

# COMPETENCY REQUIREMENTS OF INDUSTRY FOR ELECTRICAL ENGINEERING GRADUATES

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**Abstract**— The challenge of engineering education is to simultaneously prepare students for their first job and their career 25 years later. This suggests that engineering education must provide initial competencies for careers. The main purpose of the study is to find out what the competency requirements are of industries for electronic engineering graduates. The list of competencies was identified by the managers and supervisors of agencies that take care of communication systems in government and private firms. Based on the analysis, skills demanded by the industries are both soft skills and hard skills. Soft skills desired by them are communication skills, both oral and written, critical thinking, and problem-solving. Knowledge of the use of technology as a tool to research, organize, evaluate, and communicate information, as well as the use of digital technologies such as GPS, networking tools, and social networks to manage, integrate, evaluate, and create information, is expected from a graduate of Electrical Engineering. Hard skills required by industries from EE graduates are technical skills in managing large-scale electronic equipment or machinery for use in manufacturing or power generation or transmission.

**Keywords:** Electrical Engineering, Competency Requirement, Hard Skills, Soft Skills

## I. INTRODUCTION

Engineering is vital to the economy and has important benefits to society. However, engineering education has emphasized technology rather than its benefits to society. It is now recognized that this perspective has limited the attractiveness of engineering as a career to many young people, especially women and underrepresented minorities. An engineering education, which prepares students for leadership in benefiting society through innovation, will also enable a more diversified engineering workforce, one that taps into all the available talent our society has to offer. The importance of engineering concepts must be more widely disseminated outside the traditional engineering curriculum (e.g., K-12 education, liberal arts education, business education) (Busch-Vishniac & Jarosz, 2004).

There has not been a fundamental change in engineering curricula in the Philippines since the shift to a more science-based engineering education in the 1970s (Mihellic, et al., 2006). However, many organizations in the Philippines have recognized the need for and the importance of revolutionary change in engineering education and have begun to take steps in that direction. The engineering education provider in the Philippines has developed a new approach that offers engineering schools more flexibility to update their curricula and to introduce innovations. Some of the key ideas that have been piloted and tested include: recognizing that the student, industry, or government is the customer and providing flexibility in engineering curricula to pursue a variety of careers with an engineering background; expanding research-based and student learning approaches in the undergraduate education curriculum (Becker, 2006; Billing, 2003; Borrego & Cutler, 2010; Swart, 2010). Educating engineers for leadership in an increasingly technological society can be done by broadening engineering education and emphasizing communication, teamwork, policy, environment, and ethics; developing a variety of lifelong learning programs in engineering; as well as the innovative use of online learning tools (Zhou, 2012).

However, the challenge of engineering education is to simultaneously prepare students for their first job and their career 25 years later. This suggests that engineering education must provide initial competencies for engineering work and developmental competencies for careers (CHED, 2008). The specific core competence should reflect the following unique feature of the professional core competencies: firstly, reflected in the target of specific training, and closely linked to application capability and explicating capability. With this contention, this study was conceptualized to identify the competencies desired by the industries or stakeholders to continually align the engineering curriculum with the needs and demands of the industries.

This study aimed to identify the competency requirements of the industries and employers for Bachelor of Science in Electrical Engineering (BSEE) graduates. It specifically sought to determine the required soft skills of industries from BSEE graduates along learning and innovation skills; information, media, and literacy skills; and life and career skills. In addition, it also determined the required hard skills of industries from BSEE graduates in terms of design, consultancy, operations, and construction and installation.

### **Electrical Engineering Graduates Skills and Competencies**

The competencies of Electrical Engineering graduates are divided into two major skills: hard skills and soft skills. Hard skills describe the job functions performed by the electrical engineer, while soft skills describe the abilities of electrical engineers to interact with their work environments. These categories are interrelated, and they collectively form the basis for identifying the competencies necessary to keep electrical engineers at a competent level. The soft skills are derived from the 21st-century competencies, such as learning and innovation skills, information media and technology skills, and life and career skills. The hard skills of electrical engineers were taken from CMO 34 series of 2008 of the Commission on Higher Education in the Philippines, which outlines the profile of duties and competencies of Electrical Engineers (CHED, 2008).

