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An Analysis of Knowledge Areas in Industrial Engineering and Management Curriculum

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Abstract

Industrial Engineering and Management (IEM) is a continuous, flexible and dynamic area of engineering. Its intervention relates not only in manufacturing industry, but also in hospitals, education systems, transport systems, financial institutions, etc. Thus, there is the need to prepare students to the extended scope of IEM and the curriculum has to provide this broad vision. This range of IEM is evident in curriculum rationale. Graduates have to be ready for a wide range of jobs in the labour market. This is a challenging demand to cope with when designing and developing the curriculum. Thus, a selection of a special focus is the basis for the curriculum design process and for that reason the curriculum programs have different emphasis. The aim of this study is to analyse four IEM curriculum programs in Europe based on a classification of courses by areas of knowledge. Furthermore, the relative weight of areas was computed based on courses' credits. Two interrelated group of areas were used, one aggregated and another one for IEM specific areas. This framework revealed to be useful for curriculum analysis and the results show that the four program curricula have a comparable weight of specialization area of IEM and that Production Management is the specific area with the larger weight in all programs. The results show that one of the characteristics of IEM curriculum programs is diversity in the knowledge areas related to IEM specialization. This study also emphasizes the importance of a structured framework for characterization of IEM programs, enabling benchmarking exercises, and facilitating the dialogue between academia and the profession of IEM.

Key words: Industrial Engineering and Management; Knowledge Areas; Curriculum Analysis

1. INTRODUCTION

Engineering programs have sought to improving curriculum as a way to improve engineers' profile. According to the report from UNESCO [1] "University courses can be made more interesting through the transformation of curricula and pedagogy using such information and experience in more activity - project and problem-based learning, just-in-time approaches and hands-on application, and less formulaic approaches that turn students off. In short, relevance works! (...) The future of the world is in the hands of young engineers and we need to give them as much help as we can in facing the challenges of the future." Thus, engineering programs have to be linked to current problems and situations. The engineer

professional practice, besides technical knowledge, also involves how to communicate, how to work in teams, how to solve problems [2-5] Therefore, these competences should be addressed in curriculum planning, and in its implementation and evaluation.

The last decade (2000-2010) was marked by changes in European higher education area related to Bologna process demands: new structures and tools, quality assurance, social dimension, student mobility, lifelong learning and employability [6]. These principles have a strong impact on policies and practices in the universities, not only on staff and students' performance, but also on the curriculum design, content, resources, methodologies and assessment.

The transformation of educational practices within Bologna context involves the idea that the student has an active role in the learning process: he or she needs to engage in research, to explore, and to analyse. This implies a more interactive and student-centred learning environment. It is expected that learning process becomes more meaningful, independent and motivating for students in order for them to develop the competences needed for professional practice, which must be aligned to the industry and society requirements [7]. These principles are also highlighted by the European Commission: "The education, training and employment policies of the Member States must focus on increasing and adapting skills and providing better learning opportunities at all levels, to develop a workforce that is high skilled and responsive to the needs of the economy" [8].

Thus, higher education institutions are responsible to ensure conditions, resources and learning opportunities for students to develop the competences related to their professional practice because initial training is a key moment to achieve that purpose [8-11]. Curriculum design is of great importance in this context. It has to be revised in a continuous way, in order to analyse the relevance of what students learn and what labour market and society requires of them.

Industrial Engineering and Management (IEM) is the knowledge area related with the project, improvement and management of systems composed by people, materials, equipment, financial resources, information and energy, that deliver products and services [12-13]. IEM is based on specialized knowledge and competences from math, physics, and social sciences integrated with the concepts and methods of the engineering projects. The denomination of the area is not standard and different approaches and several other designations can be quite similar or overlapping with IEM: Industrial Engineering, Industrial Management and Engineering, Engineering Management, Production Engineering, and Manufacturing Engineering. In this paper references from several approaches are used. IEM is an engineering field that has evolved over the last century without leaving the traditional approaches, constantly moving and innovating into new technologies and tools to the industries [42]. According to Greene [14] from a historical perspective, the professional of IEM is responsive to society's needs, and to creating new technical tools in nearly if not every industry in the world. Some questions arise in this context: Is the curriculum program aligned to the IEM trends and principles? How can we know if a curriculum program is relevant, useful and meaningful for the graduates, teachers and employers? How can a curriculum program be analysed?

