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New educational innovation methodology to determine the suitability of final degree reports for a quality Assessment and Accreditation framework. A case of study applied to Industrial Engineering degree

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Resumen/Abstract: Final project reports are essential subjects designed to set actual evidences of capabilities that are reached by students once they have passed all the courses of a university degree. Therefore, the main purpose of a final work assessment is to demonstrate if the student is able to transform academy achievements into a full professional capability by developing a matter of work within the degree scope. This work is commonly proposed and guided by a tutor, that encourage student to develop a self-learning process as a methodology to face future professional problem-solving events.

The relevance of such final degree reports in relationship with the future application of professional competences is also a matter of study for higher education quality assessment agencies, that must face the problem of applying standard guidelines to analyse the possible wide range of topics covered by final degree reports and what usually lead evaluators to introduce a subjective factor in such process.

The aim of this paper is to introduce an innovative methodology in the field of Industrial and Management Engineering to help external quality assessment evaluators to discern up to which point a final degree report falls within the university degree expectations or not.

Palabras clave/Keywords: Final degree report, quality assessment, industrial and management engineering

1. Objetivos o propósitos/ Introduction and Research Scope

The aim of this research proposal is to introduce as a matter of study in the field of Industrial Engineering and Management Engineering, the relevance of final degree reports or dissertation in relationship within the future application of professional competences in what the universities makes focus through this field of knowledge.

Under the point of view of university framework, the transformation of academic competences into professional abilities is the main goal that students need to accomplish in a final degree report. This transformation process takes place under the guidelines of a university tutor that leads students to a self-learning process to solve a problem as a professional challenge.

Management Engineering and Industrial Engineering it is defined by multidisciplinary environments where the efficiency, optimization, performance

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improvement, budget management, innovation development among other professional skills may bring together technological, financial or competitive profits to industrial and organizational companies.

In order to put into practice this research there are some premises that were used to centre the scope of the problem, like the sub classification for the field of knowledge of industrial and management engineering in order to group together all the academics reports.

2. Marco teórico: Academic and Professional Background.

The competences of Spanish industrial engineers in the European higher education area (EHEA) have been studied through several publications in relationship this matter (Marín-García, et al., 2008)(Mula, et al., 2012), (Roca-González, 2016) since the first publications analyzed the three types of academic competences (González & Wagenaar, 2005) known as instrumental, interpersonal and systemic competences.

In relationship with the professional background the first accepted definition of competence was provide by Thomas Gilbert in 1978, as the "state of having the ability to consistently produce the results (the worthy outcomes of behaviour) that are required for the most efficient and effective achievement of the larger organizational goals" (Gilbert, 1996) at (Teodorescu, 2006).

The experience of mixing both points of view with six domains for the professional understanding of Industrial and Management Engineering proposed by AINGOI, encouraged the author of this report to link together the Industrial Engineering final degree reports of the University Center of Defence at the Spanish Air Force Academy with a rank system in where each report could be marked to identify quantitatively its relationship with these six professional domains.

The six domains proposed by AINGOI were:

- 1) Manufacture Management, Process, Operations and Supply Management.
- 2) Enterprise Resource Management and Planning.
- 3) Industrial Labour and health Safety
- 4) Project Management.
- 5) Research, Development and Innovation Management.
- 6) Regulations and Standards Management..

These six domains can be understood as the foundation of the theoretical background. Aligned with this idea this research proposal follows to star with a survey questionnaire to provide a radar layout for each FDR for a selection of Universities in the last four or five years. Not only the results analysis but this

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radar idea itself when tested and passed by other experts is what afterwards could be of interest for any Academic Agency for Quality Assessment, such it is ANECA at Spain, if it becomes as an easy and fast tool for evaluators to check the relationship of any FDR within the Academy purpose in this field of knowledge

As an example, the next sections introduce a score table for each domain whose main possible score is ten points. The scoring is done by wondering if some sentences fit with the FDR work so in case of being of application for the FDR it matches with a previous mark value. As there are six domains the hypothetical max score could be of Sixty points, however it is expected that there is not a single FDR able to score all the sixty points, just because the real FDR will make focus sometimes in one more domains over the rest of them, what finally is also a main research goal: To reveal aspects that may help to classify the FDRs.

