

METHODOLOGICAL PROPOSAL FOR THE DESIGN OF THE PROFILE OF AN ELECTRONIC ENGINEER ACCORDING TO THE REQUIREMENTS OF COLOMBIAN COMPANIES

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Abstract: The present work proposes the development of a methodology that evidences the requirements of the industrial sector in order to provide the educational sector with a base that allows its students to obtain the knowledge required by the industry. In this way, it seeks to align the profile of the electronic engineer of Santo Tomas University. For this purpose, the methodological tool of Régnier's Abacus is used, since it integrates the relationship with a group of experts that makes it possible to reliably demonstrate the needs of the sector by choosing as a sample: graduates and companies. Additionally, a technological trajectory map is used to identify the main focuses of interest of the business and educational entity, to obtain an indicator for the design of the electronic engineer's profile.

On the other hand, a search of profiles of different universities in the district is made and, in addition, a survey is made of the sample described above. From this review, we found significant verbs for the development of an academic curriculum such as lead, and develop, among others. Similarly, there is evidence of transversal areas such as management of office automation tools, English, leadership, and administrative activities, among others. Also, areas include IoT, software development, energy saving, data analysis, maintenance, nanotechnology, and embedded systems.

Keywords: Graduation profile, universities, methodology, curriculum, term cloud, career map, industry sector, graduates, Power Bi.

INTRODUCTION

According to the research conducted by Serna M, et al., engineering in Colombia is in crisis despite the fact that this profession transmits people to create and innovate and thus constantly improve the quality of life (Serna M. Serna M., E., & Serna A., 2015) through new and daring solutions. However, over time, there has been an increase in the concern of different countries such as Germany, the United States, and England: Germany, the United States, and England. Since the formative advances in the areas of Engineering are static and their contribution is not reflected according to the technological advances.

Likewise, the article presents an analysis of the responsibility of the formative processes and working methods used in the faculties of Engineering (Logreira et al., 2016), in which it is concluded that this crisis is due to the universities and their formative process. Since the universities are not clear about the requirements of the industrial sector at the time of hiring an engineer (Garzón G, 2008).

Finally, due to the dynamics of the business sector, its conquest of the market, permanence, and search for new opportunities, it derives that these are more demanding when looking for integral and competent professionals (MOHAMAD et al., 2018) who take risks before the challenges that arise; for this reason, and also due to the absence of students in careers related to Engineering, especially in Electronic Engineering, the Higher Education Institutions must meet the requirements of the labor market, rethinking the training of their students, to achieve a better adaptation to the society where they will perform.

CONCEPTUAL DEVELOPMENT

In the development of a qualitative investigative process, it is important to find harmony between the techniques and instruments for the collection, analysis and processing of information, so as to achieve show the diversity of perspectives through the points of view that coincide or are isolated between the researcher and the subjects, this being one of the potential aspects of qualitative research that consolidates studies of quality for society, making it possible for said results to become more relevant and not just remain in a percentage statistic (Sánchez Bracho et al., 2021).

A search is made in employment portals to know the requirements of the companies in the city of Bogota and its metropolitan area and also a contact is generated with graduates of the Universidad Santo Tomas and the companies from which information is obtained by which a survey is generated through the Google Forms tool which is divided by multiple choice and open questions, then a relationship of the information collected with bibliographic documents such as the following is made: National Qualifications Framework (MNC) (Prieto et al., 2010), ACOFI (ACOFI, n.d.) and documents of the Ministry of Information Technology and Communications (MinTIC) (Telecomunicaciones, 2021). Once the analysis is finished, a trajectory map is made using the following items: development managers, technological areas, technological lines, technological sub-lines, verbs and transversal areas. On this occasion, each of these items is according to certain questions generated in the form such as: The main areas in which an engineer works, the fields of action that were worked according to Acofi, the areas of greatest interest, the performance required by the industry, and the verbs that were obtained after the analysis using the Power Bi program which allows migrating

information from Excel books, SQL Server, CSV, among others. In this case we worked with an Excel database. Hence, the term cloud tool is used. In this way the verbs and terms are visualized according to the profile offered by the different universities in Bogota in which the Electronic Engineering program is offered and the transversal areas obtained according to the information provided in the survey.

The following is one of the terms clouds that were used in the analysis.

