

# Knowledge and Skills Level of Graduate Civil Engineers Employers and Graduates' Perceptions

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**Abstract**—The Civil Engineering Program at Sana'a University, Yemen aims to provide quality education that develops students' knowledge, skills and aspirations in preparation for a career, nationally and regionally. This research aims at finding out to which extent the employability skills are available to the program graduates. Comprehensive data collected through questionnaires and interviews on the main issue of this study, the focus of which is if the new graduates have the knowledge and interpersonal skills to meet the requirements of the labour market from the perception of graduates and employers. The output of the analysis shows that graduates gained sufficient technical knowledge, but missed on an early preparation to meet the challenges they may face in the workplace, particularly project management and key transferable skills. As this study might be the first of its type in engineering colleges in Yemen, the findings may provide appropriate inputs to improving engineering education, and particularly the programs study plans.

**Keywords**—Civil engineering graduates, employers, knowledge and interpersonal skills, Sana'a University.

## 1 Introduction

The mission of the Faculty of Engineering (FOE), Sana'a University is to offer an accredited and distinguished engineering education that meets the development needs and labor market requirements, locally and regionally.

The FOE receives annually more than 8000 applications from all over the country from students who have completed scientific secondary school education and scored above 80% in this level exam. The planned intake according to an official enrolment plan approved by the university is limited to about 300 seats. As a requirement for admission, applicants should sit for an admission exam on the main scientific subjects. The weight of this exam is 70% of the final score, and the remaining 30% is assigned to the secondary school exam score. Then the top 300 students in the final

score list are admitted, based on their score and desire, into the five engineering programs that are run by the FOE; nearly half of those are received by the Civil Engineering Program (CEP) [1], [2].

The CEP that was founded in 1983 is the largest department. The study period of the program is five years, after which a BSc degree in civil engineering is awarded. The CEP's mission is to provide students with a high quality civil engineering education that prepares them to be qualified and committed professionals who can pursue graduate studies and research as well as play a leading role in the sustainable development of the country and its integration into the regional economy [3].

The admission process is highly regulated and brings top quality students to the CEP. The question is if the CEP is able to accommodate the rapid scientific and technological developments, quality requirements, local and international accreditation, labor market needs so that its graduates are well armed with technical knowledge and interpersonal skills that enable them to smoothly get into the profession.

The engineering education is undergoing rapid changes necessitated by future job requirements. The skills needed to be successful in a civil engineering profession have been the subject of many researches and studies. Almost all studies have concluded that there is a need for both, technical skills (knowledge and practical) and interpersonal skills (communication, teamwork, professional development) among graduates. The Body of Knowledge of the American Society of Civil Engineers states that civil engineering is an inherently broad field encompassing a wide array of technical areas that contribute to infrastructure, public health, and safety. Civil engineers must possess technical breadth and strong problem-solving ability in multiple technical areas of the civil engineering discipline [4]. To describe what students are expected to know and be able to do by the time of graduation, ABET has adopted a revised set of criteria. The student outcomes criteria relate skills, knowledge, and behaviors that students should acquire as they progress through the program ABET [5].

AlMunifi pointed out that the current drives of engineering education are: current and future employers' needs; the competitiveness in the labor markets; the quality assurance and accreditation requirements; the rapid scientific and technological development; and the requirements of future jobs [6]. Researchers agree that the 21st-century engineers must have a set of interpersonal skills that were not highlighted in the past. In response, most of the universities have started to implement program changes in order to graduate well-rounded engineers. And as an attempt to assess the gap between what universities are showing their engineering students to and the requirements of the industry [7]. Engineering graduates confront critical issues during the transition from university to an engineering career. These issues included taking on new responsibilities, performing under pressure, dealing with superiors and communicating with people from diverse backgrounds [8].

Engineering education in Yemen faces many challenges. There is high demand that has led to significant expansion of engineering colleges during the past two decades with no firm licensing standards. Although there are regulations to ensure the quality of academic programs to a minimum, the lack of accountability leads to graduates that are not well prepared scientifically and professionally [9]. AlMunifi [9] stated that the FOE developed a strategic plan aimed at establishing a quality system in all compo-

nents of the educational process. All its programs are committed to quality standards to be accredited locally by the Council for Accreditation & Quality Assurance–Yemen (CAQAY) [10], and internationally by the Accreditation Board for Engineering and Technology (ABET) [5].

The researchers will investigate to what extent the employability skills are available to CEP graduates in term of technical knowledge and interpersonal skills from the perception of both, graduates and employers.