3. Metodología/ Methodology: FINAL DEGREE REPORT (FDR) SURVEY EXAMPLE

| MANUFACTURE MANAGEMENT PROCESSES, OPERATIONS AND SUPPLY MANAGEMENT, | # | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--|
| The FDR exposes a case of study, valuation, layout design or improvement proposal for an industrial facility, an industrial process or a logistic system. | 1 | |
| The FDR shows main aspects in relationship with Quality of manufactured product or industrial services provided. | 1 | |
| The FDR involve a design proposal to optimize an industrial process through a industrial automation implementation. | 1 | |
| The FDR introduces a productive design or a software implementation to increase the efficiency of a logistic or productive system. | 1 | |
| The FDR includes a design, analysis, evaluation or proposal of a feasibility project in relationship with an industrial facility linked to the manufacturing of products or services. | 1 | |
| The FDR includes a time and motion study | 1 | |
| The main scope of the FDR follows to optimize industrial processes to achieve higher efficiency. | 2 | |
| The FDR displays working definition of industrial processes, emerging technologies, reference books, technical drawings, statistical analysis, computer simulations, software development or another similar aspect that increase the Industrial/business profit and efficiency. | 2 | |
| Total | 10 | |

| ENTERPRISE RESOURCE MANAGEMENT AND PLANNING | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--|
| The FDR implements theoretical concepts of industrial marketing or business management frame into real cases of study in order to improve the organizational or industrial efficiency. | 2 | |
| The FDR analyzes cases of study in relationship with operations research to propose optimal solutions to improve industrial or business processes subjected to limited resources. | 1 | |
| The FDR carries out a statistical study to propose an improvement inside any industrial/business organization. | 1 | |
| Total | 10 | |

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| PROJECT MANAGEMENT AND PROJECT REPORT. | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--|
| The FDR carry out an Work Breakdown Structure (WBS) a task sequencing or a task/resources planning. | 2 | |
| The FDR provides a case of study that analyzes and completes the document required by any of the international project management certification organizations. | 2 | |
| The FDR includes a feasibility study, cost estimations, economic balance, counting analysis in relationship with a business or industrial environment. . | 2 | |
| The FDR is about a design, implementation, optimization or improvement of an integrated communication systems for an industrial or business organization. | 2 | |
| The FDR is a technical project about energy efficiency or industrial lay-out, industrial measurement, computer simulations, a report to minimize the waste of resources, technical and budget auditing among other types of projects from the industrial and business organizations environment. | 2 | |
| Total | 10 | |

| RESEARCH, DEVELOPMENT AND INNOVATION MANAGEMENT | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--|
| The FDR analyzes, evaluates, simulates or improve a patented innovation, utility, design, plant, reissue patent or a defensive publication idea or a statutory invention registration in order to develop a knowledge transfer process to improve the efficiency of a productive process/organizational service. | 2 | |
| The FDR is about the design or implementation of a R&D management system in relationship with international standard or certification organizations. l | 2 | |
| The FDR includes the report, drawings and any other information requested for a patent registration process or dual use technology transfer process. | 2 | |
| The FDR proposes an economic budget study in relationship with a R&D program. | 2 | |
| The FDR evaluates the strategic implications and the competitive status of an industrial business/organization in relationship with R&D results. | 2 | |
| Total | 10 | |

4. Discusión de los datos, evidencias, objetos o materiales/Discussion and data analysis

Once that the selections of FDR have been done, the research could display the results in a radar diagram that can be include inside the FDR as an attached document that summarizes the main Industrial and Management Engineering domains in where the DFR may make focus. The final radar display can also be contrasted with the theoretical radar track for a pure FDR on each domain (See Fig. 01) or use to contrast several FDR (See Fig 02.) or by applying an average estimation to contrast several universities results (See Fig.03).

