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1. Introduction

The “Towards responsive engineering curricula through Europeanisation of dual higher education” project (from now on Dynamic) addresses the need for more flexible routes for acquiring industry related skills in the Manufacturing sector. To achieve this purpose, regular practical phases in entities will be included in the curricula in the ongoing engineering studies, applying the dual higher education model.

During the project the following three University Bachelor’s Degree programs were developed, implemented, tested and validated: Mechatronics from Lucian Blaga University of Sibiu (ULBS), Naval Architecture and Marine Technology from Technological University of Varna (TUV), and Mechanical Engineering from University of Juraj Dobrila in Pula (UNIPU).

2. Context of the evaluation

The dual higher education model is based on the recognition that the company is a special learning space where new knowledge is generated. Therefore, all concepts originate from the same root, the need to bring academia and business together and to integrate these two worlds. According to Geay (1998), it is the interaction of a priori two contradictory types of logic: the logic of transmission of knowledge from the university and the logic of production of the company. The integration of these two logics cannot be done by simple juxtaposition of periods of dominance. In this respect, dual education is not a simple model; it requires the construction of a systematic suitable relationship between the higher education institution and the company. It is not merely alternating between theory and practice, it involves building a system in which the relationships are bidirectional.

Dual education is an original model for professionalization. "The relationship between knowledge and competence is not a simple cause and effect relation, it depends on the commitment of the person in action. It is through a confrontation with the world as it is that the individual builds its skills, mobilizing its personality, its knowledge in use and the capabilities of formalization. Therefore, activity and competition are inseparable and articulation of various educational spaces of the school and the world of work is necessary" (Malglaive, 1993: 44).

Given the pedagogical and educational dimension, in dual education a series of relationships between the actors involved in the training are established. In these relationships between actors double tutelage arises. Indeed, the student is accompanied throughout its training path by both the company and higher education institution, in particular by company and academic tutors. Double mentoring appears to ensure and regulate the student’s progress. In this regard, the company tutor plays a key role in the workplace for its ability to organize the learning and define the objectives; the academic tutor is in charge of relations with the tutor of the company to adjust the training process of the student. Success lies in being able to integrate and combine the different learning from the higher education institution and company.

Since there are at least two realities involved nobody except the student has a complete overview. Thus, the student becomes a process owner, responsible for the “integration” part of the learning process. Part of the success of the process depends on the autonomy and the role of the student. The trio consists of the student, the company (company mentor) and the higher education institution (academic mentor). To ensure the efficiency of this training, the three actors in this process, student, company mentor and university mentor, shall thus have to:

- Define the practical phase of the student with both industrial and pedagogical results. It has to be adapted to build a progressive process with respect to the level of capacity of the student throughout the training (formative work experience)
- Provide the knowledge, know-how and soft skills needs to carry out the practical phase in the company
- Develop active pedagogy to help a better understanding of problems upon which example the theory is conceptualized (Problem Based Learning)
- Develop critical thinking by the students in order to capitalize on the acquired skill in the company field.

Due to the performance of the students in two realities, there is a gain-gain interaction for companies and higher education institutions. From the one hand, the dual education provides the labour market with skilled and adaptable workers who answer to the needs of companies. From the other hand, higher education institutions also gain the knowledge provided by students and companies, as the latter obtain know-how to improve their skills. Finally, it is important to highlight the impact of incorporating qualified young people in SMEs based on traditional models, since they can bring important changes both at the organizational and operational levels, facilitating the transition of companies to activities and sectors with greater added value.

Since there is no “one size fits all” model, a potential transfer of dual study programs to interested countries needs to be adapted to the particular national and local context. It can be noted there are three key pillars for the promotion and consolidation of dual in higher education:

- Educational and labour legislation and financial regulation to support their development
- Training structure with an appropriate pedagogical model and adapted resources
- Companies network to accept and to support the training of students

The aim of this report is to evaluate the incorporation in the ongoing engineering studies curricula of regular practical phases in entities (the conversion of a traditional higher education model into dual higher education model) taking into account the national and institutional legislation and existing curricula.

3. Description and comparative analysis

In this section the description of each undergraduate pilot dual higher education programme developed during the project and a comparative among them is done. For the comparative purpose 2 well setted dual Bachelor programmes, the Bachelor's Degree in Process and Product Innovation Engineering from the Dual Engineering School of IMH in Spain (pioneering centre offering dual higher education in Spain with a dual university studies since 1996) and FH Joanneum in Austria (DYNAMIC project consortium partner with extensive experience in the dual model in higher education), are included.

