Significance of Skill and Management Formation for the Future of the Formation of Engineering

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KEYWORDS: *Engineering, Management, Business.*

ABSTRACT: *With the present work, we want to present how and why are necessary the acknowledgement in business for industrial engineers and for information technologies engineers. In Spain, and especially in the Comunidad Valenciana where our university is located (Polytechnic University of Valencia), the main business net is small private companies (SMEs). These companies are demanding generalists professionals. These companies do not have the resources to hire an engineer, a bookkeeper or a specialist in marketing. The majority of the companies that hire engineers, they need that these professionals have knowledge of management and business administration in order to face the work they have to perform. When we observe, as teaching institution, this situation we try to bring up and simulate companies real situations in order to teach the acknowledges of business administration and management to our students. We believe, it is necessary to complete the formation of an engineer with acknowledges and skills like motivation, leadership and team working. These should take a significant relevance in their careers in order to become professionals with successful future.*

1 INTRODUCTION

In this work we defend the following hypothesis: "the need for training and education in the field of Business Management and Organization for Engineers in our Country". For this end, first we will define the concept of Engineering and we will contextualize our hypothesis in different areas. In the business context, we will focus on small and medium-sized enterprises (SME); we will explain the professional functions of Industrial Engineers in Spain and their role in the social context; and finally we will analyze the functions of Industrial Engineers in the 21st Century.1

Let's start defining Engineering as "The knowledge and applied process required to plan, design, develop, build, operate, sustain, recycle or remove something that possesses a significant technical content for a specific purpose: a concept, a model, a product, a device or mechanism, a process, a system, a service, a technology".

According to Hedberg (2001) "the General Engineer is necessary to allow technology to advance in harmony in pace with the evolution of society and with the dreams and expectations of its citizens and is a part of the engineer's responsibility to apply his/her technical skills and his/her abilities to some problems of our society -environment, energy, lack of food, poverty, water shortage, etc."

Reub (2001) states that Engineering is, therefore, a broad profession that provides opportunities to develop a wide range of research and development activities, design, project management, manufacturing and assembly planning, and sales and customer services, of engineering products

[1] Estudio: "ESTUDIO DEL PERFIL DEL INGENIERO INDUSTRIAL GENERALISTA EN EL NUEVO ESPACIO EUROPEO DE LA FORMACIÓN SUPERIOR Y DEL LIBRE EJERCICIO PROFESIONAL". 2003.

2 BUSINESS ENVIRONMENT

We will classify this context according to the size of the companies into large companies, either national or multinational, and small and medium-sized companies (SME).

The employment policies of graduate engineers in the different companies vary considerably depending on the size of the company and on the nature of its products and processes. Large companies tend to employ engineers with a general education at a greater extent than small or medium-sized companies. In large companies this is because they operate on a long-term planning basis, whereas small and medium-sized companies base their policies on short-term planning, and thus they only hire engineers to cover some specific lacks or to plan and implement structural changes. As a consequence of scarce resources, small and medium-sized companies require engineers with a general education with some knowledge in technical aspects as well as in business administration and management.

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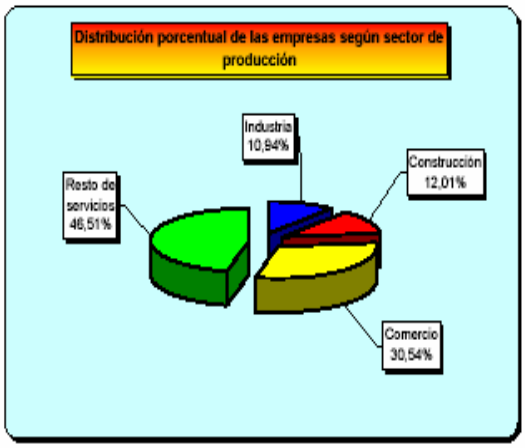

The studies of Industrial Engineering present a multidisciplinar content, with an important scientific theoretical background and specialization in one of the conventional industrial fields.

The Engineering curriculum starts with Mathematics and experimental sciences, particularly Physics and Chemistry, and in the last years the curriculum covers general technologies, with a particular emphasis on the industrial branch selected.

When the Industrial Engineer graduates, he/she must be able to apply in practice all his/her theoretical knowledge to the design and manufacture of any kind of industrial product

3 PROFESSIONAL ENVIRONMENT OF THE INDUSTRIAL ENGINEER.

The studies of Industrial Engineering were created with a real general vocation of service not exempt of sacrifice, because Industry requires qualified people, with the adequate technical and intellectual training, and used to facing all types of problems, professionals with a broad-spectrum instruction who get involved in the problems of the company and are responsible for the business organization and control, and are aware of new business opportunities and challenges.