## **2 Literature Review**

AlMunifi [6] in the framework of discussing the chronological development of engineering education pointed out how industry after 1990 started recognizing the growing gap between the skills of graduating students and those needed for engineering practice. Since then engineering educators have started to give much emphasis to students' interpersonal skills. Ramadia and his co-authors [11] explored the gaps between industry expectations and perceptions of engineering graduates' skill sets in the Middle East and North Africa region. Their study measured the importance that managers of engineers placed on 36 skills relevant to engineers. In addition, managers' satisfaction with engineering graduates' skill sets was measured. The results of this study showed significant gaps between managers' expectations of and satisfaction with all 36 skills. The areas in which managers felt that graduates needed most improvement were communication, time management, and continuous learning. Bay-tiyeh and Naja [12] examined the perceptions of engineering graduates of Lebanese engineering students as a case study of the Middle East region regarding the difficulties they encountered in their transition from the university to the workplace. The authors surveyed practicing engineers to identify their current employment situations and their attitudes toward their academic preparation. The analysis revealed three main challenges facing engineering graduates; communication, responsibility and self-confidence. Answers to open-ended questions illustrated the quantitative findings and were used to gather information regarding needs that may facilitate such a transition. Participants' comments recommend a strong need for cooperation between the engineering industries and the academic institutions to facilitate a smoother transition. This point has been emphasized in our research. And to get comparative data we have targeted employers to get their viewpoints.

Enshassi and Hassouna [13] evaluated the performance of the newly graduated civil engineers from the Islamic University of Gaza Strip. The researchers used a questionnaire and informal interview to gather the required information. The population of this study consisted of 35 workers and 7 Owners. The questionnaire was developed to evaluate the quality of the Islamic University civil engineers who have obtained their degrees in the past five years. The evaluation involved several aspects such as practical, social, ethical, technical writing, communication skills, and computer skills. The results of their study indicated that most of the Islamic University civil engineers have some practical problems in construction sites. On the other hand, they have several

strong characteristics such as computer skills, ability to develop themselves, and an understanding of ethical responsibilities.

Stiwne and Jungert [14] studied how students experience in their transition from their education to being employed as engineers in relation to the concept of employability. Four cohorts of students in a master's program in engineering in this study were monitored annually with a 'follow-up' one year after graduation. The results showed that there were differences in the way students talked about their curricular design, career plans, job search, becoming an employee and employable, and job satisfaction. Many students said that general skills and cultural values are best learned in extracurricular activities and in work contexts, and that doing a thesis project in a firm was the best learning experience. The authors concluded their study that the students argued that on the job, the most valuable acquired key skills were considered to be mathematics and subject-specific knowledge, problem-solving skills, time management skills, learning skills, and an ability to manage stress and heavy workloads. Love and Haynes [15] studied the graduate engineers' skills from the construction managers' perceptions. They found graduates are generally meeting the expectations. There are, however, skills where graduates fell below the expectations of contracting organizations, for example, practical building knowledge, interpersonal, time management and ability to exercise professional judgement.

Wickramasinghe and Perera 2010 [16] explored employability skills that employers, university lecturers and graduates value to bring to the workplace, when graduates are applying for entry-level graduate jobs in the field of computer science in Sri Lanka. The study findings reveal that graduates prefer to have these skills in them and that the university lecturers and employers prefer graduates to possess these skills though there are some differences in their preferences. Overall, all the groups ranked problem solving, self-confidence, and team work as the most important employability skills.

Rutto [17] studied the challenges facing engineering education that offered in Kenya in relation to the society and industrial needs. The author highlighted the future demands needed on Kenyan engineering education and is expected to inspire education designers and curriculum developers in preparing programs that provide for the society and industry. Some of the more important outcomes of the analysis are the following: redesign curricula and involve industry in the development of these new curricula, new engineering curricula must teach students the real value of teamwork and stress the need for clear communication including verbal, written and visual. Students must have technical/specific skills in relevant fields, but also solid background knowledge to adjust work to the market. The researcher emphasized that students must be taught engineering as well as relevant basic elements of business, finance, management and quality.

Itani and Srour [7] examined the perceptions of a sample of engineering students about the importance of various soft skills. As well as how well their universities have prepared them in gaining the associated abilities. Students were also surveyed about their career goals in an attempt to determine whether these goals affect their perceptions. The results of this study shown that, although the students showed a significant understanding of the importance of soft skills, some of these perceptions could be

attributed to their career aspirations. This finding suggests that universities need to play a stronger role in strengthening students' nontechnical skills in specific areas such as oral communication skills. From this finding, we have paid attention to the soft skills in the term to understand its impact on graduates in their performance in workplace.

Bigelow and his co-authors [18] addressed the shortages in the previous studies in their efforts to determine the skills the construction industry expects graduates and entry-level professionals to possess. The authors used a survey to gather information from the members of the Construction Industry Advisory Council at Texas A&M University. The main domains were the four levels basis (Awareness, Comprehension, Application, and Analysis). Nonetheless, neither the expected depth of understanding in those skills nor the industry's priority of those skills have been explored. They have evaluated the depth of understanding on a four level basis (Awareness, Comprehension, Application, and Analysis) and priority was based on participant ranking. The results show that soft and technology skills are expected to be understood at a higher level, while other construction skills are expected at a lower level. Further, soft skills comprised 8 of the top 10 skills in priority.