It should be mentioned that none of the three countries (Bulgaria, Romania and Croatia) involved in piloting a dual programme in this project, to date has a specific regulation dedicated to dual higher education, and each partner has taken the best possible approach to develop and implement the model taking into account their particular situation.

3.1. Bachelor in Mechatronics (ULBS, Romania)

Development and implementation of a dual bachelor degree in Mechatronics, in parallel to regular programme, at University Lucian Blaga Sibiu of Romania.

3.1.1. Development

University Lucian Blaga Sibiu of Romania has taken a holistic approach for the dual curriculum development in Mechatronics Bachelor's degree. In their approach they have done a revision of the regular curriculum and the content design of the practical phases using competence-based principles and formulation of dedicated learning outcomes for the practical training components. The adaptation of the programme has been carried out in both languages in which the Bachelor's degree is offered, Romanian and English.

In the approach of adapting to the dual model proposed for the Mechatronics programme, it was decided, on the one hand, to define a new curriculum for practical activities and, on the other hand, to adapt the syllabuses of some subjects to be closer to the needs of the participating entities. The number of entity practice duration has increased from 240 existing practical activities hours in regular study programme to 1050 hours spread over the 8 semesters. For that purpose they have used summer holiday periods after 2nd semester (9 weeks, 270 h), 4th semester (9 weeks, 270 h) and 6th semester (9 weeks, 270 h). In addition, the content of certain subjects (Microcontrollers programming, Computers programming, Digital Electronics, Power Electronics, Hydraulic and pneumatic driving systems and Programmable Logic Controllers) have been modified to integrate the requirements of the industrial partners into the educational process. The Mechatronics programme has been specialised/concretised to respond to a specific sector in the Sibiu area, the automotive sector. The syllabus of above mentioned subjects that have been adapted have been adjusted to respond to this specific sector.

In turn, students following the dual programme will be required to attend additional courses organised by the companies, while for their counterparts in the regular programme such attendance will be optional.

3.1.2. Implementation

The implementation of the pilot programme took place during the 2019 summer holiday period (between July and September) for a duration of 9 weeks, with an additional week for assessment.

The choice to follow the dual programme is first the students option, and in a second phase, it is the entity themselves who make the selection of the students admitted to the dual programme. During this first period, of the 57 students enrolled in the Mechatronics programme, 41 were selected by the entities, and 35 completed the 9-week stay; 2 entities were participating in the dual programme, Continental Automotive Systems Sibiu (from now on CASS), with 26 students, and Marquardt Schaltsysteme SCS Sibiu (from now on MSS), with 9 students. Due to the number of students participating in the programme, rotations within each company were carried out in order to gain access to different departments and carry out different activities.

The content of the practical activities in each entity were not exactly the same, they were adapted to meet the needs of the industrial partners, but in both cases with the aim of complying with the new curriculum designed by the LBUS. During the practical activities in both entities, the students were tutored by mentors from the entity itself, tutors trained for this work through the course "Train the trainer (by The Romanian-German Chamber of Commerce and Industry, AHK Romania)".

The contractual relationship between students, entity and the university has been formalised through contracts and agreements as follows:

- Entity-student sign an internship contract (the amount to be paid by the entity is agreed between the entity itself and the student, according to the specific laws and regulations in each situation)
- University-entity-student sign an agreement on the work to be carried out during the practical activities

The final assessment was done at the end of each practical activity period in front of examination committee formed by university teachers and representatives of partner companies.

3.2. Bachelor and Master programmes in Technical University Varna (TUV, Bulgaria)

University of Varna, after conducting a market survey and identifying the existing needs in the market, decided to select three existing programmes to upgrade the existing programme and align it with the real industrial needs. Those three programmes were: "Bachelor in Naval Architecture and Marine Technology", "Bachelor in Marine Engineering" and "Master in Design of Marine Power Plants and Systems". Taking into account the different characteristics of the 3 selected

programmes, the degree of changes allowed in the curriculum to design the dual approach in each of them is different. The one that offers the most flexibility in terms of dualization the existing programme is "Naval Architecture and Marine Technology" and only through a stepwise approach.

