicklung Kroatien 2017 bis 2019 (reale Veränderung gegenüber dem Vorjahr in %)



1) Waren und Dienstleistungen

2) Prognose

Quelle: Frühjahrsprognose der Europäischen Kommission, Mai 2018; © 2018 Germany Trade & Invest

Figure 3: Economic Development in Croatia for the period of 2017 until 2019 (real change compared to previous year in %)

Source: Germany Trade & Invest

Croatia's economy has overcome the severe crisis of previous years and will continue to expand in 2018. Growth is driven by private consumption and strong investment momentum. Booming tourism is providing impulses, but the labor shortage is slowing down the optimism. Risks to the economy arise from the unresolved problems of the Agrokor Group and the difficulties in other important industries, such as the shipbuilding industry

During 2016, the growth in economic activity observed in 2015 accelerated following a six-year recession. The real growth of GDP amounted to 2.9% and was primarily driven by the strengthening of domestic demand. At the same time the contribution of net foreign demand and inventory changes was negligible. Positive developments in economic activity are expected to continue in the medium term. The projected real growth of GDP in the amount of 3.2% for 2017 is expected to somewhat slow down to 2.8% in 2018, 2.6% in 2019 and 2.5% in 2020. Such slowdown regarding the projection period is the result of the convergence of GDP growth in relation to the growth of potential GDP in the medium term. Economic growth for the entire projection period will be based solely on domestic demand. The contribution of net foreign demand will be slightly negative throughout the projection period, although it is expected to gradually decrease towards the end of the period.



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The expected economic growth in 2017 was significantly impacted by the comprehensive tax reform implemented at the beginning of the year. The due multiplier effect was estimated at 0.5% of GDP. The initial effect of the reform was enabled by the estimated release of funds to the household and business enterprise sector in the amount of 0.5% and 0.2% of GDP, respectively. Taking into account the current economic cycle, the calculation of the multiplier effect presumes that both households and business enterprises will, in the first instance, spend, and, in the second instance, invest approximately 70% of released funds.⁵

Status of Cooperation

There is no co-operation between the chamber and industry mentors in Croatia, and there is no legal regulation for the chambers to act. Croatia is just about to have a complete analysis and profile of mentors in companies.

Steps and methods involved in the design of practical phases

The results from the conduction of the feasibility study showed the adaptable elements in the three countries participating in project Dynamic. As next steps will be presented the methods and the phases of designing the practical phases in ULBS, TUV and PTP. The showed results are a summary, based on the regional focus group meetings, conducted in each country.

Regional Focus Group Meetings - Bulgaria

During the focus group meetings at Technical University Varna, the objectives, specifics and expected positive outcomes were introduced, as well as the tasks of AHK, TUV, MTG Dolphin and Keppel FELS Baltech were clarified. Discussions about the peculiarities related to the practical training and its specifics, curricula for maritime specialties and syllabus for various subjects were held. For the preparation of practical phases several discussions about national legislation, provisional authorization and accreditation took place during this meeting. Emphasized was, that any adaptation made to the curricula and contents of syllabus for various subjects regarding dual education, should be approved by the responsible institutions. An important issue is whether the students, who are already having part-time education and working in shipbuilding or ship repair companies, can continue working there and proceed with practical training in relation to dual education. Partners have agreed that, as described in the project description, the pilot implementation of the program at TUV will follow the so called "block model", but for some of the subjects, the students will be involved in the practical training every week during the semester. For some of the subjects, the students will perform practical training in industry during the first two years.

Students will go through a competitive selection process to find their future industrial partner and they will sign a contract as well as they will receive payment. It is planned that between the semesters and during the summer break, students will be involved in the practical training. In this way, TUV will not need to change significantly the previously accepted curricula in the phase of pilot implementation. Within a WP 5 phase, an academic tutor from TUV will stay in contact with the industrial mentors and will be responsible for the assessment of the students' results.

