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University-Enterprises: a win-win relationship, from business to research

Ana M Beltrán[1]*, Paloma Trueba[1], Nuria Salan[2]**, José M. Bayo[1,3], José A. Rodriguez-Ortiz[1], Yadir Torres[1,*]

[1] Departamento de Ingeniería y Ciencia de los Materiales y del Transporte, Escuela Politécnica Superior, Universidad de Sevilla, Seville (Spain)
[2] Departament de Ciència dels Materials i Enginyeria Meetal·lúrgica, ESEIAAT, Universitat Politècnica de Catalunya (Spain)
[3] Empresa de Ingeniería: CT-Ingenieros, Seville (Spain)
*Abeltran3@us.es **nuria.salan@upc.edu

Teaching at University is always a difficult task because it implies too much theoretical lessons while students ask for practical knowledge and Enterprises claim for good junior professionals. Finding an equilibrium among all the interests is challenging but at the same time, it is the key of success. This work shows the experience of teaching in collaboration with companies to achieve a more practical and attractive approach to day-to-day Engineering work while meeting teaching objectives. It is a win-win relationship since it motivates students because they see the direct relationship between their studies and the future job; it also helps teachers to know the knowledge required by engineering companies and, besides, enterprises will have future engineers better trained, already familiar with process and tools. Furthermore, it also increases the collaborations between University and enterprises, which is key to innovate and develop new business models.

Introduction

Human capital is the most important asset of a company, because it is what really contributes to the progress of the company, to the development of innovation and productivity within the company. To this end, the degree of training of new workers must be adequate for the performance of the task entrusted to them. Training future engineers is a complex task because of the difficult to find an equilibrium between theoretical and practical teaching. Focusing on technical bachelors, it is quite challenging due to different aspects. On the

one hand, students need to learn basic (theoretical) concepts and, on the other hand, they also require more practical learning. In most of the cases, students do not find the relationship between what they learn at the University and their future job.

For instance, in Spain, the new study programs of Engineering Degree are organized into three large blocks:

a) Basic subjects common to the different Engineering branches: Mathematics, Physics, Chemistry, Graphic Expression, Computer Science and Business.
b) Subjects of a common nature in the industrial branch: Energy Engineering and Heat Transfer, Fluid Mechanical Engineering, Materials Engineering, Electrical Technology, Industrial Electronics, Industrial Automation, Machine and Mechanism Theory, Material Resistance, Structures, Manufacturing Processes, Projects.
c) Subjects of a specific nature for each branch of engineering.

The aim of this division is to satisfy the competences required by the current educational system, but it does not answer to descriptors as it happened before. In spite of the fact that these study programs have already been active for more than 5 years, it is still a problem for teachers, and it is very difficult to go deeper into many aspects and trust in the autonomous work of the student. This is also a great difficulty for students who, on many occasions, do not find a direct relationship between what they learn and the future job, considering their formation very theoretical and/or far from the true work of an engineer.

Faced with this situation, teachers attempt to use new learning methodologies to adapt themselves to the study programme, while at the same time trying to satisfy students' concerns. It means to prepare students for their professional future, whether they want to develop their career in business or in research.

On the other hand, companies receive the engineering graduate, who contributes with his newly acquired theoretical knowledge. It is the companies that must update this knowledge and adapt it to the needs as well as teaches them the necessary tools to complete the training for a fully-integration in the competitive labour market. Companies usually assume this training period during the first employment contracts, which usually last a few months and have low economic remuneration, with the intention of improving working conditions as the graduates complete this training period and increase their productive value for the companies. This implies a large economic investment on the part of the company. For that reason, the possibilities of practices of companies, suppose a help for the companies since they do not have to invest a lot of resources in the formation. University-Company interaction is a win-win relationship since, on the one hand, it helps students to motivate them and see the relationship between what they study and the final work they are going to do in the future, it gives them visibility on the possibilities to channel their future, on the other hand, it helps the company so that the new incorporations have already had an approach to a work process and to the tools they have to use, minimizing the training time in the company and, therefore, increasing its productivity.

This work presents the experience of teaching in collaboration with companies to achieve a more practical approach to teaching that is attractive to students while meeting teaching objectives. This initiative is being carried out at the *Escuela Politécnica Superior de Sevilla* (EPS) [1] of the Universidad de Sevilla (US), given its vocation to train engineers

through study, teaching and research, with undergraduate, master's and doctoral training projects, committed to the comprehensive training of people in collaboration with *Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa* (ESEIAAT) [2] of the Universitat Politècnica de Catalunya (UPC).

