Conchado Peiró, A.; Bas Cerdá, MDC.; Gharaibeh, KM.; Kaylani, H. (2016). Influence of firm size on the competencies required to management engineers in the Jordanian telecommunications sector. European Journal of Engineering Education. 1-14. doi:10.1080/03043797.2016.1197890.

Title

Influence of firm size on the competencies required to management engineers in the Jordanian telecommunications sector

Abstract

The objective of this study is to identify the competencies required to achieve success in the transition from higher education to the labor market based on the perceptions of employers. This paper analyses the assessments made by a group of engineering company employers. An item-battery of twenty competencies was grouped into three dimensions by using factor analysis. Subsequently, respondents' scores were also clustered into three groups and characterized through contingency tables. The competencies demanded by employers were grouped into business and finance, problem-solving and strategic planning. Significant differences were found between responses from employers working in medium and small companies, who placed more importance on competencies related to problem-solving and strategic planning, and employers in big companies, who were more concerned about the difficulties of finding well-trained graduates. The findings from this paper have important implications for research in the areas of higher education and organizations that usually employ graduate engineers.

Key words: Competencies, Higher education, Management engineers, Labor market

Introduction

In the last decade, the Information and Communications Technology (ICT) sector in Jordan has achieved advanced levels of performance and competitiveness, despite the instability that affects bordering countries (Twaissi, Rollins, Worsdale, 2008). This has been especially true in terms of mobile services, as reported by Schwab (2013) in the 2013-2014 Global Competitiveness Report. According to this report, the percentage of individuals using the internet in Jordan reached 41% between 2013 and 2014, with mobile telephone subscriptions increasing by 139.1% and landlines decreasing by 6.7%. Similarly, the Jordan Information and Communications Technology Association (2011) published the penetration rates of mobile phone and landline services from 2009 to 2011, showing that mobile phone

rates had increased from 6,014,000 (101%) to 7,483,000 (120%), while landline penetration rates had decreased from 501,000 (8.40%) to 424,000 (6.8%). There are a number of factors that have contributed to the expansion of the telecommunications sector, such as a remarkable increase in government support, through a series of policies and regulatory reforms, and the recent and growing success of telecommunication companies (Almatarneh, 2011).

Thanks to fast growth in the ICT sector and increasing concern over the economic and social needs of the Jordanian labor market, the educational levels of the workforce have increased remarkably in the last few years. According to UNESCO statistics (2014), the number of higher education graduates in Jordan doubled from 31,329 in 2000 to 62,168 in 2012, and consequently, a high number of new higher education institutions, such as universities, schools and technical institutes, were established in this decade to provide organizations with qualified, well trained workers. Likewise, these higher education institutions offer new more specialized study programs which focus on the latest advances in all fields of study. A common aim of these new degrees is to improve the quality of education and ensure that students have the relevant labor market skills needed to effectively compete for domestic, regional and international employment. To this end, most of the existing study programs at different faculties and departments have also been upgraded or reformed over the past decade (Kanaan, Al-Salamat and Hanania, 2009). However, these initiatives cannot replace the key role of policy makers, practitioners and academic researchers in assisting people at an early stage of their careers (Pinnington, 2011). In this context, the education system faces the challenge of producing graduates who possess skills that are sound and flexible enough to close the so-called mismatch between job opportunities and higher education institutions (Dekker, De Grip and Heijke, 1980), which is usually linked to lower levels of job satisfaction (Allen and De Weert, 2007). Research has shown that graduates working in jobs for which a lower level of education is required (overeducation) usually generates staff turnover, choice of job and lower levels of job satisfaction (Hersch, 1991; Topel, 1986; Tsang and Levin, 1985). In general terms, the wage effects of overeducation are usually less desirable for graduates (Allen & Van der Velden, 2001). In these circumstances, it is clear to many engineers that management-related studies may help them to shift

to managerial positions, as revealed by Srour, Abdul-Malak, Itani, Baskan and Sidani (2013), based on the analysis of a survey of 58 management engineers in Lebanon.

The question of how should engineers select the most appropriate management degree cannot be addressed simply by considering the rankings of Master's degrees in Business Administration (MBA) programs. Identifying the specific skills engineering graduates need to perform their jobs successfully has been a frequent research topic in the last years. The so-called hard skills, such as technical skills and problem-solving appear to be one of the most highly demanded group of competencies for engineers (Passow, 2012, Reio & Sutton, 2006, Zaharim, Yusoff, Omar, Mohamed & Muhamad, 2009). Remarkable advances have been made in this area and traditional techniques, like brainstorming, have been considered insufficient to generate innovative and useful ideas to solve engineering problems. Subsequently, the theory of inventive problem solving (TRIZ) has been suggested as a new approach to overcome this limitation based on the application of previously identified patterns when engineers come up against new problems (Mao, Zhang, & AbouRizk, 2009).

Other abilities have recently been suggested to broaden the scope of these core competencies. The importance of business and finance skills for engineers was initially suggested by Perryman (1992), who stated that every engineer needs to possess some management and business skills in order to succeed in their workplace and become a competent professional. Some years later Angeles et al. (2004) and Male, Bush and Chapman (2010) confirmed this conclusion. Planning, scheduling and project management have also been emphasized as being necessary skills for engineers (Tong, 2003). The education of management engineers in project management was examined by Carbone and Gholston (2004) who used a benchmarking analysis to come to the conclusion that organizations do not contribute substantively to developing project management skills, though they usually demand project manager profiles with official certifications.