3.2.1. Development

In the approach of adapting to the dual model proposed for the Naval Architecture and Marine Technology programme (4 years bachelor programme), it was decided to organise the practical activities in two phases, on the one hand at the TUV university itself, and on the other hand after the 6th semester, during the summer vacations, at the entity. In addition to the already existing practical activities in the regular programme, "Introduction practice" (30 hours) and "Specialised practice" (60 hours), it is proposed to incorporate the option of a 12-week stay at the institution with a time commitment of 640 academic hours.

The regular degree programme in "Marine Engineering" has a duration of 4 years for full-time students, and includes in the regular curriculum 6 months of onboard training (after the 3rd year, in summer vacations) and production training. Due to its vocational character it is necessary to pass a state examination in order to obtain a bachelor's degree and a professional qualification. For this reason, the curriculum must meet the requirements of the International Maritime Organisation and other requirements of the Executive Agency "Maritime Administration"; therefore, it is not as flexible for changes as other programmes.

In the regular programme there is the option to take optional training subjects "Onboard training" or "Shipyard training" with a duration of 6 months which can be taken at the end of the 4th, 6th or 8th semester or during the preparation for the state exam.

Taking into account all the existing regulatory restrictions and in order to be able to make the curriculum more flexible, it was decided to plan all practical activities included in the regular curriculum that until now were carried out in the TUV laboratories, in an entity. It was also planned that laboratory exercises in specialised subjects, if possible, to do also at institutions outside the university; and the hours planned for independent work in the curriculum will also be incorporated into practical activities in entities. The specialised subjects selected for developing in entities were "Repair of ship machinery", "Metal turning" and "Metal fitting"; the three of them in MTG Dolphin company and each one with 60 hours (2 weeks) duration. These subjects were offered to 1st, 2nd, and 3rd year students in agreement with the curricula for the current semester. 4th year students carry out mandatory practical "Repair of ship machines and mechanics" subject.

The dual model was not taken into account in the design of the Design of Marine Plants and Systems Master's Degree curriculum, but it was decided to implement the dual model pilot programme with all first year students of the master's degree in autumn 2018 (2 years duration). The following list shows the subjects taught in full or in part at companies:

"Computer systems for design of ships and marine structures" subject (1st/2nd semester)

- 15 h lectures at TUV
- 180 h (6 ECTS) exercises/practical training led by experienced designers at company (1st part autumn)
- 180 h (6 ECTS) exercise/practical training at company (2nd part winter)

“Design of engine room and marine structures” subject (3rd semester)

- 30 h lectures at TUV
- 165 h (6 ECTS) exercise/practical training at company

“Design of ship pipelines” (3rd semester)

- 30 h lectures at TUV
- 165 h (6 ECTS) exercise/practical training at company

Final thesis on industry-related problem in direct collaboration by company.

3.2.2. Implementation

Pilot implementation of dual study for the Naval Architecture and Marine Technology programme was based on a voluntary choice by 3rd year students, and 5 of them expressed their desire to be involved. The pilot implementation took place in the summer of 2019. The presence of the students in the entities during the practical activities was rewarded according to the conditions of the entity. Specific training agreements were signed by counterparts in which reward conditions and others were described.

It was decided that taking into account the number of carry out mandatory practical “Repair of ship machines and mechanics” subject in MTG Dolphine during 2 weeks after finishing the 7th semester. During 2018/2019 academic year 6 students and during 2019/2020 academic year 11 students complete the industrial training of 60 hours of the “Repair of ship machines and mechanics” subject in MTG Dolphine. During the practical activity the students record the experience in a diary that both the university and company mentor will have to validate.

The decision to implement the Design of Marine Plants and Systems Master's Degree dual pilot programme starting in autumn 2018 was taken. It was implemented for the 4 students enrolled in the programme at that time. The practical activities of “Computer systems for design of ships and marine structures” subject were undertaken in “IHB Ship Design” company in October 2018 and February 2019; while the practical activities of the subjects "Design of engine room and marine structures" and "Design of ship pipelines" of the 3rd semester were carried out in October 2019 in the same company.

During the practical trainings the students were required to fill in their logbooks, at the end of the training the mentors complete the evaluation reports for the work than and gained practical knowledge and experience by students. The final students' assessment was carried by academic lecturers, academic mentors and company mentors.

