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Competences in master's degrees in Industrial Organization and real demand of employees

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Abstract In the design of new master's degrees the acquisition of the competences required in the professional development of the student's labor life is promoted. The construction of the European Higher Education Area supposes the implementation of a new educational model with new learning results. In this paper we compare the competences defined in master's degree in Industrial Organization study plans and the real competences required by companies in order to analyze the fit between higher education and business world.

Keywords: Competences, Engineering, Industrial Organization, Master's Degree.

1. Introduction

In this paper we present a review about Spanish universities that are implementing specific Industrial Organization master's degrees, in order to know the professional profile of an engineer and the similarities and dissimilarities between them. Moreover, we compare competences and skills described in the study plans and the ones existing in a real business environment. In addition, there are some papers focused in the analysis of competences in industrial engineering study plans designed to obtain a degree level (for instance, see Canós-Darós et al., 2011; Marín-García et al., 2009; Marín-García et al., 2010). Nowadays, there are no comparative studies about master's degrees. In consequence, there are not comparative

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studies about competences acquired in a University master's degree and profiles demanded by companies in real business world.

To reach our goal, we looked for a master's degree in Industrial Engineering, which together with the corresponding degree would be equivalent to the traditional Industrial Engineering higher degree. Nevertheless, we found that each university denominates its masters freely; so therefore, the "master's degree in Industrial Engineering" (literally) does not exist. For instance, the University of Cantabria denominates it "master's degree in Industrial Engineering Research". This is the reason because, with the aim of developing a valid study of the competences demanded by companies, we have included master's degrees with the generalist spirit of industrial engineering and industrial organization. As an example, in the Polytechnic University of Valencia we find the master's degree in Data Analysis Engineering, Process Improvement and Decision Making and the master's degree in Advanced Production Engineering, Logistics and Supply Chain. Even though these degrees are related to the industrial organization, we find them very specific so we have not taken them into account. It should be noted that we have only considered official master's degrees, not own titles of each university neither the master's degrees still not homologated at the moment. The sources of all data are the main websites of Spanish universities (www.universia.es). With this first screening approach Table 1 is prepared.

Table 1 Universities that offer master's degree in Industrial Organization Engineering or similar.

University	Master's Degree
University of Cantabria	Master's Degree in Industrial Engineering Research
University of Coruña	Master's Degree in Industrial Engineering and Technology
University of Extremadura	Master's Degree in Engineering and Architecture Research.
Polytechnic University of Catalunya	Master's Degree in Industrial Organization Engineering
Polytechnic University of Madrid	Master's Degree in Industrial Organization Engineering
Rovira i Virgili University	Master's Degree in Industrial Organization
University of Sevilla	Master's Degree in Industrial Organization and Management
University of Vigo	Master's Degree in Industrial Innovation and Process Optimization

In the next section we define and analyse competences offered by Universities in its study plans about master's degrees in Industrial Organization. Then, we compare them with competences required in the business companies. Finally, we show some brief conclusions and a list of final references.

2 Competences described in study plans

Once excluded the universities that do not offer the previous master's degree, we visited the websites of the engineering schools in each university and identified the competences appearing in their curricula. Sometimes we worked from brief descriptions of the master's degree, since there are universities that do not offer a list of competences in their websites. As examples, competences are listed in the websites of the Polytechnic University of Valencia and the University of Cantabria. In this case, information extraction was simple, since it was very detailed. In other cases, competences have been deduced, since available information was very limited. In universities that offer a list of skills,

When studying in detail competences in master's degrees study plans, we see they are similar, coinciding even in the description of skills. Therefore, the competence described by University of Cantabria, "Students must be able to integrate knowledge and handle the complexity of formulating judgments from information that, being incomplete or limited, include thoughts on social and ethical responsibilities linked to the application of their knowledge and judgments", too much resembles the one from University of Extremadura: "Ability to integrate knowledge and handle the complexity of formulating judgments from information that, being incomplete or limited, include thoughts on social and ethical responsibilities linked to the application of their knowledge and judgments". As it happens in this case, it is not surprising that almost all the competences coincide.

