IMPLEMENTATION REPORT CROATIA - UNIPU

November 2020

D5.1.-3 – Implementation Report

Project information

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PU	Public	X
PP	Restricted to other programme participants (incl. Commission Services)	
RE	Restricted to a group specified by the consortium (incl. Commission Services)	
CO	Confidential, only for the members of the consortium (incl. Commission Services)	

Document Log

Version	Date	Description of Change
1	27.11.2020	First draft report
2		Adapted to Project reporting requirements set by HSW

Contents

1. INTRODUCTION

The following Implementation Report (IR) is based on the results after organising and conducting practical activities by UNIPU and the partner companies, with the goal of designing and implementing a dual-curricular practice integrated program that gives students more hands on experience in industrial practice. The organised activities were within the framework of the European project titled DYNAMIC – Towards responsive engineering curricula through europeanisation of dual higher education under ERASMUS + Programme, Key Action 2. ERASMUS+ DYNAMIC is a dual-education project which consists of studying and gaining practical knowledge at higher education institutions along with practical knowledge and skills at enterprises during the educational process. Project was approved within Erasmus+ Knowledge Alliances programme with a duration of 36 months. Croatian partners on the project are Juraj Dobrila University of Pula, Holcim Hrvatska d.o.o., and the company Red Fork, while associated partners are Istrian Region and Croatian Chamber of Commerce – Regional Chamber Pula.

The project was implemented, developed, tested and validated by three different undergraduate programmes in the field of Mechatronics and Robotics (Sibu, Romania), Shipbuilding and Construction (Varna, Bulgaria) and Mechanical Engineering and Production (Pula, Croatia). The University of Jurja Dobrile in Pula, in cooperation with the VISIO scientific technology institute, has a strong experience in CAD modeling, 3D printing, FEM analysis, rapid prototyping, IoT (internet of things), virtual reality and last but not least in sharing knowledge. The Department of Engineering was established in 2016, under the University of Jurja Dobrile in Pula with the aim to educate engineers at the level of today's technical knowledge in the areas of production and computer engineering, by combining new technologies and industrial practice. In addition to the basic technical, conventional and mechanical disciplines, the department is becoming more focused on the study of new STEM technologies, with the emphasis on 3D printers, mechatronics and robotics. Students can have hands-on experience in this new technology on the premises of the science and technology institute VISIO. The VISIO scientific technology institute has a laboratory equipped with eleven Prusa i3 3D printers, which are used daily for both educational and productive purposes.

For the Dynamic project VISIO ensured laboratory infrastructure for students in order to assure an adequate level of equipment in order to acquire the necessary skills needed for training purposes in two companies HOLCIM Ltd. and RED FORK. The company HOLCIM Ltd. is engaged in the production of cement, concrete and mineral aggregates, top quality products, produced according to world standards. RED FORK is a company for research & development in the area of biotechnology, nutrition, business and additive technology as well as IT science.

2.OBJECTIVES AND METHODOLOGY

2.1. Objectives of the Implementation Report

The following Implementation Report (IR) will:

- present the practical activities carried out by the students on behalf of the Mechanical Production Engineering dual-curricula programme;
- present the practical activities timeline;
- present the integration of the supplementary hours of practical activities into the present curriculum;
- show the student selection process criteria for the dual-curricula program;
- analyse the results of practical activities organized by UNIPU and partner companies;
- analyse the development and the implementation of the dual-curricula program in the field of Mechanical Production Engineering.
- evaluate the students and the company involved in the practical activities conducted in this project.

2.2. Methodology used

The practical activities conducted within the framework of the DYNAMIC project, were conducted by second and third year students of Mechanical and Production Engineering undergraduate studies during the academic year 2019/2020., since UNIPU as a partner entered the project just in 2019. One part of the selected students attended only one academic year of the dual-curricula program, considering that at the time of their enrollment in the study there was no option to choose a dual-curricula study program. However , it served as a good test for future generations of students By the end of practical activities, students have performed different tasks including designing, prototyping and preparation of workshop documentation including parts and assembly drawings. The data in the presented report were collected from the workshop documentation, discussion and directly by representatives of the companies.

3. OVERVIEW

The Department of Engineering is a new department within the University of Jurja Dobrile in Pula. The studies in the Department of Engineering are divided in two branches, Computer Science and Production Mechanical Engineering. The department of Production Mechanical Engineering has been in existence for four years, while for the department of Computer Science this is the primary year. Since the study of Computer science has only just started with the beginning of this academic year, it will also be interesting to analyse its implementation of dual education. The classes in both departments include lectures and exercises for the acquisitions of theoretical knowledge and laboratory exercises in modern equipped laboratories. These studies provide not only conventional mechanical and computer disciplines, but additionally to them some modern technologies like automation, electronics, additive technology, AI and mechatronics.

