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Global Engineering Education Formatting Guidelines (Certification of Professional Engineering in Colombia: From the multi-criteria analysis approach and innovation)

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Abstract

Currently the Colombian professional engineering, presents the challenge in professional mobility to other countries, which is affected by the fulfillment of the requirements for degrees abroad; similarly, the criteria for professional certification differ between certification bodies. Adapting to the conditions in each country for professional mobility is desirable; therefore, to analyze the criteria for professional certification and alternative international engineering and propose the most appropriate model to support the professional certification process in Colombia is key to improving occupational mobility. It is proposed to apply the Analytic Hierarchy Process in the context of goal-based selection to determine the weight of criteria (objectives), the preference levels for each alternative (certification models) and identify the most appropriate model for certifying professional engineering in Colombia. This process will contribute to review various alternatives and criteria that apply international professional certification bodies, in order to determine the most appropriate model for Colombia. The framework of selection based on goals (Goal Based Choice) is the analysis and decision-making by the PROACT method (Problem, Objectives, Alternatives, Consequences, Transactions). After apply the Analytic Hierarchy Process in order to determine the weight of criteria (objectives), the preference levels for each alternative (certification models) and to identify the most appropriate to certify professional engineering model in Colombia.

Keywords
Professional Certification, Multicriteria Decision Analysis, PROACT method, Analytic Hierarchy Process.

1. Introduction

Currently Colombian professional engineering, presents the challenge in job mobility to other countries, which is affected by compliance with the requirements for degrees abroad; similarly, the criteria for professional certification differ between certification bodies. The adaptation to the conditions of each country to professional mobility is desirable, therefore, to examine the criteria and alternatives for professional certification international engineering and propose the most appropriate model to support the professional certification process in Colombia is key to improving occupational mobility.
Initially, we propose the analysis of alternatives and criteria relating to certification of professional engineering. Different techniques have been used to analyze alternatives and criteria for decision-making. One of the techniques used is within the framework of selection based on goals (Goal Based Choice) is the analysis and decision-making by the PROACT method (Problem, Objectives, Alternatives, Consequences, Transactions).

Arises applied the Analytic Hierarchy Process in the context of selection based on goals to determine the weight of criteria (objectives), preference levels for each alternative (certification models) and identify the most appropriate

model for certifying professional engineering in Colombia. This process will contribute to review the alternatives and criteria that apply international professional certification bodies, in order to determine the most appropriate model for Colombia.

After you apply the Analysis Hierarchy Process in order to determine the weight of criteria (targets), preference levels for each alternative (certification models) and identify the most appropriate to certify professional engineering model in Colombia. To this end. The application of Hierarchical Analysis Process (AHP for its acronym in English) which is part of the multi-criteria decision analysis is performed. Multi-Criteria Decision Analysis (MCDA Multicriteria Decision Analysis) is a broad term that includes a collection of concepts, methods and techniques that aim to help individuals or groups to make decisions that involve different conflicting viewpoints and multiple stakeholders (Belton & Stewart, 2002). Although there is an important multicriterion literature, tools, methods and even self-reflection multi remain largely unknown by technicians and managers at all levels (Pomerol & Barba-Romero, 1997).

Moreover, some important implications to consider are presented, because the models are dependent on the perception of the weights of the criteria provided by the decision makers and the generation of model-based may be limited for some organizations findings. Indeed, in practice, to develop a multi-criteria analysis methodology that results in a construct Councils and Professional Organizations Professional certification may support more engineering expertise.

The adoption of the PROACT method establishes a methodical and systematic analysis of alternatives and determination of criteria. Similarly Analysis Hierarchy Process (AHP) was used because this method has a hierarchical structure that helps prioritize levels of importance and preference, can work with a lot of information, different viewpoints and the ease of comprehension and understanding people are not experts in the subject.

