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Article *in* Engineering Management Journal · April 2015

DOI: 10.1080/10429247.2013.11431985

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Career Planning and Progression for Engineering Management Graduates: An Exploratory Study

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Abstract: When faced with the decision of selecting an advanced degree, many engineers opt for management related studies rather than further specialization in a technical field. This article attempts to highlight the reasons behind such choices, and explores the role that a Master's degree in Engineering Management (MEM) plays in career planning and progression. A survey of 58 MEM graduates, who completed their studies at a prominent university in Lebanon between 1992 and 2009, reveals that the majority of the respondents follow a linear career path, rapidly paving the way towards managerial positions. For most of the respondents, earning a graduate degree in engineering management played a primary role in, or at least contributed to, making this shift. The article concludes with a diagram sketching the possible career paths for MEM graduates. By showing the number of years spent at different career stages, the diagram serves as a career-planning tool for MEM graduates, engineers, managers, and researchers.

Keywords: Career Planning, Career Progression, Career Switching, Engineering Management

EMJ Focus Areas: Developing Engineering Management Professionals; Engineering Management: Past, Present & Future

Upon completing their studies, fresh engineering graduates start facing the dilemma of whether to start their professional career or pursue graduate education (Ficco, 2009). The main question that they ponder is "what is the best degree to pursue and when is the right time to do it?" as pronounced by a fresh engineering graduate from the American University of Beirut (AUB), a prominent university in Lebanon. Although some students choose to pursue post-graduate studies in their technical domains, others believe that such an education might keep them stuck in technical routine jobs and tasks and therefore consider other management-oriented programs (Slack, 1999; Lees, 1991). Many fresh graduates of engineering schools face this dilemma and opt to pursue graduate education in engineering management (EM) (Palmer, 2003).

Educational and research programs in EM have increased tremendously in the last few decades (Cordero and Farris, 1992; Nambisan and Wilemon, 2003; Reisman, 1994). This growth is mainly attributed to two factors. The first factor is the need for technical managerial skills in a variety of industrial sectors because of the natural progression of many engineers to assume managerial positions or handle managerial tasks a few years after starting their engineering career (Wilde, 2009). The second factor is the severe competition resulting from the fast pace of technological advancement (Kocaoglu, 2009; Kotnour and Farr, 2005). Consequently, more engineers are needed to manage the process of developing and implementing new technologies in the workplace (Kocaoglu et al., 2003). Due to this competition, companies have an interest in engineers who are capable of working in multi-functional and multi-cultural teams, leading small work groups, and understanding the business and societal impact of engineering decisions (Wilde, 2009). As such, engineers need to possess both business and management skills in addition to their technological know-how (Kocaoglu et al., 2003; Ternel, 2008). As summarized by Bell Atlantic Corporation: "the genius of the future lies not in the technology alone, but in the ability to manage it" (Kocaoglu, 1990).

Earning a management-related graduate degree such as a Master's in engineering (MEM) or a Master's in business administration (MBA) provides engineers with the tools necessary to participate in several facets of the engineering discipline: technical, managerial, and business (Patel, 2011; Williamson, 2010; Wang and Wang, 2008; Karlin, 2004; Slack, 1999; Lees, 1991). A review of the literature shows that, while many engineers opt to earn a graduate degree in EM, only a few studies (e.g., Kocaoglu, 1994; Lannes, 2001; Williamson, 2010) have addressed the role played by this degree in shaping their careers. The literature also reveals that the available studies have not looked into the reasons why those engineers decide to pursue an engineering management degree as opposed to a technical degree and how this degree affects their career path transitions. This article addresses these gaps and introduces a tool to trace the career path of engineers from diverse domains who earned an MEM degree. This tool is beneficial not only for engineers who are planning their careers, but also for academics who can use it as an advisory tool. The next section presents a literature review regarding the different types of careers and the various career paths that engineers can take.

Theoretical Background

Career Definition and Types

Over the years, much has been written about the definition of the term "career." Greenhaus et al. (2010), in their book *Career Management*, present more than one approach to understand a career. One approach views a career as a "structural property of an occupation or an organization" (e.g., a career in engineering). Another approach views a career as a "property of an individual," thereby acknowledging the uniqueness of each person's career. Ultimately, a career can be defined as a "pattern of work-related experiences that spans the course of a person's life" (Greenhaus et al., 2010). Normally, careers involve upward movements, also called progressions, which are associated with increased remuneration (Simpson, 1994). The literature shows that there is no orderly way of how progressions are made because of the differences in every person's career preferences and ambitions (Driver, 1994). Some people are motivated by power and promotions and choose to move linearly; others might not be satisfied by upward career movement and instead prefer to move in another direction or choose another

Refereed Research Manuscript. Accepted by Associate Editor Farris.

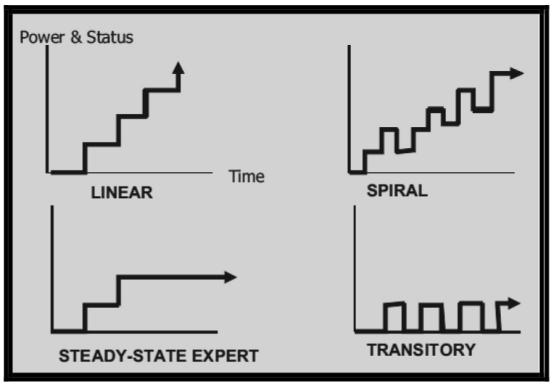
profession. Based on these principles, Driver (1994) built a career model that consists of four career types to explain this behavior (Exhibit 1). These career types differ according to three dimensions: frequency of movement (i.e., job change), direction of movement, and type of change in job content.

As shown in Exhibit 1 (upper left curve), a consistent upward movement on a clearly defined ladder within a single field is characterized as a linear career type path. For example, in the corporate world, individuals following this path start assuming management or business related positions at a certain stage in their career. The curve in the lower-left represents individuals who follow a steady-state type path by choosing their career once for a lifetime, committing to one profession with no job change. In the corporate world, these persons might become "experts" in their fields; however, they never assume senior business or management responsibilities. Persons with a spiral career preference (upper right curve) keep shifting into related fields or professions every seven to ten years, developing new skills. Finally, individuals who follow a transitory career (lower right curve) move every one to four years from one field to a different, possibly unrelated, field. They frequently change their professions without any period of stability (Driver, 1994; Brousseau et al., 1996). These four career concepts have provided an effective classification scheme for people and organizations for many years.

Most engineers typically follow the single ladder strategy (Allen and Katz, 1986). This is similar to the linear career path depicted in Exhibit 1. This type of career is rewarding for scientific and engineering professionals because it allows them to move to managerial positions. However, Allen and Katz (1992) found that not all engineers favor moving to managerial positions. They reported that there is a strong minority of engineers who prefer to stay close to technical problem solving. These engineers might not be satisfied by leaving their technical responsibilities for managerial posts. As a result, Allen and Katz (1992) proposed a "dual career ladder" to describe the career of engineers: some are promoted to managerial positions at some stage of their careers while others are promoted to higher technical positions.

The different career types in engineering are not, however, limited to the pure "technical" or "managerial" tracks (Kennedy, 2009). Several other engineering career paths have been identified such as project-based, hybrid, and entrepreneurial paths (Trembley et al., 2002; Badawy, 1988; Igbaria et al., 1999). Engineers following a project-based path do not specialize in one specific sector. They work on several technical projects where they expand their technical knowledge and gain new experience (Bailyn, 1991). Conversely, engineers following the hybrid approach do not follow one specific path. They switch among the technical, managerial, and project-based paths. Finally, the entrepreneurial path is pursued by engineers who intend to start their own business. Professionals who have a preference for this path typically see limited advancement opportunities in the corporate world (Page et al., 1992).

Exhibit 1. Four Career Types (from Driver, 1994)



Engineering Management: Bridging the Gap Between Engineering and Management

While transitions are possible from one career path to another, most of the reviewed literature focuses on the shift from the technical path to the managerial path. Many engineers, after pursuing the technical path for several years, prefer to leave their technical jobs and switch to the managerial track seeking better compensation opportunities (Roberts and Biddle, 1994). Moreover, achieving a high managerial position is recognized as a measure of success in most organizations (Johnson and Sargeant, 1998).

This transition from the technical to the managerial path is not always smooth (Wilde, 2009). Engineers might face derailment while making this transition (Visser, 2007). Derailment, as explained by Shipper and Dillard (2000), refers to the situation in which engineers do not meet the performance expectations of their organizations when they switch to managerial positions due to the lack of needed management skills. Earning advanced management degrees, such as a graduate degree in EM or project management, allows engineers-turned-managers to acquire skills for management, leadership (Farr and Brazil, 2009), and decision-making (Hauck, 2010). These skills help promoted engineers successfully achieve their managerial responsibilities and reduce the risk of derailment (Hauck, 2010).