Furthermore, the development of soft skills may help graduates to make decisions and interact with others while on the job, thus supplementing the previously described hard skills. Robar (1998), for example, enumerated the benefits of possessing the ability to communicate effectively with non-technical

individuals or groups for management engineers. First, they usually are faced with the task of explaining how projects are being managed and they frequently have to debate the merit of the decisions made in their projects. In addition, management engineers must able to participate in public forums and communicate effectively with their teams and contractors (American Society for Engineering Education, 1994; Nair, Patil & Mertova, 2009; Tong, 2003). Another important soft skill for graduates is teamwork (Passow, 2012; Tong, 2003), whose relevance in industry was first revealed by Jones (1992). More recent studies have emphasized the positive effects of teamwork on productivity (Mendelsohn, 1998), project outcomes (Chan, Ho & Tam, 2001), creativity and innovation tasks (Hoegl, Parboteeah, & Gemuenden, 2003; Hoegl & Parboteeah, 2007) as well as the difficulties some engineers find in successfully developing this skill (Krug, 1997). Other teamwork-related skills, such as leadership, emotional intelligence and ethics, have been highlighted as key competencies that most graduates should possess (Nair, Patil & Mertova, 2007). Farr & Brazil (2009) explored the new concept of leadership as a key issue in the career progression of management engineers, considering the changing nature of labor markets in a globally competitive environment. Similarly, other researchers have provided a framework to illustrate how management engineers should be aware of ethical issues and how to face them (Godbold, 1999; Seebauer & Barry, 2000). Emotional intelligence has also been shown to be essential in managing and leading people in project management (Butler & Chinowsky, 2006; Palethorpe, 2006 Sunindijo, Hadikusumo, and Ogunlana, 2007). Last but not least, the American Society for Engineering Education (1994) instilled the need for lifelong learning in the careers of graduate engineers. Coll & Zegwaard (2007) also emphasized the relevance of the ability to learn new knowledge for recent science and technology graduates, whereas Clapham (2005) explored why professional training is vital for management engineers and the importance of persuading engineers of its benefits. Essentially, he stated that professional training helps to deliver tangible benefits to any business, in the short and long term, through profit enhancement and the generation of leaders for future generations.

In the context of the Jordanian engineer labor market, Zaharim et al. (2009) emphasized that engineering training should take into account the social, economic, and political contexts of engineering

practice, whereas Al-Zoubi (2012) identified leadership competencies as the most influential factor in establishing a competitive advantage in the Jordanian telecommunications industry, as shown in the results of an interview survey on a total sample of 120 middle line department managers, supervisors and team leaders. Other competencies were also considered important by managers in this study, such as strategy development, communication skills, fostering innovation and creativity, development of leadership, and hiring talent. Nabi and Bagley (1998), in an analysis of graduate opinions, pointed out that this group tends to rate its level of ability as being lowest in IT skills and highest in its ability to work without supervision, allowing for possible differences between the views of males and females.

All these studies have tried to answer the first research question of this paper through theoretical contributions or quantitative assessments from heterogeneous samples of graduates and employers. However, the question of how to broadly determine the competencies employers require of graduates is difficult to address for different reasons (Allen and van der Velden, 2008). Firstly, the growing participation of students in higher education, as well as the development of knowledge-intensive and high-technology economic sectors, indicate that there is a shift towards a knowledge-based society, where abilities and skills become rapidly out-dated (Teichler, 1999). Hayes and Allinson (2000) remarked that different employees, and specifically managers, might need to develop different sets of idiosyncratic competencies, while there may be some competencies that are universally relevant. In addition, the demarcation lines between work, leisure time, education and care have become blurred for graduates, leading to patterns of increased mobility and flexibility and the destandardization of professional careers, especially in the present international and globalized labor market (Schimd, 2000). On the other hand, organizational heterogeneity involves a challenge in identifying a standard profile of graduate, who must be able to satisfy all the training and knowledge requirements in the workplace. Therefore, it seems essential to examine the relationship between different company profiles and their needs for distinctive competency profiles.

One of the most relevant factors influencing training and competency demands is firm size, as evidenced by the methods used in recruitment processes. The problem of how to select the engineer that

best fits in a particular job was originally posed by Moore (1921). This study proved that technical school grades cannot be used to differentiate engineers for various kinds of jobs, except in very general terms. Nevertheless, the question still remains. Two decades ago, Zenger (1994) stated that small firms are more efficient in offering contracts that reward performance, using a sample of 912 former engineering employees. This research concluded that small firms tend to attract engineers with better abilities and skills. However, the scope of this research was widened in a later article to a sample of R&D engineers in Silicon Valley and the Route 128 area. This subsequent study considered the advantages small companies enjoy as regards the incentive-intensive employment contracts that lure top engineering talent and motivate high effort (Zenger & Lazzarini, 2004). Conversely, Elfebein, Hamilton and Zenger (2010) pointed out later that scientists and engineers in small firms are more likely to become entrepreneurs than their large firm counterparts. Despite the benefits they can obtain from working in small companies, the skills required to succeed in these organizations are also valuable in entrepreneurship.

Additionally, the effect of firm size may also have an influence on recruitment and selection processes. Behrends (2007) showed that the smaller a company, the more strongly organizational recruitment behaves as the outcome of a social process, which is largely supported and/or undertaken by the employees. Bartam, Lindley, Marshall and Foster (2011) found that the selection and recruitment procedures used by small businesses, and especially those employing 10 people or less, was far more informal and unstructured. However, these conclusions may not be applicable to all small companies. There is considerable diversity amongst small and medium-sized enterprises (SMEs) in relation to their use of human resource practices, as described by Cassell, Nadin, Gray and Clegg (2002) in a survey conducted with 100 senior SME managers. Similar conclusions were obtained by Tanova (2003) in North Cyprus, showing that small organizations are more likely to rely on informal methods of recruitment. Generally speaking, recruitment methods may vary according to the industry: in the services and traditional manufacturing sectors, informal methods such as word-of-mouth and referrals are preferred. However, in high technology areas, and specifically the telecommunications sector, more formal methods are widely used, such as newspaper advertising, employment agencies and the internet. In fact, it has been shown that all employers, regardless of organization size and activity type, tend to use more sophisticated,

objective and cost-effective methods of recruitment and selection than before (Branine, 2008). In a sense, finding competent workers is one of the most important problems for large firm employers, as small and medium enterprises are usually not the first employer of choice for job seekers (Richtie, 1993), due to the negative image that these organizations have among higher education graduates (Moy & Lee, 2002). Moreover, according to Garen (1985), individuals who acquire more schooling will choose to work in larger firms, due to the observed correlation between firm size and wages.