⁵ Wirtschafts-ausblick Kroatien (Juni 2018)

<http://www.gtai.de/GTAI/Navigation/DE/Trade/Maerkte/Wirtschaftsklima/wirtschaftsausblick,t=wirtschaftsausblick--kroatien-juni-2018,did=1935156.html>



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During discussion with Mr. Stoev, it was pointed out, that the main challenge in the organisation of dual-study curricula is to assure that such curricula can provide for example 20 hours free time in the students' schedule, so that they can participate in the practical training. In order to make this possible, it is necessary to adjust the curricula in such way, so that these 20 hours can be guaranteed. Giving a questionnaire to the students, will give them the opportunity to share their ideas and visions and it can be very helpful when it comes to rearranging the dual education curricula.

During another meeting, a discussion, covering various aspects of the implementation of practice-integrated education has been opened arousing the following questions:

- Usefulness for the students, conducting dual training to write a diploma work in the last year of study, related to their activity in the corresponding company
- The enterprises, included in the project should be established an appropriate crossing regime
- The course "train the trainer" can be delivered in the form of "face-to-face" workshop with 40 lesson units, although this will be difficult to accomplish from Keppel FELS Baltech Ltd.
- Elaboration of common training logbooks for all country
- Whether the logbooks should be in two languages (Bulgarian and English)

Two different curricula for the specialty "Marine Technology" were presented by Prof. Georgiev. The curriculum includes "specialized practicum" with 60 academic hours (2 ECTS), which will be held during summer vacation after 6th semester.

During a discussion about the opportunities for introducing the practice-integrated dual learning for partners, it was clarified that the internship, part of the current curriculum, could be organized in the summer vacation after 6th semester. Currently there are not so many opportunities to provide practice-integrated dual learning for students of Marine engineering, in comparison to the specialty "Design of marine plants", which is appropriate for dual education.

A summer mandatory internship, followed by paid internship of about 160 hours per month for 3 months can be organised. For acquainting business partners with students and vice versa, several workshops are to be organized.

Regional Focus Group Meetings – Romania

During the focus group meetings organised at ULBS the Romanian Agency for Quality Assurance in Higher Education (ARACIS) was introduced as a main body which organizes the accreditation process. A presentation about the history of Mechatronics as a branch of technical sciences and its evolution towards higher education was made.

Other topics that were discussed during the meetings were: the syllabus for student practical works, the main requirements, objectives, evaluation and marking procedures. "Continental Automotive Systems" proposed a system for students internship at the company. An important moment is the willingness of the specialists with the company to participate in the adapting the curriculum to the dual-practice integrated specialization.

Marquardt Schaltsysteme presented the organisation of internships in the company and emphasized on the fact that the company is interested in extending the duration and improving the quality of student internships. During the meeting, it was also presented an analysis about employer expectations related to the skills and abilities of graduates, where the focus was on the technical studies. The results showed that the practical skills are seen as very important on the labour market level. The analysis revealed, that there is a need of dual-practice integrated higher education study programmes and they are highly encouraged by the employers. Highlighted was that the graduates of multidisciplinary specialization, as Mechatronics, are in great demand. It was also especially emphasized the willingness of ULBS to collaborate with industrial partners. Professors from ULBS pointed out that the amount of time for practical works needs to be significantly increased and a detailed structure for this purpose was proposed and accepted by the partners afterwards. The curriculum for Mechatronics specialization, was considered adequate by Continental. It was agreed that week points in the syllabuses should be corrected in joint corrective action within discussions with the course lecturer. During the discussion it was noted that the computer programming courses should be specifically targeted on high level



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programming languages and software for embedded systems. It was also pointed out by the specialists from Marquardt that it is important for an engineer to be able to work with office software as well as with project management software. As a high priority was mentioned the language skills of the engineers. For a successful communication and exchange of information with the colleagues in an international world of globalization, it will be expected that the graduates from Mechatronics should improve their foreign language skills. It was also stressed the fact that the partner companies will contribute to the training of the students with organizing the extra-curricular courses during the practical works of the students within the company.