There is the belief2l that graduate engineers are usually highly sought for in the working market (about 95% find work within 6 months after finishing their studies, and nearly 100% in the next two years). Many students are even working for a company before finishing their studies. This fact, together with the high number of students applying for registering at the School of Engineering as a consequence of the high possibilities for engineers to find a job, allows us to state that occupation levels are actually taken into account in the design of the new Plan of Studies.

Therefore, when a Decree regulates the professional functions and scope of the Industrial Engineers, it considers the possibilities for engineers to act on any industrial field

It is convenient to know and to take into account that not all university studies present a professional scope defined by a Decree. Even university studies as old as or even older than Industrial Engineering, with renowned prestige, do not dispose of any Decree, and have been regulating their functions through legal acts. Probably, in the near future, no government will dare regulate the functions of graduate

[2] II Plan de Calidad de las Universidades: Informe de Autoevaluación de la ETSII

students for the newly-created university studies, so that the new studies will have to open their own way in Industry and to define their functions and scope in Court.

Because of its relevance, next we quote part of the text of the Decree [3] which states the professional scope and functions of the Industrial Engineers.

....Industrial Engineering studies undoubtedly constitute one branch of the official studies that completely responds to the aim for which it was devised; the particular characteristics of the industrial problem in our country demanded an education of Engineers with a broad scientific basis that, allowing the specialization in the different industrial sectors, at the same time provide our medium enterprises with Managers possessing knowledge on chemical. mechanical, and electrical aspects. The progress of the Spanish Industry and to have redeemed it from foreign technical management are the main proof of the excellent task developed by the Industrial Engineers

...ARTÍCLE 1.- The degree of Industrial Engineer of the state civil schools confers graduates full capabilities to project, execute and conduct any kind of installations and exploitations comprised within the fields of chemical, mechanical and electrical industrial techniques and industrial economics:

ART. 2.- In addition, the Industrial Engineers of the State Civil Schools specifically possess the capacity to develop and conduct any kind of studies, works and to manage bodies and institutions in the economic-industrial, statistical, social and labor spheres.

The assessment, analysis, and chemical, mechanical and electrical tests of materials, elements and all kind of installations.

Intervening in issues of industrial nature.

Development of topographic works, gauging, valuation and demarcation

Legal reports, specialist's reports and technical reports and actions in legal, official and particular matters.

The construction of industrial buildings and facilities.

Additional industrial applications in urban works

As many works as commended by the legislation in force and their fees.

ART. 3.- The degree of Industrial Engineering of the State Civil Schools confers full capacity to sign all kind of plans or documents that make reference to the subjects specified in the two previous articles and to conduct and execute their works and installations, as long as the Administration is informed of such function and there is no hindering of issues that have to be supervised by public offices (Presented in Madrid on the eighteenth of September of one thousand nine hundred and thirty five NICETO ALCALA-ZAMORA Y TORRES Minister of Public Instruction and Fine Arts .JOAQUIN DUALDE Y GOMEZ

4 SOCIAL ENVIRONMENT: THE NEW DEMANDS OF THE COMPANIES TO POSTGRADUATE STUDENTS.

It seems interesting to comment on a research study performed by the University/Enterprise team of the Quality Management Club; the study analyses the educational needs of the labor market, improvements in high education: suggestion from companies"4 .The best Spanish companies and universities participated in this research study. Independently of the studies followed by the university students, the companies considered to be of great value a number of skills and knowledge demanded by the labor market. The new demands of companies for the graduate students are: Leadership, Team work, Change Management, Ethics, Corporate culture, Problem Identification, Creativity, Project Management, Sales processes, self-learning/self-development, Quality and Communication In addition to these requirements, the analysis also detected a number of skills and specific knowledge necessary to satisfy the needs required by companies. From these requirements, we will develop those skills and knowledge more closely related to business organization and management; we have chosen these skills because we agree with the idea of this work of "fostering the incorporation of graduate students to the labor market and transmitting the university institution the need for and pressure to include in its actions the instruction requirements"

1. Skills and knowledge on Leadership.

As skills in the aspect of Leadership, the new employee has to be able to lead persons, personal involvement, so that the manager shows his/her commitment with the company to lead group meetings.

[3] Decreto del 18 de septiembre de 1.935, publicado en la "Gaceta de Madrid" nº 263, 20 de septiembre de 1935.

[4] Estudio "Mejora en la formación universitaria: sugerencias desde la empresa" realizado por el Club Gestión de Calidad. 1998.

Within the required knowledge, the new graduates have to know subjects such as: leadership, motivation, individual coaching and empowerment.

2. Skills and knowledge on Team Work.

With respect to the skills required for team work, the new employee has to be able to work with others and to relate his/her own success to group success, to make decisions and skills in interpersonal relationship, with the ability to create trust and mutual collaboration links. The knowledge required is related to topics such as group dynamics, work meetings, net-working and establishment of groups.