Lappalainen [19] examined leader qualities more broadly through functional knowledge, personality characters, socio-emotive skills, cultural awareness, and ethics and values. The aim is to conceptualize and operationalize effective leader behavior in industries to identify relevant and targeted emphases for engineering pedagogy. The survey included some questions fetched up from the previous studies. The results show that the engineering education needs to incorporate themes such as self-leadership and self-reflection into the degree curricula to ensure a solid basis for constructive dialogue and positive communication in industries. Besides serving engineering communities through more experienced and effective leadership, such improvement will allow engineering graduates, be they leaders or subordinates.

Koehn [20] investigates how civil engineering students at Lamar University, by being involved with cooperative, part-time, and summer work experiences, improved their understanding of several subject areas required by ABET and recorded in the program criteria. The findings of his paper suggest that both undergraduate and graduate students believe that three areas have been critically enhanced with engineering work. These include structural engineering, project management/scheduling and estimating, and teamwork. In addition, undergraduates observe that their understanding of health and safety issues and ethical considerations have also increased. From this research, we can ensure that the cooperative training and summer work experience have an impact on students understanding of several issues regarding the real work.

Sait and co-authors [21] present an overview of a Senior Capstone Design Project (SCDP) experience that has been practiced well in engineering colleges of King Abdulaziz University in Saudi Arabia. The results show that the SCDP allows senior-level students to gain professional engineering design experience through an opportunity to practice teamwork, quality principles, communication skills, life-long learning skills, realistic constraints and awareness of current domestic and global challenges. With a result, graduates students from these engineering colleges were hired by well-known companies in the region and have interacted well with employers and

fellow employees. Moreover, many of them were able to continue their studies and practice in the academic field. The role of the graduation project in speeding up graduates' employment is considered in design of our questioners and interviews.

### **3 Research Goal**

This research aims at finding out to which extent the employability skills are available to graduate civil engineers of Sana'a University, in term of technical knowledge and interpersonal skills. This goal will be accomplished through investigation and assessment the graduates' achievements in the CEP learning outcomes four domains. These are Knowledge and Understanding, Intellectual skills, Practical and Professional skills, and Key Transferable skills [3]. Furthermore, the employers' assessment to the program graduates will be considered.

#### **3.1 Research questions**

- How does a graduate civil engineer assess his technical knowledge and interpersonal skills in the workplace?
- Do technical knowledge and interpersonal skills of a graduate civil engineer meet the requirements of the labour market from the employers' perspective?

#### **3.2 Research boundaries**

Engineers graduated from the CEP-Sana'a University between the years (2009-18).

#### **3.3 Research contribution to knowledge**

To enrich knowledge by providing appropriate recommendations resulting from the analysis of the results of this study, which may help in improving the curricula contents, study plan, teaching, and learning strategies, and assessment methods, with the purpose to bridge the gap between school and labor market needs. This study might be the first of its type in engineering colleges in Yemen.

## **4 Research Methodology**

The research depends on a descriptive approach. Specifically, the researchers had followed the principles of the survey method. The problem was studied in depth. Questionnaires and interviews were designed and posted to participants through electronic means. The statements of the questionnaire were properly constructed to reflect the knowledge and skills that the graduate engineers should have gained through the years of their studies. The questionnaire was structured according to the ABET [5] and CAQAY [18] Standards. Open-ended questions also were part of the questionnaire to have a greater variety of responses from participants.

The researchers have approached employers through interviews by electronic means. The questions of the interviews were designed in the same manner to measure by employers the knowledge and skills of the newly employed civil engineers.

#### **4.1 The questionnaire**

The questionnaire was structured based on the eleven (a)-(k) expected outcomes for graduate civil engineers adopted by ABET; As well as according to the Standards of CAQAY, in which the intended program learning outcomes are grouped into four domains. These are Knowledge and Understanding, Intellectual skills, Practical and Professional skills, and Key Transferable skills, as shown hereunder.

The targeted group is the graduates of the Civil Engineering Program - Sana'a University. The questionnaire aims to measuring knowledge, practical skills, and interpersonal skills of graduates; and how as newly graduated engineers can perform in the workplace. The open questions also were part of the questionnaire to let engineers express freely their views on their education, and to assess the points of strengths and weaknesses during the first hand experience at the start of their careers.

The following Intended Learning Outcomes following ABET [5] & CAQAY [18], based on which the questionnaire and interviews were designed.

##### **The knowledge and understanding:**

- The ability to apply knowledge acquired from undergraduate courses to initiate analysis and design of various engineering facilities.
- Full understanding of the impact of the proposed engineering solutions in the general, economic, environmental and social context.
- Knowledge of contemporary issues in the field of engineering and technology and continuous knowledge of developments of the profession.

##### **The intellectual skills:**

- The ability to identify and explain engineering problems in an easy and acceptable scientific manner.
- The ability to offer solutions and to logically handle the engineering problems.