This study aims to undertake an analysis considering four IEM curriculum programs in Europe in order to: 1. develop a framework to identify and analyse IEM curriculum programs, based on knowledge areas that can be applied in other contexts and 2. analyse the IEM areas of knowledge in four curriculum programs in Europe.

2. CURRICULUM: SCOPE AND DEVELOPMENT MODEL

This study focuses upon IEM curriculum in Europe, by analysing and classifying programs and their rationale. The aim is to identify how, where and why it is necessary to improve IEM curricula. Kuo[15] states that "(...) industrial engineering programs need to be benchmarked, challenged, and assessed from time to time". This perspective can be expanded to IEM programs. This section describes the curriculum concept with a particular emphasis on curriculum development model for higher education context presented by Zabalza[16].

Some of the initial theoretical approaches of curriculum [17-20] point to a vision based on the structuring and organization of knowledge into programs and disciplines developed over a period of time. Other definitions of curriculum extend this approach, also considering what is taught, how to learn and with whom, its goals and assessment. By articulating and implementing these elements, the curriculum enhances learning experiences resulting from the interaction between teachers and students in a specific context. In this way curriculum is recognized by situations that provides the acquisition and development of knowledge, attitudes and values essential for students' personal and professional development [21-24].

In spite of several approaches and positions, the curriculum concept includes practices that result from interaction of different levels, structures and people [20; 25-26]. Therefore, it is seen as a project that involves unity, continuity and interdependence between intentions and what actually happens in the classroom.

Higher education is a level of education with a differentiated curriculum setting. It implies the presentation of educational projects that higher education institutions offer for the accreditation of students in a professional field [16]. The author presents five components to consider for higher education curriculum: 1. The definition of the professional profile; 2. The selection of contents; 3. The organizational framework of the study program; 4. The pragmatic conditions for the development of the curriculum program; 5. The assessment of the curriculum program.

These components are essential to put into practice a given curriculum and they complement each other. The definition of the professional profile (1) can be understood as a guide to curriculum in several areas of knowledge. The selection of content can be clustered into three groups – general disciplines, specific disciplines and practicum (2). The organization of the curriculum content may be seen as a cyclic structure, in which the first years focused on general disciplines and the last years in specific disciplines (or specialization). Thus, the distribution of disciplines and the hours of each semester, translated into ECTS (European Credit Transfer and Accumulation System) in Europe, set the formal organization of the curriculum program (3). The implementation (4) depends on resources (laboratories,

libraries, classrooms, software, etc.) and also external partners (industries, other universities, etc.). Finally, the assessment of a curriculum program (5) involves not only the results of a given curriculum program, but also its implementation process.

The curriculum components described earlier are related to curriculum levels presented by Goodlad [25] – ideal curriculum, formal curriculum and operational curriculum. The ideal curriculum is based on the intentions that are expected to be achieved. In Higher Education it is associated with the definition of professional profile (1) and, in this way, the curriculum is an expression of several positions that converge into a shared vision. When this vision is embodied into documents (with definition of content, activities, learning outcomes, competencies...), the ideal curriculum is changed to a formal curriculum (2) (3) (4). The operational curriculum refers to what happens in practice, in the classroom: approaches around the contents, activities, relation between teachers and students, and amongst students, use of resources, etc. The ways in which curriculum can be understood and experienced by the students, teachers and other stakeholders, the level perceived curriculum have to be taken into consideration in its assessment (5).

In this study the aim is not to make an integrated curriculum analysis, considering all the components provided in Zabalza's curriculum model, as well as all curriculum levels. Our goal is rather to focus on two components: 2. the selection of contents – aiming at identifying areas of knowledge associated with IEM; the organizational framework of the study program – aiming at assessing the weight that these areas have in curriculum program, considering the ECTS/hours specified for each course. Therefore, this study focuses on the formal curriculum level.