3. Skills and knowledge on Corporate Culture

In order to satisfy the requirements of business corporate culture demanded by the company, the graduate will have to possess entrepreneurial skills, to be able to develop personal attitudes of autonomy and initiative. In addition, the graduate has to have a vision of the company, organizational skills in order to weigh and structure the company, as well as skills to recruit human resources. With regard to the knowledge relative to business culture, the graduate has to know subjects related to business and management systems.

4. Skills and knowledge on the Identification of problems

The skills required from a graduate student to be able to identify problems are: analysis skills, to distinguish and sort out data in a complex situation to have a clear idea of reality; relation skills in order to possess an overall view of the problem, and synthesis skills in order to summarize or control complex issues or situations. The knowledge required must be related to decision making, documentation and presentation techniques, high-performance equipment..

5. Skills and knowledge on Creativity

As skills in the field of Creativity, the graduate needs the abilities of innovation and change, in addition to that of development of inductive thought in order to guess the principles from the data through a bottom-up logical approach. From the practical point of view, the student, in order to develop in the professional world, has to learn the following techniques: brain-storming, Delfos method, suggestion mailbox, scenario design, morphological analysis, lateral thinking, etc.

6. Skills and knowledge on Sales processes

In order to cope with sales processes, the graduate needs skills such as analysis skills, data-mining techniques, negotiation and persuasion skills, planning and management skills. The specific knowledge required from the graduate is related to concepts such as: who is the client, techniques of customer service, marketing techniques, sales techniques, etc.

7. Skills and knowledge on Communication

Communication in the company can be analyzed at two levels: the theoretical level relative to management skills, and communicative skills. To control these two levels, the graduate will have to possess motivation and leadership skills and data-mining skills, and possess a good command of oral and written skills

5 QUALITIES OF THE ENGINEER IN THE 21ST CENTURY

According to Hedberg (1999) the engineer must have a high technical and scientific ability, but in addition, he/she must be able to communicate in his/her mother language, in English and other foreign language, possess skills for intercultural communication, as well as skills for management and team work; the engineer must possess a sound knowledge on ethical and environmental issues, be tolerant, innovative, imaginative and creative, cultivated in humanities and possess a deep knowledge on the relationship between technology and social development; the engineer should have curiosity and be sensible, willing to learn and to assume responsibilities. A high ideal that greatly coincides with the so-called Engineer of the Renaissance.

Engineers should possess, together with these technical skills, abilities to think in terms of different systems, in order to establish causal relations and to assess the consequences of their work on society and on the environment.

This set of skills is required by the different realities such as the presence of the companies in international markets and the need to support competitiveness with research and technological development, in addition to the dramatic increase in the services sector and the need for managing the

implementation of the new technologies. All these realities will strongly affect higher education and training.

According to the conclusions of the Seminar organized by SEFI (1992)5, the education programs must be devised to:

- provide a sound knowledge of the foundations,
- develop the ability to think and to apply knowledge for problem solving,
- develop the ability to "learn how to learn" and to keep using it for a long time,
- develop good communicative skills, including mastering different languages,
- develop the ability to work as a member of a team,
- develop basic management skills,
- possess a high degree of multidisciplinariety,
- educate engineers to assume their social and environmental responsibilities
- offer specialized courses to prepare students for their first job.

6 CONCLUSIONS.

We conclude this work stating that Engineers need some knowledge and skills in the field of business management to be able to develop their professional careers successfully. It is necessary to possess some basic knowledge on management in addition to skills such as team work, communication, leadership, …and, of course, the technical aspects required in the Engineering studies

REFERENCES

PUBLICADO EN LA GACETA DE MADRID, *Decreto del 18 de septiembre de 1935*, nº 263, 20 de septiembre de 1935.

ESCUELA TECNICA SUPERIOR DE INGENIEROS INDUSTRIALES. *II Plan de Calidad de las Universidades*: Informe de Autoevaluación de la ETSII

Estudio del perfil del ingeniero industrial generalista en el nuevo espacio europeo de la formación superior y del libre ejercicio Profesional. 2003.

HEDBERG T. The *role of the Global Engineer- Aeuropean view. Educating the Engineer for the 21st Century*. Proceedings of the 3rd Workshop on Global Engineering ducation. Kluwer Academic Publishers. 2001.

MEJORA EN LA FORMACIÓN UNIVERSITARIA: *sugerencias desde la empresa Estudio realizado por el Club Gestión de Calidad*. 1998.

REUBER M. y KLOCKE F. *News demands on engineers-Paths in education leading to professional qualifications*. Educating the Engineer for the 21st Century. Proceedings of the 3rd Workshop on Global Engineering Education. Kluwer Academic Publishers. 2001.

SEMINARIO, *La educación en Ingeniería en los 2000. Europa necesita especialistas o generalistas?*. SEFI. 1992.

[5] Seminario La educación en Ingeniería en los 2000. Europa necesita especialistas o generalistas?. SEFI. 1992.