##### **The practical and professional skills:**

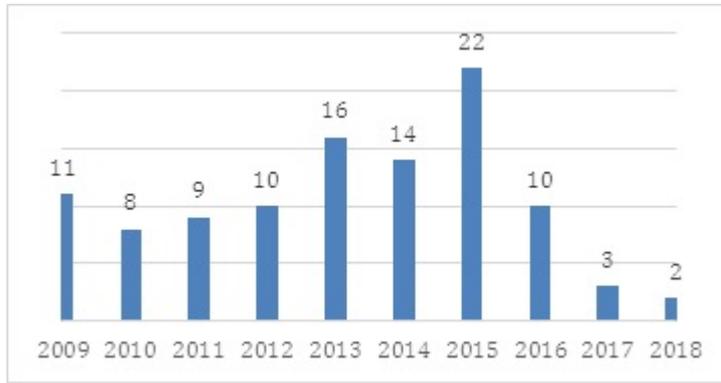
- Ability to conduct laboratory and field experiments, interpret their findings and make necessary recommendations.
- The ability to design an integrated engineering project that meets the requirements, while taking into consideration economic and environmental aspects, social and political constraints, professional ethics, health, safety and sustainable development.
- The ability to understand and use modern engineering tools and applications to practice excellence and continue to keep pace with professional modernity.

**The Key Transferable Skills:**

- Communicate effectively (Report Writing, Presentation, and Messaging).
- Ability to work in a team consisting of multiple disciplines (engineering, commercial and educational).
- Good understanding of professional and ethical responsibilities.
- Understand the importance of self-learning and continuous development of professional abilities.

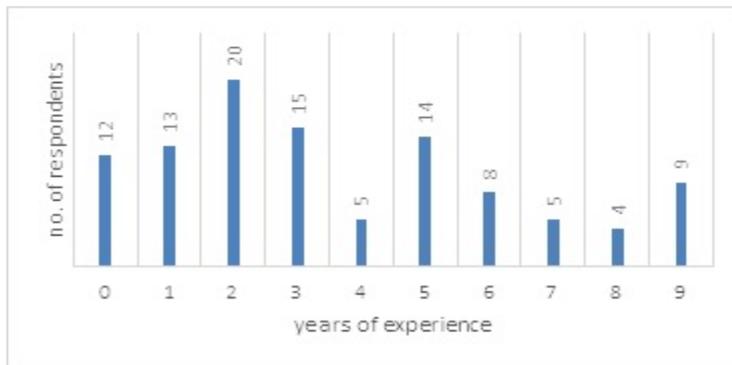
**5 Analysis and Discussion**

**5.1 The research sample**



**Fig. 1.** No of respondents according to graduation year

The sample limited to the graduate civil engineers between the years 2009 and 2018 from the CE Dept. Faculty of Engineering/Sana'a University as shown in Fig. 1.



**Fig. 2.** No of respondents according to years of experience.

As shown in figure 2, 105 responses were received. The experience of the respondents is ranging from 9 years to nil. The responses are dominated by those having five or less years of experience, with nearly 50% of the whole sample having two or less years of work experience. This is good for the purpose of research, which is focusing on the newly graduates to measure the knowledge and skills they have been armed with. Most of the respondents are working in areas of the very diverse civil engineering profession, ranging from designers, site engineers, planning engineers, quantities surveyors, consultants, researchers, construction project managers, to contractors. The employers are very diverse, and are local and abroad, mainly in the Gulf States where the Yemeni engineers are very competitive. In this definition of the sample, it is also suitable for the purposes of this research in terms of diversity of functions, and work-places.

## 5.2 Analysis According to Domains

**Knowledge and Understanding:** One of the basics student outcomes that graduates should be well prepared for is how to synthesize the knowledge and skills acquired in the course work in a major design experience. In a response to a question about the ability of graduates to apply knowledge acquired from undergraduate courses to run analysis and design of various engineering facilities, the results show graduates' confidence as seen in table (1). Where 12.4% of respondents strongly agreed, 59% agreed, 13.3% are neutral and only 15.2% disagreed.

**Table 1.** Graduates feedback on Knowledge and Understanding learning outcomes

Knowledge and Understanding					
No	Ability statement	Strongly agree	Agree	Neutral	Disagree
1	The ability to apply knowledge acquired from undergraduate courses to initiate analysis and design of various engineering facilities.	12.4%	59%	15.2%	13.3%
2	Full understanding of the impact of the proposed engineering solutions in the general, economic, environmental and social context.	5.7%	47.6%	25.7%	21%
3	Knowledge of contemporary issues in the field of engineering and technology and continuous knowledge of developments of the profession.	17.1%	40%	28.6%	14.3%

Full understanding of the impact of the proposed engineering solutions in the general, economic, environmental and social context is very crucial. As it is known, engineering facilities and civil work projects have serious positive as well as negative impacts on people lives as to the surrounding environment. Engineers used to be asked for solutions, and they should be aware about the negative dimensions of the proposed solutions. This issue has been addressed through a question to graduates civil engineers on how they fully understand the impact of the proposed engineering solutions. As shown in table (1), good number of respondents, nearly 50%, are either neutral or disagree (25.7% and 21% respectively). Only 5.7% strongly agreed, and 47.6% agreed.

To measure the of graduates awareness of contemporary issues and their current and future effects on people and environment, the participants were requested to value their knowledge of contemporary issues in the field of engineering and technology, and whether they continue developing their knowledge on new developments of the profession. The survey shows in table (1) that only 17.1% are strongly agree and 40% agree. A very good percent (28.6) are neutral and 14.3% disagree.

