
AC 2011-1421: CHALLENGES FACING GRADUATING ENGINEERS IN THEIR TRANSITION FROM COLLEGE TO CAREER

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Challenges Facing Graduating Engineers in Transitioning from College to Career

Abstract

Transitioning from college to an engineering career is highly complex and critical for graduating engineers. This research study examines the career transition of Lebanese engineering students as a case study of the Middle East region. Practicing engineers (n=217) from Lebanon who were scattered in several countries around the world and working in different social and multicultural settings were surveyed. The survey identified their current employment and their attitudes toward their level of academic preparation as it relates to their transition. While locating a job seems to be uncomplicated due to the high prosperity of the Arabic Gulf States, it is evident that engineering graduates confront critical issues during the transition process. An Exploratory Factor Analysis revealed three main challenges facing engineering graduates: communication, responsibility, and self-confidence. Answers to open-ended questions are used to illustrate the quantitative findings and were used to gather information regarding needs that may facilitate such a transition. Participants' comments suggest a strong need for collaboration between the engineering industries and the academic institutions to facilitate a smoother transition.

Introduction

Previous research has shown that students choose to enroll in a particular major for several reasons including parents' influence, the profession's prestige, aptitude in the subject, as well as other reasons¹. When graduates start their profession, they are confronted with the realities of a sustained full-time work². From one perspective, the work may be combined with environmental constraints, job security, and administrative tasks. From another perspective, specific skills with knowledge are needed for the company's productivity and performance.

Few research studies have examined the college to career transition. Johnston³, who lamented the scarcity of literature on employment from the graduates' perspectives, called for more research focusing on the experiences of graduates regarding their working conditions and culture in their early employment years including job expectations, satisfaction, and commitment. Kaufman and Feldman⁴ studied graduates' experiences of transitioning to work in relation to developing their identity during their college years. Such studies showed that the experience of college plays an important role in forming students' self-perceived identities. It has also been shown, however, that most students are not aware of the dramatic differences between the educational and corporate environmental settings. Succeeding in college does not imply success at work⁵. Graduates seem underprepared, however, for specific challenges to succeed on their job such as fitting into a new culture, politics, power and reward structures, building effective working relationships, being accepted as a team member, and earning respect and credibility⁶.

While engineering curricula ensure that graduates possess adequate qualifications to start a professional career, the outcome of these curricula in terms of how graduates construe themselves as professionals is not well understood. Engineering education can be viewed as a

highly structured curriculum while the engineering career is surrounded by a highly unstructured environment with multidimensional tasks. This study investigates how graduate engineers experience the transition to the new context of working life and to what extent has the college experience helped in this process.

Theoretical Framework

Once they have graduated from college, engineers start their career to be practitioners of the subject. They work in teams to develop and test new products, to find solutions for problems, and work on new inventions. Lave and Wenger⁷ defined a Community of Practice as a group of people who engage in a shared activity, while social interaction is a critical component of learning, and practice by itself is a learning process. Learning, therefore, is a function of the activity, context, and culture in which it occurs.

The concept of legitimate peripheral participation explains how novices become full members of a community⁷. Newcomers become more proficient through practice, and their identity is developed while moving from the periphery to the center. Thus, this movement from the peripheral to the core means becoming progressively more engaged and active in the practice within the community. The core is defined by participation and commitment leading to expertise and mastery. In this study, the transition from college to working life is viewed as the trajectory from the peripheral to the core of the engineering community, where engineers search for their identity in their life career. This transition is scrutinized to understand the difficulties and challenges that novice engineers face to become full-fledged members of the engineering community.

Context of the Study

A dearth of research is observed in education in the Middle East region and particularly in the engineering field where graduates' experiences during their early employment years are rarely identified. Colleges of Engineering in Arab countries were founded after World War I in Egypt and Lebanon, and started in the Arab Gulf States in the 1960s⁸. For this research, Lebanese engineers were targeted as a case study. Indeed, higher education institutions in Lebanon represent a prosperous source of fresh engineers for the Arab Gulf States⁹.