Several studies (e.g., Badaway, 1988; Hauck, 2010; Shipper and Dillard, 2000; Yeh, 2008) examined the issues surrounding the transition from technical to managerial career paths. However, very few of these (e.g., Howard, 2003; Wilde, 2009) examined the specific reasons behind derailment or difficulties with transitioning. As stated by Howard (2003), the challenges that engineers might face upon transitioning to managerial positions include:

1. "So much going on": the engineering manager role involves balancing many more responsibilities, tasks, and priorities than the engineering role.
2. Relationship changes: personal relationships, interaction, dynamics, and engineer perceptions change due to the transition.
3. Delegation: this career progression presents the challenge of leaving the hands-on technical behind and learning to work through others.
4. More stress: promoted engineers face increased stress and pressure associated with increased responsibility.
5. Developing new skills: different skills are associated with a managerial transition; engineers need to capture a new set of skills (managerial skills) as they become managers.
6. Resources and getting the work done: engineering managers have to find the time, the staff, and other resources to get the work done efficiently and effectively.

Wilde (2009) showed that these points, which are attributable to Howard (2003), are realized by a large population of engineering managers. He also stated that identifying these challenges allows academia and industry to be more aware of the skills needed for engineers to effectively handle managerial positions and successfully elude derailment.

Lannes (2001), in an attempt to explain the engineering management discipline, put a time frame around the shift in the engineer's career from technical to managerial tasks. Engineers typically spend the first five years of their career working on engineering or technical tasks. During this phase, they practice the activities in which they were trained and taught. These include technical problem-solving activities in designing, constructing/manufacturing, or operating engineering systems. During this time, they usually accomplish their tasks in a mentored environment.

Engineers, then, switch to managerial work. Regardless of whether, and when, the engineer becomes a manager, s/he is expected to complete management assignments during this period, which lasts anywhere from 5 to 25 years. This is the phase in which the real need for EM skills appears. Engineers at this stage have the opportunity to move from practicing technical problem solving to managerial problem solving, which requires integrative and interdisciplinary skills. As mentioned earlier, this transition is not easy for most engineers; however, it can be very rewarding. Success during this phase does not depend on technical skills alone. Skills such as marketing, human resource management, project management, communication, and finance are mostly required for the growth in this phase (Childs and Gibson, 2010). Graduate education in EM provides engineers with the knowledge and skills required for success in this phase (Wang and Wang, 2008).

In the third and last stage of their career, engineers arrive to the highest levels of understanding in their business. They become more involved in issues relating to business level strategy and industry competitiveness. During this phase, which lasts 25 to 30 years, they should acquire strong executive knowledge and skills.

Kotnour and Farr (2005) used a different approach to explain EM. They described EM as the bridge that integrates the traditional engineering discipline (e.g., civil, mechanical, electrical) to the management discipline. In support of Kotnour and Farr's approach, Omurtag (2009) also addressed EM as a bridge between disciplines. Specifically, he viewed EM as synthesis-oriented rather than analysis-focused, which is the emphasis of the classical disciplines. EM, also, allows for the integration of technical, human, and managerial disciplines.

The need for technical managerial skills encouraged several universities and institutions to introduce management courses and degrees to engineers (Alvear et al., 2006; Nambisan and Wilemon, 2003). This is true for developed and developing countries alike. By the end of 2003, the number of universities offering EM degrees in China was 212 (Wang and Wang, 2008). Similarly, by the end of 2005, more than 85 universities were offering EM degrees in the US (Kotnour and Farr, 2005).

MBA or MEM?

Rather than going for further studies in any of the traditional engineering disciplines (e.g., civil, mechanical, electrical), some students prefer to pursue an MBA or an MEM. Although an MBA is an older post-graduate degree option for engineers aspiring to gain management and business knowledge and skills, many engineers, especially fresh and junior, are favoring MEM as their choice of graduate education for several reasons (Patel, 2011). A typical MBA requires at least two years of experience and provides its students, who mostly come from business backgrounds, with advanced knowledge and skills to deal with any kind of business (LaFerla, 2005). On the other hand, MEM programs typically do not require any experience and are therefore accessible for fresh engineering graduates. Moreover, MEM students are subjected to a medium-level exposure to management and business skills studied in an engineering/technology context along with other advanced technical studies (Patel, 2011). For those engineers who do not know for sure which career path to follow, technical or managerial, MEM helps them determine their career path aspirations by exposing them to both options (Williamson, 2010).

Many academic institutions addressed the limitations of MBA degrees, as revealed from industry, by initiating technology-focused MBAs that are especially tailored for engineers (Karlin, 2004). However, a traditional MBA remains a good option for mid-career and senior engineers who are willing to move out of technical tasks and supervision and run their companies from the top. Thus, an MBA can always be pursued at a later stage in one's career independent of acquiring an MEM or another management related graduate degree earlier (Williamson, 2010). Lannes (2001) supports this by advising engineers who wish to gain managerial skills, yet want to remain in their technical domains (i.e., follow a linear career path according to Driver), to pursue graduate education in engineering management. Conversely, engineers who would like to shift more into strategic planning or other business units in their corporations are advised to pursue an MBA (Lannes, 2001).

Engineering Management in Lebanon

Pursuing a degree in EM is a relatively new trend in the engineering discipline in Lebanon. The American University of Beirut was the first to launch an MEM program in Lebanon in 1991 with 10 students. The number of graduates has increased over the past 20 years to reach an average of 50 graduates per year. These graduates seek to learn management concepts and skills in the context of engineering and architecture (AUB, 2011). This major is expanding quickly among other universities in Lebanon as well. For instance, in 2006, Balamand University introduced a new graduate degree: Master's of science in engineering management. Other universities such as the Beirut Arab University and the Lebanese American University offer EM courses in their industrial and engineering management department (BAU, 2011; LAU, 2011).

Although universities are becoming more aware of the importance of management courses and degrees, there have been limited attempts to study the effect of this skill on career development. This is also true in Lebanon where there is scarce information on the status of engineers in the workplace in general. Lebanese engineers are in high demand in the Middle East. Fifteen thousand out of approximately forty-two thousand registered Lebanese engineers are currently working in other Middle Eastern countries; one third of them are working in the Kingdom of Saudi Arabia (Rihani, 2008).

Problem Statement

In summary, the review of the literature confirms the need to understand the role played by MEM in shaping the career of engineering graduates (e.g., planning, switching, and moving up the ladder). This cannot be done by solely adopting the industry's perspective, as done by Lannes (2001)'s work, which emphasizes the importance of gaining early management skills for engineers who are currently being assigned engineering management tasks early on in their careers. Conversely, looking solely at the EM education from an academic perspective would not allow for understanding its role after graduation and implications to engineering managers, although it would explain its perceived importance by examining the increasing figures of supply

and demand of such degrees as was done by Kocaoglu (1994). Understanding this role takes more than just examining the EM degree versus other similar management degrees and selecting a few of the program's graduates to assure the reaped benefits to their careers as was done by Williamson (2011). These gaps in the literature confirm the need to study the academic and professional choices of MEM graduates. Why do many engineers opt for an MEM degree as opposed to further specialization in their technical fields? When is the best time to earn a Master's degree in EM? What factors play a significant role in the career progression of MEM graduates? This article tries to address these questions through a survey that addresses various career issues discussed in the literature. The results of the analysis presented in the following sections provide answers to the following questions: How are the career paths of MEM graduates determined and how difficult is it to switch to other career paths? How many years do they need to become managers? Ultimately, what is the role of the MEM degree in the career progression of its holders? This exploratory research attempts to answer these questions for a sample of MEM graduates from Lebanon and propose, based on the preliminary conclusions, a set of general hypotheses to be tested in future research studies.

Methodology

The nature of this study is exploratory and theory building. The study is based on a survey of MEM graduates covering issues related to career selection, planning, shifting/switching, and progression/development. Additionally, the survey investigates the role that advanced degrees in EM play in the career progression of engineers.

The American University of Beirut, a prominent university in Lebanon and the base of this study, is ranked among the top 10 universities in the Middle East. Its graduates, especially engineers, are known to serve as a pool of resources for various countries in the region and some even opt to work in Europe or North America. Given the small size of the Lebanese market, companies in Lebanon, especially engineering and technology-oriented ones, are increasingly expanding their scope of operations to entail other countries in the region and a considerable portion of Lebanese engineers are involved in projects abroad even if they are home-based. Being the first university in Lebanon and the region to introduce an EM related program, AUB has graduated more than 300 MEM students up to the date of conducting the questionnaire (Summer 2010). The university's Alumni Center and the Faculty of Engineering and Architecture Career Center provided the email addresses of 325 graduates, out of which 19 were affiliated with companies no longer found in the market. An email was sent to the remaining 306 addresses asking the graduates to confirm the validity of their addresses. A total of 115 responded confirming the validity of their contact information. Of these 115, 58 responded to the survey in a period of approximately four weeks yielding a response rate of 50 percent. Consequently, the results of the study were formulated based on the 58 responses, which constitute 19 percent of the total population.