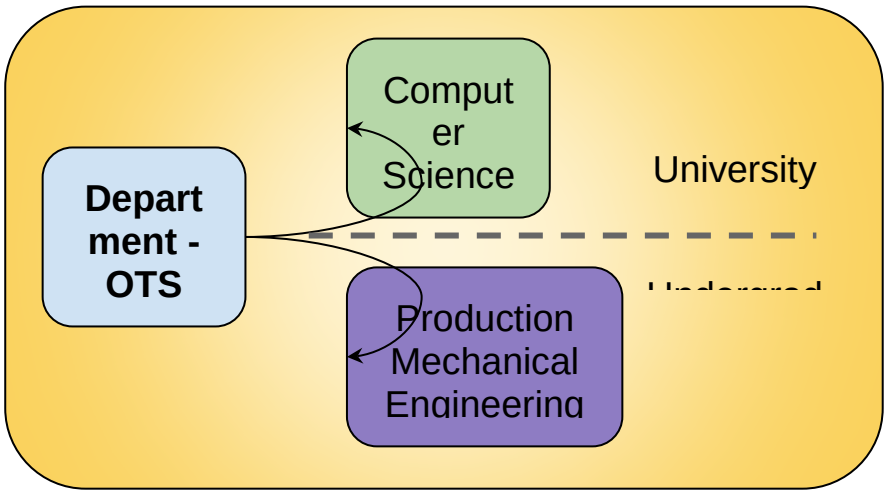

Figure 1: Schematic representation of technical studies on Department of Engineering

At UNIPU, Mechanical Production Engineering undergraduate studies program is organized in Croatian languages. This year, Mechanical Production Engineering graduate studies opened for the first time and the first generation of students enrolled. Organizing Mechanical Production Engineering as a dual-curricular specialization together with the rapid industrial development, would contribute to a higher interest of students in this study.

Mechanical Production Engineering undergraduate studies program at UNIPU, as a regular study program is unfolded in 6 semesters, with a compulsory amount of practical activities of 390 hours. Students pursue practical activities in all the three years of their undergraduate studies (2nd 4th and 6th semesters). The practical activity from semester 2 and 4 carry a load of 4 ECTS while the practical activity of the final semester carries a load of 5 ECTS, with a total of 13 ECTS for practical activities. For the dual-curricula Mechanical Production Engineering undergraduate studies program, supplementary hours of practical activities were added. A supplementary amount of 660 hours of practical activities were added to the existing 390, which will lead to a total amount of 1050 hour for the dual-curricula option. The additional practice has been added in all semesters based on student's availability, which is therefore slightly different from the initial proposal (represented on figure 3) of the dual-curriculum implementation. The winter semesters (1st, 3rd, and 5th semesters) were introduced

to 5 weeks of practical activities, while for the summer semesters (2nd, 4th, 6th semesters) additional 2 weeks have been added. The figure 2 shows the integration of the supplementary hours of practical activities into the present curriculum.

	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
W1						
W2						
W3						
W4						
W5						
W6						
W7						
W8						
W9						
W10						
W11						
W12						
W13						GW
W14						GW
W15						GW
W16						GW
W17		W1		W1		W1
W18		W2		W2		W2
W19		W3		W3		W3
W20		W4		W4		W4
W21						
	W1		W1		W1	
	W2		W2		W2	
	W3		W3		W3	
	W4	W5	W4	W5	W4	W5
	W5	W6	W5	W6	W5	W6
	5*30	6*30	5*30	6*30	5*30	8*30
	150	180	150	180	150	240

Courses and laboratories
Exams
Holidays
Graduation work
Mandatory practical activities (now)
Proposed practical activities

Figure 2: Schematic representation of technical studies on Mechanical Production Engineering Department