In line with the above, previous research has used theoretical and quantitative approaches to address the question of which key competencies are required in graduate workplaces. Yet there is still little empirical research on the specific competencies required of engineers, as well as their specific training needs, based on their company profiles. Hence, the present study tries to examine both research questions to improve the match between higher education studies and the skills needed by the domestic, regional and international labor market:

- RQ1: Which competencies are required of engineers by employers in the Jordanian labor market?
- RQ2: What is the relation between company profiles and their demand for competencies?

Methodology

Participants

The sample was initially composed of 115 telecommunications engineers working in industry, and of industry managers and graduate students in Jordan. 21 respondents dropped out of the study in the section of the questionnaire on competencies, which consequently meant the sample was composed of 94 employers (47% response rate). About half of the employers (45.2%) worked in organizations which provided mobile phone services, whereas a lower percentage of companies provided other services, such as internet connections (36.9%), landline telephone connections (23.8%), equipment manufacturing (10.7%) and research and development (6%). The majority of respondents worked in firms in the domestic market (45.2%) but a considerable percentage of them (20.2%) worked in organizations which

worked exclusively with international markets. The remaining respondents stated that their companies worked in both the domestic and foreign markets.

Instrument

A standardized questionnaire was designed to provide more specific and readily understood knowledge of local telecommunication market needs. This questionnaire was drawn up and revised by a group of nine professors from engineering and management disciplines who are experts in industrial-oriented engineering programs. All the participants completed an English version of the questionnaire, which consisted of four sections. The first section aimed to collect information about company profiles, particularly the type of business, market orientation, size, and the educational level of their technical staff. The following section asked questions about employability and satisfaction with graduate competencies. Finally, the last section dealt with the competencies preferred by employers to fulfill graduate requirements for workplaces (Gharaibeh, Kaylani, Murphy et al., 2014).

Data collection and analysis

The questionnaire was sent to employers on paper and by e-mail. All the participants were previously informed of the research aims. Some specific guidelines were also given in order to avoid any misunderstandings when filling in the questionnaire.

Respondents were asked to rate a battery of twenty competencies by using a five-point Likert scale in which 1 = not important and 5 = very important. Employers' responses were analyzed by applying exploratory factor analysis with maximum likelihood extraction and varimax rotation using PASW18 software. Items with communalities under 0.3 were eliminated from the scale, which yielded a revised 17-item scale (Harman, 1976). Similarly, items with factor loadings under 0.40 were excluded from each scale (Hair, 2007). The number of factors to be retained was decided by using the Kaiser criterion (eigenvalues ≥ 1) (Kaiser, 1958). The criteria developed by Catell and Vogelmann (1977) was also considered. This decision was based on the lack of consistency of the Kaiser criterion when the number of subjects per variable is small, but we aim to analyze a large number of variables (Gorusch,

1974; Zwick and Velicer, 1986). According to these results the use of the scree plot, followed by a second evaluation of the intrinsic validity, by examining the internal consistency of the item and parcel factoring, may help to distinguish larger substantive factors from those of a trivial lower degree of variance, which are due to errors and other sources.

Internal consistency was tested using Cronbach's alpha (1951) in order to confirm the reliability of each dimension and the overall reliability of the instrument. An item analysis was also performed through item-total correlation and Cronbach's alpha when each item was deleted so that the contribution of each item to the total scale of statistics could be assessed.

Additionally, standardized scores resulting from factor analysis were estimated for all respondents in each factor by using the regression estimation method. These scores represent the relative importance given by each respondent to each dimension of required competencies. Subsequently, cluster analysis was applied to these standardized scores to split the sample of employers based on their preferences in each competency factor (Kaufman & Rousseeuw, 1990). This procedure of analysis aims to avoid correlation in the variables included in the cluster analysis by analyzing uncorrelated factors instead of the original set of items (Hair, 2007).

In terms of cluster analysis, several solutions were initially tested using non-hierarchical algorithm analysis. Subsequently, the selected solution was tested with the hierarchical algorithm for cluster analysis, using Ward's method of clustering and the squared Euclidean distance (Ward, 1963). Significant differences were identified in average mean scores by cluster, using analysis of variance (ANOVA). In addition, contingency tables were obtained for questions about company and recruitment processes to identify company profiles.

Results

Exploratory Factor Analysis

The first research question examines which competencies were most highly in demand according to employers. Exploratory factor analysis was performed on the data for the initial 20 item-battery so as to examine this research question. Three items: 1. competition and regulation issues; 4. soft skills: communication and negotiation, marketing, strategic thinking, and 6. language skills – English) showed communalities under 0.3 and consequently could not be classified in any factor. Therefore, they were all excluded from the scale. As shown in Exhibit 1, the remaining 17 items were clearly clustered in three factors in the final version of the scale. The first factor was labeled 'Business and finance' as all items related to this competency obtained high rotated factor loadings, whereas the second and third factors were labeled 'Problem-solving' and 'Strategic planning' respectively, for similar reasons. The item 'Human resource management' obtained high rotated factor loadings in two factors simultaneously (F1 and F2), indicating that the variability of this item can be explained by high percentages of common variance in both factors (Harman, 1976).

These three factors with eigenvalues greater than one (i.e., F1: 6.03, F2: 2.09 and F3: 1.53) accounted for 56.79% of total variance. A fourth factor could also be included according to Kaiser's criterion, though this factor contributed to the factorial structure with a small percentage of variance (3.0%). Thus, following Catell and Vogelmann (1977) three factors were eventually retained. The reliability coefficient score (Cronbach's alpha) for each factor was F1: 0.865, F2: 0.789 and F3: 0.723 and the overall alpha was 0.876, which indicated a satisfactory level of internal consistency for each scale and the overall instrument.