After conducting the literature review on which the study questions were devised, the survey questions were written following the responsible conduct of social and behavioral research that involves human subjects. Because the survey was targeted for a specific audience (AUB MEM graduates), the designers of the survey constituted a team of AUB's EM faculty and graduate students who have a deep knowledge of the characteristics of this degree and its graduates. Yet to avoid bias, the university's career center and a few faculty members from the business school were asked to validate the survey where they served as pilot testers and helped in validating the questions especially in terms of internal and linguistic validity. After pilot testing, recommended modifications to the survey questions and structure were implemented and the study was granted Institutional Research Board (IRB) approval prior to distribution to the graduates' sample whose informed consent was acquired.

To meet the study objectives and establish meaningful relationships out of the collected responses, it was necessary to combine both open-ended and close-ended questions in the survey in order to come up with both quantitative and qualitative results. Not being uncommon in social sciences research (Ray, 2012), the method of combining both fixed alternative and open-ended types of questions in the survey was found necessary in this study due to the absence of another research tool and the assumption that not all respondents would be up-to-date with the EM field and its terminology and so might need "Other" options and some room for explaining their answers. In spite of the difficulty in validating all aspects of the questionnaire such as sensitivity and discriminant validity, and the varying response rates across questions resulting from some respondents omitting some questions, the results derived from the sample are assumed to be generalizable at least to the region in which AUB operates because of the following reasons:

- The survey respondents are graduates of a MEM program that closely resembles internationally recognized MEM degrees,
- The engineering industry in Lebanon closely resembles the engineering industries in the region with few variations (e.g., in salary),
- Around one-third of the respondents have had experience outside Lebanon,
- Engineering firms in Lebanon operate regionally and engineers are often involved in international projects.

The survey, which is shown in the Appendix, comprises 23 questions divided into six sections covering the respondents' demographics and educational information, employment information, work history, career decision-making, assessment of career shifting, and career progression. The first section of the survey contains 12 questions about the respondents' demographics (e.g., age, gender, and marital status), educational information, and opinions regarding their undergraduate and graduate degrees. Because the survey was specific to AUB graduates, some of the educational information questions were designed based on AUB's and Lebanon's programs' offering. Two such questions are Question 4 (Bachelor degree) and Question 5 (Area of concentration while pursuing MEM degree). In addition to gathering data about their EM education, graduates were also asked about the reasons behind their choice to pursue such a degree (Question 9) and if they find a need to expand the currently offered areas of concentration of the MEM program (Question 10). The second part relates to employment information such as the range of their annual salaries and the countries in which they are based. This set of questions aims to identify the factors that affect the annual salary of the engineers, which is used in a separate study. The third part of this questionnaire covers the "career planning" topic. It includes questions about the work history of each MEM graduate and the type of career s/he is pursuing. These questions assist in the construction of the potential career paths of MEM graduates. The fourth part identifies the factors that affect an engineer's decision

when choosing his/her career path. In this part, the respondents are asked to rank the influence of certain factors on career selection. The fifth part of the questionnaire covers the difficulties that respondents faced when shifting to a job of a different type and the role that the MEM degree played in facilitating such career shifts. Finally, the last part tackles the career progression of respondents. The different factors listed in the questions of the last three sections were the result of three activities: (1) a thorough review of the body of knowledge which was presented earlier, (2) the findings of an interview with the university career center, which remains in touch with employers and alumni, and (3) the survey designers' knowledge of AUB graduates and their perceptions.

Results and Analysis

The first part of this section presents descriptive statistics about the sample. The second part highlights the reasons for pursuing an advanced management degree as opposed to a higher technical degree and the best time to earn this degree. The third part presents different factors affecting career selection, switching, and progression. Finally, the fourth and fifth parts analyze the career paths of the respondents, present a career planning tool, and discuss the effect of graduate EM education on the career progression of engineers.

Respondents' Demographics, Educational, and Employment Profile

The following is a summary of the most important descriptive statistics of the studied sample (based on the responses to Questions 1, 2, 4, 13, 14, and 15 of the survey):

- Age: the majority of the respondents fall in the 25-34 (57%) or 35-44 (34%) age groups, which is a reflection of the age of the MEM program at the identified university.
- Gender: the vast majority of respondents were male (76%).
- Education: about 35% of the respondents have a Civil Engineering background followed by Mechanical Engineering (21%) and Electrical and Communication Engineering (21%).
- Work experience: the work experience of the respondents ranged from 3 to 20 years with an average of 9.6 years; approximately two out of three had less than 10 years of experience.
- Work location: The majority of the respondents (70%) were working in Lebanon, 17% in the Arabian Peninsula, and 13% in North America and Europe.
- Annual salary: around half of the respondents earn more than $40,000 annually; there is no basis for benchmarking this figure given that the country does not maintain statistics on income by profession.

The following section addresses the reasons for why the respondents decided to pursue a graduate degree in EM as opposed to a higher or more specialized technical degree. This is followed by a discussion of the best time to earn an MEM degree, and whether the respondents have the desire to pursue a PhD degree in EM or not.

Engineering Management Graduate Education

An open-ended question (Question 9) targeted the reasons that MEM graduates pursued an MEM degree as opposed to a post-graduate technical degree in their engineering field. To interpret the answers, a coding process was performed based on the keywords that emerged from the data collected. The reasons provided varied greatly—some respondents only answered the part pertaining to why they chose MEM while others only explained why they did not consider a technical master's degree. Some respondents also gave more than one reason for their postgraduate choice; thus, the code mapping resulted in having a number of mapped responses that is greater than the number of respondents. The most frequent keywords were "career," "management/managerial," and "diversification." When mentioning "career," respondents often indicated career advancement, career goals, career opportunities, and career path, which were interpreted to having a competitive advantage in the market or in the job. Approximately half of the respondents reported that they pursued an MEM degree because they felt that this degree would give them a competitive advantage over other engineers in the market. More than one-third of the respondents pursued an MEM degree as they were interested in gaining management knowledge or occupying managerial jobs (many of them, at a certain point in their careers, had managerial responsibilities). Another one third of the respondents decided to earn the MEM degree because they had interests in diversifying their knowledge and believed that an MEM degree is more interesting than an engineering post-graduate degree that is "too technical." A few responses could not be mapped to any of the above categories. One respondent mentioned that s/he felt MEM was a middle-way solution between an MBA and a master's in engineering while another simply said that s/he likes engineering management. It can be inferred from the statistics that different people pursue MEM for different reasons but most of them expect that this degree will help them advance in their careers. The degree will expose them to management knowledge while opening managerial opportunities in the future.

A total of 40 respondents (i.e., 70%) believed that the best time to earn a master's degree in EM (Question 7) is after having gained 1 to 4 years of work experience. The majority of those engineers believed that having such experience helps in establishing a relevant link between theory and practice. They added that, by relating academic concepts to real-life practices, individuals could better understand the EM material and exchange work experience with colleagues. Other respondents believed that 1 to 4 years in corporate life was needed to help engineers determine their field of interest within the wide engineering world, thus implicitly emphasizing the importance of career planning at that stage and the role played by the MEM degree in this process. Around one-quarter of the respondents (23%) believed that it is best to pursue an MEM degree immediately after graduation. Some explained that earning the MEM degree early on opens new career opportunities and facilitates the job search process. This opinion supports the argument presented in the literature review of why some engineering graduates opt for MEM after graduation rather than the MBA degree that usually requires several years of experience as a prerequisite for joining the program. Others considered that the "drive to study" might diminish as the person gets into the workplace. They also mentioned that in the later stages of their careers, they might not have enough time to enroll in the EM program either due to their family responsibilities or geographical constraints. Finally, four respondents believed that the right time for earning an MEM degree is after gaining 5 to 10 years of work experience. They indicated that earning an MEM degree after shaping their career path helps solidify this path, support it, and complement it with the necessary theory. They also believed that one should acquire enough experience in order to understand the concepts better and benefit from management theories.

More than half of the respondents (i.e., 33 out of 58) expressed a desire to pursue a PhD in EM (Questions 11 and 12) at a certain stage in their career. For many of these respondents, this stemmed from the desire to specialize in one area of concentration within EM (e.g., Projects and Built Environment, Operations Research, Financial Engineering, Information and Organization Management). The master's degree, as they stated, introduces engineers to management aspects of the engineering business, but does not make them specialists in the domain. Others stated that pursuing a PhD degree would offer them a chance to cope with international markets and maintain a competitive edge. One respondent considered pursuing a PhD in EM as a means to transition to an academic path. Consequently, the association of post-graduate EM education with career progression and career-path determination can be also determined from the respondents' desire to pursue continued education in the EM field.

The following section discusses the factors affecting career selection, switching, and progression for MEM graduates.

Factors Affecting Career Selection, Switching, and Progression

Exhibit 2 shows the level of influence that various factors had on career selection (Question 17). A 1-to-5 rating was used to describe the level of influence, with 1 indicating "no effect" and 5 indicating "an extremely high effect." The numbers represent the average for each of the factors across all respondents.