2. Statement of the case

The engineering profession has taken a key role in major social risk that can happen on the impact of engineering activities on society. Ensuring the professional competence and experience is imperative for professionals and vital to the production structure and infrastructure development in the country councils. Ensure compliance with the requirements for the suitability of professional engineering is one of the main duties of the professional engineering advice in Colombia. Moreover externally dilemma presented for professional Colombian engineering is framed in that job mobility to other countries affected by compliance with the requirements for degrees abroad that certification bodies seeking and criteria each certification body are different in each country. It is important to be aligned with the new demands and requirements requested by certification bodies in other countries where the Colombian professional engineering can impact the development of their professional activities. Given Ramirez Mendoza C. L. (2012), the migration profile in Colombia against foreigners perform their professional activities in our country belong to Venezuela, United States, Ecuador and Spain at 82.3% of the total analyzed by the International Organization for Migration, while the amount of Colombian professionals of higher learning abroad are located in Spain, USA, Brazil, Argentina, Mexico, Chile, France and Canada at 84.6% of total Colombian highly trained. In this regard, it is essential to adapt to the conditions established by each country to professional mobility, thus it is necessary to identify and define the criteria for the certification of professionals based engineering analysis models of other certification countries and propose a methodology for multi-criteria analysis to support the certification process engineering professionals in Colombia.

3. Methodology

The analysis of alternatives to establish the most important decision criteria for determining professional qualities of Colombian engineer require a methodical analysis of secondary data that support common elements with the standards required by professional consortia and international certification organizations, the method facilitates PROACT this process and guides the decision maker to better analysis of alternatives and criteria. This activity was developed by an expert who has consulted, researched and analyzed secondary data and applied the Analytic Hierarchy Process. Then the characteristics of the expert who developed the study and performed the implementation process of PROACT method and Multicriteria Analysis Process described.

Expert Profile: Candidate for Doctor of Engineering-Industry and Organizations, Industrial Engineering, Project Management Engineering Specialist and Master of Business Administration MBA. With extensive experience in the productive sector. Moreover, alternatives and criteria analyzed, described in greater depth and detail is disclosed

Analysis of alternatives

For the analysis of the PROACT alternative method where the analysis of secondary information from professionals and fellow members international certification bodies was performed was used. Based on the recovered information, selection criteria was performed.
The selected alternatives are.

A1. Consortium Washington Accord

The International Engineering Alliance (IEA) consists agreements Consortia Washington Accord, Sydney Accord, Dublin Accord, International Professional Engineers Agreement (IPEA), International Engineering Technologist Agreement (IETA), APEC Engineer Agreement, which established a document entitled "Graduate Attributes and professional competencies" Version 3: June 21, 2013 in which the guidelines discussed based on the criteria for program evaluation, development of competency-based standards for professional registration bodies that educational and professional guilds have developed for mutual recognition of qualifications, resulting in a document that defines the attributes of the graduate and professional skills profiles of three cycles of professions: Engineer, Engineering Technologist and Engineering Technician. Washington Accord provides for mutual recognition of engineering programs, Sydney Accord provides mutual recognition of engineering technology programs and Dublin Accord provides for mutual recognition of engineering technicians.

For the case study will consider the guidelines associated with the engineer (professional engineering) as Washington Accord.

A2. Consortium Bologna Process EHEA

The purpose of the Bologna Framework is to provide mechanisms linking qualification frameworks of each of the member countries and the European framework resulting in a rationalization of common elements. The Bologna Framework has three cycles that are key to understanding the framework elements. These three cycles are composed of descriptors that determine the characteristics of each cycle. The descriptors have been developed in consultation with stakeholders and interested parties. (stakeholders) in Europe. These descriptors are named Dublin Descriptors. These descriptors are very general nature, however they can engage a wide range of disciplines and profiles, as well as variations of each of the criteria at the national level of the member countries. In the case of graduate professionals, the descriptors of the first cycle will be considered, as they are applicable to the titles of graduates (Bachelor Degree) and higher education (Diploma Highter). In Europe these names belong to European levels Qualification Framework 6 and 7 and 8 of the Irish Framework Levels.