At a later stage it was presented the draft of syllabus for practical works for the students which will be enrolled in the dual study program Mechatronics. Emphasized was that the syllabus was organized in such a way, that meets the competencies and skills which the industrial partners expect and at the same time the requirements for Mechatronics study program graduate curricula. Important is to keep the link between the theoretical knowledge, provided through courses, laboratories, and practical application of them within the internships at the receiving industrial partners. The practical works, unwind in Continental and Marquardt, will be mostly oriented on the application of Mechatronics in automotive industry.

It was also presented the draft version for the evaluation and selection criteria of the students that will take part in the dual study programme. As main selection criteria was agreed that the grades during the study year would be taken into consideration as well as an interview. Important advantage, which Marquardt and Continental can offer, is provision of accommodation for the students during their summer internships. The closing discussions were in regard to the content of syllabus of the student practical works and more specifically how to adapt them to the specific partner companies, to the national law of higher education and to the curricula for Mechatronics.

Regional Focus Group Meetings – Croatia

During the first regional focus group meetings in Pula conducted by PTP were introduced several possibilities of designing a tool for dual educational plan between teaching and practical processes. A discussion regarding possible courses, which can be involved in dual education, numbers of ECTS, content and learning outcomes from each course involved in dual education. The outcome from the discussions is the agreement from all the partners that in dual education will be involved 43 ECTS from total 180 in study program. Courses, which are involved are: Material Technology I, Team work and practicum III, Electronics 2, Material Technology II, Team work and practicum IV, Project management, Team work and practicum V, Professional practice, Team work and practicum VI and Bachelor Thesis with content and learning outcomes.

Professors from Polytechnic Pula and industrial mentors are responsible for the draft of syllabus for each course included in the dual study program. During the focus group meetings has been discussed about the payment methods and amount of student payment. As a result, the partners have agreed that the students will be paid for the duration of the pilot project (24 months). The amount of student payment for one year will be 15.000,000 kn, netto. A contract between the companies, university and student will be drafted in accordance with the national law.

Designing of practical phases includes a detailed syllabus with theoretical and practical part of the teaching. During the practical period, is also planned monitoring and evaluation of the student work. Furthermore, the industrial partners will provide for each student protective clothing, necessary workplace, safety courses and possible medical examinations. Regarding the criteria for student selection, Holcim and Uljanik have defined their methods of selecting their students.



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Comparative Report

In the following section, the results of the ten working groups meetings will be discussed below. Partner universities from Romania, Bulgaria and Croatia have met together with their industrial partners to develop a strategy for curricula adaptation using the dual study principles, using as an examples the Austrian and German model. More flexible routes for acquiring industry-related skills were defined to boost and sustain innovation in the field of engineering. To achieve that, project Dynamic applied country-adapted model of dual high education. The following three study programs were developed, implemented, tested and validated: Mechatronics (ULBS), Naval Architecture and Marine Technology (TUV), Undergraduate Study Program “Polytechnic” (PTP).

Tertiary Education	Romania	PhD and Doctorate					
	Bulgaria	Doctorate					
	Croatia	PhD					
	Romania	Master					
	Bulgaria	Magister	Magister				
	Croatia	Postgraduate study					
	Romania	University	Higher VET				
	Bulgaria	University	Specialised Higher School	College			
	Croatia	University	Non-university (professional study)				
Secondary Education	Upper secondary education	Romania	General Programs	Vocational Programs	Technological Programs	School & workplace based VET	Apprenticeship
		Bulgaria	Gymnasiums	Profiled High schools	Profiled Schools	Professional Gymnasiums/Technical School	
		Croatia	Gymnasiums	Art School	Technical & similar vocational school	Vocational School	Short term vocational education
	Lower secondary education						

Table 1: Structure of the education system – comparison between Bulgaria, Romania and Croatia



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Bulgaria - TU Varna

Naval Architecture and Marine Technology

With introducing of a subject called “Specialized practice” – 60 academic hours with 2 ECTS, during summer vacation after 6th semester TU Varna adapted partially their curricula into the dual education curricula. This will be organized in two phases: During semesters in TUV and in partner company in summer vacation after 6th semester.