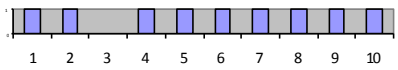
After examining and filtering the information, we conclude that most of the universities focus on similar competences and therefore those common competences are extracted as items to study. Thus, we proceed to develop Tables 2 and 3.

Table 2 Competences-items.

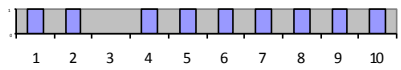
1	Multidisciplinary	6	Communication
2	R&D	7	Resources management
3	Management	8	ICT
4	Lecturer-researcher training	9	Critical thinking
5	Teamwork	10	Ethics

Table 3 Competences in the study plans from Spanish universities.

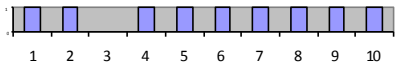
University of Cantabria



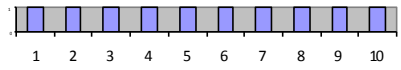
University of Coruña



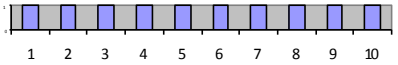
University of Extremadura



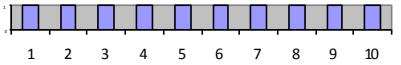
Polytechnic University of Catalunya



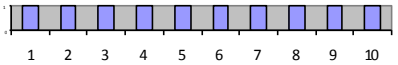
Polytechnic University of Madrid



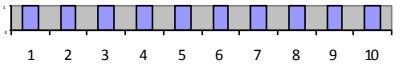
Rovira i Virgili University



University of Sevilla



University of Vigo



The definition of the competences appearing in master's degrees study plans are:

Multidisciplinary: To train versatile and general-purpose technicians for industry. Provide a solid scientific training and a wide range of expertise in diverse technologies in order to become multidisciplinary professionals. This competence is mentioned in all the universities under study.

R&D: Information about managing innovation is always offered. The competence is mentioned in all the universities under study.

Management: It is about organizing and planning in the field of business and other institutions and organizations. Five universities in our study outstand this competence, the ones that offer masters based on Industrial Organization, not the most technological ones.

Lecturer-researcher training: This competence is oriented to the beginning of a PhD, after studying a master, as well as to the realization of scientific articles. The competence is mentioned in all the universities under study.

Teamwork: Techniques, roles, cooperation, status, coordination, etc. The competence is mentioned in all the universities under study.

Communication: Based on the domain of oral, written, interpersonal and nonverbal communication. Also communication in different languages and communication as the capacity of transmit knowledge, whether through teaching as well as through scientific articles and publications. It is considered in all the universities.

Resources management: Material resources, human capital or effective and efficient time management. It is mentioned in all the universities under study.

ICT: To know and use Information and Communications Technologies (ICT) in professional and personal fields. It is considered in all the universities.

Critical thinking: Problem solving, creative thinking or logical thinking. The competence is mentioned in all the universities under study.

Ethics (or ethical sense): To make reflections on social and ethical responsibilities linked to the application of their knowledge and judgements. The competence is mentioned in all the universities under study

3 Competences demanded by companies

Based on the foregoing, we are aware of the competences offered by universities. Now we must determine whether these competences are the ones required by companies. For this, as a reference we use a research developed by Canós and Santandreu (2010) that shows common characteristics for innovative companies (located in a Spanish region called La Safor), all of them associated with employees' competences and skills. The competences required by companies for their staff, according to Canós and Santandreu (2010) are:

Shared vision: Degree of staff identification with corporate culture and level of socialization. Five universities in our study outstand this competence.

Rotation: Change between jobs or tasks in the company. Rotation allows employees to know the company from multiple perspectives and develop not only one routine, but creative work. Rotation allows duplication, that is, the deliberate overlapping of information, operational and management responsibilities, to create knowledge (Nonaka et al., 2000). This competence is considered in all the universities under study.