3.3. Bachelor in Mechanical Production Engineering (UNIPU, Croatia)

Development and implementation of a dual bachelor degree in Mechanical Production Engineering, at Juraj Dobrila University of Pula in Croatia.

3.3.1. Development

Juraj Dobrila University of Pula in Croatia has taken a module dualization of on-going curricula approach for the dual curriculum development in Mechanical Production Engineering Bachelor's degree. In their approach they have added extracurricular practical activities with the aim of dualizing the existing programme. The dual-curricula programme has been carried out in Croatian language.

In order to generate a dual programme in parallel to the regular Mechanical Production Engineering programme, more hours of practical activities have been added to the compulsory 420 hours existing in the regular curriculum (360 hours of mandatory practical activities + 60 hours of Thesis work). In the regular model curriculum, such practical activities take place in the second, fourth and sixth semesters; while in the dual model, 630 additional hours are included to those already existing, spread over the 6 semesters of training. Winter and summer vacations are used for that purpose: in winter vacations 5 weeks and in summer vacations 2 weeks. In total 1050 hours of practical activities are planned in the dual model.

The hours for practical activities in the dual programme are counted as extracurricular activities that are compulsory as a student in the dual programme.

3.3.2. Implementation

The implementation of the pilot programme took place during the academic year 2019/2020 with second (two years left to finish their studies) and third year students (one years left to finish their studies).

The dual programme was presented to 31 2nd and 3rd year students with the possibility to apply to the programme and to participate in the selection process. 5 students, 2 from the 2nd year and 3 from the 3rd year, were selected to carry out the first placements in two different entities, RED FORK and HOLCIM Ltd. The selection process was carried out on the basis of academic results, motivation letter, personal interview and previous knowledge in certain disciplines by UNIPU and the entities.

Due to the late incorporation as a partner of the RED FORK, the periods of practical activities in both entities were not carried out in the same period as defined in the initial calendar. 3rd year students were in HOLCIM Ltd. during 5 weeks in winter semester and 2 weeks in summer semester, as planned; while 2nd year students carry out the 7 weeks practical activities in summer

semester. The students were mentored throughout the period of the practical activities by the tutors in their respective companies, and were guided by the staff of the VISIO laboratory at UNIPU.

Due to the low number of students participating in the programme, there was no need for rotation within each company in order to access different departments and carry out different activities; all students in each company were able to work on very similar concepts at the same time.

The final assessment was done by entity mentoring tutor using different evaluation tables for each entity.

3.4. Comparative analysis

In the following lines a comparative between different programmes is done. As mentioned at the beginning of this section, in order to compare the programmes developed in this project with others implemented some years ago and well setted, two programmes have been taken into account: "Production technology and organisation Bachelor's degree" from FH Joanneum and "Bachelor's Degree in Process and Product Innovation Engineering" at IMH. At the same time, in order to compare the most dualized possible Bachelor's programmes, from TUV only the "Naval Architecture and Marine Technology" programme will be taken into account.

For comparative purposes, the following criteria were defined:

- (1) total number of ECTS of the programme
- (2) total nº. of ECTS corresponding to practical activities in the regular programme
- (3) total number of ECTS of the dual programme
- (4) total no. of ECTS/real hours corresponding to practical activities in the dual programme
- (5) timing of practical activities (semesters)
- (6) dual activities incorporated in the regular timetable or using holiday periods
- (7) selection criteria for practical training entity
- (8) contract/agreements
- (9) payment during practical trainings
- (10) quantity business partners
- (11) assessment

As can be seen from the summary in the Table 1, the increase in the number of hours of practical activities in the 3 pilot programmes developed in this project is noticeable. Compared to the IMH and FHJ programmes, they are approaching the amount established in these universities. Taking

into account in each situation the regulatory and legislative restrictions, different approaches have been found to get closer to the dual model and to include more hours of practical activities in the programme. It should be borne in mind that each country, university and even programme is a different reality and it is not intended that the durations are the same or that the approach is exact; on the contrary, the aim is to use different approaches to include hours of practical activities in the programmes.

Regarding the beginning of the practical activities in entities, it can be noticed that in most cases (including IMH and FHJ) the beginning is between 2nd and 3th semesters. In all universities that are adapting their programmes towards dual studies, in addition to the regular hours of the normal timetable, vacation periods have been used to provide time for practical activities to be carried in entities. The exception are the two universities used as example, IMH and FHJ.