Phase in TUV

- 3 Workshops in TUV and in the two companies: the first workshop explains the conditions among students; second and third – the conditions and requirements of the business partner
- Practical tasks will be given from the companies during the exercises

Phase during summer vacation

Internship after 6th semester and 3 months practice in both companies. Practice starts with the students' application and after approval by the company. Practice time of about 160 hours per month will be paid according to the company conditions. The conditions between students, companies and university will be described in the corresponding agreement. Logbooks for the pilot implementation are also included. Students choose whether they will participate in the 3 years course for 2018/2019 voluntarily.

Summary

- Structure for pilot implementation of dual practice-integrated training in specialty of Naval Architecture and Marine Technology of TUV has been adopted, which takes into account existing national and institutional legislation and existing curricula
- Pilot implementation of dual study will be based on voluntary choice by students of the 3 year course for the 2018/19 academic year after approval by business partners
- Main part of the training will be provided during summer vacation and will consist of 160 hours per month paid according to the company conditions
- All the necessary documentation (contracts, logbooks, reports etc.) will be developed by taking into account local conditions and based on good practices in partner countries involved in the project
- Currently not so many opportunities for dual education for students from Marine Engineering for their entire course of education, however students from this specialty will be accepted by MTG Dolphin in their 4th year of education for practical training “Repair of maritime machinery”
- Students from Marine Engineering in their 1st and/or 2nd year of education will be considered to undergo for the second part of their practical training on “Metal turning” and/or “Metal fitting” at MTG Dolphin
- A newly accepted specialty – “Design of marine plants and systems” is very appropriate and easily adaptable for dual education, the discussions about implementing dual practice-integrated training for this specialty will be started after the enrolment procedure.

Below is presented a detailed table with the adaptation changes for dual curricula in TUV:



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Name of the Program	Naval Architecture and Marine Technology (dual education)	Marine Engineering (partially dual) bachelor	Design of Marine Plants and Systems master (part time training)
Total Numbers of ECTS for entire Study	237	281	120
Total Number of ECTS for Practical Activity	20	33 + 30 credits for onboard practice of 900 hours	6 (3 each part)
Number of Hours or duration of practical activity	600 academic hours	915 hours for all practices + 900 hours of practice	210 (105 each part) 60h pract=1 sem=2 ects
Number of Semesters for Practical Activity	1 + additional practice connected with Bachelor Thesis	3	2 (parts/semesters)

Table 2: Study Program adaptation to dual model of education

Croatia – PTP

- A few courses from undergraduate study program Polytechnic (duration 3 years and 180 ECTS) will be offered as dual course
- Courses will be from 2nd and 3rd year selected in agreement with industrial partners:
- Material Technology I, Teamwork and Practicum III, Electronics II, Material Technology II, Teamwork and Practicum V, Teamwork and Practicum IV and Bachelor Thesis. Total number of ECTS involved in dual education are 43 ECTS.
- Organization of theoretical and practical phases:
- Students will participate at PTP during teaching process and after that they will take a part in the practical phase in the company as follows:
- 2nd year – 8 weeks (February 2019/June 2019/ September 2019)
- 3rd year – 10 weeks (February 2020/ June 2020/ September 2020)
- Equal scoring on all courses and in both companies, which will be written in a book for monitoring the student.
- Contracts between PTP – industrial partner – student - **for practical work**
- Contracts between industrial partner – student – **for scholarship**