Method and Data Collection

A mixed method approach¹⁰ with a sequential explanatory design was used to understand the transition of engineers from college to career. Email addresses of practicing engineers were collected from engineers' syndicates and university alumni lists. An online Likert-scaled survey was randomly sent to 1000 engineers who have been practicing for no more than 10 years. Out of the 1000 emails, 94 returned with delivery errors and 217 completed the survey. This represents a 24% response rate. The survey questions were based on findings and recommendations of previous studies related to the transition from college to working life^{2,11}. The survey also gathered participants' demographics and information related to their process of locating a job. Participants were requested to use a 5-point Likert scale to rate five factors that may have helped them in the transition process such as an internship, final project, or career centers. Participants

were also asked to rate 10 factors on a 5-point Likert scale reflecting the challenges they may have faced when they started their career.

Five open-ended questions were included at the end of the survey asking participants to share the particular aspects that would have facilitated a smoother transition process. For example, they were asked to describe if their summer school training and the final project helped them prepare for that transition and how the transition could be smoother or easier. The engineers' comments provided by the engineers helped in providing some illustrations for the quantitative findings. The comments were analyzed inductively using the constant comparative method¹². Data were coded for the key points and patterns related to questions about the main skills that engineers view as needed for a smoother transition. Themes that emerged include: communication skills, internship and projects, and collaboration between industries and academia.

Results and Discussion

Descriptive statistics were calculated to obtain the measures of central tendency as well as the measures of variability for each of the items. The measured items revealed a Chronbach alpha reliability of 0.901. The majority of the participants was male (78%) with only (22%) female. Participants were distributed among the following specializations: Civil (32%), Mechanical (23%), Electrical (27%), Computer (10%), and Management (8%). The greater part (67%) of participants was young engineers who have been practicing for less than five years. Although 43% of participants are working in Lebanon, more than the half (57%) work abroad; in the Gulf region (33%), Europe and North America (14%), and Africa (10%).

Locating a Job

Upon graduation, engineers face two options: (1) having the opportunity to find an employment in a firm that fits their career goals; or (2) taking the first available offer. In the end, it is not a matter of being employed. It is about finding a job that can be transformed into a sustainable career for financial and professional growth. To succeed in the competitive job market, engineers should be aware of strategies to refine their job search to identify a company that is a strong match for ones' talents and interests. When a job is not chosen wisely, engineers face the risk of accepting employment in a limited context where professional growth cannot be achieved. Such a situation may lead to disappointment and regret that will negatively impact the engineer's future career¹³.

This study's results showed that 28% of participants had the chance to be interviewed on campus and 27% signed job contracts before graduation. Another 72% signed a job contract within three months of graduation. Such findings imply that students encountered no major difficulties in finding a job, probably due to the growing demand for engineers¹⁴. Also, some engineers (19%) were offered multiple job opportunities. This can be attributed to the fact that the oil producing countries in the Middle East have been investing billions of dollars at home, building industries, repairing roads, and expanding social services. This has resulted in a high demand for engineers. Further, it appears that graduates find their job mostly through personal contacts (31%) and the internship (26%), where novice engineers may have relied on personal connections to find a job.

Only (3%) of participants, however, located their job through college career centers. Such a finding questions the role of career service offices throughout these universities.

Nonetheless, signing a contract does not imply that the engineer has found the suitable job. About a third (31%) of participants declared changing their first job within the first two years. Such a percentage might not be surprising because previous research studies have shown that 50 to 80% of new college graduates leave their first job within the first three years¹⁵. In contrast, about half (52%) of the participants revealed they were working for the same company. This implies that these engineers may be adapting to the new environment of working life or did not have the opportunity to consider a better offer. Changing one's job during early career employment should be investigated further to determine whether the leading motives are due to dissatisfaction or due to exploring new working environments.

Another survey question was intended to understand to what extent engineers are satisfied in their job. About two-thirds (66%) of the participants claimed positive contentment in their job while the remaining one-third (34%) showed non-satisfaction. Because succeeding in school is very different from succeeding at work², holding an engineering degree is not enough to become a successful engineer. Being not satisfied could be related primarily to the lack of career goals and planning or it may be due to other reasons such as compensation, work ambiance, type of tasks to perform, fulfilling one's ambitions, or one of several other factors. Previous studies have claimed that the better the match between one's vocational interest and actual job, the higher the level of job satisfaction. Erez¹⁶ confirmed this hypothesis after testing 109 engineers at a principal industrial organization in Israel. To provide some enlightenment to this finding, several participants (19%) disclosed they would not choose to study engineering if they had the chance to begin again. Hence, part of the unveiled dissatisfaction might be due to lack of knowledge about the engineering career, inadequacies of college orientation, self-assessment failure, or a miscalculating decision-making regarding major enrollment.