The analysing of Table 1 shows that the rotation rhythms (academic activities and practical activities in the entities) do not have a common pattern in any university, except for the vacation periods used in TUV, ULBS and UNIPU. It is worth mentioning that the adaptation of existing programmes, keeping regular and dual programmes running in parallel, makes it difficult to maintain a constant rotational rhythm in most cases.

The selection process and criteria also vary from one university to other. In some universities is the students who make the first choice of the entity and then the entity makes the selection. In some others, the university and the company make the selection and ultimately it is the student who decides.

One of the critical points in dual approaches is usually the payment to the students from the entities.

It can be seen in the comparative table that all the students undertaking dual programmes are paid. Related to agreements and contracts there are several type of options: TUV and FHJ have only company-student contracts; IMH and UNIPU have company-student and company-university-student contracts regarding the scholarship payment; and ULBS have a tripartite contract among company-university-student and 3 more between the three parties.

Table 1: Comparative from adapted curricula of TUV, ULBS and PTP, and IMH.

		TUV (Bulgaria) <i>Naval architecture and Marine Technology</i>	ULBS (Rumania) <i>Mechatronics</i>	UNIPU (Croatia) <i>Mechanical Production Engineering</i>	IMH (Spain) <i>Process and Product Innovation Engineering</i>	FH Joanneum (Austria) <i>Production technology and organisation</i>
Regular programme	(1)Total nº of ECTS program (nº of semesters and years)	237 ECTS (8 sem., 4 years)	240 ECTS (8 sem., 4 years)	180 ECTS (6 semes., 3 years)		
	(2)Practical activities ECTS/ nº hours)	90 h	240 h	420 h		
Adaptation to dual model	(3)Dual program: Total nº of ECTS program (nº of semesters and years)	237 ECTS (8 semesters, 4 years)	240 ECTS + 18 ECTS=258 ECTS (8 semesters, 4 years)	180 ECTS (6 semesters, 3 years)	240 ECTS (8 semesters, 4 years)	180 ECTS (6 semesters, 3 years)
	(4)Total nº of DUAL ECTS or real hours	Total h Dual activities 90 h (regular) + 640 h (dual) = 730 h	Total h Dual activities: 240 (regular) + 810 h (dual)(18 ECTS) = 1050 h	Total h Dual activities: 420 h (regular) + 630 h (dual) = 1050 h	66 ECTS (3600 h)	5900 hours
	(5)DUAL activities when	Regular hours during semester + summer vacations after S6	Regular hours during semester + summer vacations 1st <u>year</u> : 9 weeks (end 2 nd sem.) 2nd <u>year</u> : 3 week (regular) + 9 weeks (end 4 th sem.) 3rd <u>year</u> : 3 week (regular) + 9 weeks (end 6 th sem.) 4th <u>year</u> : 2 week (regular)	Regular hours during sem.2 and sem.4 + winter and summer vacations (sem.1: 5 weeks, sem.2: 2 weeks, sem.3: 5 weeks, sem.4: 2 weeks, sem.5: 5 weeks, sem.6: 2 weeks)	During S2, S3, S4, S5, S6, S7, S8 Every week: Mon.-Tues.-Wed. (entity) Thurs.-Fri. (university)	During S3, S4, S5 and S6 Months
	(6)Dual activities incorporated in the regular timetable or using holiday periods	Vacation periods	Vacations periods	Vacations periods	Regular calendar	Regular calendar
	(7)Selection criteria for practical training entity	Students voluntary choice of an entity, and approval from entity	Students choice, and entity selection	Academic results, motivation letter, personal interview and previous knowledge in certain disciplines.	University and entity selection, agreement from student.	Voluntary choice and industrial partners recommendations from professors

(8)Contract/agreements	YES Company-Student	YES Company-University-Student Company-Student Company-University University-Student	YES Company-University-Student Company-Student	YES Company-University-Student Company-Student	YES Company-Student
(9)Payment during practical trainings	YES	YES	YES	YES	YES
(10)Quantity business partners	1	2	2	More than 100	Several

The next criteria is about the quantity of business partners participating in the programmes. In the case of the universities that are currently adapting their programmes to dual programmes, the partners involved are few, 1 in the case of TUV and 2 in the cases of ULBS and UNIPU. In the reference universities, the number of entities participating in the programme is very large.