**The Intellectual Skills:** The respondents are quite confident in their ability to identify and explain the engineering problems as is summarised in table (2). 53.3% and 13.3% of the respondents agreed and strongly agreed, respectively, with the question statement to confirm their ability to identify and explain the engineering problems in an easy and acceptable scientific manner. While only 7.6% disagree and again a good percentage of 25.7 are neutral, table (2).

**Table 2.** Graduates feedback on Intellectual Skills learning outcomes

The Intellectual Skills					
No	Ability statement	Strongly agree	Agree	Neutral	Disagree
1	The ability to identify and explain engineering problems in an easy and acceptable scientific manner.	13.3%	53.3%	25.7%	7.6%
2	The ability to offer solutions and to logically handle the engineering problems.	13.3%	55.2%	22.9%	8.6%

On the other hand, the responses of the sample to a question that is a continuation of the previous ability, on the ability to offer solutions and to handle logically the engineering problems, are almost identical as is summarised in table (2). 55.2% and 13.3% of the respondents agreed and strongly agreed respectively, to be able to offer solutions and handle engineering problems. While only 8.6% disagree and again a good percentage of 22.9 are neutral, table (2).

**The Practical and Professional Skills:** Laboratory and field experiments, results interpretation, and report recommendations seem to be one of experiences that graduate engineers were not exposed to enough. As shown in table (3), a good number of respondents, nearly 50%, are either neutral or disagreed, 26.7% and 21%, respectively. Only 6.6% strongly agreed, and 45.7% agreed to able to do so.

Are graduate engineers able to design an integrated engineering project that meets the requirements, while taking into consideration economic and environmental aspects, social and political constraints, professional ethics, health, safety and sustainable development?. Almost 30% of respondents have shown disagreement with this statement, and 21.9% are neutral as shown in table (3). Those who agreed and strongly agreed do not exceed the half of the sample. A very important missing skill, a feedback that shows the lack of integrated teaching and learning strategies in capstone courses.

A good number of graduates make well use of their college time. They attend out-of-class training courses on engineering applications. The table (3) shows that 19% strongly agree to a question measuring their ability to understand and use modern engineering tools and applications to practice excellence and continue to keep pace

**Table 3.** Graduates feedback on Practical and Professional Skills learning outcomes

<b>The practical and professional skills.</b>					
<i>No</i>	<i>Ability statement</i>	<i>Strongly agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>
1	Ability to conduct laboratory and field experiments, interpret their findings and make necessary recommendations.	6.6%	45.7%	26.7%	21%
2	The ability to design an integrated engineering project that meets the requirements, while taking into consideration economic and environmental aspects, social and political constraints, professional ethics, health, safety and sustainable development	10.5%	39%	21.9%	28.8%
3	The ability to understand and use modern engineering tools and applications to practice excellence and continue to keep pace with professional modernity.	19%	40%	21.9%	19%

with professional modernity. So they are self-learning skills for which (40%) also agree. While 19% do not agree and 21.9% are neutral, which might be interpreted as a lack of self-motivation in groups of learners. However, the disagreed and neutral responses might explain a weakness in the program formal contents.

**The Key Transferable Skills:** Skills that employers want most and might make a crucial difference in graduates' career are communication skills. As shown in table (4), a quite large percentage, 21.9 of respondents do not agree that by the end of their college life they have the ability to communicate effectively through writing reports, creating and delivering presentations, drafting letters etc. Add to them 23.8% who expressed their views as neutral; only 39% agreed and 15.2% strongly agreed to have gained these skills.

The ability to work as part of a multi-discipline team is also one of the important graduate attributes that are sought by employers. As shown in table (4), the majority of respondents are confident of having the capability to do so, with 51.4% agreed and 21.9% strongly agreed. Few respondents, 7.6% think they have not gained this skill and 19% are neutral.

Graduates should behave professionally and ethically towards their colleague engineers, employers, and society. Does the program of study pay adequate attention to the area of professional and ethical responsibilities? A good percentage, 31.4 of respondents strongly agree and 42.9% agree, as shown in table (4). While only 9.5% are in disagreement that they have a good understanding of professional and ethical responsibilities. The neutrals are 16.2%.

It seems that there is good awareness of the importance of continuous learning and professional development. In a response to a question if graduates understand the importance of self-learning and continuous development of professional abilities, only 1% found that they are lacking this ability, and 9.5% are neutral as shown in table (4). While the large majority of respondents, 90% either agree (50.5%) or strongly agree (39%).