Helpful Factors

The survey asked participants to rate on a 5-point Likert any help they acquired from the internship, the graduation project, professional societies, career centers, and professional certificates (1= Not helpful at all, 5= Very helpful). The internship appears to be very helpful ($\mu = 4.2$). Previous studies have shown the internship as one of the most important factors that helps students work independently and take decisions¹⁷. Internships are viewed as a positive developmental experience for college students with several favourable outcomes such as improving career decision-making and self-efficacy and allowing the student to acquire job relevant skills¹⁸. The graduation project also seems to be a supportive mechanism ($\mu = 3.3$). This could be due to the fact that topics are generally practical rather than theoretical. Although professional societies and professional certificates are intended to be helpful for engineers, participants rated both factors extremely low ($\mu = 1.2$ for both factors). Apparently, the majority of students seem unaware of the importance of such affiliation for their future career. Regarding professional certificates, the low rate implies that some engineers did not obtain such certificates prior to starting their job, or they were poorly informed about such opportunities. The most unexpected rate, though, is that students rated career centers below average ($\mu = 1.7$). This rate reflects the deficiency of academic institutions in providing students with an essential source of

assistance for their life career. The results suggest that career centers are either not established or not performing adequately. College should not be only a place that provides academic degrees to students, but should also be a place to explore options that lead to a career choice¹⁹.

Perceived Challenges

Another question on the survey asked participants to reflect on the challenges they have faced when starting their career. They assessed the 10 criteria shown in Table 1. Interestingly, one criterion, Language problems, was perceived as not being a challenge by the majority (75%) of participants. This may be due to the current educational system in Lebanon, in which most students are fluent in Arabic, French, and English. With this result, this item was excluded from the challenges list; therefore, only nine items were considered as challenging factors.

	Mean	Std. Deviation
Working under pressure	4.33	1.0
Taking responsibility	4.59	1.0
Working by yourself	4.16	0.9
Responsible for results	4.29	1.1
Working with people from different background	4.61	1.1
Afraid of failure	3.55	0.9
Dealing with your superiors	4.39	1.1
Not knowing enough	3.96	1.1
Language problems	1.99	1.2
Learning on your own	4.18	1.1

Table1: Challenges criteria

An exploratory Factor Analysis (FA) was applied with principal components extraction, eigenvalues greater than 1.00, and absolute value more than .40. Both results of Kaiser-Meyer-Olkin (KMO) measure of sampling equal to .833 and Bartlett's test ($p < .0001$) showed that using FA is appropriate for this study. The FA with the principal components extraction yielded three factors accounting for 61.6% of the total variance. Table 2 shows the rotated factor loadings, which are the correlations between the variable and the factor. For items that were loaded under two factors, only the highest loading was retained.

By evaluating the items loaded under each factor, descriptive names were generated. Factor 1 with a variance ($\sigma^2 = 39.6\%$) was labeled *Responsibility Challenge*; factor 2 ($\sigma^2 = 12.0\%$) was labeled *Communication Challenge*; and factor 3 ($\sigma^2 = 10.0\%$) was labeled *Self-Confidence Challenge*. Three new variables were computed based on the mean of the items falling under each factor. A one-way repeated measures ANOVA was conducted to detect the main effects between the located variables. The results revealed significant differences among the three factor scores, ($F(2, 368) = 24.15, p < .0001$). The results revealed that the *Communication Challenge* factor was the most complicated factor for engineers during the transition from college to career with a mean ($\mu = 4.50$) and standard deviation ($\sigma = 1.1$) on a scale of five. This may reflect that college does not place much emphasis on communication and administrative related skills. The *Responsibility Challenge* factor ($\mu = 4.34, \sigma = 1.1$) appears in the second place, followed by the

Self-Confidence Challenge factor ($\mu=3.89$, $\sigma=1.1$). With the rapid evolution of technology, engineers need to be updated with the latest applications available in their field. It is somehow expected, therefore, that participants would feel challenged in a competitive work environment where they are expected to be self-learners with more responsibility and self confidence demands.