Exhibit 1. Rotated factor loading scores

Exhibit 2 shows descriptive statistics for each item and factor, as well as a reliability analysis for each item, through item-total correlations and Cronbach's alpha when the item had been deleted. The mean scores for the two items with high rotated factor loadings in F3 'Strategic planning' were the highest: 'Management of telecom networks' (mean = 4.37, SD = 0.83) and 'Management, project management, team management' (mean = 4.29, SD = 0.83), which suggested that employers were more in agreement with the need to recruit graduates who possess both competencies. The lowest average score corresponded to 'Accounting, economics, finance' (mean = 3.18, SD = 1.13), 'Entrepreneurship' (mean = 3.29, SD = 1.11) and 'Human resource management' (mean = 3.43, SD = 1.08). However, these results revealed that employers in this study did not consider these competencies as being very necessary for the jobs carried out by graduates as the average scores for all the items were above the midpoint of 3 (on the five-point Likert scale). Therefore, employers viewed all items included in the questionnaire as being important for graduates to perform their tasks, though they placed less emphasis on these particular competencies.

Exhibit 2. Descriptive statistics for each item and factor (Means)

In terms of the contribution of each item to the analysis, all item-total correlations were greater than 0.3, supporting the decision to include each item in its corresponding scale. Only one item 'Management of telecom networks' obtained an item-total correlation close to this lower limit, which confirms its lack of discriminant capacity with regard to the rest of items. Moreover, it was the only item that would have involved an increase in Cronbach's alpha for the third factor if it had been excluded (Current $\alpha = 0.723$; if excluded $\alpha' = 0.75$). Both results confirmed that this item did not contribute significantly to increase the internal consistency of the third factor. Nevertheless, these peculiarities are

mainly due to the high importance almost all employers placed on this item. Accordingly, it was decided not to eliminate this item from the scale.

Exhibit 3. Reliability analysis for each factor

Cluster Analysis

In order to address the second research question (RQ2), a cluster analysis was performed on the standardized scores for all respondents which had previously obtained through factor analysis, so that employers with similar preferences on the set of required competencies could be grouped together. As a result, solutions with two to four clusters were initially considered to classify employers' requirements for competencies. However, the three-cluster solution was eventually selected because it yielded the most homogeneous group among employers within clusters and also maximized the characterization of different competencies required by employers in each cluster.

Different employer profiles were identified by comparing the mean score of each cluster with the total mean score. All the mean differences were significant according to the analysis of variance, performed for standardized scores in each factor per cluster. Following this procedure, it was observed that employers in the second cluster perceived a strong need to develop problem-solving skills, as the mean score for this second cluster (16.04, SD=2.25) was significantly higher than the total mean score (14.63, SD=3.41). Similarly, most of the employers in cluster two also considered that strategic planning skills were relevant, since their mean score for this third factor (30.48, SD=2.68) was greater than the total mean score (28.79, SD=4.03). Both results suggested that employers in the second cluster were more aware of the importance of competencies related to problem-solving and strategic planning.

Despite the small size of the third cluster of employers, the item and scale scores were not especially different for this cluster. Only a slight increase was detected in this third cluster regarding business and finance competencies. However, the most remarkable difference was the clear preference of this cluster for the 'Human resource management' competency, which obtained the highest score (4.50

versus 2.60 in the first cluster and 3.60 in the second cluster). The item with the highest score was 'Management of telecom networks'. Employers generally considered this competency as a common requirement for telecommunication engineers, regardless of the cluster they were in.

Once general preferences about the competencies needed for engineers' jobs had been identified for each cluster, several contingency tables were explored so that a further insight into company profiles could be provided. Results showed that most of the employers included in the first cluster worked in large companies: 76% of them worked in organizations with more than 200 employees, and exactly the same percentage of respondents in this cluster worked in organizations with more than 50 engineers. The proportion of people who worked in companies with more than 200 employees decreased for the second cluster (61.7%) and also for the third cluster (58.3%). Similar conclusions were reached considering the number of engineers working in the organization.

Likewise, other aspects about the organization of the company were also covered, like the hiring of external subcontractors and the availability of a research and development department. Results pointed out that most employers who belonged to the second and third cluster worked in medium and small enterprises, respectively. 88.0% of employers belonging to the first cluster worked in organizations which usually subcontract some of their tasks, but this percentage decreased for employers in the second cluster (76.6%) and the third cluster (83.3%). This result could be related to a possible lack of resources in small and medium enterprises in establishing an R&D department. 64.0% of employers in the first cluster stated that their organizations had their own research and development department, whereas the proportion of companies with this feature fell to 48.9% for employers in the second cluster.

Interesting conclusions were also drawn in this paper about employers' perceptions of recruitment processes. 60% of employers in the first cluster pointed out the difficulties in finding well-educated, skilled staff, whereas the percentage of employers who agreed with this statement decreased to 55.3% in the second cluster and 33.3% in the third cluster. Similarly, all employers included in the first cluster stated there was a need to improve the managerial skills of telecom engineers, though this percentage diminished to 93.6% in the second cluster and 91.7% in the third cluster.

Discussion and implications

The present study examined the competencies demanded by employers in the Jordanian telecommunications sector, as well as the particular competencies needed according to firm size and company profiles. This paper contributes to empirical research in this topic through the identification of three main competency dimensions by using factor analysis. These findings could lead to the improvement required in new curricula for Jordanian telecommunications engineers, based on the vision of Bologna process in curriculum development. The first factor 'Business & finance' (Angeles et al., 2004; Male, Bush & Chapman, 2010; Perryman, 1992) and third factor and 'Strategic planning' (Carbone and Gholston, 2004; Tong, 2003) are in line with the objectives of the degree, as it is focused on preparing students who are already working at telecom companies to be managers in their telecommunication business. In addition, 'Problem-solving' (Passow, 2012; Reio & Sutton, 2006; Zaharim et al., 2009) is one of the program outcomes of this degree, described as 'the ability to identify, formulate and solve telecommunications management problems'.