As shown in Exhibit 2, respondents seem to allocate slightly more importance to advancement opportunities and to whether the job fits their experience and skills than to monetary benefits (e.g., salary, housing allowance), non-monetary benefits (e.g., paid leave, overtime policy), and the job location. However, because the results for different factors were quite close to each other and statistically testing differences was not possible due to the relatively small sample size, an alternative method of analysis was used to derive meaningful results from this question. To better understand the impact of the different factors that affect career decisions and their inter-relations, a factor analysis was conducted. Principal Component Analysis was chosen as factoring method and Varimax with Kaiser Normalization rotation was chosen as rotation method. To validate the adequacy of the sample and results, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was conducted and the resulting value was 0.5. According to Field (2005), a value of 0.5 is sufficient to make sure the sample is adequate. Moreover, the Bartlett's Test of Sphericity yielded a 0.04 significance value that is smaller than 0.05 as recommended. It is notable that the factor "Location of company is suitable" was dropped from the analysis because of its low correlation to the other factors. As seen from the rotated component matrix in Exhibit 3, three components are responsible for making career decisions and are therefore given titles according to their associated factors. The first component

Exhibit 2. Level of Influence of Various Factors on Career Selection

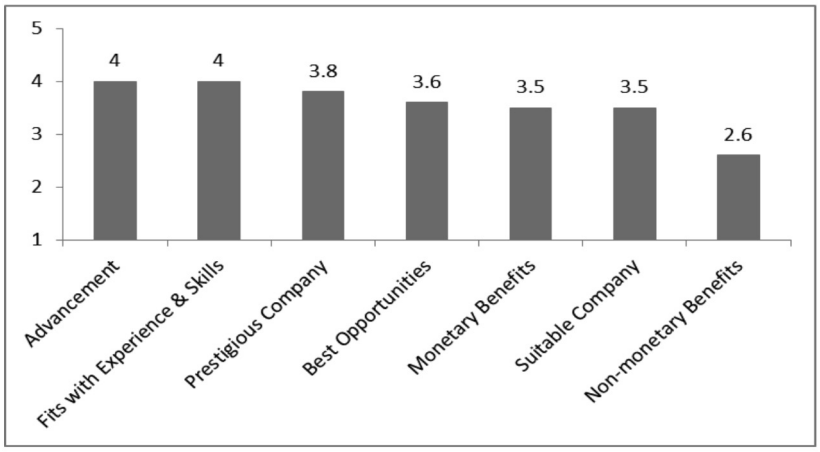


Exhibit 3. Factor Analysis on Career Selection

Rotated Component Matrix[a]	Component		
	1	2	3
Non-monetary benefits	.840		
Monetary benefits	.854		
Fits with experience and skills		.831	
Advancement opportunities		.696	
Joining a prestigious company		.531	
Best available opportunities at this time			.926

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

comprises monetary and non-monetary benefits; this means that these two factors are often looked at together when an engineer is making a career decision. Therefore, the first component can be referred to as "benefits." The second component comprises career fit with experience and skills, advancement opportunities, and joining a prestigious company. The term "prestigious company" is a common term used in the Lebanese job market to refer to medium-to-large reputable organizations that are often multinational. This component indicates that engineers aspire to find careers that meet their qualifications, progression aspirations, and other desires such as company type. Therefore, the second component that plays a role in career selection can be referred to as "career preferences." The third and last component consists of "best available opportunities at this time." This indicates that during the process of career selection, engineers are significantly influenced by the available options. In conclusion, when selecting their careers, engineers look at benefits, career preferences, and current opportunities in order to make their career selection decision.

To further understand the career progression process, eight factors were considered as shown in Exhibit 4. The respondents were asked to give a rating on a 1-to-5 scale indicating the level of influence of each of the eight factors on career progression (Question 22). As shown in Exhibit 4, "Years of experience" and "Having challenging and diversified assignments" seem to have the highest influence on career progression, whereas "Joining a professional society" has the lowest influence. The master's in EM degree has the same influence as "On-the-job training," which is lower than "Years of experience" and "Having challenging and diversified assignments," and higher than "Joining a professional society."

To better understand the impact of the different factors that affect career progression and their inter-relations, another factor analysis (Principal Component Analysis and Varimax with Kaiser Normalization rotation) was conducted. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.6, which is greater than the recommended value of 0.5, and Bartlett's Test of Sphericity yielded a significant figure of 0.000. Three components were identified in the factor analysis with two or more factors pertaining to each component. The rotated component matrix in Exhibit 5 (values less than |0.4| were suppressed) suggest that the first component consists of joining a professional society, earning professional development certificates, and formal training. These three factors are often thought of together when aiming for career progression as they all add to the professional's status and qualifications. The second component consists of having challenging and diversified assignments, years of experience, and on-the-job training, and therefore can be titled as "professional experience"

Exhibit 4. Level of Influence of Various Factors on Career Progression

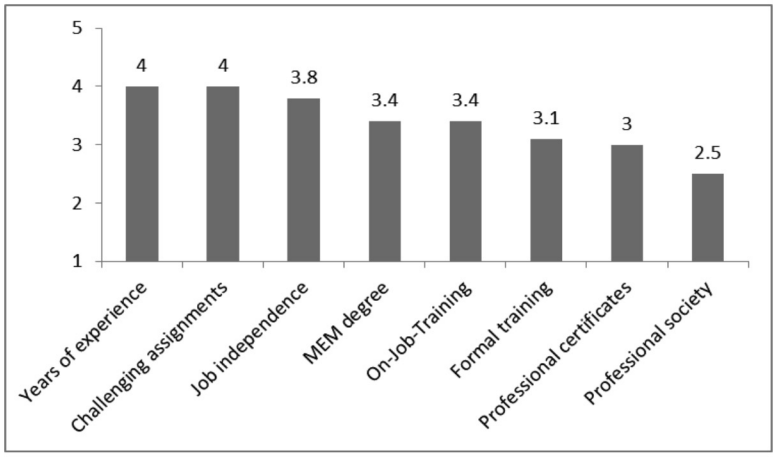


Exhibit 5. Factor Analysis on Career Progression

Rotated Component Matrix[a]	Component		
	1	2	3
Joining a professional society	.901		
Earning professional development certificates	.885		
Formal training	.885		
Having Challenging and diversified assignments		.800	
Years of experience		.721	
On-the-job training		.695	
Being independent in your job			.847
Earning the Master of Engineering Management degree			.667

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

because all its factors have to do with the experience gained. The third component involves both earning the MEM degree and independence on the job. This is an interesting finding indicating that engineers who earn the MEM degree often associate it with handling independent tasks in the job when thinking of career progression. This association may stem from the perceived role of the MEM degree in equipping its holders with necessary skills to handle complex tasks independently. In conclusion, the conducted factor analysis indicates that MEM holders perceive that three components, "status and qualifications," "professional experience," and "post-graduate education and independence on the job," play significant roles in career progression.

The following section analyzes the career paths of the MEM graduates surveyed.

Analyzing Career Path for MEM Graduates

This section is divided into two main parts. The first part examines the career planning process by sketching a career path diagram. This is based on the respondents' description of their career journey (Question 15). The second part aims at studying the role that MEM plays in the career progression of the respondents.

Only 42 of the 58 respondents answered the experience question in the survey. To be able to draw a career diagram, the work experience of these 42 respondents were first recoded into career paths.

A timeline was used to represent the starting year of each respondent's career. The title of the career path contains the respondent's gender, age range, and engineering background. The career path includes the various career stages that the respondent went through. Each step presents the number of years spent in a career stage before moving to the next one, along with the job title and the company type. Moving from a career stage to another one refers to an upward or horizontal move within the same company, or switching to another company. Finally, the milestone indicates the year in which the respondent earned the MEM degree.