Free access to information: Business knowledge becomes more fluid and easy to implement through transparency in reporting. Five universities in our study outstand this competence.

Teamwork: Teamwork techniques, roles, cooperation, status, coordination, etc. (Chiesa et al., 1996; Rothwell, 1992; Souitaris, 2002; Quinn et al., 1996). The competence is considered in all the universities under study.

Project teams: It is based in the interpretation of top managers' ideals. Teams play a key role because they provide a shared context where people can interact and establish an ongoing dialogue that enables effective reflection. Through dialogue and discussion, team members create different views that are integrated into a collective perspective (Nonaka et al., 2000; Quinn et al., 1996). The competence is included in all study plans.

Communication channels: This issue is clearly related to information, assertiveness and information systems (Rogers and Shoemaker, 1971). The competence is considered in all the universities under study.

Experience: We consider this competence if a university offers the possibility of doing business practices or internship to students. The competence is included in all study plans.

Company vision: This issue is clearly related to information, assertiveness and information systems (Rogers and Shoemaker, 1971). The competence is considered in all the universities under study.

Corporative strategy: It is considered if training about managing innovation is offered (Quinn et al., 1996). The competence is considered in all the universities under study.

Involvement of managers: Degree of management commitment in the implementation of strategies. No references have been found in any University. Following the concept of competition both from the professional and academic point of view, we might say that the result of research gives us a view of the professional profile demanded by companies. Five universities in our study outstand this competence.

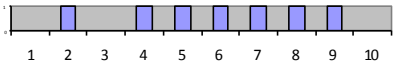
Following the concept of competition both from the professional and academic point of view, we might say that the result of research gives us a view of the professional profile demanded by companies. Competences that companies want for graduates in Spanish universities are shown below using histograms; a distinctive number has been given to each item.

Table 4 Competences demanded by companies.

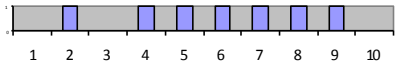
1	Shared vision	6	Communication channels
2	Rotation	7	Experience
3	Free access to information	8	Company vision
4	Teamwork	9	Corporative strategy
5	Project teams	10	Involvement of managers

Table 5 Competences demanded by companies in the study plans from Spanish universities.

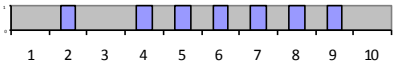
University of Cantabria



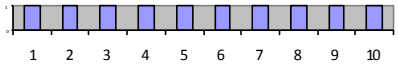
University of Coruña



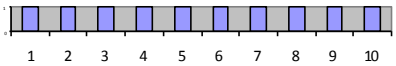
University of Extremadura



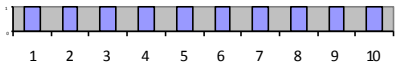
Polytechnic University of Catalunya



Polytechnic University of Madrid



Rovira i Virgili University



University of Sevilla

University of Vigo

Comparing Tables 2 and 3 (competences appearing in master's degree study plans in universities) with Tables 4 and 5 (competences demanded by companies), we see that lecturers are qualified in order to transmit to students the identified by managers' competences (a graduated acquires the competences defined in the corresponding study plan), satisfying most of the expectations that companies have when hiring a graduate.

4. Conclusions

The construction of the European Higher Education Area supposes the implementation of a new educational model that is forecasted to be a very good model because of new learning results. In consequence, master's degrees for Industrial Organization are designed by considering competences in their study plans.

In this paper, first we compare competences and skills described in master's degrees about Industrial Organization implemented in Spanish universities. Moreover, we check the fit between these competences and the ones required by companies. We base our comparison in a study developed by Canós and Santandreu (2010), in which innovative companies highlighted some competences. In this case, almost all the competences identified by managers are in all the analyzed study plans. We think this can be a reflection for new industrial Engineering master's degree designers in order to complement current curricula and better fit it to real companies requirements.

5 Acknowledgements

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