There were some studies in USA related to the analysis of Industrial Engineering (most common designation in this country) curricula, which is a quite similar context to this study. They focus on:

- Ideas for improvement the curriculum programs through benchmarking analysis [27-28]
- Characterization of common topics in industrial engineering programs to specify the industrial engineering from other engineering fields [29]
- Identify professional needs, trends and emerged areas in industrial engineering to incorporate into the curriculum [30]
- Reengineering the curriculum program based on non-traditional manufacturing industries, such as service industries, information technology industries, amongst others [31]
- Analysing the technical jobs required by the employers and preparing the students for these jobs [32]

Each work presented a different framework of analysis in relation to the knowledge areas and methodology, but reinforces the intention of this paper, which seeks to improve IEM curriculum. The framework described in this study may be seen as a tool to provide information

to know how we can have a more flexible and innovative curriculum. This is a challenge for higher education institutions because flexibility and innovation, according to Zabalza are related to: curriculum articulation, update of curriculum programs, reduction of time in class, *practicum* more linked to industries and companies and investment on mobility of students and staff [16]. These topics point out to a relevant curriculum in terms of content so that students are able to create links between different courses and modules and have a deeper learning based on competences that they are to be developed during the learning process and that are important to professional practice.

3. METHODOLOGY

This paper draws upon an exploratory study which is applied to analyse a given situation or a theme [33], considering the interaction of several contexts and topics: Higher Education in Europe, IEM curriculum and areas of knowledge. This is a complex analysis but also of great importance, particularly in Europe where the lack of studies of this kind is evident.

Data collection included three main sources: i) the selection of key references from the literature about IEM education and curriculum, including texts from key IEM professional accreditation institutions; ii) the collection of information about the structure of IEM curriculum programs for each of the selected programs from publicly available sources, such as the institutional websites of the Universities; and iii) the collection of information with Professors from the selected Universities, whenever it was necessary to complement or confirm any of the data accessed on-online.

Data analysis followed an iterative process, according to the usual guidelines of qualitative research [34-35]. We first draw a set of a prior knowledge areas typically included in the IEM education, from the descriptions found in the selected body of literature (e.g. basic sciences, engineering sciences. etc.). The literature revealed some knowledge areas which were common across the various sources, as well as some areas which were more specific to a given context or were no longer representative of current IEM programs. We identified the set of knowledge areas which were consensual across the various sources. The next step in the data analysis involved the identification of manifestations of the a priori knowledge areas in the selected sample of IEM curriculum programs. Following the principles recommended by Dey [36] the data about the courses offered in each of selected IEM programs was summarized in adequate display which facilitated the process of making sense of the data. Specifically, each course was assigned to one of the knowledge areas from the *a priori* list. The summary of the data also displayed information about the associated credits (e.g. ECTS) for each course. This has led to a comprehensive list of the courses for each IEM program and the corresponding knowledge areas, together with two indicators of its relative weights/importance in the program based on the relative weight of the courses credits in the program total number of credits. Finally

the list of knowledge areas was reviewed for the purpose of validation and refinement. This resulted in the disaggregation of one of the knowledge areas considered – the IEM area which included content areas of very diverse nature and importance in the programs - into a set of more detailed fields of specific IEM knowledge. This was followed by another round of classification of the IEM courses into the new specific IEM areas of knowledge. The empirical component of the study was therefore sought through the validation of the a priori list of knowledge areas, and to its refinement according to the current practice of IEM education. Data analysis was validated within each IEM program, by conducting the exercise of classification and assessment of the relative importance of each knowledge areas. The results were also validated across the set of IEM programs studied. The purpose was to verify the relevance of the proposed knowledge areas across the different IEM education offers considered.