**Table 4.** Graduates feedback on The Key Transferable Skills learning outcomes

The Key Transferable Skills					
No	Ability statement	Strongly agree	Agree	Neutral	Disagree
1	Communicate effectively (Report Writing, Presentation, and Messaging).	15.2%	39%	23.8%	21.9%
2	Ability to work in a team consisting of multiple disciplines (engineering, commercial and educational).	21.9%	51.4%	7.6%	19%
3	Good understanding of professional and ethical responsibilities.	31.4%	42.9%	16.2%	9.5%
4	Understand the importance of self-learning and continuous development of professional abilities.	39%	50.5%	9.5%	1%

### 5.3 Summary

Civil engineers can work across disciplines. The civil engineering programs in most of engineering colleges do their best to prepare graduates to work as design engineers, site engineers, construction engineers, planners, quantity surveyors, cost estimators, safety and quality control officers, construction managers, and project managers. For this reason, graduates civil engineers should be well-rounded, with technical knowledge and key transferable skills to be able to carry out tasks assigned to them.

Summing up, the output of analysis of respondent answers, in term of technical knowledge and key transferable skills, most of the graduates feel they have gained the required knowledge and are able to apply it; the percentage of those exceeds 70. Nevertheless, only 50% understand fully the impact of the proposed engineering solutions in environmental and socio-economic context. Similar figures for the graduates' knowledge of contemporary issues and for continuing to develop their knowledge on new advances of the profession.

It seems that graduates have received sufficient technical theoretical knowledge, but the practical component of the program is missing, where about half of the respondents have not enough exposure to laboratory and field experiments.

In addition, the linkage of different areas of learning, to serve a very important outcome related to designing an integrated engineering project according to requirements while considering various aspects including socio-political constraints, professional ethics, health, safety and sustainable development, is weak. Only 50% of the respondents positively responded; and about 67% can identify, explain, and offer solutions to engineering problems. Around 60% of respondents are familiar with and use modern engineering tools and applications. This is because of the out-of-class training courses and the graduates' desire to learn, but on the other hand, might explain the program weakness.

To be an effective civil engineer and to professionally practice civil engineering, graduates must have the ability to communicate. Skills that employers want most and might make a crucial difference in graduates' career are communication skills. Only 54% feel they have gained these skills and can communicate effectively through draft-

ing letters, writing reports, and creating and delivering presentations. The ability to work as part of a multi-discipline team is also one the important graduate attributes that are sought by employers. The majority of respondents are confident in having the capability to do so. A large percentage, around 74, of respondents have shown a good understanding of the professional and ethical behavior towards their peer engineers, employers, and society. There is also good awareness to the importance of continuous learning and professional development. Only 1% found that are lacking this ability 'disagree'.

#### **5.4 The open-ended questions analysis**

The open-ended questions were designed to let graduates express their views freely, and for the researchers to get a greater variety of answers. The following two open-ended questions were part of the questionnaire.

- What are the points of strength that you think you have gained during your study?
- What are the skills that you think you did not acquire during your study?

Respondents' answers about the most important strengths they have acquired during their studies, and the skills they have not, show a wide variety and diversity of responses. Answers were grouped following strengths and weaknesses in the knowledge and Practical skills & Interpersonal skills that graduates voiced in their answers.

**At the knowledge and practical skills domain:** Some of the responses show that the program provides graduates with the minimum scientific knowledge necessary for entering the practical life. Explicitly, knowledge and understanding of the basic principles of civil engineering and application through graduation projects and small assignments in the course of study, including design of structures in various fields of civil engineering, building construction, road projects, water and environmental projects. However, they believe that a number of courses do not keep pace with scientific developments, and that the program does not focus on a specific field of knowledge rather than rough information from all fields of civil engineering. There is also a lack in linkage to practice utilizing actual projects and placement.

A number of respondents believe that one of their strengths is the ability to model structural elements and loads to study the structural behavior under the influence of different loads; the ability to analyze and design an integrated structure; knowledge of engineering applications and conducting laboratory experiments on samples taken from the field. Others expressed their weaknesses in these skills.

While the respondents shown that they have the ability to mainly analyze and design concrete structures, nonetheless, they collectively agreed on the absence of practicing in actual projects. The curricula are lacking elements of field training and practicing in engineering offices and construction companies during the study period. In addition, there is a lack of practicing laboratory and field experiments with high efficiency.

Graduates acknowledged the importance of cooperative training as an early preparation for the labor market that enables students to get in touch with issues and challenges that they may face in the workplace. It is also a way to acquire practical skills in project planning and execution, and to familiarize graduates with the business of construction companies. Graduates also feel the need to acquire knowledge on the impact of engineering projects on sustainable development and society, as on the proper scientific research methods, and more use of the English language as a means of acquiring knowledge and learning.

**At the interpersonal skills domain:** As for the level of interpersonal skills, graduates feel they have acquired skills on how to deal with engineering problems in terms of understanding and introducing solutions. However, they believe that one of the weaknesses is the early prediction and awareness of the problems that they might face, and finding solutions in a timely manner commensurate with the engineering problem.

A good number of respondents also believe that they have acquired skills of networking and communicating with influential personalities, and are able to adapt smoothly to the work environment. Others think that the program does not pay attention to train students on how to introduce themselves to employers, and as graduates they find difficulty in easily engaging in the labor market, as well as in dealing with managers, peer engineers, and subordinates.