The last criteria is about the assessment of the practical/dual activities. It is common in almost all the cases that there is a logbook in which the activities carried out, the acquisition of knowledge, etc., are recorded. In addition to this, it is usual to carry out a final assessment in front of a committee that in most cases will be made up of company mentors and mentors/tutors from the university. In UNIPU case, the assessment is just done by company mentor.

4. Recommendations and proposed improvement plan actions

Based on the inputs and previous experience of the evaluators the following items have been highlighted for consideration and future reflections:

- **Specific regulation**

A regulatory framework should be homogeneous to allow collaboration and partnerships between different universities. In many cases, the greatest obstacle for both business and universities to engage in this type of education can be the lack of an adequate legal framework. It is essential that the governments, together with the accreditation agencies, define unified criteria so that all parties involved in the process understand the same thing when it comes to Dual Higher Education.

For example, it should be noted that there is a lack of specific regulation at Spanish level. There is only the draft of the Royal Decree that would replace the actual Royal Decree, which establishes the organisation of official university education and its subsequent modifications, refers to this Dual University Education, given that it regulates the Dual Mention in the Bachelor's and Master's degrees. This draft states that official Bachelor's and Master's degrees may include the Dual mention, provided that the following circumstances are met in the programs:

- The study plan will include compulsory external internships that will represent between 25 and 50% of the ECTS credits out of 240 ECTS in Bachelor's degrees; between 20 and 40% of the ECTS credits out of 180 ECTS in Bachelor's degrees; and at least 40% of the credits or at least 30 credits, in University Master's degrees. It should also be noted that within these percentages the Final Bachelor/Master Degree Project should be included.
- The compulsory external academic dual internship will be carried out in a company or entity and will consist of the execution of an employment contract with the student, for a duration at least equal to that of the compulsory external academic dual internships required to obtain the dual qualification.
- The aim of the employment contract will be to carry out tasks that are directly related to the Bachelor's or Master's studies, ensuring at all times the possibility of combining work and academic activity.

However, in 2018 the Basque Country Government "Department of Education" set up the following categorization criteria for characterizing the dual official Bachelor's and Master's degree programs in the Basque Country (this Spanish region has autonomy in education and in the Basque university system, and its own evaluation agency (Agency for Quality of the Basque University System – Unibasq). When defining the criteria, two options were considered: 100% of the students in Dual Bachelor/Master Degree, or dual route/path for some students (the rest of the students in traditional studies):

- The percentage of the ECTS credits that a student must take for a Bachelor's degree must be between 25% and 50% of the total, and for a Master's, at least 40% or at least 30 ECTS. Within this percentage, the Final Bachelor's/Master's Degree Project must be included. Exceptionally, in the case of already verified Bachelor's degrees, students may obtain recognition by accrediting 20% of the total, as long as they can justify reaching the established 25% within 3 years.
- The existence of a joint commission between representatives of the University and the entities is required, which will guarantee the coordination and integration of the activities developed in the entity/institution and those taught in the classroom.
- Both the entity mentor and university mentor must participate in the assessment of dual ECTS.

When designing Dual Higher Education framework, should be taking into account that it is fundamental to be the dual activities (or practical phases) integrated in the curricula. In this sense, the dual program comparing to traditional (no dual) program should not be longer in ECTS quantity and minimum vacation periods should be respected (e.g. 30 days/year as a standard employee).

Other important point to have in mind while the Dual Higher Education framework conversations should be the students allowance. It should be considered whether it is necessary to have a specific contract for this model studies, whether contracts or other types of scholarships are sufficient...

At the same time, it should never be forgotten that, as at the entity the student should be deployed in a way to contribute to the corporate success at the end of each practical term there should be a feedback talk about the performance and personal development of the student.

- **Geographical issues**

In the case of dual higher education where the student spends time both in the higher education institution and in the company/entity, it is necessary to reflect on the geographical area to be covered. If university and company are close, the presence in both can be more flexible, and the time can be shortened (e.g. the dual activities rhythm could be daily, weekly). However, when the university and the company are at great distances, the time in each of them should be longer, avoiding any continuous commuting by the student which could interfere in their studies and motivation (e.g. the dual activities rhythm could be monthly, semesters). The dual training model for implementation will force restrictions when selecting companies.