4. INDUSTRIAL ENGINEERING AND MANAGEMENT AREAS OF KNOWLEDGE

Industrial Engineering and Management is a recent area that has been growing since the 1960s. The relevance of IEM is justified by the needs from industry and society: work design and measurement, plant location and layout, material handling, engineering economy, production planning and inventory control, statistical quality control, linear programming, operations research, ergonomics and human factors [37-40]. After World War II, for instance, operation research brings important applications in industry, related to modelling and solving systems problems [41]. This implied interaction with other disciplines. The same happened with other areas that integrated IEM over time, such as ergonomics or human factors, and the evolution of other areas through the introduction of technology (e.g. in Production Planning Control).

A set of documents were analysed for the purpose of finding a comprehensive set of knowledge areas that would allow the classification of IEM curricula. One of the most important references for this work is the Maynard's Industrial Engineering Handbook, from Zandin [42]. This handbook presents the following set of aggregated areas based on the 1967 Roy report cited by Kuo [15]: Liberal and social sciences, including economics; Mathematical sciences; Natural sciences; Engineering sciences; Industrial engineering. Analysing these areas and several curricula, a similar set of areas were selected for the purpose of course classification. These were the following Aggregated Areas of Knowledge:

- Basic Sciences (including Mathematical and Natural sciences)
- Economics and Management
- Engineering Sciences
- Industrial Engineering & Management
- Research Methodology
- General Studies

Economics and Management was chosen, instead of Liberal and social sciences, because it was assumed that it would be more comprehensive for the curriculum analysis. Industrial Engineering & Management was chosen instead of solely "Industrial Engineering" because we are using this denomination in our work and also because they are similar and sometimes overlapping areas. There is no intention of discussing the differences and there is a position of considering a general area of knowledge that would include all of them. The "Research Methodology" area relates to the need to differentiate the existence of these formal courses. Finally, "General Studies" was included to accommodate programmes with courses from other areas, such as foreign languages.

The lack of a standard framework of IEM Specific Areas of Knowledge led to a set of 4 references that were the base for the definition of IEM Specific Areas of Knowledge used in this work: Kuo[15], Hicks [43], Fraser and Teran [28], Matson et al. [29]. Crossing these areas with the curriculum courses made possible the definition of the following IEM Specific Areas of Knowledge:

- IEM - Production Management (including Production System Design)
- IEM - Automation
- IEM - Quality
- IEM - Economics Engineering
- IEM - Operations Research
- IEM - Computer and Information Systems
- IEM - Ergonomics and Human Factors
- IEM - Logistics
- IEM - Maintenance
- IEM - Project Management
- IEM - Sustainability
- IEM - Product Design
- IEM - Simulation

5. IEM PROGRAM ANALYSIS

This section is intended to make the review of curricula of four IEM programs, namely University of Minho (Portugal), University of Aveiro (Portugal), University of Groningen (The Netherlands) and University of Novi Sad (Serbia). For all of them, educational programs consist of 5 years in the total, where, at the end, students get a master degree. The program from Minho is an integrated master on IEM of 5 consecutive years. The program from Aveiro is a 3+2 degree, both in IEM. The course from Groningen is also based on the model 3+2, and the specialization on "Production Technology and Logistics" was the one that was analysed. Finally, Novi Sad as model of 4+1 and it was analysed the Industrial Engineering program with specialization on "Quality and Logistics". This analysis focused in the knowledge areas defined above. This framework presents the different emphases that courses are given in different curriculum programs.

5.1 IEM Analysis Based on Aggregated Areas

It is expected that different IEM programs have a similar weight of aggregated areas of knowledge as shown in the graph of **Figure 1**. In fact this happens in general with the Engineering programs. In the case of the programs analysed they have a relatively similar curriculum based on aggregated areas. All curricula show a great emphasis in what may be called specialization area, i.e. the aggregated area of Industrial Engineering and Management (IEM). The programs from Minho, Aveiro and Groningen show a comparable share, around 60%. In particular, the Novi Sad program has the largest weight of this area and all

of the others have similar weights. For the weight of "Engineering Sciences", Groningen has the greatest weight, followed by Minho, Aveiro and then Novi Sad. It seems that UA has a stronger profile in Economics and Management and the other three have a stronger profile in Engineering Sciences.