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Romania - ULBS

- Mechatronics – 8 semesters, 240 ECTS
- Total amount of hours for practical activities is 1050 for dual study specialization
- Selection criteria: academic results (grades) 30%; interview 70%; distance from students' home to receiving location
- **Evaluation**
- Notebook for practical activities, including main knowledge achieved during internship
- Final assessment (at the end of each semester) – as a colloquium in front of examination committee
- Final assessment, consisting of discussion upon students' activity in the company, the content of the notebook and Q&A session
- Student will receive a grade for practical activities
- The adaptation of the curriculum for the dual study specialization will be implemented by adapting/changing the syllabuses of special subjects: Computers programming, Digital Electronics, Power Electronics, Microcontrollers Hydraulic and pneumatic driving systems and Programmable Logic Controllers.
- A supplementary amount of 810 hours of practical activities will be added to the existing 240 (810+240=1050 in total for dual study program)
- **Contracts:**
- Practical Work - Between student, LBUS and industrial partner
- Internship - Between student and industrial partner
- University-industrial partner

Common issues and main differences

In the following paragraph it will be focused on the adaptation of curricula of each of the three university-partners in project Dynamic to curricula with dual education elements. In order to obtain information how every university adapted their curricula to the dual study system, it is necessary to compare the results from the focus group meetings with the example of dual study system, provided by HS Wismar (Germany) and FH Joanneum (Austria). The results can be easily presented in a comparing table. Criteria for comparison were:

- total amount of ECTS for entire study,
- total amount of ECTS for the practical activity,
- duration of practical activity,
- number of semesters for practical activity,
- main subjects,
- beginning,
- rotation principle,
- selection criteria for choosing students,
- payment,
- contracts and logbooks.



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Name of the Program	TUV Naval Architecture and Marine Technology (dual education)	PTP Undergraduate Study Program "Polytechnic"	ULBS Mechatronics (dual version)	FHJ Production technology and organization	HSW Dual practice integrated degree in Mechanical Engineering
Total Number of ECTS for practical activity	20	43	18	30	53
Total Number of ECTS for entire study program	237	180	240+18 (dual study)	180	210
Number of hours or duration of practical activity	600 academic hours	255 hours 8x20h+10x5h weeks	1050 hours	5900 (40hours per week)	114 weeks
Number of semesters for practical activity	1/3(Marine Engineering) + additional practice connected with Bachelor Thesis	5	4	5	7

Table 3 : Results from Adapted Curricula of TUV, PTP, ULBS – ECTS, number of hours and number of semesters

As it can be seen from the Table 3, the three universities achieved number of credit points which is closer to HS Wismar and FH Joanneum. Taking into consideration the specifics of each university's policy, it is not possible to achieve the same amount of credit points. Similarly, the duration of practical activity cannot be exactly the same. Some of the reasons are the different types of universities and the different duration of the master's and bachelor's programs.



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Main Subjects	TUV Ship structures, Piping, Ship outfitting, Welding, Ship production process	PTP From 2 nd : year Material Technology I, Teamwork and Practicum III, Electronics II, Material Technology II, Teamwork and Practicum IV From 3 rd : year Teamwork and Practicum IV and Bachelor Thesis.	ULBS Computers programming, Digital Electronics, Power Electronics, Microcontrollers Hydraulic und pneumatic driving systems and Programmable Logic Controllers	FHJ Natural and engineering fundamentals Production and process engineering Production Organization, Quality & Environmental Management Key qualifications	HSW design engineering II design engineering III industrial design finite elements method project work A mechatronics project work B industrial placement bachelor-thesis
Duration of the program	220 Academic hours/month (during summer after 6th semester). Practice before elaboration of Diploma thesis	3 years	4 years	3 years	3,5 years

Table 4: Results from Adapted Curricula of TUV, PTP, ULBS – main subjects and duration of program

Main subjects that TUV have chosen to adapt for dual study are: Ship structures, Piping, outfitting, welding, ship production process. PTP decided that their dual study will start from the 2nd year with the following subjects: Material Technology I, Teamwork and Practicum III, Electronics II, Material Technology II, Teamwork and Practicum IV. Subjects starting from the 3rd year: Teamwork and practicum IV and Bachelor Thesis. ULBS agreed for the following subjects: Computers programming, digital electronics, power electronics, Microcontrollers, Hydraulic and pneumatic driving systems and Programmable logic controllers.