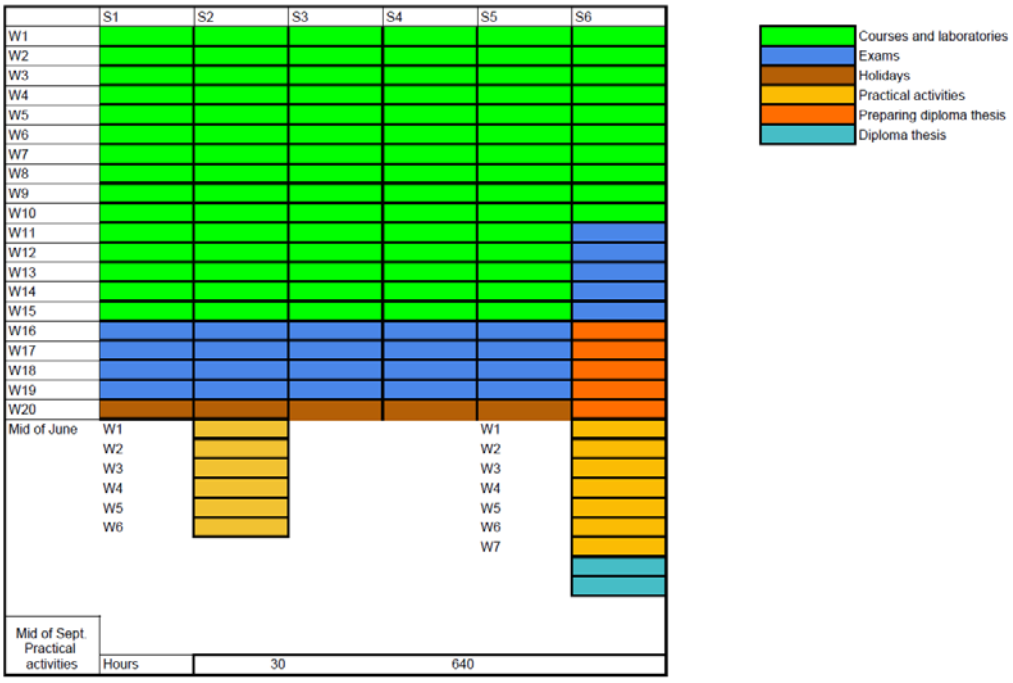

Figure 3: Dual-curriculum implementation initial proposal

As can be seen, students from the dual-study program must attend the extracurricular courses organized by the companies as a mandatory requirement. Practical activities are distributed in the way that

students are equally burdened throughout all semesters. In the academic year 2019-2020, students from 2nd and 3rd year were able to choose between the regular form and the dual form of study. A limited number of places were allocated to the dual-curricula specialization, and the selection of the students was done according to a selection procedure described in the paragraph 3.1. that was proposed and agreed between UNIPU and the industrial partners HOLCIM Ltd and RED FORK.

3.1 Student selection process

For this project, 5 students in total were selected, two students were from the 2nd and three from the 3rd year of the Mechanical Production Engineer undergraduate studies program. The selection criteria was made by UNIPU and the companies RED FORK and HOLCIM Ltd. The selection criteria involved:

- academic results - students with the good ranks were selected;
- motivational letter - students interested in the dual-study program had to write a motivational letter on why they would like to participate in this program;
- interview of the students in order to assess the student determination and motivation;
- previous knowledge and skills in the field of CAD modeling, technical documentation, and production engineering.

4. IMPLEMENTATION OF THE PRACTICAL ACTIVITIES

4.1 Specific objective

The practical activities performed by students had the specific objective to develop new industry-related skills and improve the knowledge they have acquired during their study. The students that were involved in practical activities with the company HOLCIM Ltd, acquired skills specific for the cement industry and improved their existing skills for CAD modeling and in making technical and assembly drawings. The students that were involved in practical activities with the company RED FORK, acquired new skills in the area of biotechnology, additive technology and IT science as well as improving skills for CAD modeling and in making technical documentation and assembly drawings.

4.2 Duration

The practical activities in the partner company HOLCIM Ltd were carried out between 05.11.2019. and 12.03.2020., (5 weeks in the winter semester and 2 weeks in the summer semester).
Due to the subsequent involvement of Red Fork partners in June 2020., the planned student internship activities could be carried out only in the period from: 22.05.2020. (kick off-pre start meeting) to 22.09.2020. In that period an additional 7 weeks of student practical activities were satisfied.

4.3 Location

The practical activities were conducted at the partner companies HOLCIM in Koromačno and RED FORK in Zagreb, and in the premises of the science and technology laboratory VISIO in Pula. The company HOLCIM provides large production plants and R&D facilities, while the company RED FORK is focused more on research and development of new technical products. In the VISIO laboratory within the UNIPU university, students had access to computers and programs used for CAD modeling and technical documentation as well as to laboratory equipment such as 3D printers.

4.4 Participants

The possibility to follow the dual-curricular program was presented to the students from the 2nd and 3rd year of Mechanical Production Engineering undergraduate studies, in total 31 students.
Students who showed interest were able to apply to the program and enter the student selection process described in paragraph 3.1.
5 students in total were selected, 3 students from the 3rd year to perform practical activities at the company HOLCIM Ltd, and 2 students from the 2nd year to perform practical activities at the company RED FORK.