Graduates believe that the firmness of the college and the teaching environment enabled them to be competitive. This armed them with self-reliance, self-responsibility, self-learning, non-despair, working under pressure, time management and achievement according to schedules, and skills of working as members of a team. However, they agree that they are lacking project management skills and team management skills. They also experience a clear weakness in communication skills including reporting and presentation, and technical and contractual correspondence.

Respondents are also interested in the diversity of their knowledge. They are keen to continue acquiring knowledge and learning to understand the important topics of specialization that have not been addressed by the program, especially in the practical field, and to expand their awareness to keep abreast of ongoing technical developments.

## **5.5 Analysis of the Interviews with Employers**

To ensure consistency with the graduates' feedback, the interview questions were sent electronically to a number of entities that mostly appeared as workplaces in the graduates' responses. The interviews aim to explore the opinions of immediate managers and work supervisors on the graduates' performance in terms of points of strength and weakness on knowledge and practical skills as well as the interpersonal skills of the program graduates. They were designed accordingly to enable us to assess the skills of graduates at the start of their careers, and from the professionals' point of views.

**At the knowledge and practical skills domain:** Most of the responses of employers found to be positive and praised the potentials of the program graduates. Some

employers noticed that graduates are doing better in small size projects, but need extensive training to handle mid-size and large projects. Others have stressed the graduates' needs to be trained to operate new tools and equipment.

**At the interpersonal skills domain:** Most of the engineers lack the ability to accomplish engineering tasks in a timely manner. They have difficulties in teamwork, and they hesitate to take initiative due to fear of failure. They can identify engineering problems, but are unable to propose suitable solutions. Most of them still need training to be qualified for real work.

The most important recommendation that came from the employers' responses is that the civil engineering program should consider revising the curricula contents and plans, to reflect new developments and requirements of the labor market. The practical training and construction project management as well as training on engineering applications should be heavily included in the program study plan. A full semester of cooperative training would be good enough for students to get in touch with the real world. Employers also stated that soft skills should be given attention through developing good teaching and learning strategies that focus on the skills of thinking and creativity.

## **6 Discussion and Recommendations**

This study aims at finding out to which extent the employability skills are available to graduates of the civil engineering program in Sana'a University, but could be valid to other institutes, in term of technical knowledge and interpersonal skills. This has been examined from the perspectives of both, the graduates themselves and employers.

Most of the graduates-respondents are working in areas of the very diverse civil engineering profession, with very diverse employers, locally and abroad, mainly in the Gulf States that are distinguished by a multinational-multicultural setting. A few of the CEP graduates are pursuing higher education studies at around the world education institutes.

Graduates feel they have gain sufficient technical theoretical knowledge, but have not exposed to practical training, and not fully understand what would be the environmental and socio-economic impact of the engineering solutions that may propose. They have acknowledged the missing of an important learning component, namely the cooperative training. They appreciate its importance as an early preparation for the labour market enabling them to get in touch with the issues and challenges they may face in the workplace.

Employers agreed on this statement. While they have praised the potentials of the program graduates, they have emphasized the importance of practical training as well as training on engineering applications. Some employers noticed that graduates are doing better in small size projects, but need extensive training to handle mid-size and large projects.

The responses have shown that graduates are to some extent happy with the firmness and order in the FOE. Graduates stated that this environment enabled them to be:

self-reliance, self-responsible, self-learners, work under pressure. They manage time, able to work as a team member, and achieve tasks according to schedules. Nonetheless, employers found that most of the engineers lack the ability to accomplish engineering tasks in a timely manner; they have difficulties in teamwork; they hesitate to take initiatives; they can identify engineering problems, but there have weaknesses in proposing suitable solutions. Most of the respondents including employers agree that graduates are lacking skills in project management, team management and communication.

In a response to what do employers recommend to improve the quality and competitiveness of the CEP graduates? The employers recommended that the CEP should consider revising the curricula contents and study plans to reflect new developments and requirements in the labor market.

The authors are in full agreement with this important recommendation that came from the employers. The practical training and construction project management courses as well as training on engineering applications should be heavily included in the program study plan. A full semester of cooperative training would be good enough for students to get in touch with real world. Employers also stated that soft skills should be given attention through developing good teaching and learning strategies that focus on the skills of thinking and creativity.

The CEP should respond to this feedback by looking into the curricula contents and strategies of teaching and learning. Most important the CEP management should put in mind that civil engineer graduates should be well-rounded, with technical knowledge and key transferable skills to be able to work as design engineers, site engineers, construction engineers, planners, quantity surveyors, cost estimators, safety and quality control officers, construction managers, and project managers.

Graduates are well motivated and well aware of the importance of continuous learning and professional development. The CEP could consider this as an opportunity to initiate continuous learning programs. The CEP should also give attention to the English language as a medium of teaching and knowledge acquirement.

## **7 Conclusion**

In conclusion, a graduate technical knowledge and interpersonal skills in the workplace is not only a matter of what the CEP is catering students with. Nevertheless, the graduate personality and his interaction with his colleagues as with the faculty play a major role in developing the said skills. This is clearly reflected in the cumulative responses to the research question. It is well correlated to those who use to be either distinguished students or others.