The particular case of the item 'Human resource management' which generated high rotated factor loadings in factors one and two, corresponding to 'Business and finance' and 'Problem-solving' respectively, is consistent with the meaning of the item and also with previous research. Human resource departments play a strategic role in identifying strategic and knowledge gaps in the implementation of new technologies for problem-solving (Soliman & Spooner, 2000) whereas some specific human resource management practices may have an economic impact on both intermediate employee outcomes (turnover and productivity) and short-term and long-term measures of corporate financial performance (Huselid, 1995).

The most desired competency was 'Management of telecom networks', which can be considered as a specific competency that is required for most jobs in the field of telecommunications, irrespective of the specific features of each workplace. This technical competency may be considered as a specialized requirement in telecommunication jobs. It is not surprising that this specific competency obtained the highest average score, as the acquisition of specific competencies always seems to be desirable to

353 increase the probability of finding jobs directly related to one's field study (Allen & Van der Velden,
354 2001; Boshuizen, 2004).

355 The competency 'Management, project management, team management' also obtained a high
356 average score, in line with the conclusions drawn by the American Society for Engineering Education
357 (1994), according to Carbone and Gholston (2004), Passow (2012) and Tong (2003). In general terms, all
358 the competencies obtained scores above the scale midpoint, which can be taken as a confirmation that
359 employers are concerned about the importance of recruiting well-trained graduates (Brumm, Hanneman
360 & Mickelson, 2006; Zaharim et al., 2009). Therefore, even in the case of the item with the lowest average
361 score, 'Accounting, economics, finance', employers agreed about the need for this competency, as
362 Angeles et al. (2004) and Male, Bush and Chapman (2010) pointed out.

363 As a first step to identifying different company profiles based on employers' perceptions of
364 required competencies, these results show that firm size represents a determining factor when describing
365 the needs of training in the Jordanian telecommunications market. In general, employers who work for
366 big companies seem to be less concerned about the need to improve problem-solving competencies, but a
367 majority of them are aware about the difficulties of finding well-trained graduates in recruitment
368 processes (Branine, 2008; Garen, 1985; Richtie, 1993). These conclusions had already been reached by
369 Greiner (1998), who stated that creative activities are essential for a company to get off the ground, but
370 that as the company grows, these activities become the problem. According to Grainer, when any
371 organization is growing it is usual to reach a stage where bureaucratic procedures take precedence over
372 problem-solving and innovation, as the organization has become too large and complex. As this paper
373 shows, most of these organizations usually subcontract some of their tasks and have their own research
374 and development department.

375 Employers working in medium-sized companies pointed out to strategic planning and problem-
376 solving as highly demanded competencies in their organizations. Given the heterogeneity of these
377 organizations, the concept of strategic planning may be different in each of these firms. For instance,
378 Hoorn (1979) analyzed the use of strategic planning concepts in different types of small and medium-

sized companies in Holland. After analyzing a hundred companies, he came to the conclusion that confusion often arises, not due to the application of strategic planning strategies, but because of the use of different definitions for this concept.

Finally, employers included in the third cluster, mainly made up of small-sized companies, assigned the highest average score to the item 'Human resource management' as they may be in charge of managing organizational growth. Analogously, it should be remarked that there is considerable diversity amongst small and medium enterprises in relation to their use of human resource practices (Cassell et al., 2002). These results do not necessarily indicate higher group awareness of this competency, but it can give us an idea of their importance for small enterprises as a way to foster organizational growth. As Ruiz-Mercader, Meroño-Cerdan and Sabater-Sánchez (2006) pointed out, there is a relationship between learning and its impact on organizational performance in small businesses.

Our findings in this paper have important implications for research in the areas of higher education and organizations that usually employ graduate engineers. First, the cooperation of higher education institutions with engineering employers is fundamental if the mismatch between graduate competencies and the abilities and skills demanded by employers is to be reduced (Barrella & Buffinton, 2009; Baytiyeh & Naja, 2012; Carbone & Gholston, 2004; Dekker, De Grip and Heijke, 1980; Farr & Brazil, 2009). To that end, both sides should consider implementing measures to improve the employability of engineering graduates and satisfy company needs.

Engineering employers may use these findings to design formal and informal training courses or mentoring programs for new engineers to smooth the transition of recently hired engineering graduates into their workplaces. As Rowold and Kauffeld (2009) stated, informal continuous learning activities have an impact on social, method and professional competencies, so organizations should invest in these activities. More specifically, companies should commit to weighing up and investing in the development of courses that supplement graduate programs so organizational needs can be met (Carbone and Gholston, 2004). This formal training must be combined with experiential learning and aligned with organizational strategy for projects. Farr and Brazil (2009) put forward the same idea, but focused on the need for

mentoring, professional coaching and professional development activities for the acquisition of leadership skills. These results provide strong support for the idea that engineering employers should offer and encourage more company internships or work experience in their enterprises under the umbrella of graduate programs. These initiatives would help graduates to get an insight into the labor market through the application of their knowledge and skills. Besides, internships may allow engineers to develop competencies which are difficult to gain in the higher education environment. Putting students in contact with working managers and executives who offer first-hand knowledge and experiences may be the best way of preparing engineering graduates for the workplace (Barrella & Buffinton, 2009). Engineering companies could also give universities advice on an ongoing basis about the labor market's training needs and requirements. This advice could be offered by a group of companies with different characteristics thus covering the needs of different sized firms and company profiles, taking into account the results of this study. The fact that the study was conducted in a variety of firms supports the idea that the findings could be generalized to other industrial settings. Finally, engineering companies should work to explore graduate job expectations, reporting multiple job alternatives and providing the necessary means for graduates, so that they can obtain proper training and thus meet these expectations. Thus, companies could provide detailed professional profiles for graduate workplaces, including their characteristics, requirements and competencies.