4.5 Content of the practical exercises and the activities performed by the students

The practical activities performed by students at two different companies had many similarities in the general structure. The practical activities have met the needs of both industrial partners and the new syllabus created for the dual curricula by UNIPU. The activities performed by students at HOLCIM were based more on industrial plant design, while the activities performed by students at RED FORK were based on rapid prototyping skills. From both companies students were requested to generate 3D CAD models and to make workshop and assembly drawings as well as other forms of technical documentation such as bill of material etc.

Students were mentored in every step of practical activities by their tutors from both the companies, and had the guidance from the UNIPU laboratory VISIO staff.

The mentors from both companies had significant roles in both companies and many years of experience in their industry field.

4.5 1. Implementation plan: preparation; timeline; periodical rotation/block model

Because of the small number of students, both companies decided that there was no need for a periodical rotation of the students, and that they would rather work with all the students together on the same or similar tasks.

The timeline for both the companies was similar with excepcion in certain segments as presented in figure 3 and 4.

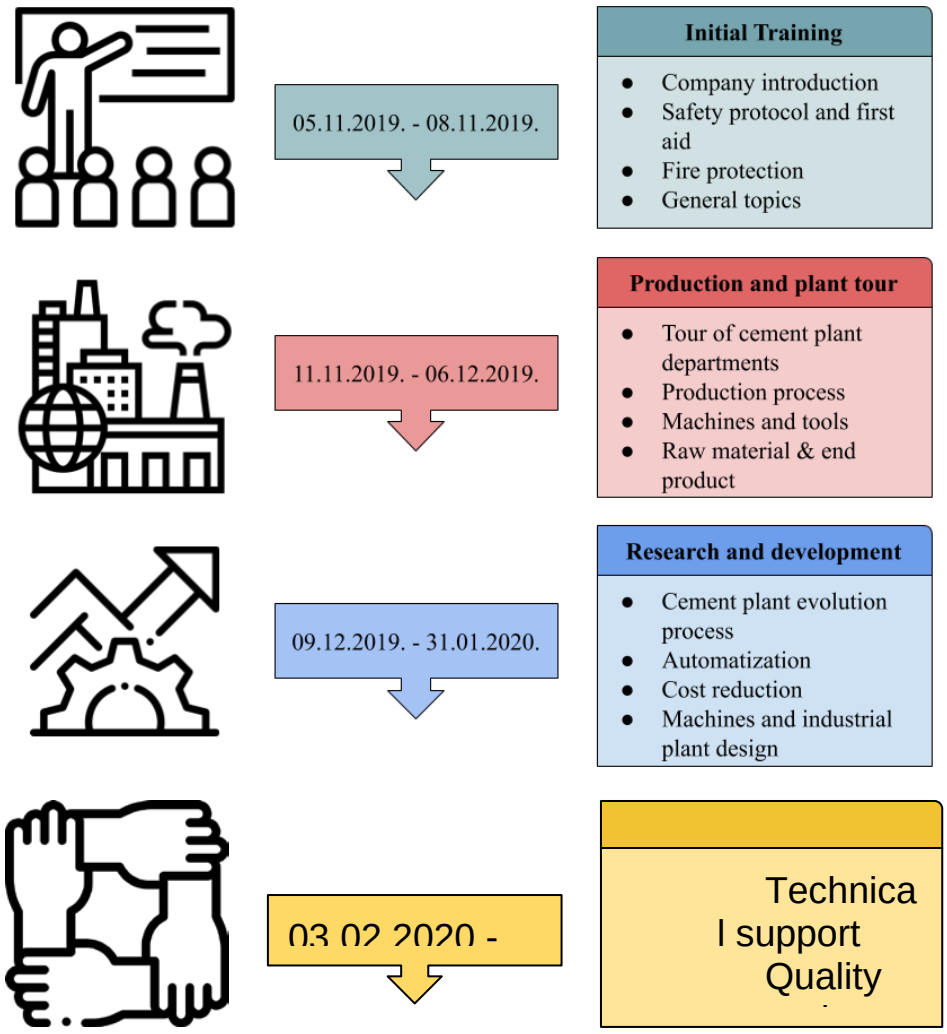

