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APPRENTICESHIP CLUSTER IN MECHANICAL ENGINEERING AND MECHATRONICS [1]

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Abstract: *The paper views the relationship between industry and higher engineering education, in particular within the region of Gabrovo, which shows a certain mismatch between the skills of engineers demanded by enterprises and the skills of young engineering graduates supplied by technical universities. To respond to that challenge, an alternative educational path at tertiary level is proposed by an international team of university lecturers, business people, local authorities, employers' organizations and social partner in the area of Mechanical Engineering and Mechatronics. A completely new form of higher education, known in most European countries as dual/cooperative studies, is considered - work-based learning with focus on apprenticeship. Actually the present paper presents in details one of its tools - an apprenticeship cluster in Mechanical Engineering and Mechatronics, which is intended to bridge the gap between the worlds of business and education so as to boost economic growth at regional level. .*

Keywords: *apprenticeship cluster, work-based learning, apprenticeship, skills mismatch, engineering graduates, academic and company mentors*

INTRODUCTION

Industry 4.0 represents considerable challenges for both engineering higher education and enterprises in Bulgaria in terms of competences and innovation potential. On one hand, enterprises need new talent, especially engineers, who think and act interdisciplinarily. In addition, they look for engineering recruits that are well-equipped with industry-relevant knowledge and skills and ready to start work immediately after university graduation so as to minimize their investment in further training. On the other hand, Bulgarian universities offering engineering degree courses experience difficulties in catching up with latest technologies and competences thus generating ill-equipped engineering graduates who appear irrelevant on the labour market in relation to both engineering and employability skills. In particular, this holds true for engineering students in Mechanical Engineering and Mechatronics where various technical areas meet and interdisciplinarity is a must. As a consequence, young engineers either take low-skilled jobs or remain unemployed for some time.

Therefore, joint efforts of industry and higher education are required to bridge the above gap for the benefit of future engineering graduates.

EXPOSITION

Industry and Engineering Higher Education in the Region of Gabrovo

One of the industry priorities in the Region of Gabrovo, outlined in its Regional Development Strategy, is the growth of Machine Building and Mechatronics. There are over 50 SMEs and multinational companies within the region whose business activities are related to

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Mechanical Engineering and Mechatronics. Most of them use cutting-edge technologies and export to Europe, Asia, South and North America. Therefore, they need skillful engineering pool combining technical and generic skills such as foreign languages, social skills, etc. However, they face a lot of challenges when recruiting young engineering graduates since the latter lack not only engineering competence but employability skills as well.

On the other hand, within the region there is a technical university (Technical University of Gabrovo) providing bachelor, master and PhD degree courses in Mechanical Engineering and Mechatronics. Although it tries to correspond to the needs of industry through alternative educational forms and teaching materials, the gap between engineering skills demand and supply is still huge.

Over the last years the university authorities, local companies and the Municipality of Gabrovo has been investigating various possibilities to overcome the engineering skills mismatch. Consequently, in 2017 a European partnership was established including two technical universities (Technical University of Gabrovo, BG, Technical University of Gdansk, PL), two enterprises (Mechatronica, BG and FEDC, PL), the Municipality of Gabrovo, BG, Gabrovo Chamber of Commerce and Industry, BG, Podkrepa-Gabrovo, BG, and Joanneum University of Graz, AT. The main purpose of that consortium is to introduce dual/cooperative studies at tertiary level, which has proved to be the most effective form of higher engineering education in leading countries such as Germany, Austria, etc. The Bulgarian and Polish partners are guided and supported by the Austrian university, which is the first one in Austria that has offered dual studies degree courses.

The main outcomes of the partnership are going to be: a Work-based Curriculum and Study Programmes for 3rd and 4th year students following a bachelor degree course in Mechatronics and an Apprenticeship Cluster in Mechanical Engineering and Mechatronics. However, the present paper will consider only the second product intended for Bulgaria, in particular its e-platform, since the first one was a subject of other scientific works.

Apprenticeship Cluster in Mechanical Engineering and Mechatronics

The Apprenticeship Cluster in Mechanical Engineering and Mechatronics (referred to as the Cluster) is designed as an open coordination and cooperation forum so as to foster the sustainable partnership between the world of higher education and business supported by local/regional authorities and social partners, and to encourage all stakeholders to overcome the existing skills mismatch of young engineering graduates. It aims to provide vacant apprenticeship positions in the field of Mechanical Engineering and Mechatronics, to promote the concept and benefits of work-based learning and apprenticeship at tertiary level and to train academic and company mentors so as to boost the regional economic growth.

