ASEE 2016
INTERNATIONAL FORUM
NEW ORLEANS, LOUISIANA / JUNE 25, 2016

Paper ID #17569

The Attributes of Future 2030 Engineers in Qatar for Innovation and Knowledge Based Economy

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Abstract:

Recent studies emphasize the needs of a wider set of skills engineers require than ever thought. These studies continue to emphasize that technical content knowledge and competencies are essential for any engineer; however, in addition to being well-grounded in mathematics and science, 21st century engineers should be well-shaped in broader knowledge-base and diverse personal/ interpersonal key-skills.

Qatar is increasingly investing in knowledge development within its boundary, either through home grown manpower or through collaborative efforts from research centres from around the world.

Interviews with students, faculty, and representatives from the major industrial sectors in Qatar have been conducted. Quantitative analysis relied on comprehensive survey with multiple stakeholders from industry and academia, while qualitative analysis is constructed based on content analysis and grounded theory approaches.

In this paper, authors report on the empirical study investigating the needs of skills in engineering in Qatar in the future for a knowledge based economy. Gaps have been identified, conceptualization is developed, and recommendations have been drawn upon.

Introduction

In facing today's globalized environment, the focus on maintaining or transforming into a knowledge-based economy has been significant in many countries. Innovation driven economy is considered as the highest level of economic development, where countries focus on the development and use of cutting edge technology, acquiring the best talent, grooming them and retaining them to excel in value addition through innovation within and outside the nation. The use of cutting edge technology and expertise refers to what we call the emphasis on knowledge-based economy (KBE).

The cornerstone role of technology and engineering in driving KBEs, the industry needs, and the emergence of engineering and technology profession has led to significant number of studies, efforts, and investigations for identifying the needed engineering talent in the 21st century (NAE, 2004 & 2005; Jamieson *et al*., 2009; Mena *et al.*, 2012; Hundley *et al.,* 2012; Knight, 2012; Spinks *et al*., 2006; Bourn and Neal, 2008). In the Middle East, the GCC, and Qatar an investigation similarly has not been conducted, hence this study sheds an important

perspectives bridging an empirical gap in the literature and contributing to better design of future engineering education in Qatar.

There are four main dimensions that are driving Qatar's economy into a KBE: 1- Qatar National Vision 2030, 2- World Cup 2022 and the associated mega projects, 3- Instability of Oil and Gas prices, and 4- Regional growth and competition for skills, products, and investments in the GCC region mainly led by UAE and Saudi Arabia.

Qatar is increasingly investing in knowledge development within its boundary, either through home grown manpower or through collaborative efforts from research centres from around the world. The country's investment in research and development, education and information and communication technology is expected to create the environment for knowledge based economy formation. The promotion of new economy is also supported through the establishment of international universities, science and technology parks, tax-exempt free zones, and relaxed employment recruitments in the tax free zones.

Since engineering and technology are the very heart of innovation and transformation in a knowledge based economy, producing the next generation of engineering talent with needed set of skills is crucial. Hence, is the importance of this investigation conducted in Qatar in light of contextual needs and global advances in engineering innovation and education.

Purpose of the Study

To enable the national shift toward a KBE, Qatar Engineering Education System is expected to advance and graduate engineers who are skilfully prepared for the future practice of 2030. For this to happen, future engineer attributes need to be identified in the context of Qatar and roadmap to achieve them should be developed.

The study aimed to achieve the following objectives:

- Identify attributes required by entry-level graduate engineers in the industry currently and in the future by 2030
- Propose recommendations for the engineering education system to better prepare skilled graduates based on the identified gaps

Global Competency Framework

A comprehensive literature review, reported in details in Abdulwahed et al. (2013), revealed several national investigations of engineering skills needs conducted in countries across the world, such as USA, Australia, UK, Malaysia; etc. Synthesis of skills and competencies from over 200 studies was performedd, and led to categorize the skills founded into a set of 22 items of global skills under 4 main dimensions:

1- **Dimension I - Core Knowledge and Practice**, which includes the following competencies: 1- Science knowledge (Math, Physics & Science Fundamentals); 2- Disciplinary fundamentals, 3- Interdisciplinary fundamentals, 4- Multidisciplinary knowledge, 5- Practical experience, and 6- ICT skills