Figure 4: HOLCIM practical activities timeline

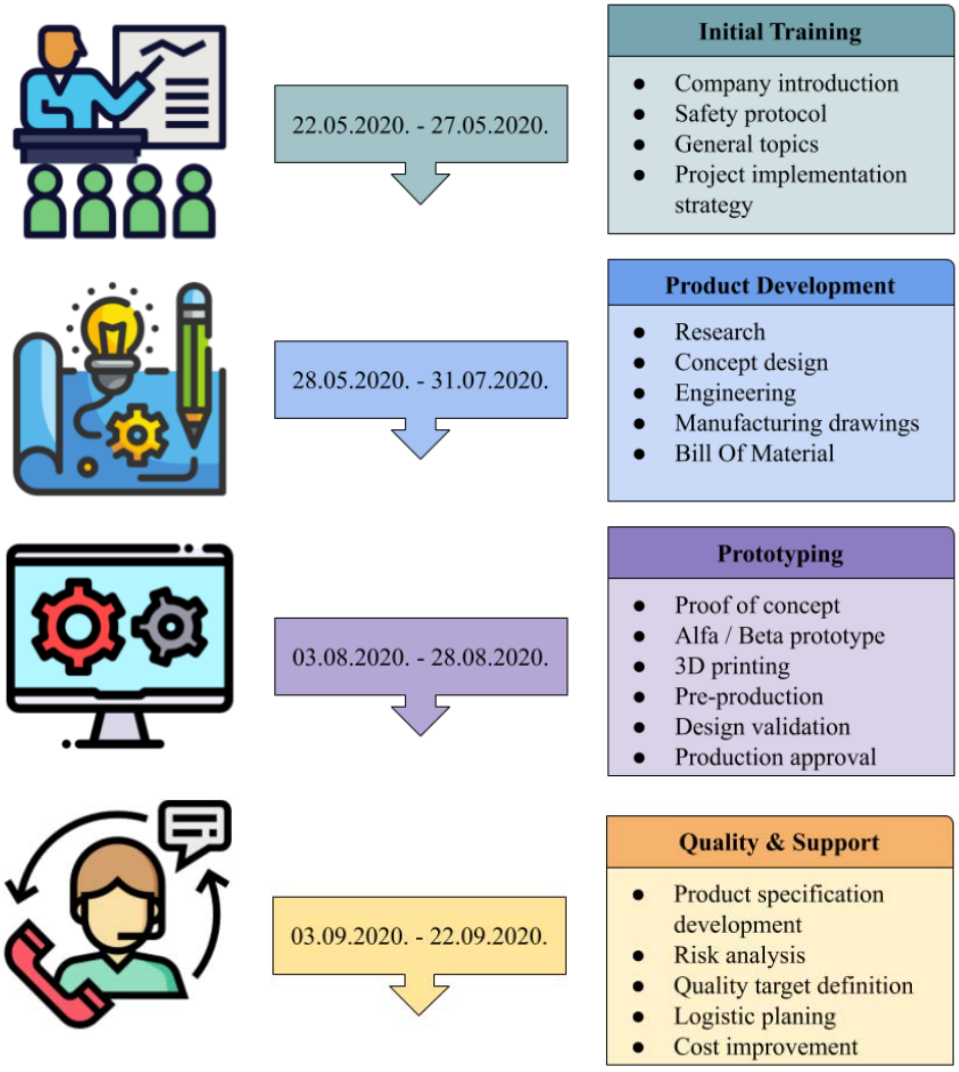

Figure 5: RED FORK practical activities timeline

5. EVALUATION

5.1 Student assessment process

The student's evaluation took place at the end of the practical activities. Mentors from each company included in the project evaluated the students.
At Red Fork, the mentors had to evaluate students by filling up the table presented below (figure 5).

Student	Department	Direct Superior	Overall Performance of Intern	Comments

Figure 6: Evaluation table at Red Fork (source: Red Fork)

At Holcim, several criteria were defined for the evaluation, and the tutors had to fill up the following table (figure 6).

Performance/Evaluation	Poor	Fair	Good	Excellent	Outstanding
Attendance (punctuality)				X	
Productivity (volume of work; promptness)					X
Quality of work (accuracy, intelligence, neatness)				X	
Initiative (self-starter, resourceful)					X
Dependability (thorough, organized)					X
Attitude (enthusiasm, curiosity, ambition)				X	
Interpersonal relations (cooperative, courteous, friendly)				X	
Ability to learn (comprehension, on-task adjustments)					X
Use of academic background (applied education to internship project)				X	
Communication skills (oral and written)				X	
Judgment (maturity, decision-making)				X	
Overall performance				X	

Figure 7: Evaluation table at Holcim (source: Holcim)

Feedback meetings were organized to assess the students' feedback regarding the first results of the internship program.