The members of the Cluster are renowned organizations at local, regional and national level, which actually represent all key actors in the area of regional development and sustainable economy: 14 enterprises from the region of Gabrovo such as Mechatronica S.C., AMK Drives, STS Electronics, etc.; two enterprises from Kazanlak - Arsenal J.S.C., M+S Hydraulic PLC; Technical University of Gabrovo; Municipality of Gabrovo; 3 employers' organizations - Gabrovo Chamber of Commerce and Industry, Bulgarian Cluster of Mechatronics and Automation, and Bulgarian Branch Chamber of Machine Building; a social partner - Gabrovo Trade Union "Podkrepa"; Regional Inspectorate of Education - Gabrovo; two professional high schools; and Gabrovo Regional Information Centre.

The Cluster offers the following features:

- brief info about its mission;
- list of members including short introduction and contact details;
- e-platform where enterprises post their vacant apprenticeship positions and apprentices apply for them;
- e-apprenticeship workshop for training purposes;
- blog for sharing good practices in the area of work-based learning and apprenticeship.

Fig. 1. Main features of the Cluster

E-platform of the Cluster

The e-platform is a web-based operating system - APACHE, PHP, MySQL, which does not require any additional software. It offers an e-mail notification for each change of status.

The Platform provides the following roles: a system administrator, a university administrator, a company administrator, an academic mentor, a company mentor, and an apprentice. The system administrator is responsible for the overall administration of the Platform. The university administrator administers students, degree courses, companies, academic mentors and assigns an academic mentor to each apprentice. The company administrator administers company mentors, current apprenticeship positions, apprenticeship applicants and assigns a company mentor to each apprentice. The academic mentors have access to their students-apprentices (their CVs, contracts, etc.). They can view apprentices' weekly reports and the assessment of the company mentors. Furthermore, they fill in their own assessment form in relation to the apprentice's performance. The company mentors have access to their apprentices (their CVs, contracts, etc.). They can view apprentices' weekly reports and the assessment of the academic mentors. Furthermore, they fill in their own assessment form in relation to the apprentice's performance. The apprentices have access to their CVs, contracts, applications, current apprenticeship positions, academic and company mentors. They fill in their weekly reports. They can view the assessment of both their academic mentor and company mentor.

The Platform offers the following functionalities in relation to the above roles.

Company administrator

The administrator signs up after completing the following data: company name, town/city, country, company profile, company web site, contact person, e-mail, phone number. Then s/he receives a notification by e-mail requiring activation of the account thus confirming the validity of the e-mail address. The password to gain access to the Cluster must contain 10 symbols and is generated by the system in a random order. It is sent to the same e-mail address after the account has been activated. After successfully completing the sign-up process, the administrator gains access to her/his section of the Platform including the following menus:

- account administration - a possibility to edit respective data;
- company mentors - a possibility to assign a "Mentor". The following data is filled in: name, position, e-mail, phone number, apprenticeship position s/he is responsible for;
- apprenticeship positions - a possibility to advertise current apprenticeship positions. The following data is filled in: position name, minimum requirements, description, additional information, start and end date;
- applicants - list of applicants for each position advertised and a possibility to change the applicant status (approval/rejection);
- project proposals - a possibility to describe a project proposal (a current engineering problem that need to be solved) that could be used as a project work or a bachelor thesis by the apprentice.

University administrator

The administrator signs up after completing the following data: university name, town/city, country, university web site, contact person, e-mail, phone number. Then s/he receives a

notification by e-mail requiring activation of the account thus confirming the validity of the e-mail address. The password to gain access to the Cluster must contain 10 symbols and is generated by the system in a random order. It is sent to the same e-mail address after the account has been activated. After successfully completing the sign-up process, the administrator gains access to her/his section of the Platform including the following menus

- account administration - a possibility to edit respective data;
- academic mentors - a possibility to assign a "Mentor". The following data is filled in: name, position, e-mail, phone number, apprenticeship position s/he is responsible for;
- applicants - list of students applying for different apprenticeship positions and their current status (*in progress/approved/rejected*).