Results and Discussion

Under this situation, this need for specific training of graduates and aware of the limitations that are found in the current study programs, EPS-US is performing different actions to try to satisfy the requirements of the students and the enterprises for the integration of graduates in the workplace. Furthermore, the present working environment does not only require technical knowledge, but also professionals with good personal skills are sought to develop their skills such as responsibility, leadership, teamwork, etc. Starting from this premise, the company sets itself the aim of developing these skills while, at the same time, making it necessary to acquire specific technical training, directly related to new technological advances, as well as analysis tools, which are developed thanks to the technical base acquired in university training.

The collaboration among EPS and companies is not limited to the traditional internship [3], but rather outsourcing activities are encouraged with a less individual approach than the practices. About these activities, it is worth highlighting:

a) Collaboration through productive activities, such as agreements in research and development and innovation activities, promoted by regional institutions for researching.
b) Creation of forums for interaction between university and business, involving business within university spaces both in teaching and in visibility activities (forums, congresses, conferences).

Among the activities planned by the EPS-US concerning graduates with a business profile, during the last two years the *Business Internship Days* have been held in this center to encourage collaboration. In this activity, different engineering companies present their business with a very participative environment where students have the possibility to ask questions, doubts. Besides, these talks, the companies have stands for a closer and more direct contact to the students. In this way, the real daily of engineering is known as the same time that students can meet different companies, areas, being able to orientate their training towards those sectors or companies that are most interesting for them. Furthermore, a considerable number of the speakers participating in these days have been former students of the EPS, who either in their stage of students were motivated to this encounter with companies or missed it and wanted to contribute to meeting these needs. In both cases, the participation in these tasks is very positive and enriching, both from the point of view of the companies and from the point of view of attracting students who can join their staff in the immediate future.

In addition, some companies also hold specific seminars throughout the course to showcase their work and the role of future engineers in these enterprises. These seminars also allow them to get closer to the reality of their future jobs, emphasizing the multidisciplinary training and collaboration with different areas, as it has been shown with the participation of different departments of the same company. This is, therefore, a process that enriches itself over time and makes it increasingly interesting for students, companies and

the university itself, as professors are aware of the real usefulness of the teaching program they teach.

This relationship University-Enterprise is not only a way to contribute to a more practical training of future engineers, but it also promotes researching in companies. This approach to the School of Engineers, to the University, allows them to get in touch to research topics and to establish collaborations. It is very positive for those students with a more scientific profile, since they can know the true meaning of Research & Development in Engineering companies. However, despite this increase of collaborations in terms of researching, there is still a huge lack of PhDs working in companies. In this sense, initiatives such as the *Industrial PhD*, a university training program that combines the profile of researcher and engineer, in which the bulk of the research is carried out in a company. It can be considered as a proper transfer of knowledge, presenting a double advantage, since it increases the connection of the University with the production and encourages to researchers to change their focus of research to adapt to a complex problem of the company and obtain resources [4]. In this way, the PhD student achieves the best of the academy and company: publications, doctorate degree and, at the same time, knowledge at the most cutting-edge in the professional world of the sector and the dynamic of a real engineering company. It must be improved mechanisms for transferring knowledge to business environments, to benefit from the leading position of the research model and innovation training system. Industrial PhD is not only an opportunity for graduates but also for Engineers, who are already working on a company and, thanks to this close relationship University-Company has decided to become PhD, taking profit from their knowledge acquired in their work as engineers.

Conclusions

In summary, the University-Enterprises training collaboration allows students to get closer to the reality of work and the exercise of their profession as future engineers, highlighting the multidisciplinary training and collaboration with different areas. It is a win-win relationship, since it motivates students and they see the direct connection between the studies and the final work they are going to carry out and, furthermore, it helps the company so that the new incorporations have already had an approach to the required work process and tools, making the new engineer productive in a very short period of time, which translates into profits for the company. Besides, it is also a great contribution to research and knowledge transfer since it helps companies to know and understand how University works and how to contribute to progress, integrating research into the day-to-day work of the business world.

References

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4 Francesc Solé Parellada, vice-president of the CyD Foundation and professor emeritus of the Universitat Politècnica de Catalunya-UPC-BarcelonaTECH