Items	Component		
	Responsibility Challenge	Communication Challenge	Self-Confidence Challenge
Taking responsibility	.807		
Responsible for results	.773		
Working under pressure	.662		
Working by yourself	.638		
Working with people from different background		.782	
Dealing with your superiors		.779	
Afraid of failure			.823
Not knowing enough			.602
Learning on your own			.493

Table 2: Rotated factor matrix with extraction method: principal component. Rotation method: Varimax with Kaiser Normalization.

Using Bonferroni’s method, the *Self-Confidence Challenge* factor appeared to be statistically significant with the other two challenge factors. This significance, however, cannot be seen as meaningful because the difference is not remarkable on a scale of five. Such a result suggests that the three factors contribute almost equally to the engineers’ challenges during the transition from college to career.

College contribution for a smoother transition

The engineers’ comments helped provide some illustration for the quantitative findings. The coded themes of “Communication skills,” “Internship and projects,” and “Collaboration between industries and academia” are expanded below using illustrative quotes from the participants’ comments.

Communication skills

The theme that participants repeated constantly related to communication skills. They identified communication as highly needed for the engineering profession and perceived it as the key behind a productive career growth. This pattern validates the quantitative results because it appeared as the most challenging factor. As such, one comment was:

It is extremely important for professional engineers to be able to communicate effectively. In today’s job market, there is a strong need for proficiency in

communication that makes engineers more competent. Poor communication skills can cost the company money...Engineers spend a great amount of time in writing reports.

Engineering is not only a field of study, but also a community where practicing engineers are expected to be collaborative members in multidisciplinary teams. These days, engineering firms are operating in dispersed branches all across the globe. Such context requires engineers to function effectively in “geographically dispersed and multi-cultural” teams²⁰. Working in such a broad spectrum of cultures, engineers should possess the adequate communication skills²¹.

Internship and projects

The majority of participants were enthusiastic about the importance of their internship. They emphasized on the importance of expanding internship activities to involve additional contact with the companies and to be exposed to different types of job activities and projects. As one of the participants noted:

Students should undergo several training sessions, more than once during the summer, and probably for longer time periods in order to have experience in different fields, maybe in several locations, because university and academic life teaches nothing about the work environment.

When exposed to real-life settings, students are expected to act independently, to make decisions, and to collaborate with supervisors and peers¹⁷. The internship, therefore, is an essential factor for the transition trajectory. It creates an opportunity for new engineers who are on the peripheral to enter the core of the engineering community to implement their knowledge and skills.

Collaboration between industries and academia

Previous research^{8,22} lamented the gap in engineering education between what industry needs and what universities offer, with authors providing several suggestions to close this gap. A constant theme evident in the participants’ comments related to the collaboration between industries and academia. The collaboration should be a joint effort where each party provides specific products and services toward a common goal. One participant stated:

There is a gap between academia and industry where both parties should work together on education goals. Such collaboration can enhance the visibility of the university’s education to meet industry’s goals.

Zaky and El-Faham²² urged industries and universities to build partnerships to provide students with opportunities to gain relevant industry experience in developing countries. Further, Baytiyeh and Naja²³ who studied cases in the Middle East region, called for strong connections between academia and industry. They stressed the urgent need to establish proper relationships through collaborations to bridge the gap between academia and industry. They asserted that such partnership would result in students who were better prepared for the challenges ahead.

Conclusion

In conclusion, college to work transition is not only a matter of finding a job, but it is also the readiness of intelligently functioning in a different world of culture, behavior, and reward. Although participants were engineers who graduated from one country in the Middle East region, they are scattered in several countries around the world and were working in different social and multicultural settings. While locating a job seems to be somewhat uncomplicated due to the high prosperity of the Arabic Gulf States, it is evident that engineering graduates confront critical issues during the transition process including taking responsibilities, performing under pressure, dealing with superiors, and communicating with people from different backgrounds. Participants' comments suggested implementing of a cooperative relationship between the engineering industries and the academic institutions in order to facilitate such transitions. Future studies are needed that involve a larger sample, which will offer additional support for the findings. It would be also interesting to examine employers' perceptions, which may shed the light on some challenges facing novice engineers. The workplace is a great opportunity to integrate knowledge, talents, and values. Although there is no magic equation for success, professional growth remains one of the key features for any successful career.

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