Implications for higher education institutions centre on developing and re-designing curricula as an essential condition to improving the match between the contents of study programs and the needs of training in the regional or national markets, as demonstrated in this paper. Lucena (2006) and Farr and Brazil (2009) discussed this need in their studies with the aim of helping graduates to develop the new skills required by employers. Recently graduated engineers should also invest in developing the competencies which are best valued by employers. Our findings on the competencies required of graduates, and management engineers in particular, make a significant contribution to previous research on the topic, since they shed light on the main skills graduates should possess when attending job interviews.

The current study has its limitations in that the design of any questionnaire is not straightforward and presents some difficulties, although this survey instrument is a very common method of obtaining information in social research. While "asking" is relatively easy, asking good questions requires imagination and experience. One of the limitations of the survey is that the data is based on the subjective opinions of respondents. In order to avoid possible confusion in respondents and the subsequently misleading results, the item wording must be done in a clear and understandable way. Another limitation of measurements via this survey is that the scope was limited to the telecommunications sector, which may lead to biased results that do not reflect reality across the board.

References

Al-Zoubi, M.R. (2012). "Leadership Competencies and Competitive Advantage: Empirical Study on Jordan Telecommunications". *European Journal of Business and Management.* Vol 4, No.7, pp. 234-247.

Almatarneh, A. (2011). "Privacy Implications for Information and Communications Technology (ICT): The case of the Jordanian E-Government". *Journal of International Commercial Law and Technology*, Vol.6 No.3, pp. 151-163.

Allen, J. and De Weert, E. (2007). "What Do Educational Mismatches Tell Us About Skill Mismatches? A Cross-country Analysis". *European Journal of Education*, Vol. 42, No. 1, pp. 59-73.

Allen, J., and van der Velden, R. (2008). *The Flexible Professional in the Knowledge Society: General results of the REFLEX project*. Maastricht, Research Centre for Education and the Labour Market.

American Society for Engineering Education (1994). "The Green Report on engineering education for a changing world", available at: http://www.asee.org/publications (accessed 5 August 2013).

Angeles, J., Britton, R., Chang, L., Charron, F., Gregson, P., Gu, P., Lawrence, P., Stiver, W., Strong, D., Stuart, P. and Thompson, B. (2004). "The engineering design competency" in *Proceedings of the Inaugural CDEN Design Conference* in Montreal, Canada.

Bartram, D., Lindley, P. A., Marshall, L., & Foster, J. (1995). "The recruitment and selection of young people by small businesses". *Journal of Occupational and Organizational Psychology*, Vol. 68, No. 4, pp. 339-358.

Barrella, E.M., & Buffinton, K.W. (2009). "Corporate Assessment of Strategic Issues in Technology Management". *Engineering Management Journal, Vol. 21*, No. 1, pp. 27-33.

Baytiyeh, H., & Naja, M. (2012). "Identifying the challenging factors in the transition from colleges of engineering to employment". *Engineering Management Journal*, Vol. 37, No. 1, pp. 3-14.

Behrends, T. (2007). "Recruitment practices in small and medium size enterprises: An empirical study among knowledge-intensive professional service firms". *Management Revue*, Vol. 18, No. 1, pp. 55-74.

Boshuizen, H.P.A. (2004). "Does Practice Make Perfect? A slow and discontinuous process", in Boshuizen, H. P. A., Bromme, R. and Gruber, H. (Eds.) *Professional Learning: Gaps and Transitions on the way from novice to expert*. Vol. 2, Part 3, Dordrecht, Kluwer Academic Publishers, pp. 75-95.

Branine, M. (2008). "Graduate recruitment and selection in the UK: A study of the recent changes in methods and expectations". *Career Development International*, Vol. 13, No. 6, pp. 497-513.

Brumm, T.J., Hanneman, L.F. and Mickelson, S.K. (2006). "Assessing and developing program outcomes through workplace competencies". *International Journal of Engineering Education*, Vol. 22, No. 1, pp. 123-129.

Butler, C. J., & Chinowsky, P. S. (2006). "Emotional intelligence and leadership behavior in construction executives". *Journal of Management in Engineering*, Vol. 22, No. 3, pp. 119-125.

Carbone, T. A., & Gholston, S. (2004). "Project manager skill development: A survey of programs and practitioners". *Engineering Management Journal*, Vol. 16, No. 3, pp. 10-16.

Catell, R.B. and Vogelmann, S. (1977). "A comprehensive trial of the scree and KG criteria for determining the number of factors". *Multivariate Behavioral Research*, Vol. 12, No. 3, pp. 289-325.

Cassell, C., Nadin, S., Gray, M., and Clegg, C. (2002). "Exploring human resource management practices in small and medium sized enterprises". *Personnel Review*. Vol. 31, No. 6, pp. 671-692.

Chan, A. P., Ho, D. C., & Tam, C. M. (2001). "Effect of interorganizational teamwork on project outcome". *Journal of Management in Engineering*, Vol. 17, No. 1, pp. 34-40.

Clapham, P. (2005). "Training to be the best". *Engineering Management Journal*, Vol. 15, No. 1, pp. 28-31.

Coll, R.K. and Zegwaard, K.E. (2007). "Perceptions of desirable graduate competencies for science and technology new graduates". *Research in Science & Technological Education*. Vol. 24, No. 1, pp. 29-58.

Cronbach, L.J. (1951). "Coefficient alpha and the internal structure of tests". *Psychometrika*. Vol. 16, No. 3, pp. 297-334.

Dekker, R., De Grip, A., and Heijke, H. (1980). "The effects of training and overeducation on career mobility in a segmented labour market". *International Journal of Manpower*, Vol. 23, No.2, pp. 106-125.