2- **Dimension II – Cognition, Mental, and Thinking**, which includes the following competencies: 1- Lifelong learning, 2- Problem solving, 3- Decision making, 4- Analytical thinking, 5- Systems thinking, 6- Critical thinking, 7- Creative & Innovation, 8- Design

3- **Dimension III – Professional and Interpersonal**, which includes the following competencies: 1- Professionalism, 2- Ethics and Responsibility, 3- Adaptability, 4- Communications, 5- Teamwork, 6- Foreign languages

4- **Dimension IV – Business and Management**, which includes the following competencies: Management, Leadership, and Entrepreneurship

The developed model aforementioned before was utilized as a base of quantitative investigation using surveys.

Methodology

A comprehensive surveys (included 20+ questions such as demographics, open-ended, and Likert-scale up type questions) have been developed and delivered to the targeted stakeholders groups. Surveys are one of the widely used methodologies in conducting research due to their practicality.

Stakeholders were asked to evaluate a set of 22 engineering skills on two main levels:

- Skills importance currently.
- Skills importance in 2030.

Stakeholders were asked to provide their answers on a Likert scale from 1 to 5 where: 1= “Strongly Disagree”, 2= “Disagree”, 3= “Neutral”, 4= “Agree”, and 5= “Strongly Agree”.

Future Trends of Skills Demands in in Qatar by 2030

The majority of stakeholders (industry, faculty, students) expected changes in the demand of competencies set of engineering graduates in Qatar in the future by 2030. In particular qualitative feedback from stakeholder highlighted the following set to be of higher demand: more demanded by various stakeholders: ICT skills, management, leadership,

entrepreneurship, innovation, problem solving, research, practical skills, communications, teamwork, and decision making.

In quantitative analysis overall, all temporal gaps for all stakeholders (industry, faculty, and students) were in the positive side indicating a higher importance or demand of engineering graduates competencies in the future (2030) than currently. All temporal gaps recorded a statistically significant difference, the gaps were relatively higher for the expert group (industry and faculty) than those reported by students. Industry in general scored higher means than faculty (faculty scored higher than students) on the future (2030) importance of practical skills, and the majority of Dimension 2 (cognition, thinking, and mental), Dimension 3 (professional and interpersonal skills), and Dimension 3 (Business and Management); however no statistically significant difference was detected between faculty and industry.

It worth mentioning that analysis of the top temporal gaps reported by the expert group (industry and faculty) have shown tendency to value the importance KBE oriented competencies higher in the future than other evaluated skills (temporal gaps were top highest for these competencies). Expert group in particular reported highest temporal gaps in highly correlated KBE competencies such as: innovation, entrepreneurship, leadership (and related attributes such as decision making, adaptability, and system thinking), management, interdisciplinary knowledge, multidisciplinary knowledge, design, and problem solving. See Table 1 for further details.

Table 1: Stakeholders Temporal gaps

Temporal gap	
Industry	**Faculty**
Management (0.46)	Decision making (0.65)
Leadership (0.46)	management (0.56)
Entrepreneurship (0.45)	Adaptability (0.56)
Interdisciplinary (0.43)	Entrepreneurship (0.52)
Multidisciplinary (0.36)	Innovation (0.51)
Innovation (0.35)	Problem solving (0.49)
Design/ Decision making (0.34)	System thinking (0.49)

Recommendations, and Conclusions

This study provided empirical analysis on engineering talent competency needs in Qatar. Targeted stakeholders (Industry, academia & students) were asked to evaluate a set of 22 engineering skills on three main levels; Importance currently, and in the future.

Communications, teamwork, management and practical experience were indeed on the very top competencies industry required in engineering graduates. Skills temporal gaps have shown higher tendency to value the importance of skills and competencies to Qatar`s Future. Respondent from all stakeholders expected changes in the demand of competencies set of engineering graduates in Qatar in the future by 2030. The engineering education system will need to provide integrated engineering education curriculum that responds to current needs and future evolutions. As for the current needs, more emphasize on practical experience and professional skills such as communications and teamwork seems essential. This would need to be accompanied by developing modules, courses, programs and activities with more focus on innovation, design, leadership, and technology entrepreneurship to accommodate future emerging needs of the country in light of vision to develop into a knowledge based economy by 2030.

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