There are two main differences in relation to aggregated areas, namely Research Methodology and General studies (foreign languages). Research methodology deserves specific courses in Minho and Groningen while Novi Sad has General Studies in foreign languages.

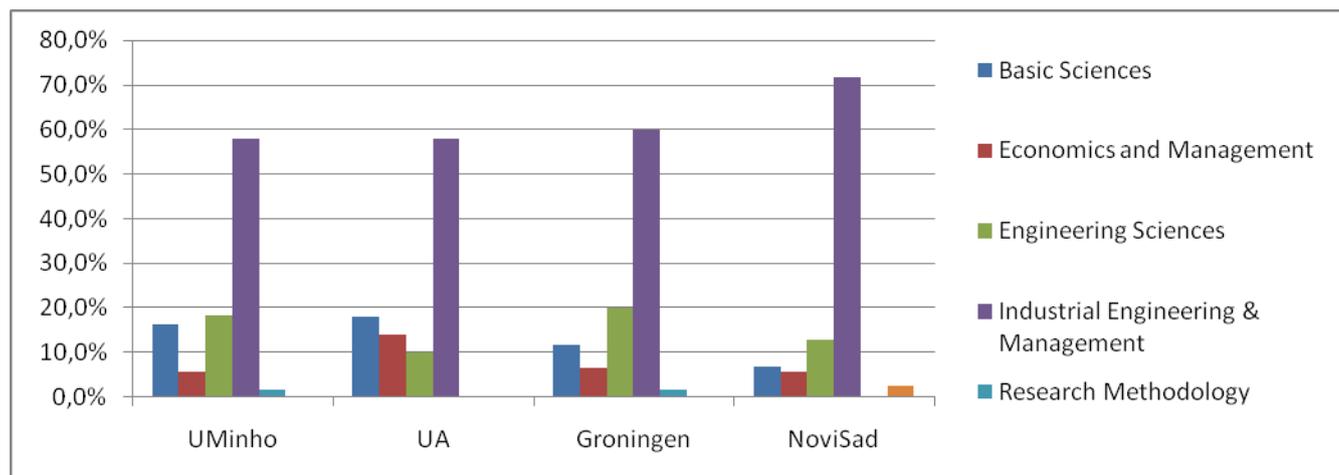


Figure 1. Curriculum knowledge areas analysis based on aggregated knowledge areas

5.2 IEM Comparison based on IEM Specific Areas

A total of 16 specific areas of knowledge were defined for the purpose of analyzing program curricula. These areas were used to classify all program courses and the respective credits (ECTS) were used as a measure of the weight of the area in each program. Finally, a relative weight was computed in relation with the total 300 ECTS credits of each program. These areas are based on the knowledge areas identified and described in the previous section. In additional specific areas necessary for the purposes of comparison, and related with practical and curricular diversity aspects were included, namely

- IEM - Dissertation
- IEM - Project
- IEM - IEM

The first of these areas include the weight of dissertations of Masters' curricula. The second of these areas implies courses whose methodology of teaching and learning is associated with the development of general projects in IEM, or interdisciplinary projects integrating different disciplines. The third of these areas include some elements of curriculum that cannot be classified in a particular area of knowledge, such as the disciplines of introduction to IEM. Besides these, there are elective courses that introduce flexibility into the

curriculum and that cannot be classified in a specific area of knowledge.

The graph from Figure 2 indicates the relative weight of each specific area in the curriculum. This graph allows us to identify differences in weight of these areas. The weight of the dissertation in Aveiro is 16%, and 10% in Minho and Groningen and Novi Sad. The weight of the project in Groningen is 6.7%, greater than 3.3% in Minho and Novi Sad. "IEM - Project" area is non-existent in Aveiro. The area of "IEM - IEM" largely represents the weight of optional subjects in the curriculum. This weight is greater in Minho (10.3%), followed by Groningen (8.3%), Aveiro (8.0%) and Novi Sad (7.3%).