Elfenbein, D. W., Hamilton, B. H., & Zenger, T. R. (2010). "The small firm effect and the entrepreneurial spawning of scientists and engineers". *Management Science*, Vol. 56, No. 4, pp. 659-681.

Farr, J. V., & Brazil, D. M. (2009). "Leadership skills development for engineers". *Engineering Management Journal*, Vol. 21, No. 1, pp. 3-8.

Garen, J. E. (1985). "Worker heterogeneity, job screening, and firm size". *The Journal of Political Economy*, Vol. 93, No. 4, pp. 715-739.

Gharaibeh, K.M., Kaylani, H., Murphy, N., Brennan, C., Itradat, C., Al-Bataineh, M., Aloqlah, M., Salhieh, L., Altarazi, S., Rawashdeh, N., Bas Cerdá, M.C., Conchado, A., Al-Zoubi, A., Harb, B., Salameh, H.B. (2014). "A Masters Programme in telecommunications management – demand-based curriculum design". *European Journal of Engineering Education*, Vol. 40, No. 3, 267-284.

499 Godbold, A. (1999). “What has ethics to do with me? I'm an engineer”. *Engineering Management*
500 *Journal*, Vol. 9, No. 2, pp. 81-86.

501 Greiner, L.E. (1972). “Evolution and revolution as organizations grow”. *Harvard Business Review.* pp.
502 37-46.

503 Hair, J. F., Anderson, R., Tatham, R. and Black, W. (2007). *Multivariate analysis*, Madrid, Prentice Hall.

504 Harman, H.H. (1976). *Modern factor analysis*, Chicago, University of Chicago Press.

505 Hayes, J., Rose-Quirie, A., and Allinson, C. W. (2000). “Senior managers’ perceptions of the
506 competencies they require for effective performance: implications for training and development”.
507 *Personnel Review*, Vol. 29, No.1, pp. 92-105.

508 Hersch, J. (1991). “Education match and job match”. *The Review of Economics and Statistics*, Vol. 73,
509 No. 1, pp. 140-144.

510 Hoegl, M., & Parboteeah, K. P. (2007). “Creativity in innovative projects: How teamwork
511 matters”. *Journal of Engineering and Technology Management*, Vol. 24, No. 1, pp. 148-166.

512 Hoegl, M., Parboteeah, K. P., & Gemuenden, H. G. (2003). “When teamwork really matters: task
513 innovativeness as a moderator of the teamwork–performance relationship in software development
514 projects”. *Journal of Engineering and Technology Management*, Vol. 20, No. 4, pp. 281-302.

515 Hoorn, T.P. (1979). “Strategic planning in small and medium-sized companies”. *Long Range Planning*.
516 Vol. 12, No. 2, pp. 84-91.

517 Huselid, M.A. (1995). “The impact of human resource management practices on turnover, productivity,
518 and corporate financial performance”. *Academy of Management Journal*, Vol. 38, No. 3, pp. 635-672.

519 Information and Communications Technology Association - Jordan and Ministry of Information and
520 Communications Technology. (2011). ICT & ITES Industry Statistics & Yearbook, available at:
521 http://www.moict.gov.jo/ (accessed 16 February 2014).

522 Jones, S. (1992). “The importance of teamwork in industry”. *Engineering Management Journal*, Vol. *2*,
523 No. 3, pp. 104-108.

524 Kaiser, H.F. (1958). “The varimax criterion for analytic rotation in factor analysis”. *Psychometrika*. Vol.
525 23, No. 3, pp. 187-200.

526 Kanaan, T., Al-Salamat, M., & Hanania, M. (2009). Financing Higher Education in Jordan. Jordan Center
527 for Policy Research and Dialogue (JCPP), Amman: Jordan, available at:
528 http://www.erf.org.eg/CMS/uploads/pdf/1245580402_FinancingHigherEducation_Jordan.pdf (accessed 6
529 February 2014)

530 Kaufman, L. and Rousseeuw, P. (1990). *Finding Clusters in data: An introduction to cluster analysis*,
531 New Jersey, Wiley.

532 Krug, J. (1997). “Teamwork: why some people don’t like it”. *Journal of Management in*
533 *Engineering*, Vol. 13, No. 2, pp. 15-16.

534 Lucena, J.C. (2006). “Globalization and organizational change: engineers’ experiences and their
535 implications for engineering education”. *Engineering Management Journal*, Vol. 31, No. 3, pp. 321-338.

536 Male, S.A., Bush, MB. and Chapman, E.S. (2010). “Perceptions of competency deficiencies in
537 engineering graduates”. *Australasian Journal of Engineering Education*. Vol. 16, No. 1, pp. 55-68.

538 Mao, X., Zhang, X., & AbouRizk, S. M. (2009). “Enhancing value engineering process by incorporating
539 inventive problem-solving techniques”. *Journal of Construction Engineering and Management*, Vol. 135,
540 No. 5, pp. 416-424.

541 Mendelsohn, R. (1998). “Teamwork-The key to productivity”. *Journal of Management in*
542 *Engineering*, Vol. *14*, No. 1, pp. 22-25.

543 Moore, B. V. (1921). "Personnel selection of graduate engineers: The differentiation of apprentice
544 engineers for training as salesmen, designers, and executives of production". *Psychological Monographs:*
545 *General and Applied*, Vol. 30, No. 5, pp. 1-85.

546 Moy, J.W. and Lee, S.M. (2002). "The career choice of business graduates: SME or MNCS?" *Career*
547 *Development International*. Vol. 7, No. 6, pp. 339-347.

548 Nabi, G.R. and Bagley, D. (1998). "Graduates' perceptions of transferable personal skills and future
549 career preparation in the UK". *Career Development International*. Vol. 3, No. 1, pp. 184-193.

550 Nair, C.S., Patil, A. and Mertova, P. (2009). "Re-engineering graduate skills – a case study". *European*
551 *Journal of Engineering Education*. Vol. 34, No. 2, pp. 131-139.