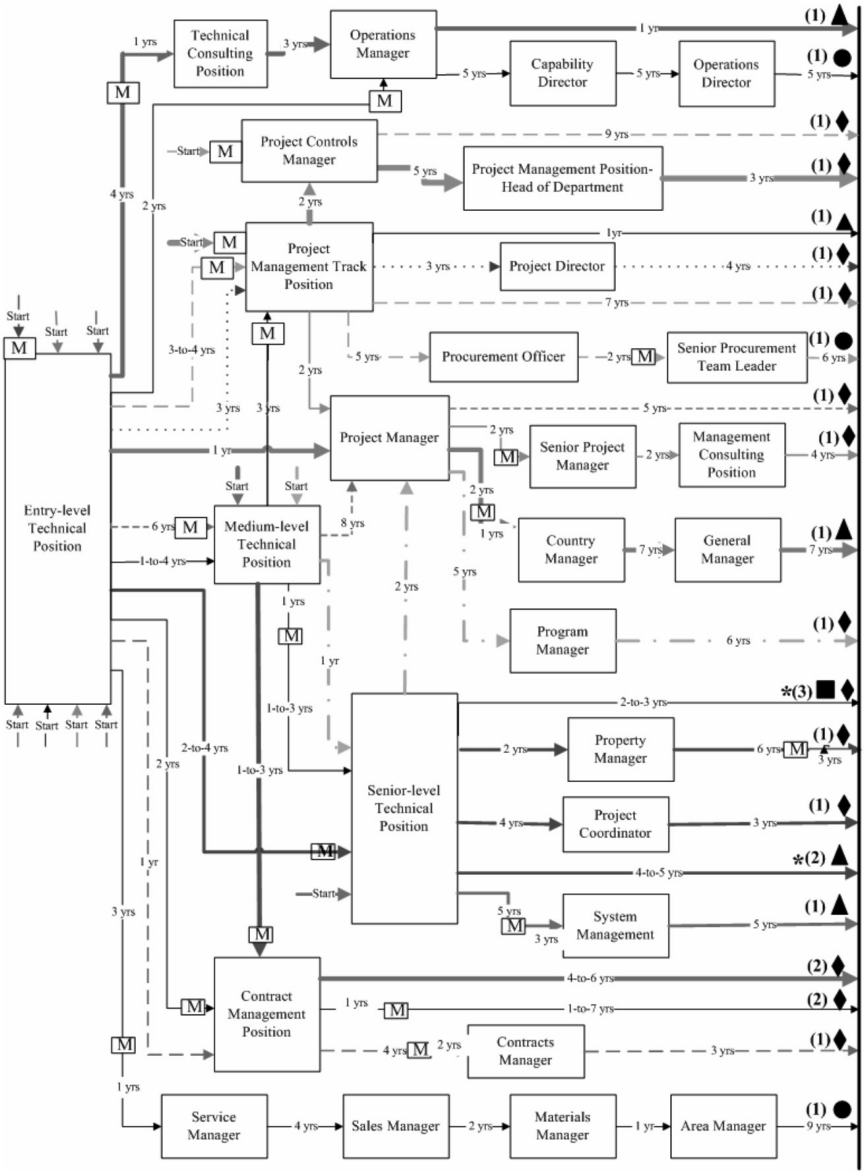
Several cases were excluded from the career path diagram corresponding to the respondents who did not specify the positions or job titles they went through (4 respondents) and others who had only one career step of less than 6 years (7 respondents). Other exclusions included respondents whose job description was either unclear or could not be accommodated in one path or another (4 respondents) and one respondent who switched several times to jobs outside the engineering field and therefore could not be integrated in the diagram. The total number of career paths included in the career path diagram, shown in Exhibit 6, is 26. The following points help to understand Exhibit 6:

- The diagram has five starting points, which are labeled by the arrow "Start."
- The arrow going out of a certain career step indicates the number of years spent in this career step before moving to the next one.
- At each career step, the entering arrow and the leaving arrow for the same career path have the same line type.
- If the arrow includes a range other than one number (e.g., 2-4 years), this means that at least two respondents have followed this career path. An arrow with one number indicates that only one respondent has followed this career path.
- The career paths are classified into four main industries: Engineering/Construction industry, IT/Telecom, Management Consulting, and Manufacturing/Suppliers. Each industry is represented by a unique shape as shown in the symbol annotation.
- For respondents who changed industries, the career path label corresponds to the industry in which the respondent is currently working.
- The vertical dark black line at the end of all career paths indicates the "date of the survey."
- The milestone of attaining the MEM degree is inserted in each career path and indicated by the letter "M" embedded in a small rectangle.

The added value of the diagram presented in Exhibit 6 is its potential use by senior engineering students, working engineers contemplating career progression or transition, employers and managers, as well as researchers. This added value stems from the limited availability of proper career counseling or guidance in several parts of the world such as Lebanon and its surrounding region, and the common trend of making career choices based on the examples of others. Because the devised career path diagram was created based on real cases rather than a theoretical framework, it can serve as a useful tool for those who are examining career options. The following points summarize how the diagram can be used by different users:

- Graduating engineers: Senior undergraduate engineers often face career dilemmas before graduation, as many are unsure of the exact career path they want to pursue. The diagram presented in Exhibit 6 presents some career guidance by first illustrating that there are several starting points for a career and that a graduate engineer should not necessarily start in an entry-level technical position. As shown in the diagram, some of the responding engineers have started in project management positions, medium-level technical positions, or in one case in a senior-level technical position. Moreover, the diagram illustrates how different engineers progressed in their careers and at what rate they could switch between different careers. This would aid graduating engineers in career planning and setting goals of career progression and transition.
- Working engineers: After gaining a few years of experience in a specific career path, engineers often pause and contemplate what might be the next step(s) in their career progression and whether it is the right time to make a transition. The career path diagram in Exhibit 6 helps them in determining their career progression desires and preferences, and in setting plans on how to pursue these goals by being exposed to real examples of how and when similar engineers have progressed in their careers.
- Employers and engineering managers: Employers and managers have a professional responsibility toward their employees and need to establish a good understanding of their subordinates' career progression plans and aspirations for promotion or career transition. The career path diagram helps managers to examine the common career progression of MEM holders and allows them to provide better career guidance for subordinates who are interested in pursuing an MEM degree. Furthermore, engineering managers can encourage their employees to pursue this track by communicating promotion opportunities or even providing stronger incentives such as financing of the graduate degree if they truly believe that their firm/division is in need of graduates with engineering management skills to occupy some positions as portrayed in the career path diagram. Employers and managers are also presented with situations where they might need to open new positions to cover for missing functions or to create

Exhibit 6. "Career Path" Diagram of MEM Graduates



Industry	Engineering Construction	IT/Telecom	Management Consulting	Manufacturing/Suppliers
Shape	♦	▲	■	●

* Steady-state career type

M Attaining MEM degree

new opportunities for already existing employees in order to motivate them and promote them. Therefore, by referring to the career path diagram they can learn about what other companies in the same industry are doing or how similar engineers as their subordinates are progressing in their careers so that they keep up with the expectations of their employees and provide the necessary opportunities.

- Researchers: The career path diagram helps researchers to examine the trends of engineers' career transitions. Its features, such as the time spent in each position and the point in time where an MEM degree is attained, allow for framing future research into the drivers behind engineers' career decisions.

Of the 26 career paths presented in Exhibit 6, 21 are classified as linear because the corresponding respondents ended up in managerial positions at a certain stage in their career. The following section closely examines these 21 paths. The career path of the remaining five respondents can be labeled as steady-state (highlighted by asterisk in Exhibit 6). Another respondent made several career switches inside and outside the engineering field (transitory career path) and was, therefore, excluded from the diagram.

The Pathway to Management Positions

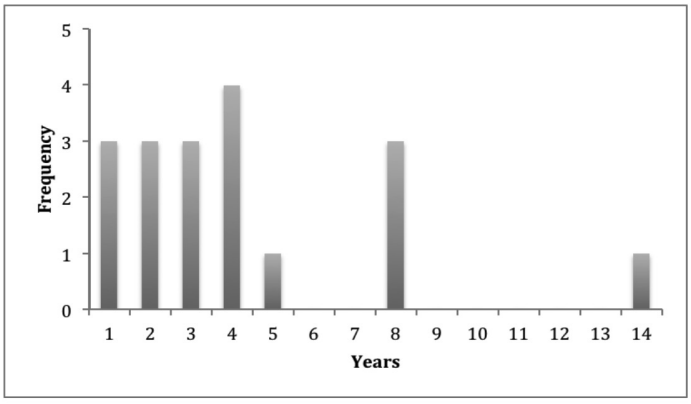
This section describes the pathway from technical to managerial positions through an analysis of the 21 linear paths shown in Exhibit 6. First, it explores the number of years that the respondents spent in technical positions before moving to other posts that require managerial responsibilities. Then, this section presents an analysis of the number of years spent before assuming

a "manager" position. Finally, it examines the role that the master's degree in EM played in facilitating upward career moves.

To estimate the number of years spent in technical jobs before starting to assume managerial responsibilities, 18 of the 26 paths shown in the diagram were considered. As mentioned, five of the eight eliminated career paths were steady state; and three additional paths were excluded because they were for engineers who occupied managerial positions immediately after graduation.

As shown in Exhibit 7, the number of years spent in a technical position before starting to assume managerial tasks ranges from 1 to 14 years, with a mean of four years, a median of 3.5 years, and a standard deviation of 4.3 years.