A3. Professional Councils Engineering Colombia

The Engineering Professional Councils in Colombia are public entities inspection, control and monitoring of the practice of engineers, based on the authority granted by Act 842 of 2003. Professional Engineering in all its branches, its related professions and their respective professions auxiliary exercise, should be guided by criteria, concepts and lofty goals, which foster I extol; therefore it must be adjusted to the provisions of the rules that constitute its Code of Professional Ethics. (Act 842 of 2003, art. 29). The duties and obligations that professional engineering must meet are set out in the Code of Professional Ethics (Law 842 of 2003).

A4. International Certifying Organizations

National Council of Examiners Guidelines of Engineering and Surveying NCEES

The National Council of Engineering Examiners and Assessors in the United States provides for the licensing of engineers taking into account the impact of the activity performed by the professional.

Guidelines European Federation of National Engineering Associations (FEANI)

The European Federation of National Engineering Associations provide for the certification of engineers within the EUR-ING Title program established for the free mobility of engineering professionals having this certification to develop their professional activities in the Member States of the Federation.

Selection Criteria

The selection criteria took into account the information extracted from the alternatives. The analysis, interrelation and interaction of different sources of information resulted in the following criteria.

C1. Professional Competence:

Having the skills to pursue a profession. You can troubleshoot your autonomous, flexible, and able to contribute to this professional environment and work organization.

SC1. Knowledge Engineering: Apply knowledge of mathematics, natural sciences, engineering fundamentals and engineering specialty

SC2. Problem Analysis (complexity analysis): Identifies, formulates, investigates and analyzes relevant literature on complex engineering problems, maintaining findings supported using the first principles of mathematics, natural sciences, and engineering sciences.

SC3. Research: Awareness of continuous technical change and fostering an attitude of seeking innovation and creativity within the engineering profession.

C2. Professional Skills:

Apply knowledge to solve engineering problems, presenting skills in information management, communication and language skills and professional ethics

SC4. Engineering Design: Design solutions for complex engineering problems and design systems, components or processes to meet specific needs with appropriate consideration of
impact of public health and safety considerations of cultural impacts on society and the environment.

SC5. Engineering Practice: General knowledge of good engineering practice in their field of engineering and the properties, behavior, fabrication and use of materials, components and software.

SC6. Transferable Skills: Understanding the engineering profession and obligation to serve the society, the profession and the environment, through the commitment to implement the appropriate code of professional conduct. A skill in economic engineering, quality assurance, ease of maintenance (maintainability), and the use of technical and statistical information. The ability to work with others in multidisciplinary projects. The ability to provide leadership considerations covering managerial, technical, financial and human. Communication skills and the obligation to maintain competence by continuous professional development. Language proficiency

C3. Impact of Certification:

Incidence of certification in the region where it is valid, considering country coverage and number of beneficiaries of professional certification

SC7. Country coverage valid certification: The granting of certification covers a large number of countries that promotes international mobility of professional engineering

SC8. Number of Colombian professionals highly rated by country: The number of highly qualified professionals who are in the country where he exercised his profession

Weighting of criteria

The criteria weights are determined by the level of importance that the decision maker will give to each of them. There are spacious and heated discussions about the granting of weights to each of the criteria and the meaning impacts the MCDA and of obtaining it.

In the Analysis Hierarchy Process (AHP), representation by means of a hierarchy of levels, one to one comparisons the upper level and the next levels are made. This binary comparison gives some results of priority. To calculate the weights of the criteria, the comparison between them wondering what approach is better than another and for this the Rating Scale is used Saaty (1980) is performed

Rating Alternatives and Criteria

After determining the judicious and assessment of alternatives and the criteria, the diagram hierarchies to organize information set. For this case study, the expert performed iterations of the criteria, sub-criteria and alternatives. Figure 1 shows the hierarchical structure of criteria and alternatives.