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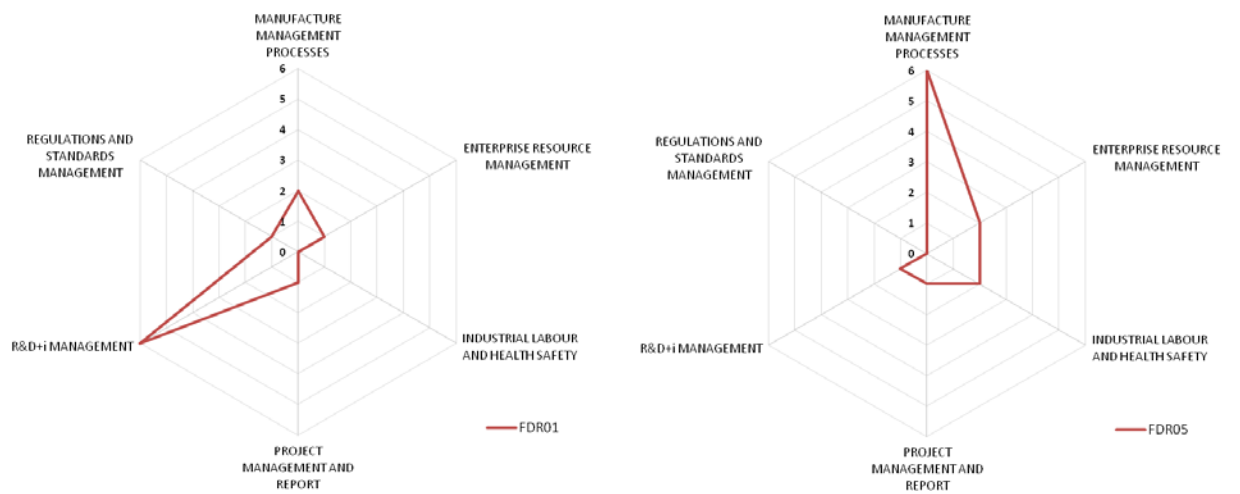
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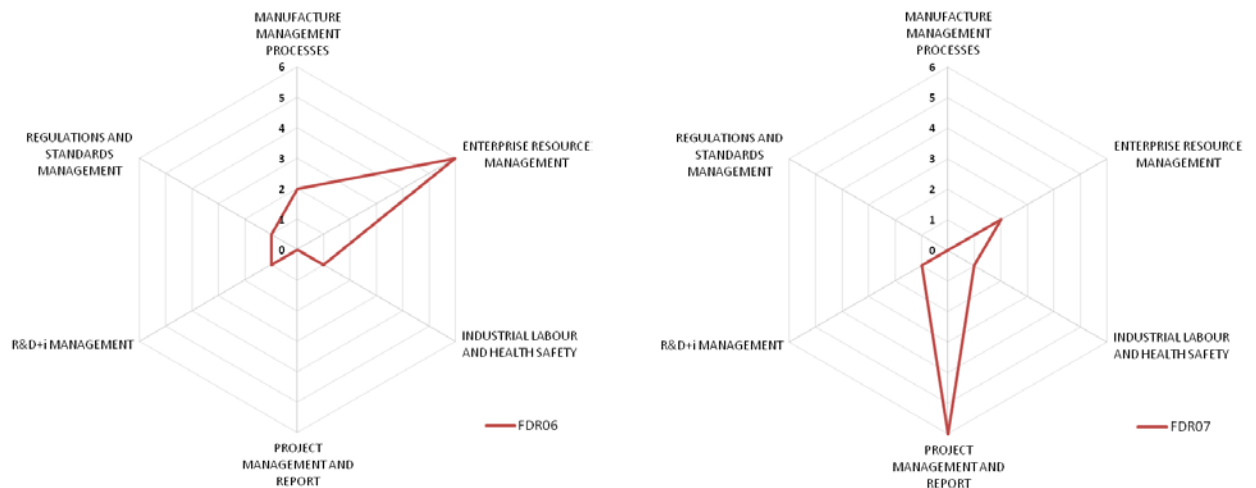
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1a. R&D+i Theoretical FDR.

1b. MMP Theoretical FDR.



1c. ERM Theoretical FDR.

1d. PMR Theoretical FDR.

Fig. 1 Theoretical Standard Scores.