This cloud of terms shows the frequency of similarities found in the different universities, in terms of the main areas of performance that form the graduates of Electronic Engineering. At the same time, this visual representation shows which of the terms obtained through the information provided in the description of the graduate profiles reflect the lower frequency, which implies that universities need to strengthen and enhance their graduates to stand out and distinguish themselves from electronic engineers from other universities.

Finally, the curricular design diagram linked to Reigner's Abacus (Martelo et al., 2017) is used, where primary information is requested from experts (companies and graduates), secondary information (thesis documents, National Qualifications Framework (MNC)(Prieto et al., 2010), Specific Manual of Functions and Labor Competences of the Ministry of Information and Communication Technologies (MinTIC) (Telecomunicaciones, 2021), and the graduate profiles of universities that offer the same academic program in Bogota.

Hence, with the information obtained above, a technological trajectory map is elaborated, a term cloud according to the verbs found in the description of the graduate profiles, and a term cloud with transversal areas.

Then, the methodology diagram for the creation of the profile of an electronic

where the offer was found and telephone number.

The companies are then contacted by telephone to find out their interest in the study, which will be validated using a survey.

TOOLING DEVELOPMENT

The questions are elaborated according to the general objective of the work, which is to obtain information that allows aligning the professional profile of an electronic engineer with the needs of the productive sector. Therefore, relevant aspects are taken into account to fulfill the objective, hence, questions are generated specifically focused on a population, in this case, companies and graduates; as a next step, the questions that provide answers to achieve the objective are selected. Finally, a validation with experts is generated to know their criteria and, if necessary, make adjustments to the survey.

TOOL IMPLEMENTATION

We proceeded to make use of the database generated from the employment portals where we obtained information from fifty-nine (59) companies of which twenty-seven (27) of them provided e-mail addresses. The database of Santo Tomás University is also used, where the information of the graduates since 1990 is found, but it is important to emphasize that the e-mail of all of them is not found.

VALIDATION OF RESULTS

Once all the aforementioned analyses are completed, the trajectory map is constructed, which is the final input in which the base themes for the design or redesign of the curriculum of the electronic engineering faculty of Santo Tomas University will be evidenced.

So the trajectory map is divided into

three parts: the first contains the primary information which is the information of the companies and the graduates, the second is the secondary information that refers to the documents that were used in this case the MNC, ACOFI, MinTIC, the thesis and the graduate profiles of the universities, the third part is made up of the verbs, the direction of development (trends), technological areas (fields of action), technological lines (areas of major interest), technological sub-lines (required performance) and the transversal areas.

To identify the technological lines, an analysis is made to relate the areas of major interest with the trends and fields of action, as well as the technological sub-lines. The transversal areas and verbs are obtained from the review of the graduate profile of the universities in Bogota that offer the program. Hence, the lucid chart tool is used to create the methodological map.

CONCLUSIONS

- Throughout its research, the purpose of this project was to associate the industrial sector with the educational sector. This influences several factors (curriculum, research line, elective approach, etc.) which generate a positive impact on the program because its approach will attract new students and will stand out from other universities, as well as build a link with the industry. Also, this project evidences the importance of job portals as a fundamental means to obtain recent and accurate information according to the needs of the industry, according to the data collected from the job portals it was possible to generate contact with the companies which allowed enriching the research.
- According to the information obtained through the questionnaire and job