It can be noted that a mixture of study period and practical period can disrupt the learning flow, as the student has to perform in the company and in the university exams. Therefore, some models in HE show that it can be useful to start in the company after finishing each theoretical term. With

this measure, the student can better concentrate on each term and its specific content. In this respect, the business culture of each country/region should be analysed to establish what is the best pace both for the students and for the companies themselves, as in some countries, it would be worrying for a student to be away from the company for a long period of time.

- **Characteristics of local/regional/national economic structure**

It is very important to take into account the sectors in which the local/regional/national economic structure operates, activities they carry out, degree of qualification they require, etc.; that is, characteristics of the local/regional/national economy have to be known in order to be able to refine the design of the educational program. Therefore, concentrating a specific field of study in a geographical environment where a specific activity sector that requires qualified professionals operates will undoubtedly make it possible to specify the field of study and the educational model, but must also be take into account the over-saturation of the market. The goal is professionalization of students and insertion in a socio-economic environment. That is why current and future work demands of the region/nation should be studied.

- **Pedagogical model for the rest of the ECTS at the higher education**

As has been mentioned several times in this report, one of the main objectives is the professionalisation of students. Apart from the dual activities, an attempt should be made to bring the other subjects as close as possible to the "industrial environment". For that it is recommended to adapt the traditional teaching model to the Project Oriented and Problem Based Learning (POPBL) model.

- **Correct rhythms with the studies (passing the subjects corresponding to each semester)**

The development of a dual model often involves the correct integration of subjects taught at the university itself with placements in companies. Both, the lectures at the university and the placements in entities are defined in a specific period of the curricula, because they have a specific purpose. When the student is not fully enrolled, or a student does not pass the subjects as expected from year to year, this can lead to imbalances the correct development of the education process.

Currently, pilot tests have been included in specific courses including placements in companies, sometimes taking advantage of holiday periods for this purpose, but without really replacing the academic hours commitment that has been made up to now with placements in companies. In the future, when real integration is considered, the above should be taken into account.

- **Organization of the practical phases in de company's**

It is very important to define correctly the skills that should be acquired in the company/entity practical phases. Furthermore, concrete activities should be identified that give the option of developing these skills. This does not mean that different activities could not be possible in different companies/entities or for different students, but it should be defined beforehand what is expected to achieved through these activities and a common way of evaluating them for all students.

It is very important to have fluent contact with company/entity and higher education institution. This will facilitate the redirection of activities that do not follow the thread initially defined to achieve the objective set for each activity. At the same time it will be essential to have frequent conversations for continuous improvement.

It should not be forgotten that the main objective of the dual model is the professionalisation of students, and the company/entity themselves are the driving force in this sense. But it should also be borne in mind that often fundamental and applied research is not carried out in the companies/entities and it may be the students who bring the knowledge to the company. Activities must be designed to provide this multidirectional gain.

It is very common for the practical phases in companies to start in the workshop in order to get in touch with the real working environment, machines, people and products. In order to promote this task as much as possible, it could be useful for the students to make specific reports of integration in the company and a technical report specifying products, process, sector to which it belongs, competence of the company...

Ongoing the students is on duty in the different departments of the company according to contents of the curriculum. Additionally the student is weaving his network in all departments. In his last practical term he should understand the interaction of the departments in a company.

The students are on duty in the different departments of the company according to the contents of the curriculum. In addition, the student is weaving his network in all departments. In their last practical term they should understand the interaction of the departments in a company, and end with the implementation of a multidisciplinary project.

- **Evaluation of the practical phases**

It is very important to reflect on such an evaluation and give feedback to all evolved persons especially to the student. Whether tutors from the company and the university participate in the evaluation, or only a committee from the university participates, it is essential to have clear evaluation criteria. If possible, for the same specific practical activity in the company/entity, the same person/persons from the university should be responsible for its evaluation, establishing clear and homogeneous criteria for all the evaluated students.

It is not recommended to use different assessment tables or rubrics as existing entities, as this makes it difficult to homogenise the assessment process.

- **Company mentors and training courses**

The university should validate the company tutors with the previously defined homogeneous criteria. Not anyone could participate in student mentoring (e.g. minimum studies required, minimum work experience...), and if they also participate in the final assessment, they should comply each country legislation in the official assessment of university students. Even if the mentors meet the established minimum criteria, it is advisable to design training courses for them.