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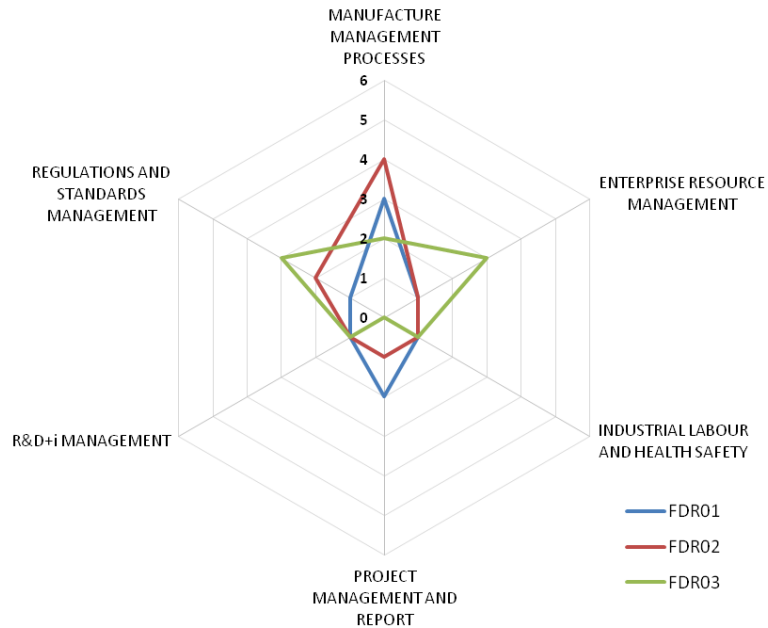


Fig. 2 Example of Three FDR contrast.

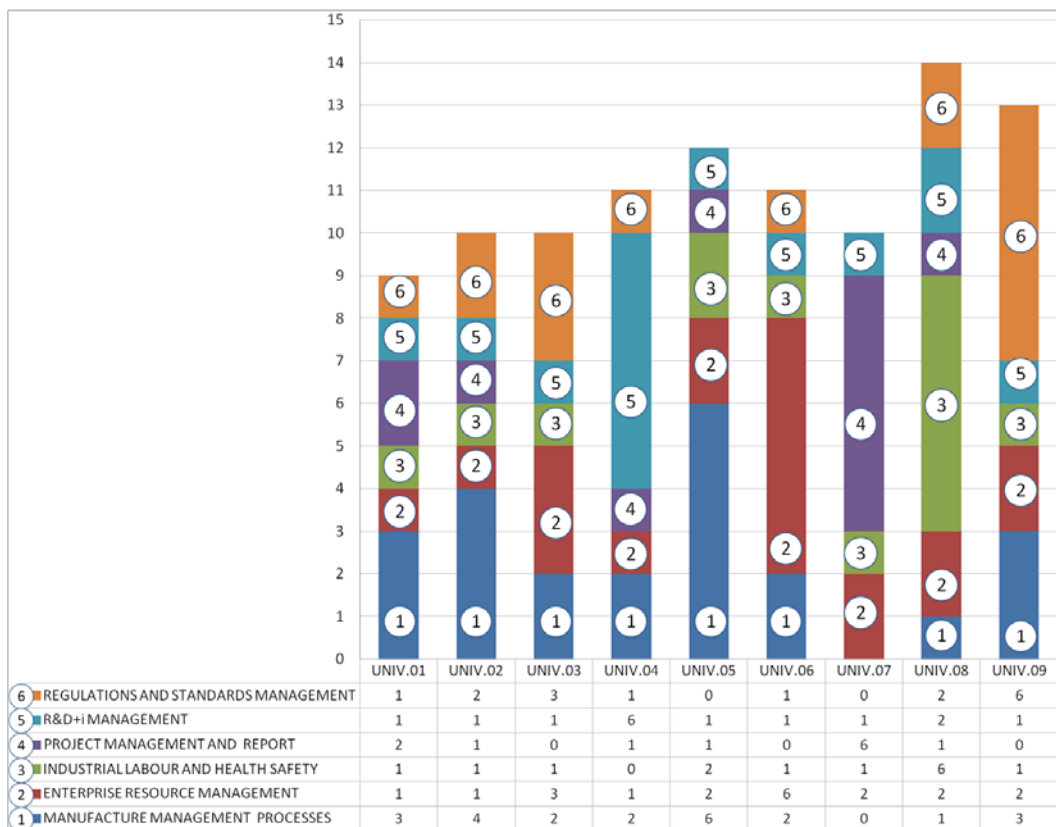
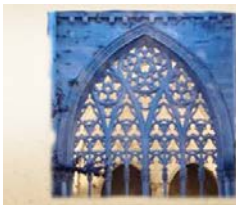


Fig. 3 Example of Several Universities FDR Averaged Score contrast.