Academic mentors

After being assigned by the university administrator, they receive an e-mail containing username, password and short instructions on how to "sign in" the Platform. After successfully signing in, they gain access to their section of the Platform including the following menus

- account administration - a possibility to edit respective data;
- assessment form - academic mentor (see fig.2);
- assessment form - company mentor (see fig. 3);
- apprentice weekly reporting form (see fig. 4).

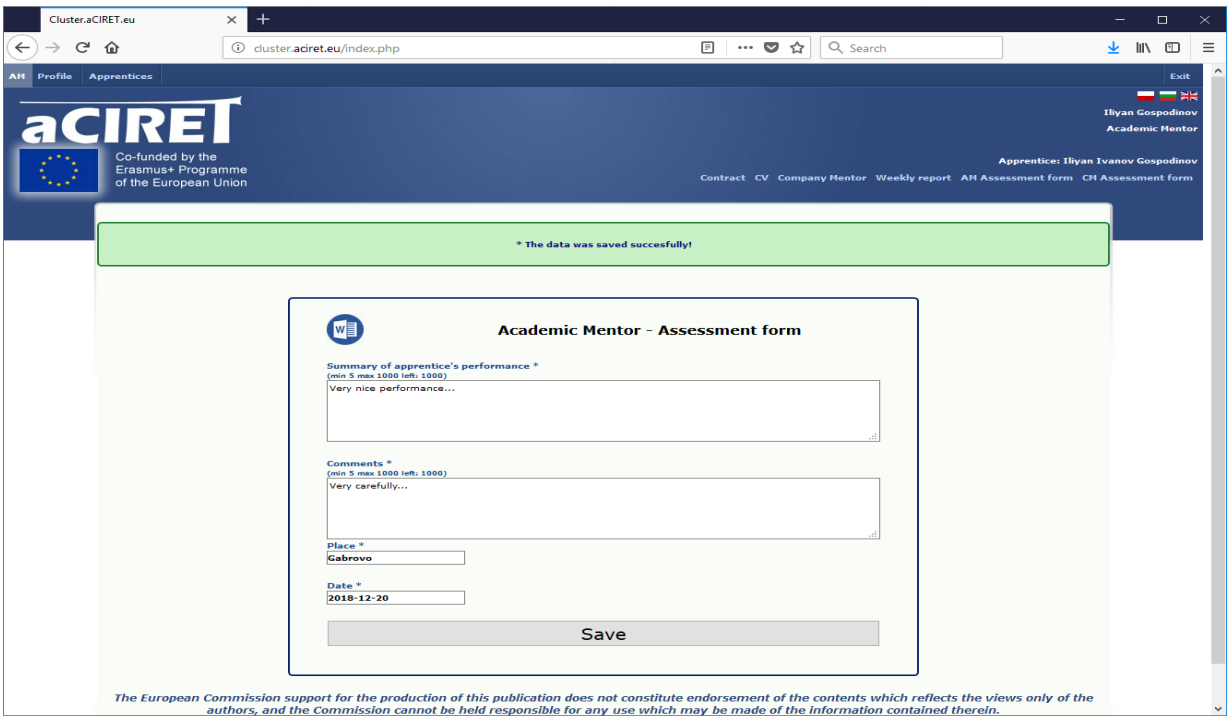

Fig. 2. Assessment form - academic mentors

Company mentors

After being assigned by the company administrator, they receive an e-mail containing username, password and short instructions on how to "sign in" the Platform. After successfully signing in, they gain access to their section of the Platform including the following menus

- account administration - a possibility to edit respective data;
- assessment form - company mentor;
- assessment form - academic mentor;
- apprentice weekly reporting form;