Beginning	TUV After 6 th Semester (between 3 rd and 4 th year)	PTP From 2 nd and 3 rd year	ULBS 2 nd year in spring and summer	FHJ In the summer, after 2 nd semester	HSW 1 st semester
Rotation Principle	Two phases: In TUV In Company	2 nd year – 8 weeks (February 2019/June 2019/ September 2019) 3 rd year – 10 weeks (February 2020/ June 2020/ September 2020)	Internal regulation for practical activities according to curricula	1 st year is non- dual year Starts in 4 th month during 2 nd semester	16+3 weeks in University during the whole study 4 weeks practice in 1 st , 3 rd , 5 th semester 8 weeks practice in 2 nd 4 th , 6 th semester 12+10 weeks in 7 th
Selection Criteria	Voluntary choice of company by students, and approval from the industry partner	Selection in agreement with industry partners	Academic results – 30% Interview – 70% Distance from student's home to receiving company	Voluntary choice and industrial partners Recommendation s from Professors	Voluntary choice and industrial partners Recommendations from Professors

Table 5: Results from Adapted Curricula of TUV, PTP, ULBS – beginning, rotation principle and selection criteria



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The next three criteria are about the beginning of the practical phase, the rotation principle and the selection of the students. Regarding the beginning, it can be noticed that in the two universities used as an example the practical phases are starting almost in the beginning of the study. Whereas the the beginning in the universities that are still adapting their curricula towards dual study are starting a bit later. For the next criteria – rotation principle – can be seen from the table that each university found their own way how to conduct the practical phases. TUV and PTP split the practice into two phases with different duration. ULBS is following the internal regulation for practical activities according to curricula. In FHJ only the first year is non-dual and in HSW have their practical phases during the whole study but with different intensity in the different semesters.

The selection procedures are also varying from one another. In TUV, FHJ and HSW the students decide voluntarily whether they will participate in the dual study or not, but the choice is approved by the industrial partners. In PTP the selection process is done together with the industrial partner. ULBS have the most strict selection procedures. They put different weight on few important aspects: academic results (30%), interview (70%) and the distance from students' home to the receiving company.

Payment	TUV Yes according to company conditions	PTP Yes Scholarship	ULBS Yes according to company conditions	FHJ Yes	HSW Yes
Contracts	Yes C-S	Yes 2 types: U-C-S C-S (scholarship)	Yes 4 types: U-C-S U-C S-C S-U	Yes C-S	Yes C-S
Logbooks	Yes	Yes Report on Students' Activity at the University	Yes 2 types: Company report on students Presentation report by the student in the university	Yes	Yes

Table 6: Results from Adapted Curricula of TUV, PTP, ULBS – payment, contracts, logbooks

The last three criteria are about payment, contracts and logbooks. From the table above it can be easily seen that all the students participating the dual study are receiving a payment.

In relation to the contracts between the three parties – students, company and university there are different approaches. While TUV, FHJ and HSW have only one type of contract - between the company and the student, in PTP and ULBS there are more types of contracts. PTP have two types of contracts – between the university, company and student and between the company and student regarding the payment in form of scholarship. ULBS have 4 types of contracts: between the three parties and each party has between themselves. In terms of logbooks or the diaries where the student activity is documented, it can be seen that all of the partners have implemented them.



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During the implementation phase as well as during the adaptation process discussions that were conducting between universities and companies can be summarized as a set of questions and answers, for a clear overview of the entire concept flow. Below is a case study from ULBS.

Questions and Answers

Question 1: What is “Mechatronics” ?