Some opinions of the students which participated at practical activities in the companies are also presented below:
“I have learned many things that will definitely help me in the future”;
“I met a lot of new people that are friendly, open-minded and ready to answer every question an intern would have and the mentors help was irreplaceable for gaining new knowledge.”;
“Practical experience is the best, and internships give us that hands-on experience we can't get in a classroom. This was a quality internship and essential to develop key skills that will help us find a job in the future”.

Some images collected during the practical activities in the partner companies are presented in figures 7-10.

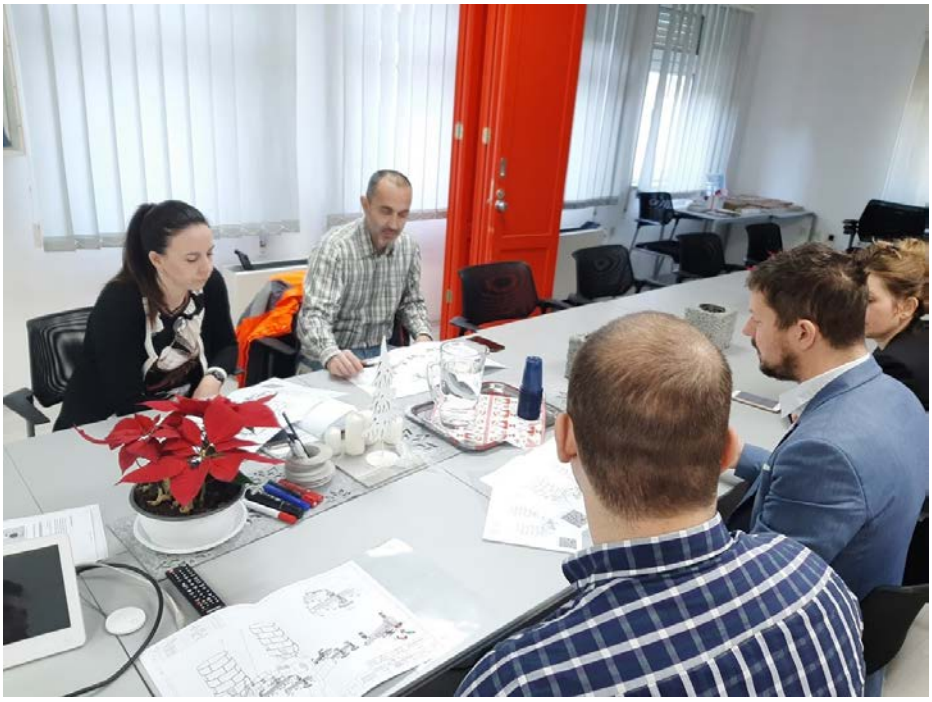

Figure 8: Meeting with the partners from industry (source: UNIPU and HOLCIM Hrvatska)