#### **Hard Skills:**

1. Design skills are the abilities of the graduate to design systems, components, or processes to meet the desired needs and identified constraints.
2. Consultancy skills require knowledge of contemporary issues and the need to keep current with developments in the specific field of practice.
3. Operation skills are the abilities to tend electrical equipment and systems and to manage, manufacture, and repair electrical equipment.
4. Construction and installation skills are the abilities to design, test, install, and maintain large-scale electronic equipment or machinery for use in manufacturing or power generation or transmission.

#### **Soft Skills:**

1. Learning and innovation skills include critical thinking and problem-solving, which require a graduate to be able to analyze, synthesize, and draw conclusions from their analysis.
2. Information, media, and technology skills cover knowledge of the use of technology as a tool to research, organize, evaluate, and communicate information, and the use of digital technologies such as GPS, networking tools, and social media.
3. Life and career skills include the ability of the graduate to adapt easily to situations that test the flexibility and self-direction of the graduate.

## **II. METHODS**

This study utilized a descriptive method of research. The participants of the study were the employers and managers of Electrical Engineering graduates from the University of Saint Louis, a top-performing electrical engineering school in the Philippines. The employers came from Local Government Units, Electric Cooperatives, government agencies, and private corporations in the Philippines.

Data collection was done through a questionnaire. The soft skills consisted of 26 items using a 3-point scale, of which 9 items were for learning and innovation skills, 5 items for information, media, and technology skills, and 12 items for life and career skills. The hard skills consisted of 23 items using a 3-point scale, of which 14 items were for design, 4 items for consultancy, 1 item for operations, and 4 items for construction and installation.

The data were analyzed using the weighted mean to describe the required soft skills and hard skills of electrical engineering graduates as identified by the industry.

### III. RESULTS AND DISCUSSION

**Table 1. Required Soft Skills of Electrical Engineering Graduates by the Industry**

<b>Soft Skills</b>	<b>Mean</b>	<b>Qualitative Interpretation</b>
Learning and Innovation Skills	2.76	Very Much Needed
Information, Media, and Technology Skills	2.63	Very Much Needed
Life and Career Skills	2.83	Very Much Needed

As gleaned from the table, the learning and innovation skills of EE graduates are highly needed by industries, as revealed in their responses. This suggests that graduates in the Electrical Engineering field should use a wide range of creative techniques to make a tangible and useful contribution to the field. In order to be creative and innovative, graduates should possess communication skills, meaning that the electrical engineering graduate can articulate their ideas effectively through oral, written, and non-verbal (using symbols) forms of communication. Learning and innovation skills also cover the ability of the graduate to work effectively and respectfully with diverse teams in order to accomplish a common goal. These soft skills include critical thinking and problem-solving, which require a graduate to be able to analyze, synthesize, and draw conclusions from their analysis (Pulko & Parikh, 2003).

The employers in the EE industries also prefer graduates who have information, media, and technology skills, as shown by the mean of their responses, which is greater than the median of 10. Hence, these skills are very much needed. These skills necessitate EE graduates to use technology as a tool to research, organize, evaluate, and communicate information (Pulko & Parikh, 2003). Knowledge of the use of digital technologies such as GPS, networking tools, and social networks is also expected from an Electrical Engineering graduate (Crosbie, 2005). Likewise, life and career skills such as flexibility and adaptability, initiative and self-direction, and productivity and accountability are expected from EE graduates by prospective employers. Therefore, these skills are very much expected from EE graduates.

**Table 2: Required Hard Skills of Electrical Engineering Graduates by the Industry**

<b>Hard Skills</b>	<b>Mean</b>	<b>Qualitative Interpretation</b>
Design Skills	2.56	Very Much Needed
Consultancy Skills	2.92	Very Much Needed
Operations Skills	2.50	Very Much Needed
Construction and Installation Skills	2.67	Very Much Needed

Table 2 illustrates the hard skills needed by industries and employers from an EE graduate. Design skills, as shown in the table, are highly needed by employers. Design skills are the abilities of the graduate to design systems, components, or processes to meet the desired needs and identified constraints (Von Hippel, 2001). These abilities require the graduate to have knowledge of mathematics, physical, life, and information sciences, as well as engineering sciences appropriate to their field of practice. They also involve knowledge of how to conduct and design experiments and the ability to formulate and solve engineering problems. Similarly, consultancy skills are highly desired by employers and industries in the Electrical Engineering field, which cover the ability to recognize professional, social, and ethical responsibilities and to communicate orally and in writing using the English language.