If we think that the curricular flexibility can be measured by the ability to adapt and customize the learning process throughout the program, one can see that these additional specific areas add curricular flexibility to the analyzed curricula. All of them allow students to adapt their learning process. The "IEM - IEM" area adds flexibility because it is primarily up to students to choose between different options. The "IEM - Dissertation" and "IEM - Project" areas add flexibility by the characteristic and unique nature of the project. In a project students aim to get a result by solving a given problem or issue and the process of this search enables them to follow different alternatives and arrive at different results. Thus, you can partially adapt the

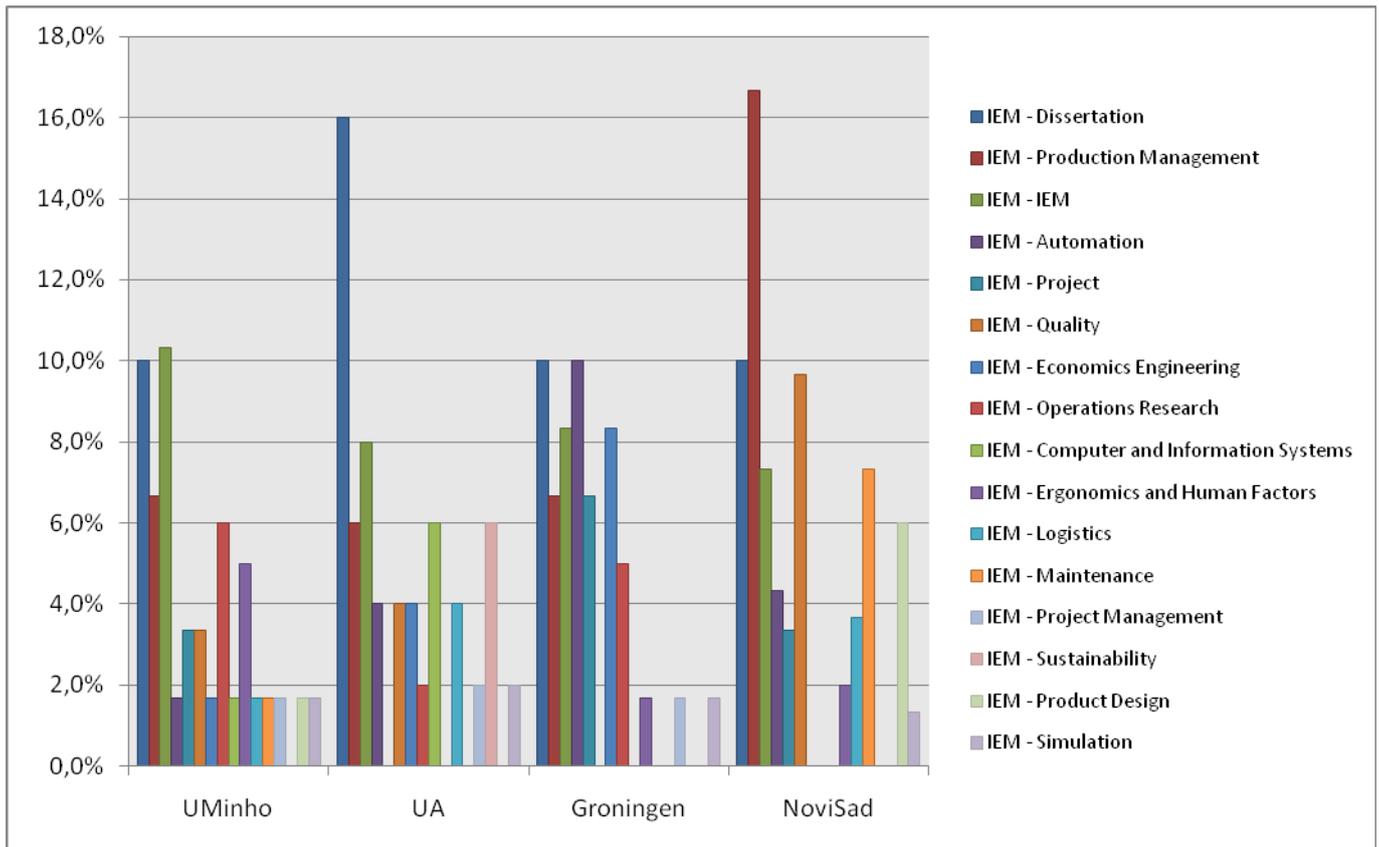


Figure 2. Curriculum knowledge areas analysis based on IEM specific areas

students learning process based on their own needs and interests.

Regarding specific areas of knowledge a number of differences in profile between the various programs can be observed. Anyway it is clear that the area of "IEM - Production Management" is the one with more weight in all courses. Minho and Groningen have similar weights with 6.7% and Aveiro has a value below of 6.0%. Novi Sad stands out with a weight above 16.7%.

As for the "IEM - Production Management" the curricula have some differences. Starting with the analysis of the curriculum of Minho, a general balance between most of the areas can be identified. This balance is broken only by an emphasis on Quality, Operations Research, and Ergonomics and Human Factors. In particular, this program gives a higher emphasis over the other three in "IEM - Operations Research" and "IEM - Ergonomics and Human Factors".

The Aveiro curriculum presents an average emphasis in "IEM - Automation", "IEM - Quality", "IEM - Engineering Economics" and "IEM - Logistics". It displays an above average emphasis on "IEM - Computer and Information Systems" and "IEM - Sustainability." Finally, it does not show compulsory subjects on areas of "IEM - Project", "IEM - Maintenance", "IEM - Product Design" or "IEM - Ergonomics and Human Factors".