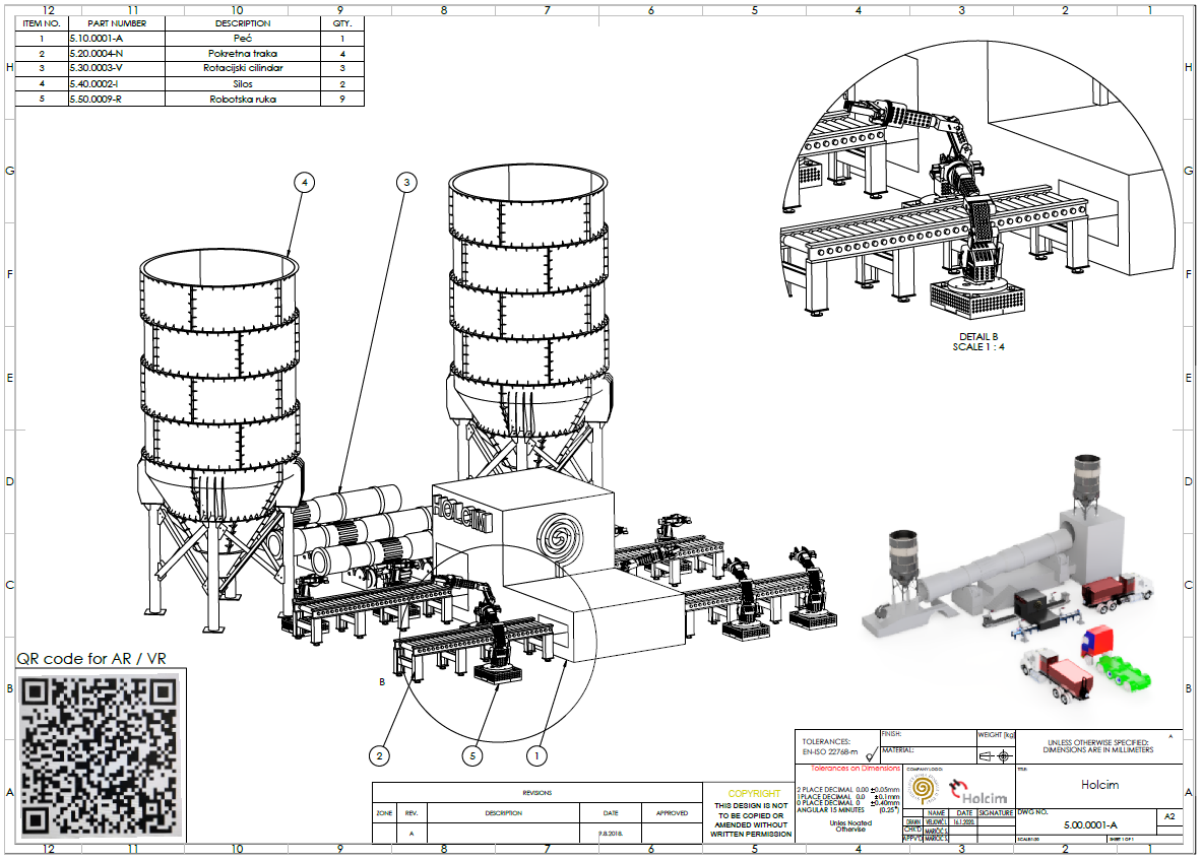

Fig. 8a: CAD model drawing - one of the results of practical activities ***(source: UNIPU and HOLCIM Hrvatska)***

Fig. 8b: CAD model drawing - one of the results of practical activities ***(source: UNIPU and HOLCIM Hrvatska)***

Fig. 11: Students and tutors at Holcim (source: UNIPU)

Fig. 9: Mentors and project partners at University of Pula (source: UNIPU and Red Fork)

Fig. 10: Some members of the team at presentation of students ideas at University of Pula (source: UNIPU and Red Fork)

Fig. 10a: CAD 3D model based on student activities during practical work (source: UNIPU and Red Fork)

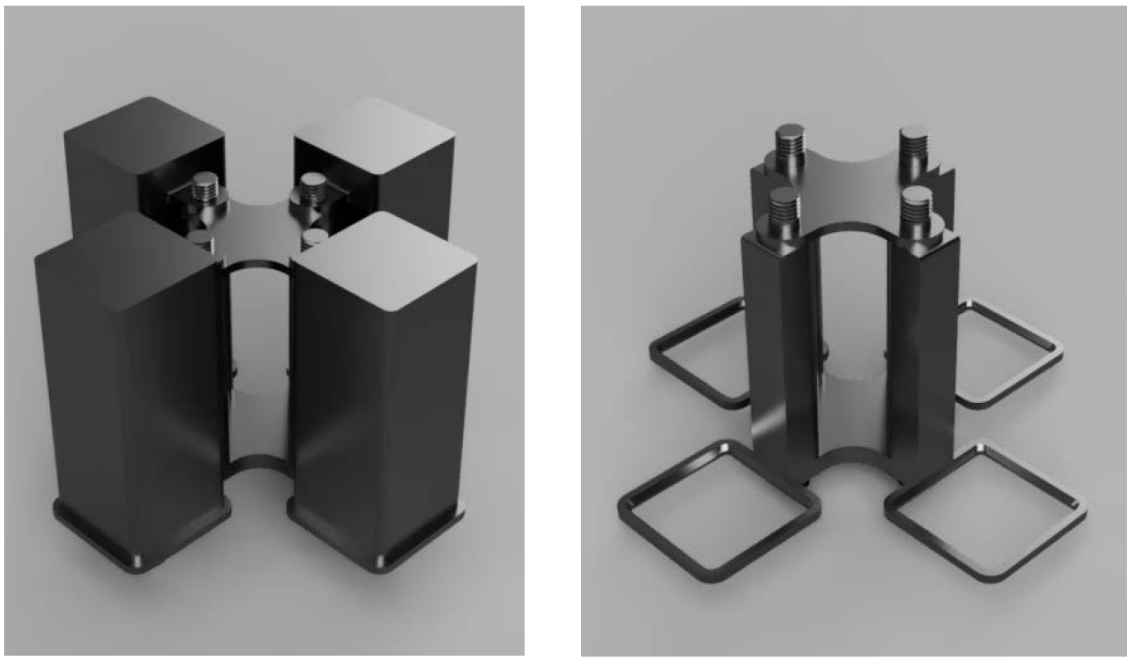

Fig. 10b: CAD 3D model based on student activities during practical work (source: UNIPU and Red Fork)

5.2 Employment rate of dual pilot students

Students that attended the dual-curricula program have learned new skills which will be a great advantage in the future when they start looking for jobs. Thus employment rate cannot be estimated for the students enrolled in the 2nd and 3rd year of study. However, it is noticeable the fact that such a way of practice has very positive influence on employment which is proven by the fact that there is a better possibility for students that participated in the dual-study program to get employed by the companies where they performed practical activities or in other similar companies.