EE graduates who can tend electrical equipment and systems and are able to manage, manufacture, and repair electrical equipment are highly preferred by employers and industries. Likewise, construction and installation skills are in high demand by employers from an EE graduate, as these are the abilities to design, test, install, and maintain large-scale electronic equipment or machinery for use in manufacturing or power generation or transmission. EE graduates should be knowledgeable in the use of computer-assisted engineering and design software and equipment to perform assignments (Make, et al., 2011). An EE graduate is also expected by the employer to easily apply principles and techniques of electrical engineering to accomplish goals.

#### IV. CONCLUSION

Skills demanded by Electrical Engineering industries from graduates have a similar singular focus on improving organizational performance. EE graduates should be able to manage significant projects in order to improve organizational performance. Managing significant projects would require highly technical skills, such as designing, testing, installing, and maintaining large-scale electronic equipment or machinery for use in manufacturing or power generation or transmission, as well as soft skills, such as good communication skills, both oral and written, and being a team player.

#### REFERENCES

- Becker, F. S. (2006). Globalization, curricula reform and the consequences for engineers working in an international company. *European Journal of Engineering Education*, 31(3), 261–272. <https://doi.org/10.1080/03043790600644786>
- Billing, D. (2003). Generic cognitive abilities in higher education: An international analysis of skills sought by stakeholders. *Compare: A Journal of Comparative and International Education*, 33(3), 335–350. <https://doi.org/10.1080/03057920302597>
- Borrego, M., & Cutler, S. (2010). Constructive alignment of interdisciplinary graduate curriculum in engineering and science: An analysis of successful IGERT proposals. *Journal of Engineering Education*, 99(4), 355–369. <https://doi.org/10.1002/j.2168-9830.2010.tb01070.x>
- Busch-Vishniac, I. J., & Jarosz, J. P. (2004). Can diversity in the undergraduate engineering population be enhanced through curricular change? *Journal of Women and Minorities in Science and Engineering*, 10(3), 111–122.
- Commission on Higher Education. (2008). *CMO 34 series of 2008*. Retrieved January 1, 2019, from <https://ched.gov.ph/cmo-34-s-2008/>
- Crosbie, R. (2005). Learning the soft skills of leadership. *Industrial and Commercial Training*, 37(1), 45–51. <https://doi.org/10.1108/00197850510576475>
- Male, S. A., Bush, M. B., & Chapman, E. S. (2011). An Australian study of generic competencies required by engineers. *European Journal of Engineering Education*, 36(2), 151–163. <https://doi.org/10.1080/03043797.2011.569703>
- Mihelcic, J. R., Phillips, L. D., & Watkins, D. W., Jr. (2006). Integrating a global perspective into education and research: Engineering international sustainable development. *Environmental Engineering Science*, 23(3), 426–438. <https://doi.org/10.1089/ees.2006.23.426>
- Pulko, S. H., & Parikh, S. (2003). Teaching ‘soft’ skills to engineers. *International Journal of Electrical Engineering Education*, 40(4), 243–254. <https://doi.org/10.7227/IJEEE.40.4.2>
- Swart, A. J. (2010). Does it matter which comes first in a curriculum for engineering students—Theory or practice? *International Journal of Electrical Engineering Education*, 47(2), 189–199. <https://doi.org/10.7227/IJEEE.47.2.6>
- Von Hippel, E. (2001). User toolkits for innovation. *Journal of Product Innovation Management: An International Publication of the Product Development & Management Association*, 18(4), 247–257. [https://doi.org/10.1016/S0737-6782\(01\)00090-X](https://doi.org/10.1016/S0737-6782(01)00090-X)
- Zhou, C. (2012). Integrating creativity training into problem and project-based learning curriculum in engineering education. *European Journal of Engineering Education*, 37(5), 488–499. <https://doi.org/10.1080/03043797.2012.714357>

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