552 Palethorpe, M. (2006). "Are you emotional but intelligent-or are you emotionally
553 intelligent?" *Engineering Management Journal*, Vol. 16, No. 1, pp. 11-13.

554 Passow, H.J. (2012). "Which ABET competencies do engineering graduates find most important in their
555 work?" *Journal of Engineering Education*. Vol. 101, No. 1, pp. 95-118.

556 Perryman, R. (1992). "Engineer your own success". *Engineering Management Journal*, Vol. *2*, No. 4, pp.
557 170-174.

558 Pinnington, A. H. (2011). "Competence development and career advancement in professional service
559 firms". *Personnel Review*, Vol. 40, No. 4, pp. 443-465.

560 Reio, T.G. and Sutton, F.C. (2006). "Employer assessment of work-related competencies and workplace
561 adaptation". *Human Resource Development Quarterly*, Vol. 17, No. 3, pp. 305-324.

562 Richtie, J. (1993). *Strategies for HRM: challenges in smaller and entrepreneurial organisations. Human*
563 *Resource Management*, Addison – Wesley, Reading, MA.

564 Robar, T. Y. (1998). "Communication and career advancement". *Journal of Management in*
565 *Engineering*, Vol. *14*, No. 2, pp. 26-28.

566 Rowold, J., & Kauffeld, S. (2009). “Effects of career-related continuous learning on competencies”.
567 *Personnel review*, Vol. 38, No. 1, pp. 90-101.

568 Ruiz-Mercader, J., Meroño-Cerdán, A.L., and Sabater-Sánchez, R. (2006). “Information technology and
569 learning: Their relationship and impact on organisational performance in small businesses”. *International*
570 *Journal of Information Management*. Vol. 26, No. 1, pp. 16-29.

571 Schmid, G. (2000). “Transitional Labour Markets. A New European Employment Strategy” in Marin, B.,
572 Meulders, B. & Snower, J. (Eds.), *Innovative Employment Initiatives*, Aldershot, Ashgate, pp. 98-206.

573 Schwab, K. (2013). “The , competitiveness report 2013–2014”. Switzerland: World Economic Forum,
574 available at: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf (accessed
575 3 March 2014).

576 Seebauer, E. G. & Barry, R. L. (2000). *Fundamentals of Ethics for Scientists and Engineers*. United
577 States of America: Oxford University Press.

578 Soliman, F. and Spooner, K. (2000). “Strategies for implementing knowledge management: role of
579 Human resource management”. *Journal of Knowledge Management*. Vol. 4, No. 4, pp. 337-345.

580 Srour, I., Abdul-Malak, M. A., Itani, M., Bakshan, A., & Sidani, Y. (2013). “Career Planning and
581 Progression for Engineering Management Graduates: An Exploratory Study”. *Engineering Management*
582 *Journal*, Vol. *25*, No. 3, pp. 85-100.

583 Sunindijo, R. Y., Hadikusumo, B. H., & Ogunlana, S. (2007). “Emotional intelligence and leadership
584 styles in construction project management”. *Journal of Management in Engineering*, Vol. 23, No. 4, pp.
585 166-170.

586 Tanova, C. (2003). “Firm size and recruitment: staffing practices in small and large organizations in
587 North Cyprus”. *Career Development International*. Vol. 8, No. 2, pp. 107-144.

588 Teichler, U. (1999), “Higher Education Policy and the World of Work: Changing Conditions and
589 Challenges”. *Higher Education Policy*. Vol. 12, No. 4, pp. 285-312.

590 Tong, L.F. (2003). “Identifying essential learning skills in students’ engineering education” in
591 *Proceedings of The Higher Education Research and Development Society of Australasia* 2003,
592 Canterbury, New Zealand.

593 Topel, R. (1986). “Job mobility, search, and earnings growth: A reinterpretation of human capital
594 earnings functions”. *Research in labor economics*, Vol.8, No. A, pp.199-233.

595 Tsang, M. C., & Levin, H. M. (1985). “The economics of overeducation”. *Economics of Education*
596 *Review*, Vol. 4, No. 2, pp. 93-104.

597 Twaissi, N., Rollins, R., and Worsdale, G. (2008) “A Review of Current Issues and Challenges for TQM
598 Implementations in the Jordanian Information and Communications Technology Sector”, in: Sami Dham,
599 N. and Aziz Anwar, S. (Eds.) Creating Architecture of Quality and Excellence in the Middle East:
600 Responsibilities, Challenges and Strategies, proceedings of the Quality Congress Middle East in Dubai,
601 United Arab Emirates, 2008, e- TQM College, pp.120-131.

602 United Nations Educational, Scientific and Cultural Organization - Institute for Statistics UNESCO
603 (2014), available at: http://data.uis.unesco.org/Index.aspx?queryid=163# (accessed 23 January 2014).

604 Ward, J. (1963). “Hierarchical Grouping to Optimize an Objective Function”. *Journal of the American*
605 *Statistical Association*. Vol. 58, No. 301, pp. 236-244.

606 Zaharim, A., Yusoff, Y.M.D., Omar, M.Z., Mohamed, A. and Muhamad, N. (2009). “Engineering
607 employability skill required by employers in Asia” in *6th WSEAS International Conference on*
608 *Engineering Education (EE’09)* in Rodos, Greece, 2009, pp.195-201.

609 Zenger, T. R. (1994). “Explaining organizational diseconomies of scale in R&D: Agency problems and
610 the allocation of engineering talent, ideas, and effort by firm size”. *Management Science*, Vol. 40, No. 6,
611 pp. 708-729.

612 Zenger, T. R., & Lazzarini, S. G. (2004). “Compensating for innovation: Do small firms offer
613 high- powered incentives that lure talent and motivate effort?” Managerial and Decision Economics, Vol.
614 25, No. 6- 7, pp. 329-345.