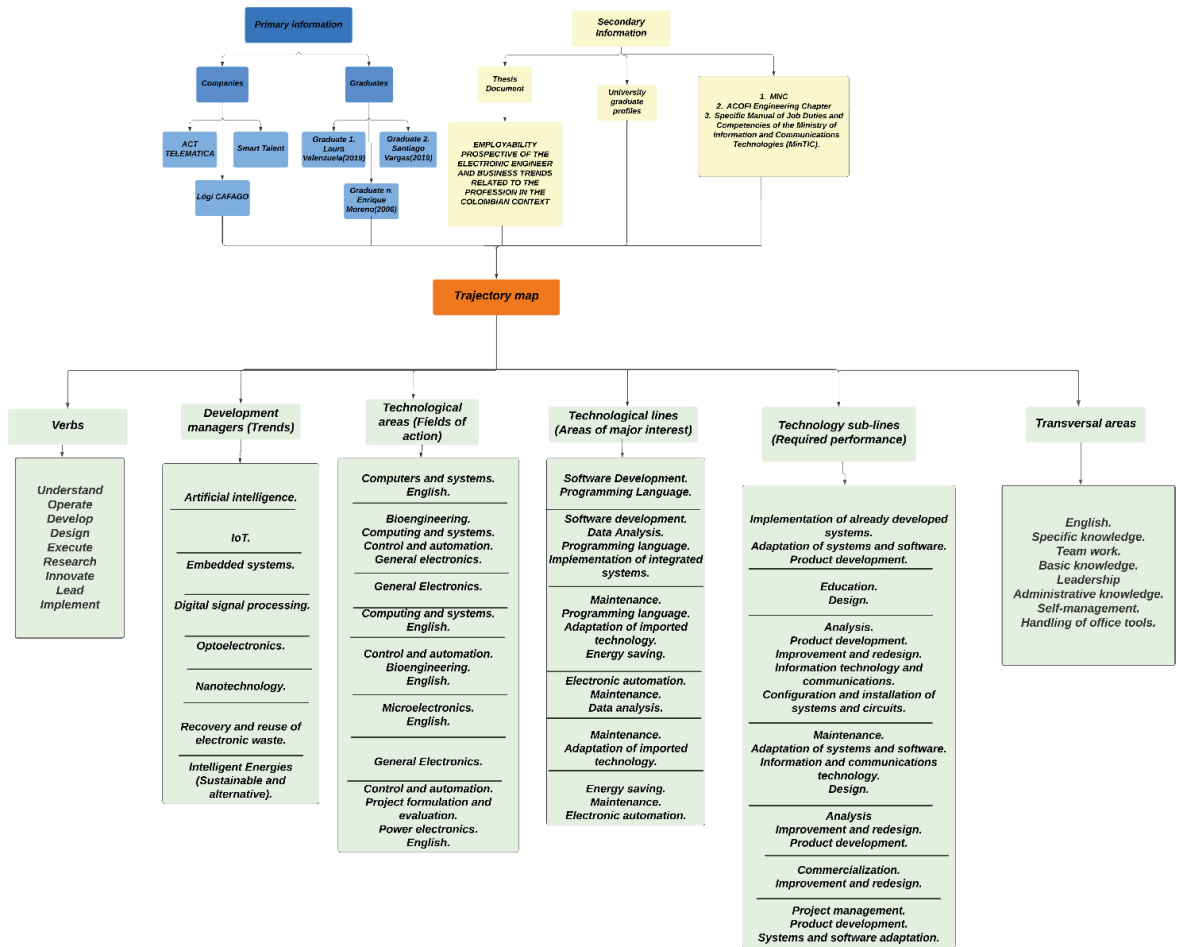


Figure 3 (Martelo et al., 2017). *Diagram of the methodology.*

portals, it is concluded the importance of associating administrative tasks and transversal areas in the development of an electronic engineer generates a plus in the development of their functions since it is essential that engineers and in general any person knows how to perform their work according to their specialty but without neglecting the needs of society such as communication and linkage with the environment in which it relates. Therefore, it is of great importance that universities evolve and integrate innovation as a fundamental factor in their programs to provide their students with the necessary skills to provide solutions to the needs of the industry.

- In addition, if the gap between industry and education is to be bridged, efforts must be made to bring together knowledge from different areas and to implement strategies that allow the skills acquired to be transferable and used in different jobs. This will allow for job growth and a better quality of life by improving workers' salaries.
- According to the constant changes that are generated in the industrial sector, it is essential to continue making incursions in the development of tools that allow us to know the trend of the labor sector and the needs of personnel so that the educational sector has a clear vision regarding the changes that must

be generated in the academic program and also the teachers are prepared with the objective of providing their students with the essential knowledge that will allow them to differentiate themselves from their competition. Also, a constant follow-up by the educational sector should be maintained to show if the changes and adjustments made in the program are benefiting the institution, its students, and graduates positively and if not, to improve the strategies that are being used. Keeping in mind that curriculum development is a process that involves the union of all stakeholders such as students, teachers, graduates, and administrative bodies, therefore it is important to maintain spaces that allow to know the points of view of each of

them, giving way to generate new ideas that contribute to the improvement of the training process. (Observatorio Laboral SENA, 2021)

- Finally, it is highlighted that the analysis shows new trends in the area of nanoelectronics and microelectronics, which are making their way into the labor market and therefore reflects the need to work constantly on the skills and abilities required to provide solutions to future problems of working life. In the same way, it is known that there are shortcomings to be reinforced by the students who do not perceive that the transversal areas and the part of project management is essential to strengthening their knowledge.

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