5.3 Experience and impressions of the academic mentors

Academic mentors are facing a rather new situation: the feedback from students with regards to the quality of their academic training is now much more realistic. Students are more than interested to continue developing practical competence in their field of specialization from both the existing partner companies or new ones. The students from the dual-curricula program got acquainted directly with the requirements on the labor market, with regards to what companies are expecting from a Mechanical Production Engineer specialist. Consequently, the students want now to be much more involved in the design of their curriculum and syllabuses.

5.4 Experience and impressions of the industrial mentors

The main objective of the industrial mentors was to develop students' competences in such a way that they acquire current industry-related skills, by focusing more on the practical side. This was fulfilled both at Holcim and Red Fork by special designed tasks. Training included several topics from general engineering to specialised fields of CAD/CAM, maintenance, processing activities, 3D modelling for virtual reality and 3D printing. The experience of the industrial mentors have revealed that, for the moment, according to the assessment process, students have been able to successfully complete all the required tasks, both the ones that are in the second, and the ones that are in the third year of study. The experience and impressions of the industrial mentors were communicated during the regular bilateral meetings between the university and the industrial companies, carried out at the university and at companies.

5.5 Communication between academic and industrial partners

Communication between Juraj Dobrila University of Pula and project partners Holcim Ltd. on the one hand and Red Fork on the other was unfolded by means of the regular bilateral meetings between academic mentors and industrial mentors, organized during the students practice. Also, online tools (emails and online meetings) were used for this purpose. Students mentored by Holcim Hrvatska Ltd, professors and assistants included in the Dynamic project have created elaboration of an automated plant technical solution.

6. CONCLUSIONS AND FUTURE ACTIONS

The project goal is to implement the dual-curricular program in the Mechanical Production Engineering undergraduate studies program at the Juraj Dobrila University of Pula. The program was presented to 31 students from the 2nd and 3rd year of study, and from that initial number 5 students were selected to enrol for a dual-curricular program. All 5 students have finalized the first 9 week of internship.

For the next academic years and the next generation of students the following points will take action:

- Mechanical Production Engineer undergraduate study students will be able to choose from a regular or dual-curricula program from the 1st semester.
- Students will continue developing practical competence in their field of specialization from both the existing partner companies and possibly new ones.
- The mentors from partner companies will be educated for this role, by means of the Train the Trainer course organized by UNIPU.

6.1 Lessons learnt, what could be better, and recommendations for the reaccreditation of the programme; recommendations for further development

After one year of implementing the program activities we learned and observed the following:

- Students that followed the dual-curricular program have generally a good impression of the program.
- There is a vast interest in new students for attending the dual-curricular program, both because of student references and because of the dissemination of information related to the Dynamic program.
- Students that have followed the dual-curricular program in the academic year 2019/2020 had a solid base, which made it easier for the companies to implement these students into the company activities.
- Students that attended the dual-curricular program have learned new skills which will put them at an advantage when looking for future jobs.
- There is a better possibility for students that participated in the dual-curricular program to get employed by the companies where they performed practical activities.

6.2 Vision for the dual programmes after the pilot implementation

The students from the 2nd year will resume the pilot dual-curricular implementation in the frame of the Dynamic program. We are expecting the program to be continued for future generations of students with the existing partner companies and possibly new ones.

6.3 Scalability of the model at country level

The program conducted at UNIPU can be transferred and replicated in other universities in Croatia for different fields of study. This program has the potential to be very well accepted and implemented from universities, companies and of course students. The first step in scaling the project to country level should be to present the project and transfer the know-how experience to few major cities such as Rijeka, Zagreb and Split.

6.4 Article and publications

Under the Dynamic project two articles were published under the University of Juraj Dobrila in Pula. The first article was published in 2019. at the MATEC Web of Conferences 299, 03006 (2019) under the title of *"VR 3D Education for Vocational Training"*. The second article will be published on 30.11.2020. under the journal ranking Q2 EUREKA: Physics and Engineering Number 6 under the title of "Implementation of optimum additive technologies design for unmanned aerial vehicle take-off weight increase".

ACKNOWLEDGEMENT

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