The rapid evolution of technology has increased the need for inter- and multidisciplinary engineering specializations within technical universities all over the world, “Mechatronics” being one of the answers for this need.

Consequently, “Mechatronics” can be considered both a field of technical sciences, but also a study programme (specialization) at technical universities all around the world.

Throughout the world, “Mechatronics” as study programme is offered either at bachelor level (6-8 semesters) or at master level (10-12 semesters);

In Romania, studies in “Mechatronics” are offered at bachelor level (8 semesters).

In 2008, at “Lucian Blaga” University of Sibiu, a new bachelor study programme in the field of Mechatronics was started. The Mechatronics specialization has proved successful since the early years of its operation. Every year, the number of candidates willing to pursue this field of study increased significantly. A favouring factor was also the significant industrial development of the automotive industry around Sibiu area, which constantly require many engineers with multidisciplinary training.

The present program aims to offer the existing “Mechatronics” specialization also as dual-study option.

Question 2: What should an engineer in “Mechatronics” be able to do ?

“Mechatronics” could be considered a synergetic combination between Mechanical Engineering, Electronics, Computer Science and Software. However, the engineer in “Mechatronics” should not be expected to replace neither a Mechanical engineer or an Electronics Engineer, nor a Computer Science engineer or a programmer.

A graduate of “Mechatronics” study programme should be seen as a system engineer, an integrator, the person who is able to bridge the gaps between the above-mentioned fields of technical sciences.

An engineer in “Mechatronics” should be able to integrate all the knowledge to design a competitive product and launch it “just in time” on the market. Moreover, he should be able to assemble and lead a team for that purpose.

Question 3: Can the curriculum of “Mechatronics” be tailored to suit the needs of partner companies ?

At national level, the curriculum design for higher education is regulated by The Romanian Agency for Quality Assurance in Higher Education (ARACIS). Every study programme has to pass two assessment stages: the provisional authorization (when the programme starts) and the accreditation (every five years)

As an example, the curriculum for “Mechatronics” specialization has to fulfil the following percentages:

Fundamental subjects $\geq 17\%$

Domain subject $\geq 38\%$

Specialty subjects $\geq 25\%$

Complementary subjects $\leq 8\%$

The lists of fundamental, domain and specialty subjects are also imposed by ARACIS.

Moreover, after two accreditations (each five years), the university is allowed to change the curriculum, without the need of passing a new accreditation only in a percentage of 20%. Such changes can dramatically affect other rules/percentages, so making them is quite a cumbersome process

A better way to tailor the educational process in order to comply with the requirements of the industrial partners is to adapt/change the syllabuses of specialty subjects.

An example of how this approach is working is represented by the syllabus of “Microcontrollers programming” – specialty subject, taught in the 5th semester. It was analyzed by LBUS staff and engineers from the industrial partners. Now the course and practical works are focused upon two main architectures, Microchip PIC16F690 and AVR ATmega328P on Arduino and both assembler and C are taught as main programming languages. After the analysis and the feedback received from partner companies the following changes at the level of curricula