The dual higher education model could require an official accreditation process for company mentors. It is essential to weigh up before deciding to include in the legal dual higher education framework or at university level, whether such accreditation will attract more mentors or whether some of them will back out for that reason.

Especially in the phase of the implementation of a dual study program it will be necessary to be more tolerant in the choice of the mentors in the companies. There are a lot of SME in which the academic care will not be easy to be ensured in the beginning. When the Dual education will be well established it will be easier to rise the demanded prerequisites of a company mentor.

- **Assessment/analysis of the companies**

It is fundamental to be surrounded by companies committed to the student's learning process because of the leading role that the company acquires in the dual educational model, and for this reason the evaluation of them as a guarantor of such learning becomes particularly relevant.

A way should be designed to evaluate companies from the point of view of the skills acquisition in it.

- **Lack of mentoring hours for higher education institution mentors**

In the dual model development and implementation should be taking into account the mentoring hours needed by higher education institution mentors. It is a difficult task to try to calculate the time required for the mentoring process in such a model; and it should be added that each approach to the dual model in each higher education institution could be completely different.

Nevertheless, we should not underestimate the importance that these people will have in the successful implementation of the dual model. They will be in charge of monitoring, taking corrective actions, probably participating in the evaluation process, etc... This is why it is recommended to overestimate the amount of time needed for these tasks of the mentors until the implementation is well established.

Moreover, taking into account the university law of each country, these hours should be counted as part of the teaching load of lecturers who also carry out mentoring tasks. This would mean that those hours spent on mentoring tasks would be taken into account in subsequent accreditation systems for academic positions (academic ranks) in each country.

Therefore, on the one hand, the university itself should ensure the correct allocation of the dedication by including as part of the teaching load, but on the other hand, it should be ensured that the accreditation processes of the agencies are aware of these models and they regularise the model existence by accepting mentoring dedication as part of the regular teaching load.

- **Students mobility**

Depending how the dual activities are allocated in the academic calendar, the students mobility for studies to other universities could be difficult.

e.g. On the one hand, if the students are regularly alternating one week at the company and the next at the university, and the next one again in the company it is nearly impossible to go for a students academic mobility in another university and be in a company at the same time. On the other hand, if the activities in companies were carried out over long periods, such as semesters, in the purely academic semesters at the university they could take mobility into other universities.

As mentioned above the chosen rhythm is a crucial mean for mobility. Nevertheless there can be found creative models for students exchange with other dual programs in other countries, e.g. that the companies of accept a student from another country in exchange.

- **Students payment by entities**

Minimum amounts to be paid by enterprises to students in dual programmes should be established as the students also contribute to the companies success. While there is no specific regulation at state/regional level on this issue, it should be up to the university to set minimums. At no time should such a task be left to the students, at least not by negotiating the minimum wage. If there is no specific regulation defining the existence of a maximum, this could be negotiated by the student with the institution.

- **Heterogeneity and number of partner entities/companies**

The heterogeneity of the existing industrial network must be taken into account. During the comparison, it has been observed that in model universities running dual programs for several of years, the number of existing partner entities/companies is high. This makes difficult to ensure

homogeneity in terms of carried out activities, the acquisition level of competences, etc. These aspects should be considered for future development/adaptation of dual programmes.

5. Conclusions

All participating universities have mentioned that in the niche sectors where their educational programmes are adjusted, there is a lack of professionals in the sector. At the same time, it is well known that students who study in conventional universities, in regular programmes, usually cite that theoretically they have the knowledge but lack the practical part; or even sometimes that the knowledge acquired at university is obsolete by the time they reach the industrial world. There is a German survey that it takes about one year of investment for a company that an alumni of the traditional university system is able to be perform in the expected position as he has to orientate in the industrial environment. The performance of a dual educated starts with the first day after his graduation as he is well introduced parallel to his academic education to the industrial demands.

Most of the time, the pace of industrial progress in companies is faster than the pace of change that a university can keep up with. Because of this, the latest developments and techniques are often found earlier in the industrial world and it is essential to have access to them during your studies in order to get a good education.

The impact of the dual model on the employability of recent graduates has not been mentioned. Analysing the implementation of the pilot programmes, no comparison can be made in this respect. But it is to be expected that with an early approach to the industrial world, more people will find employment in the companies they have been in during their training periods.

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