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5. Resultados y/o conclusiones: Conclusions:

[This proposal is under a review process in order to define the parameters that may affect the results in relationship with the type of academic degree of Industrial and Management Engineering (Bachelor/Master) what may increase the amount of information that have to be analysed. Just in the Spanish example there are about 24 bachelor and 19 master degrees sources that increases the limits of the research and require a slow process of formal request to access to the FDR records to apply the questionnaires

The Spanish case of study reveals how the Bologna process has started to provide results for the bachelor degree (EQF-6) in the year 2014 due most of the degrees adapted to the European Qualifications Framework started in year 2010, in relationship with the Master degree (EQF-7) the records to be analysed starts at year 2014 for similar reasons. The Spanish statistical information of graduated students in Industrial and Management Engineering reveals (See Fig. 04)

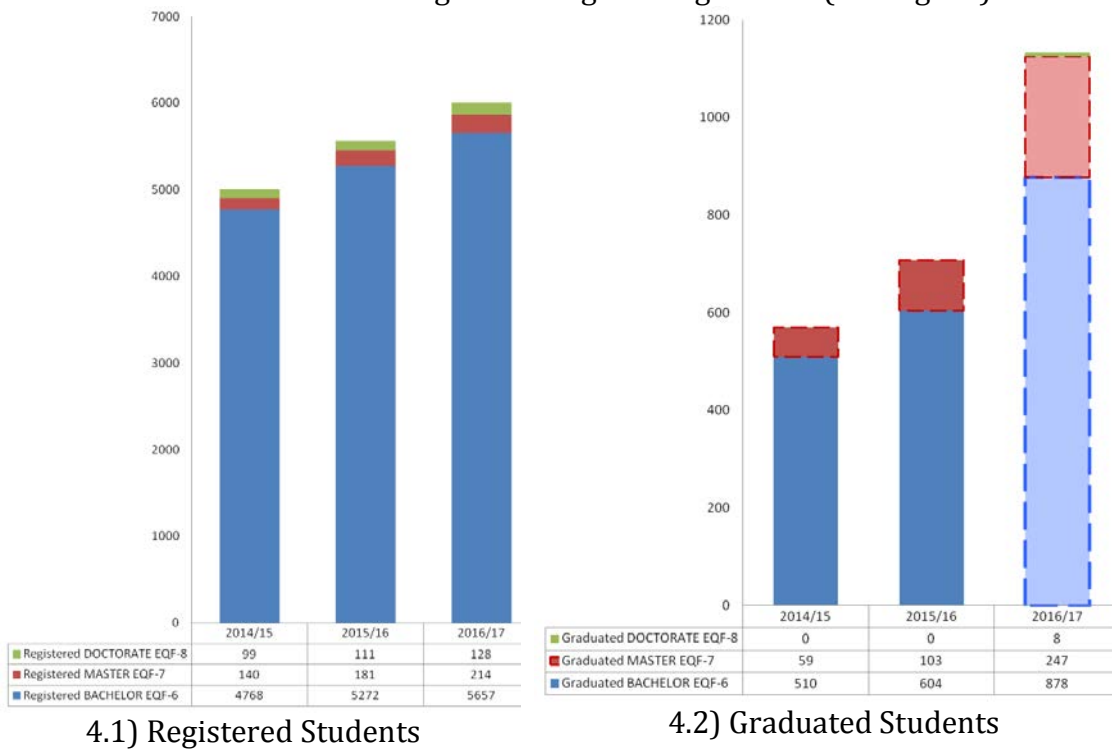


Fig. 4 Industrial & Management Engineering Academy Report from Spanish Statistical Information.

Regard the number of FDRs that have to be selected to be evaluated, it should be proposed a minimum sample range of 15 to 20 FDRs from the last five years from each University that may be increased if future collaborations allow to develop a cooperative research.

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This cooperation could take part since the beginning of this research under two main lines, one could make focus on reviewing the questionnaire and the other in the search of target universities where an internship can allow to speed up this research and finally to establish a publication policy of the results by setting up a maximum of three collaboration authors that can split the research making focus on Master or Bachelor Degrees.

6. Contribuciones y significación científica de este trabajo: Scientific Implications of this research

This work opens a new research line in relationship with final degree reports. It shows how a standardization procedure by applying a scoreboard questionnaire, over the agreement within each main knowledge domain of the university degree, may finally help quality assurance officers to perform such activity on this university requirement.

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