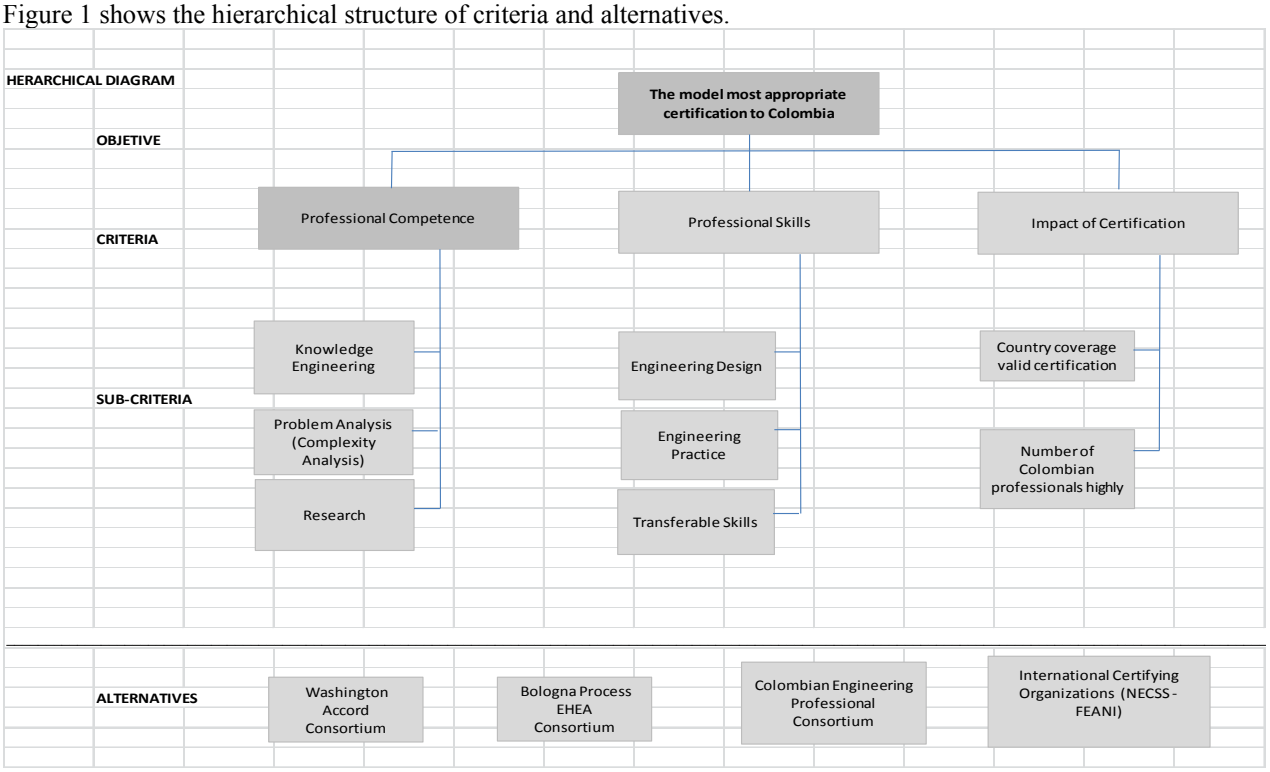

Figure 1 Hierarchical structure of criteria and alternatives.

4. Conclusions

When analyzing respective results from the analysis of decisions by the PROACT method, the method of assigning weights and hierarchical analysis process can generate the following discussions:

It is essential to have clear decision variables ie alternatives and decision criteria, which through a thorough analysis from the makers generate reliable methods for implementing elements of assigning weights. The methods of assigning weights depend directly address given by decision makers, the method is simple it will be setting the trend according to the rating given by the decision maker, this prints a great importance in terms of the choice of decision makers and impartiality and objectivity thereof. The grouping of the criteria is critical to the case of a significant number of criteria, however it is necessary to consider a good group in terms of consistency and impact against each sub-criterion presented. Given the importance of decision analysis and accompanying methods that process and the Analytic Hierarchy Process is important to further analyze the results presented in order to improve and / or refine the information and generate constructs that contribute to decisions.

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Biography

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