Regarding specific areas, the curriculum of Groningen presents a very strong emphasis on "IEM - Automation" with a weight at the level of the dissertation. It also has

a very strong weight in "IEM - Engineering Economics" very close to 8.3% of the whole program. Then it presents a high weight of 5.0% in "IEM - Operations Research." Finally, it has a weight close to 1.7% in "IEM - Ergonomics and Human Factors", "IEM - Project Management" and "IEM - Simulation." It has no weight in compulsory courses on "IEM - Quality", "IEM - Computer and Information Systems", "IEM - Logistics", "IEM - Maintenance", "IEM - Sustainability" and "IEM - Product Design."

The Novi Sad program has a strong emphasis on "IEM - Quality" with almost 10.0%. This is followed by "IEM - Maintenance" with 7.3% and "IEM - Product Design" with 6.0%. The areas of "IEM- Automation" and "IEM - Logistics" have a relative weight around 4.0%. The areas with less weight are "IEM - Ergonomics and Human Factors" and "IEM - Simulation". The program does not present any compulsory disciplines in "IEM - Economics Engineering", "IEM - Operations Research", "IEM - Project Management", "IEM - Sustainability".

6. FINAL REMARKS

A dominant trait of IEM education across Europe is the multidisciplinary nature of the knowledge areas that are offered in curriculum programs. The structure of IEM programs is, to a great extent, a response of higher education institutions to industry demands for professionals with very diverse competencies – i.e. professionals able to manage systems composed by

people, materials, equipment, financial resources, information and energy. The structure of IEM programs is therefore very much determined by the history of industrial development in a given moment, and in particular, by the characteristics of the industry and service sectors of the specific region in which each higher education institution is integrated. Despite this diversity, IEM curriculum programs share key structural elements which need to be thoroughly understood in order for them to be benchmarked, challenged, and assessed from time to time. This study provides a contribution to this issue. In this paper we develop a basis to characterize the structure of IEM curriculum programs, particularly the knowledge areas involved in the education of an IEM professional.