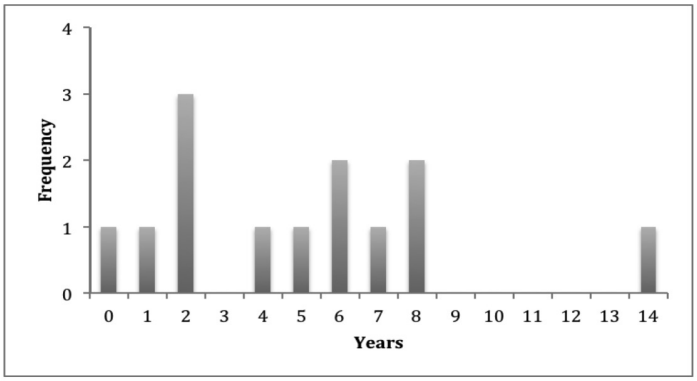
Exhibit 7. Frequency Distribution of Number of Years in a Technical Position Before Starting to Assume Managerial Responsibilities (n=18)



Of the 26 paths shown in Exhibit 6, only 13 correspond to engineers who actually held management positions. Exhibit 8 shows the number of years taken by each of the respondents before occupying a management position. This number ranges from 0 (one respondent assumed a manager title directly after graduation) to 14 years with a mean of five years. Because of the small number of candidates, a conclusion about the average number of years spent in technical positions could not be generalized. However, the results of this section support the suggestion of Lannes (2001), that engineers usually spend on average five years in the technical track before moving up to a managerial one. This is much smaller than the average suggested by Edum-Fotwe and McCaffer (2000) of at least 10 years of work experience in the construction industry before assuming a project management position. The relatively low average number of years of experience, in our study, before assuming managerial positions might be due to the following reasons:

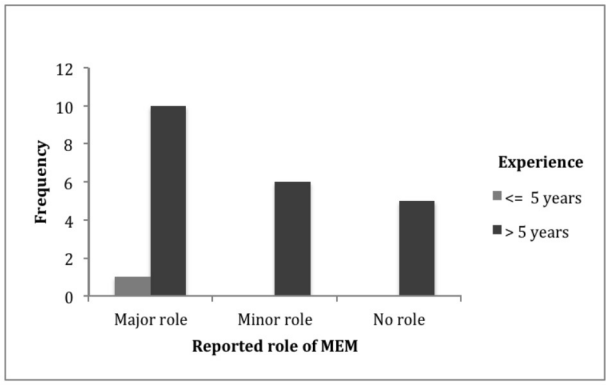
- The data used in this analysis included "Controls Manager" and "Operations Manager" positions, which are positions that an individual could reach before becoming a project manager and thus require less years of experience than the "Project Manager" position.
- The nature of the industry: Lebanon does not have many large projects or large contracting firms. Generally, there are more opportunities for growth in smaller projects and smaller organizations. Becoming a project manager on small projects is often a pre-requisite for becoming a project manager on large projects.

Exhibit 8. Frequency Distribution of Number of Years to Become a "Manager" (n=13)



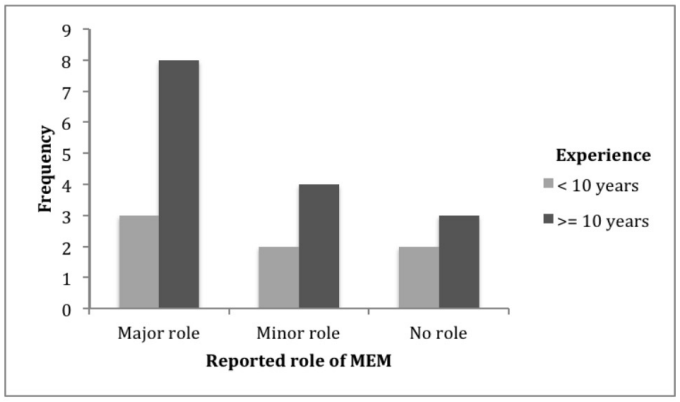
In attempting to examine the relationship between the respondents' perceived role of the MEM degree in their career shifting and their experience (Questions 20 and 21), the respondents' years of experience were recoded into two categories: 5 years of experience or less, and 6 years of experience or more. Interestingly, as shown in Exhibit 9, all those who responded to this question except one respondent had more than 5 years of experience. This could be attributed to two reasons, either that those with 5 years of experience or less have not done any career shifting yet or that these respondents were not sure about the role played by MEM in their career paths. Because 24 respondents did not answer this question due to their previous input of not having made a career shift, the remaining 12 who did not answer can be considered unsure as to whether MEM has played any role in their career shifting process.

Exhibit 9. Perceived Role of MEM in Light of Experience



To assist in making the conclusion that the MEM degree tends to play a more significant role as the engineer acquires more experience, the variable "years of experience" was recoded again into two categories: less than 10 years of experience and 10 years or more of experience. Looking at the results shown in Exhibit 10, the majority of the respondents who believed in the significant contribution of the MEM degree were experienced engineers. Based on this, it seems that as MEM graduates gain more experience and progress in their careers they tend to better understand the role that MEM plays in their career path. Also, it seems that MEM plays a more significant role as the engineer gains more experience and becomes more eligible for promotion and career shifting.

Exhibit 10. Perceived Role of MEM in Light of More Experience



To further elaborate on this result, we looked into the explanation provided by the respondents regarding the role played by the MEM degree in their career progression (Question 21). Although 5 respondents who answered the question positively had less than 10 years of experience, only one of them explained how MEM has played a major role in his/her career progression. All the remaining 7 respondents had 10 years of experience or more which demonstrates again that more experienced engineers tend to understand better how MEM would have affected their career transitions.

Exhibit 11 investigates the relationship between the type of industry and the perceived impact of the MEM degree on the career progression of the respondents. As illustrated by Exhibit 11, the responses pertaining to the industries other than "construction" are not sufficient to make any conclusion on the impact of the MEM degree on career progression. With regards to responses from the construction industry, it is clear that 10 out of 11 respondents reported that the MEM played a role in their career shifting in one way or another. Mostly, the respondents believed that the MEM played a major role in their career path. Hence, we can conclude that MEM plays a significant role in the career progression for engineers in the construction industry who usually select the "Projects and Built Environment" as their area of concentration during their graduate study.

To understand the extent of the role that a graduate degree in EM plays in the career progression of engineers, we examined 16 of the 26 paths presented in Exhibit 6. The other 10 paths were excluded from the analysis because the corresponding respondents have either recently earned the MEM degree, i.e., at the latest step in their career (6 paths), or acquired this degree before starting their professional career (3 paths). In one case, the respondent did not specify the time when s/he earned the MEM degree. A close investigation of these 16 cases revealed three types of career progression: making a leap from technical to management, making an upward movement in the managerial track, and making an upward movement in the technical track. In each of these cases, the role of the MEM degree was classified as:

- Primary: The MEM degree played a primary role if the respondent made the upward move directly after earning the degree.
- Contributory: The role is described as contributory if the respondent made the move 1-2 years after earning the degree.
- Minor: This corresponds to cases where the respondents made the move three years or more after earning the degree.

Exhibit 12 summarizes the analysis of the 16 career paths. The rows represent the three types of career progression, and the columns represent the three roles of the MEM degree. The degree played either a primary role or a contributory role for 15 out of 16 respondents. Five of the 16 respondents moved from a technical to a management position either immediately after earning a master's in EM or within two years from completing the degree. Five others moved up in the management track during the same time frame, while the remaining five made an upward move in the technical track. These results were also validated with the respondents' perceived role of MEM in their career shifts.

Examining Exhibits 9 through 12 allows for drawing conclusions regarding the perceived and actual roles of MEM in

Exhibit 11. Perceived Role of MEM in Light of Respondents' Work Industry

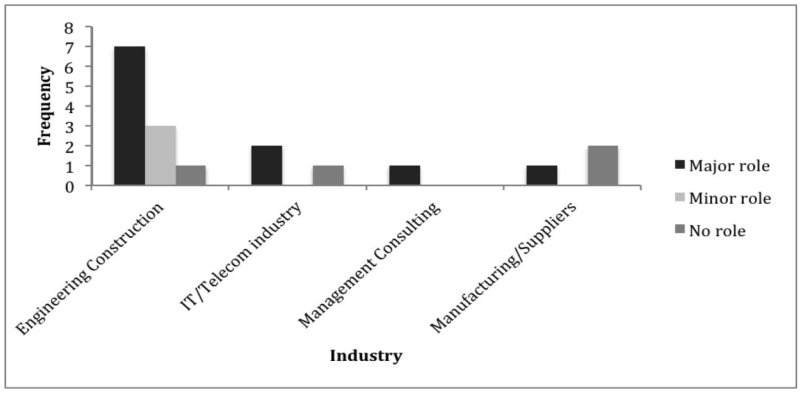


Exhibit 12. Summary of the Roles of an EM Degree in Career Progression

	Primary	Contributory	Minor
Move from Technical to Management	4	1	1
Move up in the Management Track	3	2	-
Move up in the Technical Track	3	2	-

career progression and switching of its holders. In terms of the perceived MEM role, it seems that as more experience is gained, more engineers understand the importance of the MEM degree in their career progression. Moreover, a close examination of career paths of MEM graduates showed that the MEM degree mostly plays a primary role and sometimes a contributory role in the respondents' career progression and that these respondents acknowledged the same role in their responses. These findings indicate that MEM contributes in a considerable way in the career progression of its holders, and its holders acknowledge this role. However, it would be worth noting that MEM holders better acknowledge the role of this degree as they gain more experience.