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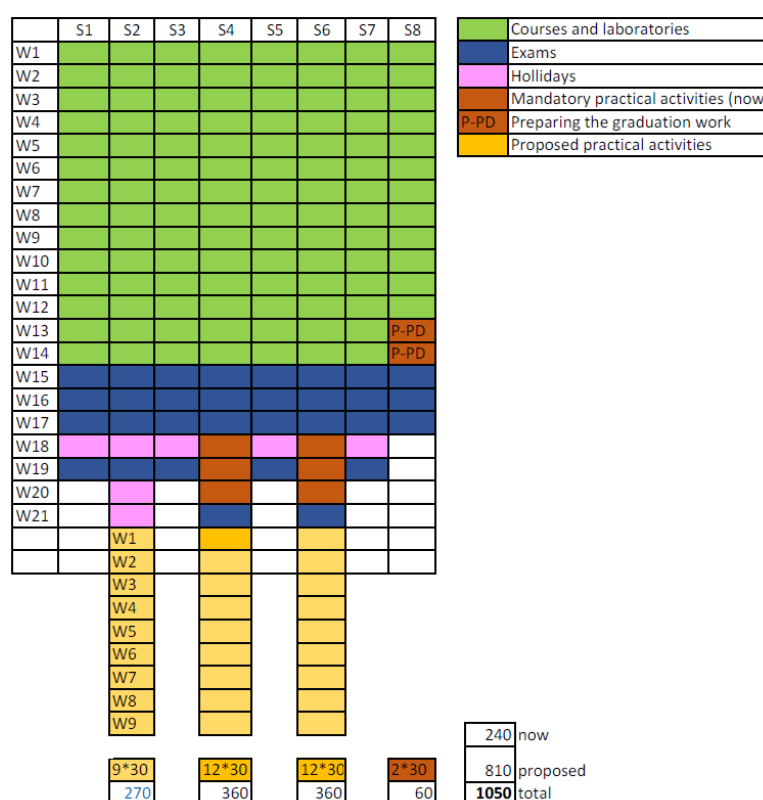
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were decided: the course will remain focused upon both architectures (Microchip PIC16F690 and AVR ATmega328P on Arduino), the practical works will be focused only on AVR ATmega328P and C will be studied as programming language (only basic assembler knowledge will be taught).

Other specialty subjects targeted by this analysis were Computers programming, Digital Electronics, Power Electronics, Hydraulic and pneumatic driving systems and Programmable Logic Controllers.

Question 4: How will the supplementary hours of practical activities be integrated into the present curriculum?

At present the “Mechatronics” at LBUS study programme is unfolded on 8 semesters, with a compulsory amount of practical activities of 240 hours. Students do not pursue practical activities in the first study year (1st and 2nd semesters).





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- the training items were designed to match the content of “Mechatronics” as multi-disciplinary study programme, the main field of activity of the partner companies, automotive industry the new paradigm of “Industry 4.0”

Question 6: How should the students be selected for the dual-study specialization ?

A selection procedure was proposed and agreed between LBUS and the industrial partners.

The main selection criteria considered:

- academic results (grades) – 30%;
- interview – 70%;
- distance from student’s home to the receiving company location.

Question 7: How should the students be assessed ?

The selection procedure also includes rules for assessment. The assessment will be based upon the following:

- students will elaborate a notebook for practical activities, which should include, among others, the main knowledge achieved during internships;
- the final assessment (at the end of each semester) will be organized as a colloquium, in front of an examination committee;
- the final assessment will consist of discussion upon the student’s activity in the company, the content of the notebook and a Q/A session;
- the student will receive a grade for practical activities.

Conclusions and Recommendations

As general remark, all three universities that were involved in the case study pointed out that currently there is a huge need of professionals, who have the skills needed in the changing world of business. All the countries pointed out the problem that the graduates from the university do know the theoretical part of their qualification, but they are not well prepared for the practical part. They do not have the skills needed in the business environment like critical thinking, decision making or teamwork. That is why a well-structured dual study program would be the best solution for the students who are willing to develop both parts – the theoretical and the practical one and also at the same time be a solution for the companies in their search for professionals. Below are listed more detailed recommendations to the partner universities:

- TUV: Giving a questionnaire to the students, will give them the opportunity to share their ideas and visions and it can be very helpful when it comes to rearranging the dual education curricula.
- possible bachelor thesis to include in bachelor thesis practical related issues and competencies achieved during practical phases
- Periodically updates on dual study curricula / for content and for practical activities
- Improvements and adaptation of final evaluation process
- Open more partnership agreements with more companies for students’ multiple choices
- TUV: Giving a questionnaire to the students, will give them the opportunity to share their ideas and visions and it can be very helpful when it comes to rearranging the dual education curricula.
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