Based on the literature about IEM education, and on the analysis of the structure of four IEM curriculum programs, a broad knowledge domains addressed in range of the courses offered is identified: Basic Sciences, Economics and Management, Engineering Sciences, Industrial Engineering & Management, Research Methodology and General Studies. Additionally, a further disaggregation of the area of Industrial Engineering and Management into a set of more specific knowledge domains (e.g. Simulation, Quality, etc.) is included. The identification of such sub-domains of knowledge in IEM is important to fully characterize the diversity in IEM programs, while providing a frame for research and comparison across the different programs.

The proposed framework provides both an aggregated perspective which exhibited a good adequacy to describe the multidisciplinary nature of IEM programs, as well as a more detailed lens to capture the specialized knowledge and competences which have been developed in the specific IEM area. Such a detailed characterization of the concepts and methods which have been specifically developed in the context of IEM education and practice was still lacking in the literature on engineering education. As such this work provides an important and timely contribution for the definition and differentiation of the field of IEM from other engineering areas. Moreover, the proposed classification can also be a relevant tool for supporting the future innovation (e.g. restructuring) of IEM curricular programs. It offers a structured framework for characterizing the programs, therefore enabling benchmarking exercises, and facilitating the dialogue between academia and the profession of IEM.

The application of the proposed classification to the four curriculum programs addressed in this study confirms that there are key structural characteristics shared across the different programs. Nevertheless the results suggest that there is substantial diversity, for example, at the level of the field of specialization offered at each higher education institution, therefore indicating that this is a field which offers important opportunities for further research. Promising areas of work include: i) a more thorough characterization of the IEM specialization areas offered in Europe, including the analysis at the level of the flexibility offered for students to choose its IEM education (e.g. relative importance of the

compulsory vs. optional subject in the curriculum); ii) the characterization of the diversity of the current offer of IEM education across several countries, and in particular the investigation of the relationships between the structure of the curriculum programs and the specific characteristics and demands of the associated economic setting (e.g. the characteristics of the industrial and service sectors in each region).; iii) finally, the replication of the exercise done in this exploratory study across other IEM curriculum programs, and contexts, would be important for the validation of the proposed classification framework.

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Analiza oblasti znanja u studijskom programu za Industrijsko inženjerstvo i menadžment

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Rezime

Industrijsko inženjerstvo i menadžment (IIM) predstavlja kontinualnu, fleksibilnu i dinamičnu oblast inženjerstva. Aktivnosti ove oblasti vezane su ne samo za proizvodnu industriju, već i za bolnice, obrazovne sisteme, transportne sisteme, finansijske institucije, itd. Stoga, postoji potreba da se studenti pripreme za široki raspon IIM i da studijski program obezbedi ovako široku viziju. Ovaj raspon IIM je evidentan u osnovnim principima studijskog programa. Diplomirani studenti treba da budu spremni za široki spektar poslova na tržištu rada. To je izazov sa kojim treba izaći na kraj kada se kreira i razvija studijski program. Stoga, izbor posebnih fokusa predstavlja osnovu za proces kreiranja studijskog programa i iz tog razloga studijski programi imaju drugačiji fokus. Cilj ovog rada je analiza četiri studijska programa za IIM u Evropi na osnovu klasifikacije kurseva prema oblastima znanja. Na dalje, relativna težina oblasti je računata na osnovu kredita za kurseve. Korišćene su dve međusobno povezane grupe oblasti, jedna u kojoj je sve ujedinjeno i druga za posebne oblasti IIM. Ovaj okvir se pokazao korisnim za analizu studijskih programa, a rezultati pokazuju da četiri studijska programa imaju uporednu težinu specijalizovanih oblasti IIM i da je Proizvodni menadžment posebna oblast sa većom težinom u svim programima. Rezultati pokazuju da je jedna od osobina studijskih programa za IIM raznolikost u oblastima znanja vezanih za specijalizaciju IIM. Ova studija takođe naglašava značaj strukturiranog okvira za karakterizaciju IIM programa, čime se omogućavaju benchmarking vežbe i olakšava dijalog između akademskog i poofesionalnog dela IIM.

Ključne reči: industrijski inženjering i menadžment; oblasti znanja; analiza studijskih programa