Regarding the career switching process either within the engineering field (e.g., from design to construction) or across different industries (e.g., IT programming to management consulting), respondents were asked to choose from a list of four difficulties derived from the literature and were granted the option of listing any other difficulties they faced when they switched jobs. Out of the 58 respondents, 26 made a major career switch and only six of them reported difficulties due to this shift. The other 20 respondents did not explain why or how they have avoided these difficulties and thus the available data was too narrow to make any statistical conclusions regarding the relationship between the MEM degree and derailment that is sometimes experienced in career shifting and progression.

Conclusions and Recommendations for Future Work

This study addressed three major gaps in the literature. First, it examined the relatively new trend of engineers pursuing management education subsequent to completing a technical degree. The analysis of the data shows that about 50% of the respondents decide to pursue an MEM degree as opposed to a higher technical degree because they believe that it gives them a competitive advantage in the market. The majority believes that the best time to earn an EM degree is after gaining 1 to 4 years of industry experience. More than half of the respondents expressed their desire to pursue PhD studies in EM.

Second, the study examined the factors that affect career selection, shifting, and progression. The elements that appear to be influencing career selection are "benefits," "career preferences," and "current opportunities." The elements influencing career progression are "status and qualifications," "professional experience," and "post-graduate education and independence on the job."

Third, this study provides fresh engineering graduates, working engineers, and engineering managers with a career planning tool. The career path diagram, which specifies the possible career paths for MEM graduates, provides insight to MEM students on the different possible career paths. The analysis of this diagram reveals that:

- A linear career path (as opposed to steady-state and transitory paths) seems to be the most popular choice for MEM graduates
- The average number of years that an MEM graduate takes to move from a technical job to a job in the managerial track is 3.5 years
- The average number of years that an MEM graduate takes to become a manager is 5 years

This study is limited by the relatively small sample size. As such, it would be of interest to test and try to generalize some of the relationships inferred in this study on a larger sample. This might include graduates from other universities and other management degree programs in different parts of the world. The sample can include engineers working in different domains. This can lead to the integration of more career path options in the career path diagram and to a valuable analysis of the difference in annual salaries across different engineering industries. Including engineers who do not necessarily hold an MEM degree would allow for a better understanding of the role that an MEM degree plays in career selection and progression. For example, one can look at the number of years before MEM degree holders become managers versus the number of years before non-MEM degree holders become managers. Larger and broader samples will also help perform testing for multiple hypotheses that might stem from the preliminary conclusions of the study such as:

- There is a direct correlation between the engineering graduates' reasons for pursuing an MEM and their perceived best time to pursue it,
- MEM graduates progress in their careers and become managers faster than non-EM holders,
- MEM holders are less likely to experience derailment after career-shifting than non-EM holders.

Moreover, further research might look into the role of demographic factors (e.g., gender and marital status) on career selection and progression, and the role of MEM in preventing derailment. Other suggestions for future work include using other research tools in addition to questionnaires, such as interviews, in order to collect more detailed responses regarding certain areas of interest. Because the presented career path diagram only consisted of linear or steady-state career types, it would also be of interest to examine other career types and include them in a more comprehensive career path diagram that can also highlight the milestone of earning the MEM degree in the different career paths.

References

Allen, Thomas J., and Ralph Katz, "Age, Education and the Technical Ladder," *IEEE Transactions on Engineering Management, 39*:3 (August 1992), pp. 237-245.

Allen, Thomas J., and Ralph Katz, "The Dual Ladder: Motivational Solution or Managerial Delusion?" *R&D Manage*ment, *16*:2 (April 1986), pp. 185-197.

Alvear, Audrey, Guillermo R. Rueda, Ivan P. Hernandez, and Dundar F. Kocaoglu, "Analysis of the Engineering and Technology Management (ETM) Educational Programs," *Proceedings of the Portland International Conference on Management of Engineering and Technology,* (July 2006), pp. 1325-1331.

American University of Beirut (AUB), "Engineering Management Program – Overview," http://webfea.fea.aub.edu.lb/fea/emp/aboutus/overview.aspx (cited May 2011).

Badaway, Michael K., "What We Have Learned About Managing Human Resources in R&D in the Last 50 Years," *Research Technological Management*, *31*:5 (September 1988), pp. 19-35.

Bailyn, L., "The Hybrid Career: An Exploratory Study of Career Routes in R&D," *Journal of Engineering and Technological Management*, *8*:1 (June 1991), pp. 1-14.

Beirut Arab University (BAU), "Department of Industrial and Management Engineering," http://www.bau.edu.lb/pdf/PG_Eng1011.pdf (cited May 2011).

Brousseau, K. R., M. J. Driver, K. Eneroth, and R. Larsson, "Career

Pandemonium: Realigning Organizations and Individuals," *The Academy of Management Executive*, *10*:4 (1996), pp. 52-66

Childs, P., and P. Gibson, "Graduating Professional Engineers and Management Skills: Are They Adequate for the Workplace?" *Proceedings of the 3rd International Symposium for Engineering Education,* (July 2010).

Cordero, Rene, and George F. Farris, "Administrative Activity and the Managerial Development of Technical Professionals," *IEEE Transactions on Engineering Management, 39*:3 (August 1992), pp. 270-276.

Dalton, Gene W., Paul H. Thompson, and W. Norman Smallwood, "Helping Engineers Help Themselves," *IEEE Spectrum*, *23*:12 (December 1986), pp. 43-47.

Driver, Michael J., "Careers: A Review of Personal and Organizational Research," *Key Reviews in Managerial Psychology*, John Wiley and Sons (May 1994).

Edum-Fotwe, F. T., and R. McCaffer, "Developing Project Management Competency: Perspectives from the Construction Industry," *International Journal of Project Management*, *18* (April 2000), pp. 111-124.

Farr, John V., and Donna M. Brazil, "Leadership Skills Development for Engineers," *Engineering Management Journal*, *21*:1 (March 2009), pp. 3-8.

Ficco, M., *What Every Engineer Should Know About Career Management*, CRC Press (2009).

Field, A.P., *Discovering Statistics Using SPSS, 2nd Ed.*, Sage Publications (2005).

Greenhaus, J.H., G.A. Callanan, and V.M. Godshalk, *Career Management*, *4th Ed.*, Sage Publications (2010).

Hauck, R., "Comparing an MEM to Other Degrees," http://www.mempc.org/degree/comparison.html (cited June 2010).

Howard, A., "From Engineer to Engineering Manager: A Qualitative Study of Experiences, Challenges, and Individual Transitions for Engineering Managers in Aerospace Companies," unpublished PhD dissertation, Pennsylvania State University (2003).

Igbaria, M., S. Kassicieh, and M. Silver, "Career Orientations and Career Success Among Research and Development and Engineering Professionals," *Journal of Engineering and Technological Management*, *16* (March 1999), pp. 29-54.

Johnson, D., and A. Sargeant, "Motives for Transition: An Exploratory Study of Engineering Managers," *Human Resource Management*, *8*:3 (July 1998), pp. 41-53.

Karlin, S., "Not Your Father's MBA," *IEEE Spectrum* (September 2004), pp. 55-60.

Kennedy, Donald A., "Best Before Forty: The Shelf Life of an Engineer," *Engineering Management Journal*, *21*:1 (March 2009), pp. 19-26.

Kocaoglu, Dundar F., "Engineering Management: Where It Was, Where It Is Now, Where It Is Going," *Engineering Management Journal*, *21*:3 (September 2009), pp. 23-25.

Kocaoglu, Dundar F., "Research and Education in Engineering Management," *IEEE Transactions on Engineering Management*, *37*:3 (August 1990).

Kocaoglu, Dundar F., "Technology Management: Education and Trends," *IEEE Transactions on Engineering Management*, *41*:4 (November 1994), pp. 347-349.

Kocaoglu, Dundar F., Halime I. Sarihan, Iwan Sudrajat, and Ivan P. Hernandez, "Educational Trends in Engineering and Technology Management (ETM)," *Proceedings of the Portland International Conference on Engineering and Technology Management,* (2003), pp. 153-159.

Kotnour, Timothy, and John V. Farr, "Engineering Management: Past, Present, and Future," *Engineering Management Journal*, *17*:7 (March 2005), pp. 15-26.

Kovach, B.E., "Successful Derailment: What Fast Trackers Can Learn While They're Off the Track," *Organizational Dynamics*, *18*:2 (Fall 1989), pp. 33-47.

LaFerla, B., *IEE Engineering Management* (February 2005), pp. 34-35.

Lannes, W. J., "What Is Engineering Management?" *IEEE Transactions on Engineering Management*, *48*:1 (February 2001), pp. 107-110.

Lansley, P, "Engineers Should Look Beyond the MBA Education," *The Times* (March 21, 1994), http://search.proquest.com/docview/318095716?accountid=8555.

Lebanese American University (LAU), "M.S. in Industrial Engineering and Engineering Management," http://soe.lau.edu.lb/ime/programs/ms-industrial/ (cited May 2011).