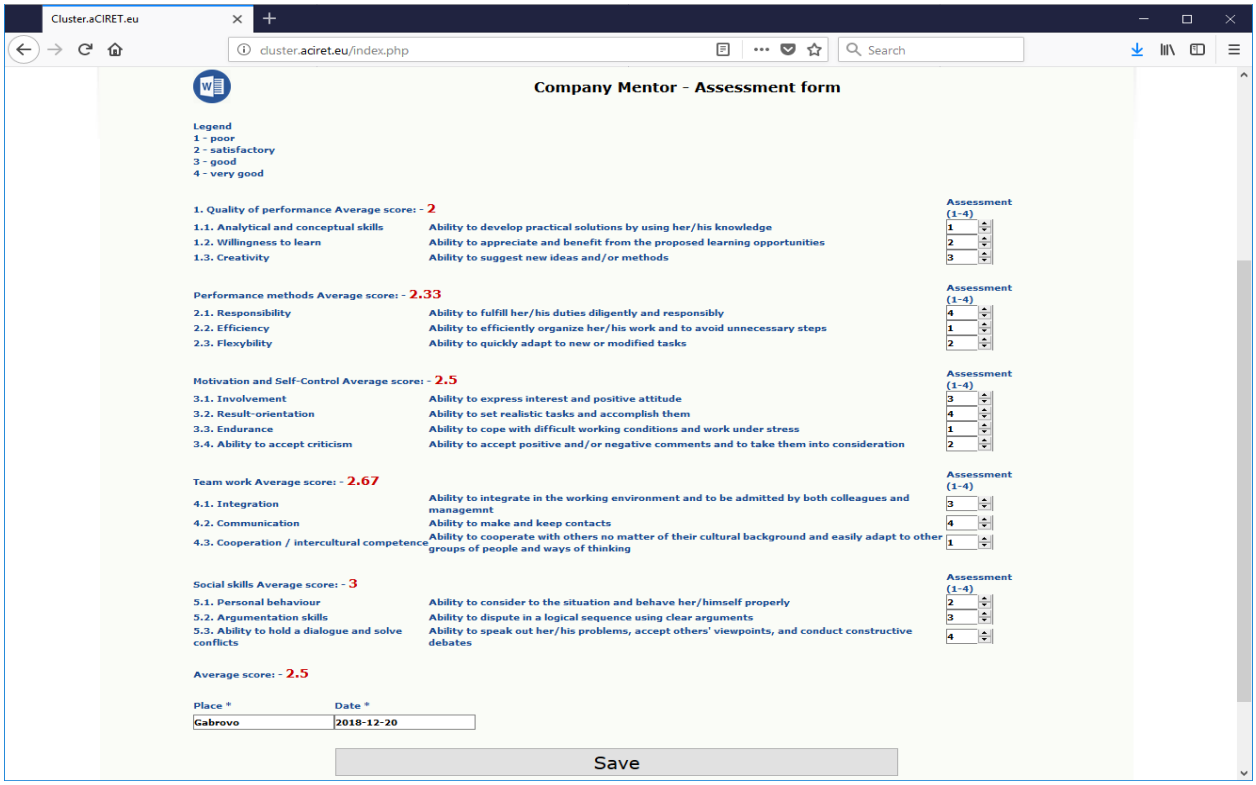

Fig. 3. Assessment form - company mentors

Apprentices

Students signs up after completing the following data: name, student number, degree course, town/city, country, university, academic year, date of birth, e-mail, phone number, address for correspondence. Then they receive a notification by e-mail requiring activation of the account thus confirming the validity of the e-mail address. The password to gain access to the Cluster must contain 10 symbols and is generated by the system in a random order. It is sent to the same e-mail address after the account has been activated. After successfully completing the sign-up process, the students gain access to their section of the Platform including the following menus:

- account administration - a possibility to edit respective data;
- news - messages sent by their academic mentors and/or company mentors regarding their apprenticeship;
- CV - a possibility to create an on-line CV which is available for the companies where their apply for apprenticeship;
- additional documents - a possibility to upload additional documents such as a cover letter, certificates, references, etc. which can be attached to the CV;
- current apprenticeship positions - a list of apprenticeship positions advertised by the companies;
- applications - a list of apprenticeship positions the students have applied for and their current status (in progress/approved/rejected). Upon approval on behalf of the company, the students are required to confirm their apprenticeship before concluding their contract with the company;
- weekly reporting form - an on-line form where apprentices keep record of the work done on a weekly basis. It contains the following data: date, assignment, description of the tasks performed, likes, dislikes, appraisal given - what for and by whom, learning outcomes;
- assessment form - company mentor;
- assessment form - academic mentor;
- former apprentices - a list of former apprentices.

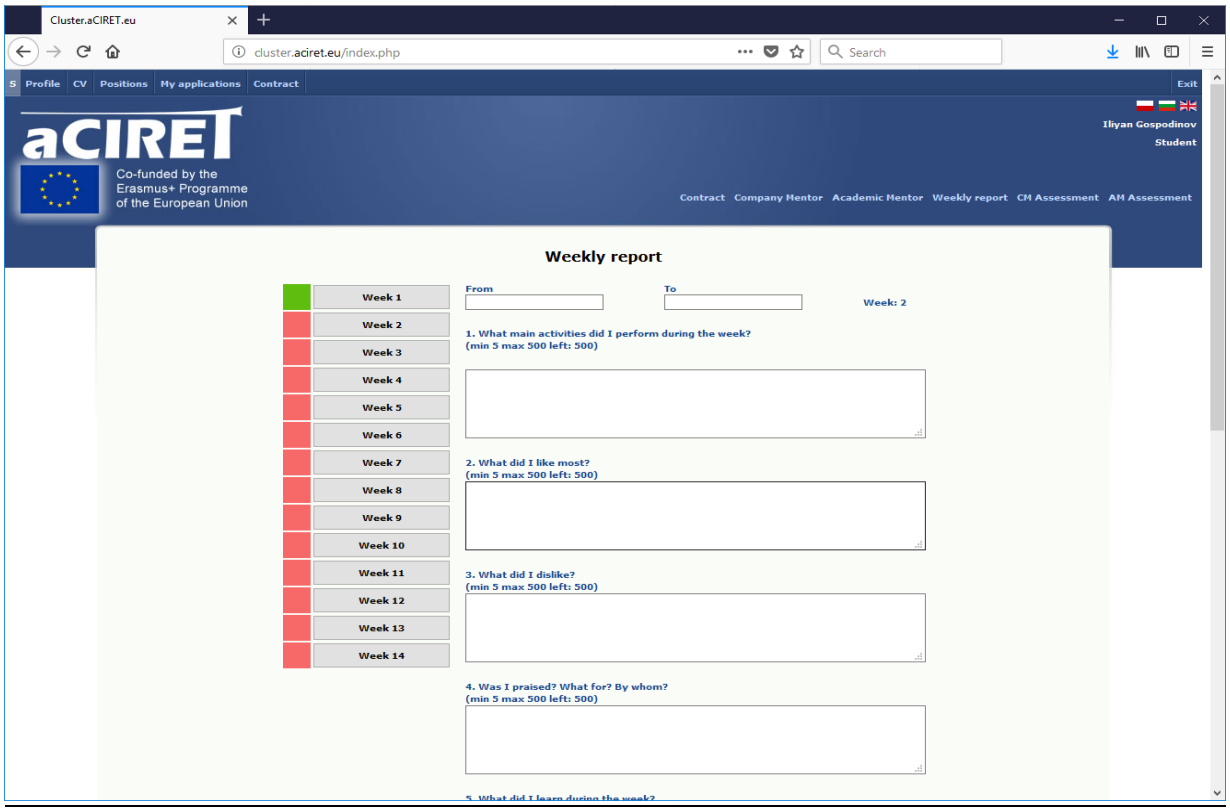

Fig. 3. Reporting form

The roles described above are involved in the following process step by step:

- The students sign in, go through the apprenticeship positions advertised by the companies and apply for one, several or all available ones.
- The company administrator receives a notification that there is an applicant for the position advertised. S/he looks through the applicant's documents, requires additional information (if needed) by e-mail, phone or face-to-face, and approves or rejects the applicant.
- The applicant receives a notification whether her/his application has been approved or rejected. In case of approval, the applicant confirms her/his agreement to conclude an apprenticeship contract.
- The university administrator receives a notification that a contract is due to be signed between a company and a student and assigns an academic mentor to supervise and guide the apprentice.
- The company and the student sign a contract;
- The company assigns a company mentor to supervise and support the apprentice.
- The apprentice fills in a reporting form every week.
- The academic and company mentor read the apprentice's reports. After the completion of the apprenticeship both the academic mentor and the company mentor fill in assessment forms. In addition, they have an option to fill in some personal comments which cannot be seen by the apprentice.

CONCLUSION

The Apprenticeship Cluster is expected to gather all stakeholders affected by the engineering skills mismatch in the area of Mechanical Engineering and Mechatronics such as enterprises, educational institutions, local authorities, employers' organizations and social partners so as to facilitate the transition of university students from graduation to work. In addition, it will support companies, universities and students in their attempt to provide the latter with a future engineering

career path. The Cluster will also provide all interested parties with best practices in work-based learning, apprenticeship, dual/cooperative studies, etc. at national and European level so that successful industry-relevant educational practices are promoted at tertiary level.

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