From the authors' long academic and industrial experiences as well as the continuous interaction with graduates and tracing their progress, the responses reflect to some extent authenticity and satisfaction that they are graduates of the country top program. Yet, they seek improvement to certain areas.

The employers' feedback is to some extent and in many aspects coincides with graduates' viewpoints. The CEP graduates are doing well in the technical part, but

there are weaknesses in few areas including interpersonal skills. This statement has been heard in various occasions that gathered both CEP staff and labor market representatives.

The findings of the current work could be considered as valuable input for further research on revising and alignment the civil engineering programs according to the expectation of both, graduates and recruiters. Parallel comparative studies with other engineering education providers, preferably at private universities may provide another dimension to the subject matter.

## 8 References

- [1] FEM (The Faculty of Engineering Manual). Sana'a University Publications. (2014).
- [2] FE (Faculty of Engineering), Sana'a University. Accessed in June 2018 <http://eng-su.edu.ye>
- [3] CEPSD (Civil Engineering Program Specifications Document). Faculty of Engineering, Sana'a University. (2014).
- [4] CE BOK (Civil Engineering Body of Knowledge) for the 21st Century-Preparing the Civil Engineer for the Future. Second Edition, 2008 & CE BOK 3rd edition DRAFT March (2018). [http://www.asce.org/civil\\_engineering\\_body\\_of\\_knowledge/](http://www.asce.org/civil_engineering_body_of_knowledge/)
- [5] ABET (ABET Criteria for Accrediting Engineering Programs) (2015).available via <http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/>.
- [6] AlMunifi, A. (2018). Current Trends in Engineering Education, Seminar at the Unaizah College of Engineering. Qassim University. Saudi Arabia.
- [7] Itani, M. and Srour, I. (2015) Engineering Students' Perceptions of Soft Skills, Industry Expectations, and Career Aspirations, American Society of Civil Engineers.
- [8] Baytiyeh, H. and Naja, M. (2012) Identifying the challenging factors in the transition from colleges of engineering to employment, European Journal of Engineering Education, Vol. 37, No. 1, 3–14 <https://doi.org/10.1080/03043797.2011.644761>
- [9] AlMunifi, A. (2014) Efforts of the Faculty of Engineering to establish and adopt a quality assurance system for the academic programs towards out-comes based education, Workshop Proceedings on the Modernization of the academic programs to cater market needs. June 2014. Sana'a University. Yemen.
- [10] CAQAY Standards (2017) The Council for Accreditation & Quality Assurance –Yemen Ministry of Higher Education & Scientific Research. Sana'a.
- [11] Ramadia, E., Ramadia, S. and Nasra, K. (2015) Engineering graduates' skill sets in the MENA region: a gap analysis of industry expectations and satisfaction, European Journal of Engineering Education.
- [12] Baytiyeh, H. and Naja, M. (2011) Challenges facing graduating engineers in their transition from college to career, American Society for Engineering Education.
- [13] Enshassi, A. and Hassouna, A. 2005 "Assessment by employers of newly graduated civil engineers from the Islamic University of Gaza" European Journal of Engineering Education Vol. 30, No. 3, September 2005, 309–320. <https://doi.org/10.1080/03043790500114466>
- [14] Stiwne, E. and Jungert, T. 2010 "Engineering students' experiences of transition from study to work" Journal of Education and Work. Vol. 23, No. 5, 417–437. <https://doi.org/10.1080/13639080.2010.515967>

- [15] Love, P., Haynes, N. and Irani, Z. (2001) Construction managers' expectations and observations of graduates, *Journal of Managerial Psychology* Vol. 16 Iss 8 pp. 579 – 593. <https://doi.org/10.1108/EUM000000006301>
- [16] Wickramasinghe, V. and Perera, L. (2010) Graduates', university lecturers' and employers' perceptions towards employability skills, *Education*
- [17] Rutto, D. (2015) Industry Demands and Future of Engineering Education in Kenya, *International Journal of engineering Pedagogy (iJEP) – Volume 5, Issue 2, 2015.*
- [18] Bigelow, B., Escamilla, F. and Kuecker, L. (2015) Construction Degree Graduates: An Evaluation of Depth of Skill Understanding and Skill Priority by Construction Industry Professionals, *The American Institute of Constructors*, Volume 39, Number 02.
- [19] Lappalainen, P. (2017) Industrial Leadership that Inspires Managerial Communication as an Emerging Pedagogical Focus in Engineering, *International Journal of engineering Pedagogy (iJEP) – Vol. 7, No. 2, 2017.*
- [20] Koehn, E. (2004) Enhancing Civil Engineering Education and ABET Criteria through Practical Experience, *Journal of Professional Issues in Engineering Education Practice.* [https://doi.org/10.1061/\(ASCE\)1052-3928\(2004\)130:2\(77\)](https://doi.org/10.1061/(ASCE)1052-3928(2004)130:2(77))
- [21] Sait, H. Turkman, N. Ishaq, R. 2018 Managing the Senior Capstone Design Project for Undergraduate Students at King Abdulaziz University, *International Journal of engineering Pedagogy (iJEP) – Vol. 8, No. 5, 2018.*

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