Lees, M. A. "Do You Want to Be an MBA?" *Engineering Management Journal* (October 1991), pp. 201-206.

Nambisan, Satish, and David Wilemon, "A Global Study of Graduate Management of Technology Programs," *Technovation, 23*:12 (December 2003), pp. 949-996.

Omurtag, Yildirim, "Engineering Management: Past, Present and a Brief Look into the Future for the EMJ Founders Special Issue," *Engineering Management Journal*, *21*:3 (September 2009) pp. 33-35.

Page, R.A., G.K. Stephens, and A. Tripoli, "Traditional and Entrepreneurial Career Paths: Variations and Commonalities," *Advances in Global High-Technology Management* (1992), pp. 151-175.

Palmer, S., "Postgraduate Management Study Options for Engineers," *International Journal of Continuing Engineering Education and LifeLong Learning*, *13*:5 (2003), pp. 546-555.

Patel, P., "The Other MEMs," *IEEE Spectrum* (February 2011), p. 24.

Ray, W. J., *Methods Toward a Science of Behavior and Experience, 10th Ed.*, Wadsworth Cengage (2012).

Reisman, Arnold, "A Brief Review of the last 40 Years and Some Thoughts on Its Future," *IEEE Transactions on Engineering Management*, *41*:4 (November 1994), pp. 342-346.

Rihani, Abdallah M., "An Investigation into the Impact of Workforce Diversity on Organizational Performance: A Study on Lebanese Engineers," unpublished M.S. thesis, American University of Beirut (2008).

Roberts, Karen, and Jeff Biddle, "Questions Associated with the Transition to Management," *Human Resource Management*, *33*:4 (Winter 1994), pp. 565-579.

Shipper, Frank, and John E. Dillard, "A Study of Impending Derailment and Recovery of Middle Managers Across Career Stages," *Human Resource Management*, *39*:4 (Winter 2000), pp. 331-345.

Simpson, B., "How Do Women Scientists Perceive Their Own Career Development," *The International Journal of Career Management*, *6*:1 (1994), pp. 19-27.

Slack, J., "The Value of an MBA for Engineers," *Engineering Management Journal* (October 1999), pp. 231-234.

Slocum, Walter L., *Occupational Careers*, Aldine Publications (1966).

Ternel, I., "Graduate Engineering Management Education," http://www.internationalgraduate.net/managers.htm (cited June 2008).

Tremblay, Michel, Thierry Wils, and Caroline Proulx, "Determinants of Career Path Preferences Among Canadian Engineers," *Journal of Engineering and Technology Management*, *19* (March 2002), pp. 1-23.

Visser, H., "Transformation of Managerial Skills of Engineers," unpublished PhD dissertation, University of Johannesburg (2007).

Wang, D., and Y. Wang, "Evolution and Development of Engineering Management Education in China," *Proceedings of the Engineering Management Conference* (2008).

Wilde, J.A., "An Investigative Study of the Difficulties Experienced by Engineers Transitioning into Leadership/Management Positions," unpublished M.S. thesis, School of Technology, Brigham Young University (2009).

Williamson, Suzette, "A Matter of Degrees," *IEEE Potentials*, *29*:4 (March 2010), pp. 23-26.

Yeh, Quey J., "Exploring Career Stages of Midcareer and Older Engineers: When Managerial Transition Matters," *IEEE Transactions on Engineering Management*, *55*:1 (February 2008), pp. 82-93.

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Appendix: Survey Questionnaire

Demographics and Educational Info

1. Age
   a. <25 b. 25 to 34 c. 35 to 44 d. 45 to 54 e. 55 or older

2. Gender
   a. Male b. Female

3. Marital Status
   a. Single b. Married

4. Bachelor Degree
   a. Civil b. Mechanical c. Computer & Communication d. Electrical & Communication
   e. Architecture f. Industrial/System g. Other

5. Area of concentration while pursuing MEM degree
   a. Projects and Built Environment b. Industrial Management
   c. Operations Research and Financial Engineering d. Information and Organization Management

6. Start year of MEM degree: _____ End Year of MEM degree: _____

7. When do you think is the best time to earn an MEM degree?
   a. Immediately after finishing undergraduate studies
   b. After gaining 1 to 4 years of work experience
   c. After gaining 5 to 10 years of work experience
   d. After gaining more than 10 years of work experience

8. Please explain your answer to the above question (i.e., question #7):

9. What made you decide to pursue a Master's degree in engineering management vs. any of the classical engineering fields (e.g., Civil, Mechanical, Computer and Communication, Electrical, etc.):

10. If the EM Program is to expand its areas of concentrations, which of the following areas do you recommend we add or emphasize?
    a. Construction law
    b. Contract management
    c. Sustainable construction management
    d. Financial and commercial management
    e. Industrial management
    f. Organizational management
    g. Information management
    h. Real-estate management
    i. Other:

11. Based on your experience with the EM program and your professional experience, would you consider pursuing a more advanced degree in EM such as a PhD degree?
    a. Yes b. No

12. Please explain your answer to the previous question (i.e., question #11):

Employment Information

13. Which country are you based in?

14. Which bracket does your annual salary fall into?
    a. <$10k b. $10-$20k c. $21-$30k d. $31-40k e. $41-50k f. $51-60k g. >$60k

Constructing Career Path

15. Work history:
    Please list the various positions you have held since finishing your Bachelor degree, the types of companies you have worked in, the number of years spent in each position, and the % increase in your salary from one job to another (the "% increase in salary" related to row "Position #1" is not applicable).

	Job Title	**Type of Company**	**From Year**	**To Year**	**% Increase**
Position 1					
Position 2					
…					

16. Based on your work history defined in question #15, how do you describe your career type?
    a. "Linear Career": This type is characterized by a consistent upward movement on a clearly defined ladder of a single field. For instance, working as a design engineer for few years, making it to a design group leader position, then becoming a design manager, and then moving up to a design project manager position. Or, working as a site engineer for few years, moving to a lead site engineer position, then to construction manager position, and ultimately making it to the position of project manager.
    b. "Steady-State Career": Individuals choose their career once in a lifetime and commit to one profession with no job change (i.e., remaining in technical jobs at different levels trying to increase their technical skills). For example, a structural engineer eventually becoming a group leader but cannot reach the position of project manager.
    c. "Spiral Career": Persons keep shifting into related fields or professions every seven to ten years and developing new skills. For instance, working as a design engineer for few years then moving to the contracting industry as part of a site team. Or, working as an IT engineer for few years, then deciding to move to management consulting because the progression in the IT sector was very slow.
    d. "Transitory Career": Individuals move every one to four years from one field to a different or totally unrelated one. They frequently change their professions without any period of stability. For example, an engineer working in a certain sector of the engineering industry leaves that industry to open a totally unrelated business such as a restaurant or a security company.

Decision Making

17. To what extent did the following factors affect your decision for choosing your career path?
    Please give a rating on a 1-to-5 scale (1-No effect, 2-Low, 3-Moderate, 4-High, 5-Extremely High).
    a. Monetary benefits (such as basic salary, house, rent allowance, etc.):
    b. Non-monetary benefits (such as leave policy, overtime policy, etc.):
    c. Best available opportunities at this time:
    d. Fits with your experience and skills:
    e. Advancement opportunities:
    f. Location of company is suitable:
    g. Joining a prestigious company:

18. Looking back at your career, did you make at any point a major career shift? (For example: working in a design firm then shifting to a contracting firm, or working in an IT firm then shifting to a consulting firm.)
    a. Yes b. No

If your answer to question #18 is "No," please go directly to question #22.

Assessment of Career Shifting

19. Did you face any difficulties when you shifted to a job of different type?
    a. Yes b. No
    If the answer to the previous question is "yes," select the difficulties you faced due to career switches:
    a. Difficulty to cope with the new job environment because the nature/tasks/duties of work turned out to be different from what you expected
    b. Having non-supportive co-workers
    c. Being stuck in your new position with no opportunities for promotion
    d. Feeling unappreciated in your new job (i.e., your efforts were going to waste)
    e. Other:
    What did you do to overcome these difficulties?

20. Please indicate if and how the MEM degree played a role in your career shifts:
    a. Yes, it played a major role b. Yes, it played a minor role c. No, it did not play any role

21. If your answer to question #20 is "yes," please explain your answer:

Career Progression

22. To what extent do the following factors play a role in your career progression? Please give a rating on a 1-to-5 scale (1-has no role, 2-low, 3-moderate, 4-high, 5-extremely high).
    a. Earning the Master's of engineering management degree (MEM):
    b. Years of experience:
    c. On-the-job training:
    d. Formal training (such as attending seminars, workshops, courses, etc.):
    e. Joining a professional society (such as IEEE, etc.):
    f. Earning professional development certificates:
    g. Having challenging and diversified assignments:
    h. Being independent in your job:

23. Please list the names of any professional development certificates that you have earned and specify how each one helped you in your career progression: