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Assessing the performance of Libyan supervising engineers

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In the Libyan construction industry, the supervising engineer plays an important role in checking time schedules and protecting the client from delays and associated claims but there is no existing means of determining their proficiency in performing this task. A list of factors identifying a broad range of characteristics and skills necessary for the effective supervision of construction projects is compiled. A field survey comprising semi-structured interviews and questionnaires with 32 client and contractor project managers experienced in the Libyan construction sector is undertaken. The responses are used to develop a method of assessing the effectiveness of supervising engineers in dealing with construction project delays through a set of weighted criteria which are scored according to currently perceived levels of performance. The results indicate that Libyan supervising engineers are currently deficient in a number of areas, particularly communication skills (33%); obtained scientific, technical and legal knowledge (34%); knowledge in dealing with claims (36%); previous experience (37%); knowledge and use of modern techniques (37%). These factors are therefore a key focus for the professional development needs of supervising engineers and the method of assessment should assist clients in the process of selection and appointment.

Keywords: Supervision, delay, performance evaluation, project control, Libya

Introduction

The construction industry throughout the world faces a variety of challenges related to the satisfactory completion of projects. Many articles, commentators and client-based organizations (Construction Industry Institute, 1990) have, over a lengthy period of time, identified programme and cost overruns, poor quality and performance, low profitability, onerous contract conditions and a multitude of disputes. The industry has been characterized by adversarial attitudes, with litigation often continuing long after projects have finished. Delays, due to the risky and competitive nature of construction contracting, conflicting objectives among the different participants, design changes and claims, have a direct impact on the completion time and/or cost of a construction project (Barrie and Paulson, 1992; Abudayyeh, 1994). In the UK, seminal reports by Latham (1994) and Egan (1998) both identified a pressing need for change and inspired a number of initiatives, including Rethinking Construction and the Movement for Innovation. Although precise and verifiable data related to subsequent performance improvement are difficult to obtain within the private sector, the analysis of public sector projects can provide some indication of the current levels of success. As recently as 2003, in the UK, the National Audit Office (2003) reported that 70% of construction projects were delivered late to the public sector. The Libyan construction industry is governed by the *Administrative Contracts Regulations* (General People's Committee, 1999) which are based on English contractual arrangements such as the New Engineering Contract (Institution of Civil Engineers, 1995) and faces similar challenges. As the instigator or client of all large construction projects, the Libyan government has to carry the significant additional costs caused by project delays.

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Project delays and performance measurement

Fenn (2006) provides a comprehensive review of the literature related to why construction contracts go wrong. Of the 38 studies reviewed, many identify time, project delays, delay claims, scheduling, monitoring and controlling, as major factors in the causation of conflict and construction disputes (for example: Kumaraswamy, 1997; Gould *et al.*, 1999). Fenn (2006) also includes a review of 25 further studies regarding project success criteria and/or factors and, as might be expected, many are directly linked to, or extrapolations of, the commonly accepted triumvirate of time, cost and quality factors. In addition, several of the studies (Pinto and Slevin, 1988; Chua *et al.*, 1999; Cooke-Davies, 2002) point to issues of human competence in tasks related to scheduling, monitoring and controlling.

Naoum (1994) identified 10 factors to measure the project performance under conventional contractual arrangements: preconstruction time; construction time; total time; speed of construction; unit cost of building; time overrun; cost overrun; and client satisfaction with time, cost and quality. Of these 10 factors, six are directly related to time and the remainder would also be affected by delays. More recently the construction sector has adopted benchmarking and key performance indicators (KPIs) as mechanisms for monitoring and demonstrating project success. The national set of 10 KPIs developed in the UK (Constructing Excellence, 2004) includes two specifically related to construction time and time predictability. It is clear therefore, that the importance of time performance is widely accepted and that it is in the interests of all parties that delays are reduced (Deng and Nadeem, 2004). However, most performance measurement techniques are output based and traditionally time performance is measured by reference to a programme, be it a bar chart, network or precedence diagram (Horner, 2006). These approaches have two weaknesses: first it is difficult to carry out comparisons of performance across a range of projects on a like-for-like basis since many of the variables are hidden; for example: project time/duration will inevitably vary because of differences in quality, complexity or functionality (Horner, 2006). Secondly, there is little if any diagnostic assessment that provides data which could be used to improve future performance. Hence, we can see that a project is late but are unable to identify the causes, particularly those related to the human competence issues identified earlier. Consequently, there is a need for more diagnostic techniques to help address the causes of delay and their management, thereby contributing to performance improvement. The objective of this study is to develop one such method to assess the effectiveness of Libyan supervising engineers in managing or dealing with construction project delays.

Supervising engineers

Stanger (1989) identified the tasks of the construction client, which include communicating requirements, instructions and ideas to the contractor and to other related participants; contract administration; monitoring of the works; evaluating the works for making interim and final payments; and confirmation of when the job is completed. To perform most of these tasks, the client usually appoints someone who has the appropriate experience to act as their representative. The National Economic Development Office (NEDO, 1988) stated that the owner's representative (referred to in the report as 'customer representative') can be found among architects, engineers, surveyors and project managers, and in contracting companies with management and/or design skills as well as those of construction. Whatever title is used, they are the contact point between the client and the other teams associated with the project (Jawahar-Nesan and Price, 1997).

A client's representative, project manager or supervisor can be defined as a professional (individual or company, either in-house or outside of the client's organization) designated by the client to advise and act on his behalf as a distinct member of the project team to monitor, make decisions, resolve disputes and coordinate the various parties of the project within the limits set by the client (Meredith and Mantell, 1989). They are tasked with attempting to satisfy the client's objectives which are traditionally categorized under the themes of time, cost and quality.

The client's representative in the implementation stage of a construction project in Libya is called the supervising engineer (General People's Committee, 1999) and is selected and appointed either through a Supervision Consultant Bureau or individually as a supervising engineer (SE). This SE may support the effectiveness and efficiency of the overall project delivery, but is not assigned as leader of the construction project. The SE does however have clearly defined responsibilities to monitor project performance, the most problematic of which, according to Krima *et al.* (2005), is the recording and scrutiny of time schedules in order to protect the client from delays and delay claims. According to Burris (1994) the SE is responsible for the plan of work, but not for the construction work itself. Therefore, while the SE is the nominative manager, the actualization of the project is in the hands

of the contractor's project manager. With this role assigned to the contractor's project manager, the SE uses the baseline framework to monitor the progress achieved in the execution stage of the project. As the project progresses, tasks accomplished to the required standard, on time and within budget are assessed as satisfactorily executed. If, however, tasks are extended or delayed so as to fall behind schedule, then the SE is responsible for taking action to ensure the contractor is correcting the problems and getting the project back on track.

One of the most important decisions for the client is who should undertake this supervision work on their behalf to ensure achievement of their goals. It is important that the client engages the right SE who has the capability to monitor the contractor and enable the project to be completed within the agreed time. Change and Ibbs (1998) identify that many consultants' performances are not at a satisfactory level. However, identifying an effective SE is not straightforward: clients do not have comprehensive data to evaluate the past performance of SEs and may not consider all important criteria. In particular, there is no rational and systematic tool to evaluate and select the best performing SEs. Hence, developing an appropriate technique is crucial since it would assist Consultant Bureaux in selecting and appointing SEs by ascertaining their effectiveness in dealing with delay, and could also be used by clients and Consultant Bureaux to assess existing SEs to determine any deficient areas.

Supervising engineer effectiveness factors

Jawahar-Nesan and Price (1997) identified the important tasks to be performed by a client's representative as: organizing a joint management team, measuring and reviewing performance, communications, motivation, coordination and documentation. Tang *et al.* (2003) add supervision at implementation stage, which is subdivided into further criteria such as control of work progress and completeness of site records. Essentially, these are the same as the tasks assigned to the Libyan SE and are included in the *Administrative Contracts Regulations* (General People's Committee, 1999). These regulations give substantial authority to the Libyan SE on public projects, on the basis that they are protecting the government and public funds.

It is accepted that effective project managers are essential to project success and many organizations have spent large sums to improve the selection of managers (Hauschildt *et al.*, 2000). Mian (1999) offers a model to select a project manager where three main criteria are identified. First, administrative and supervisory skills, which include leadership ability, communication skills and problem-solving skills; secondly technical knowledge, which includes project knowledge, experience in the field and education level; and thirdly personal abilities which includes self-confidence, decisiveness, personal integrity, entrepreneurship and aggressiveness. In contrast, Zimmerer and Yasin (1998) suggest that, historically, strong technical skills and knowledge have been the key selection criteria and that today's complex project environments require greater skills in leadership than ever before. They claim that performance expectations for quality, cost-effectiveness, timely delivery, and a host of other client measures are ratcheted up each year, and rank the characteristics of an effective project manager as: leadership, vision, technical competence, decisiveness, good communication, good motivation and supportive to other team members. Hauschildt *et al.* (2000) also propose seven factors and 25 variables which affect project manager efficacy. The seven factors are: organization under conflict, experience, decision making, productive creativity, organizing with cooperation, cooperative leadership and integrative thinking. The variables are: critical ability, time management, ability to delegate, conflict tolerance, years of employment, knowledge procedures, leadership experience, experience in the field, holistic thinking, judgment, decision making, shows creativity, ideas and initiatives, carries through ideas, cost management, willingness to learn, planning and organization, team management, sensibility, ability to cooperate, ability to motivate, expresses oneself clearly, attends to others, systematic thinking, variance explained.

Goodwin (1993) also examined the role of the project manager in relation to the skills required to fulfil this position. Goodwin concludes that the project manager's effectiveness is dependent on conceptual, human and negotiating skills as well as, to lesser extent, technical skills and the ability to communicate. Mead (2001) agrees that effective communication is one of the key factors in determining the success or failure of a project. Similarly Thomas *et al.* (1999) identify effective team communication as a major challenge to a project success.

Jensen *et al.* (1997) explain that most common contractual disputes are related to project claims for extensions of time due to delays and/or additional work not included in the original contract. To manage delay and potential claims situations effectively Abudayyeh (1996) suggests that the SE should know how to deal with them. Semple *et al.* (1994) also point out that avoiding construction delay claims and disputes requires an understanding of contractual terms, early non-adversarial communication, and an understanding

of the causes of delay claims and cost overruns. Yates and Audi (1998) explain how computers can provide a consistent, detailed, and systematic analysis of progress, help predict delays, and provide possible causes of delays. In addition, they can suggest ways to prevent further delays and be used to provide a list of possible corrective measures.

Further relevant studies include work by Ogunlana *et al.* (2002), which identifies the factors used in industry to assign project managers to projects, and develops a matching model for selecting construction project managers. Earlier work by Pettersen (1991) reviewed almost 30 publications and summarized with the required profile of effective project managers in general. Moreover, other authors have provided their own lists of characteristics, for example, Fraser (2000), Dainty *et al.* (2003) and Krima *et al.* (2005). Their findings and lists are lengthy but offer similar observations to those already considered here, with some occasional exceptions.

The literature reviewed identifies a broad range of characteristics and skills, with much consensus and overlap. A summary is provided in Table 1. However, it also demonstrates that there is less agreement on the

Table 1 Summary of supervising engineer/project manager characteristics and skills

Characteristics and skills	Pettersen (1991)	Goodwin (1993)	Semple *et al.* (1994)	Hecker (1997)	Jensen *et al.* (1997)	Jawahar-Nesan and Price (1997)	Zimmerer and Yasin (1998)	Yates and Audi (1998)	Mian (1999)	Thomas *et al.* (1999)	Hauschildt *et al.* (2000)	Fraser (2000)	Mead (2001)	Ogunlana *et al.* (2002)	Dainty *et al.* (2003)	Tang *et al.* (2003)	Krima *et al.* (2005)
Organizing	x					x					x			x			
Measuring and reviewing	x					x											x
Communications	x	x	x			x	x		x	x		x	x		x	x	x
Motivation	x					x	x				x						x
Documentation	x					x										x	x
Supervision	x								x							x	x
Management	x			x		x			x		x						x
Coordination	x					x								x			
Leadership	x						x		x		x				x		
Problem solving	x								x			x					
Technical knowledge and skills	x	x					x		x		x	x			x		x
Experience	x								x		x	x					x
Education	x								x								x
Commitment	x						x										x
Cost management	x													x			
Conflict resolution	x										x						
Decision making	x										x	x			x		x
Cooperation	x										x						
Holistic thinking	x										x			x			
Creativity and initiatives	x										x						
Planning and follow-up and schedules	x				x									x			x
Negotiating	x	x												x			
Delay management			x		x			x		x							x
Claims and disputes			x		x					x							x
Dealing and adopting with changes	x				x							x		x			x
Contracts and contractual terms	x		x														x
Use of computers								x									x
Learning	x			x													x
Use of modern techniques	x													x			x
Other personal characteristics	x								x					x	x		

relative importance of the various factors: some authors place more emphasis on so-called hard skills such as expertise in planning and control techniques, management information systems, etc., whereas others suggest that the softer skills are more important: negotiation, flexibility, people management, motivation, etc. An important aspect of the study would therefore be to consider the relative significance of the various factors identified in the literature.

Since the focus of this study is the effectiveness of Libyan SEs, it was necessary to refine the list compiled from the broad review of published work in the field, so that it correlates with SEs' duties. Although they are responsible for the planning, coordination and control of the project (and therefore need skills similar to those of a project manager), SEs do not require skills needed for the actualization of construction activities which are the responsibility of the contractor's management staff. In addition, it is important to consider only those duties specifically related to dealing with project delays. A preliminary consultation with three Libyan construction experts helped to edit and re-sort the factors and criteria into suitable categories and a final list to measure the effectiveness of SEs was agreed (see Table 3, columns 1 to 3).

Assessing the effectiveness of supervising engineers

There is no existing quantitative tool with which to determine the extent of an SE's effectiveness, and it was therefore necessary to develop a method of comparing the ideal/optimum performance with current levels of performance in practice. In order to measure standards of achievement against each of the factors identified, the study intended to harvest the opinions of experts in the Libyan construction industry. A draft questionnaire was developed which required respondents to quantitatively assess the relative importance of the listed criteria. A set of weightings was then calculated which, according to the sample population, represented the ideal balance of skills and characteristics necessary to deal with delays effectively. In subsequent sections of the questionnaire, respondents were to be asked to rate the existing degrees of effectiveness of SE in the Libyan construction industry. A pilot study was conducted, the results reviewed, and some adjustments were made accordingly to produce a final questionnaire.

The research employed the questionnaire in a field survey of Libyan construction experts. On the basis of previous experience, it was anticipated that the likely response rate to a mailed questionnaire in Libya would be poor. Similarly, there would be limited confidence that the 'expert' had actually completed those surveys which were returned. Consequently, the questionnaire was incorporated into semi-structured interviews, to boost the quantity and quality of responses, and also enabling any uncertainty over the interpretation of questions to be clarified.

The sample population of the study was drawn from the Libyan 'Public Committee of Monitoring and Follow-up' and a list was drawn up with the assistance of the Consultant Bureaux, with which the government has had contracts for a minimum of 10 years. Most experts in the construction supervision field in Libya have worked for both clients and contractors alike, and are thereby able to offer opinions reflecting a broad range of experience. Fifty experts were identified who satisfied the following requirements: (a) they are recognized for their knowledge of the construction industry in Libya; (b) they have worked in different types of project organizations; and (c) they have a minimum of 10 years' experience in the field. Interviews were arranged and conducted with the 32 experts who agreed to take part in the study (64% of sample population).

A program written in Visual Basic was developed to incorporate the questionnaire: questions, codes, marks (values), instructions, and the data gathered. A data analysis plan attached codes to question numbers and then linked these to the criteria and factors indicated, enabling results to be summarized in a single table (Table 3). The system was tested by comparing the program outputs with outputs from Excel using the pilot study data. The compilation and analysis of results (see Tables 2 and 3) were subsequently tested, reviewed and assessed by specialists in statistics and information technology.

Data analysis and computation of results

The questionnaire asked experts about the importance of each identified criterion (see Table 3, columns 1 to 3) on a rating scale of 1 to 10. The arithmetic mean of these ratings was then calculated for each criterion (Table 2, column 5: mean rating for criterion (MRC)). The weighted mean ratings for each factor were then calculated (Table 2: mean rating for factor (MRF)) and these results normalized to provide a weighting for each factor as a percentage (Table 2: normalized factor weighting (NFW)). The summation of all normalized factors forms the total ideal effectiveness degree of the SE as equal to 100. The normalization step was taken to make comparison with existing performance more straightforward by using a convention scale. Table 3, column 4 shows the results of the assessment of ideal

Table 2 Calculating the ideal effectiveness of the supervising engineer: example showing factors 1 and 2

Factor	Criterion	Total rating (R)	Total frequency (J)	Mean rating for criterion (MRC)
1	1.1	$R_{1.1}=\sum_{i=1}^{10} fx_i$	$J_{1.1}=\sum f$	$\bar{X}_{1.1}=R_{1.1}/J_{1.1}$
	1.2	$R_{1.2}=\sum_{i=1}^{10} fx_i$	$J_{1.2}=\sum f$	$\bar{X}_{1.2}=R_{1.2}/J_{1.2}$
	1.3	$R_{1.3}=\sum_{i=1}^{10} fx_i$	$J_{1.3}=\sum f$	$\bar{X}_{1.3}=R_{1.3}/J_{1.3}$
	1.4	$R_{1.4}=\sum_{i=1}^{10} fx_i$	$J_{1.4}=\sum f$	$\bar{X}_{1.4}=R_{1.4}/J_{1.4}$
	1.5	$R_{1.5}=\sum_{i=1}^{10} fx_i$	$J_{1.5}=\sum f$	$\bar{X}_{1.5}=R_{1.5}/J_{1.5}$
		$R_1=\sum_{i=1}^{5} R_{1.i}$	$J_1=\sum_{i=1}^{5} J_{1.i}$	
		Mean rating for factor (MRF) $X_1=R_1/J_1$		
		Normalized factor weighting (NFW) $W_1=\left[X_1 \Big/ \sum_{i=1}^{10} X_i\right]\times 100$		
Factor	Criterion	Total rating (R)	Total frequency (J)	Mean rating for criterion (MRC)
2	2.1	$R_{2.1}=\sum_{i=1}^{10} fx_i$	$J_{2.1}=\sum f$	$\bar{X}_{2.1}=R_{2.1}/J_{2.1}$
	2.2	$R_{2.2}=\sum_{i=1}^{10} fx_i$	$J_{2.2}=\sum f$	$\bar{X}_{2.2}=R_{2.2}/J_{2.2}$
	2.3	$R_{2.3}=\sum_{i=1}^{10} fx_i$	$J_{2.3}=\sum f$	$\bar{X}_{2.3}=R_{2.3}/J_{2.3}$
		$R_2=\sum_{i=1}^{3} R_{2.i}$	$J_2=\sum_{i=1}^{3} J_{2.i}$	
		Mean rating for factor (MRF) $X_2=R_2/J_2$		
		Normalized factor weighting (NFW) $W_2=\left[X_2 \Big/ \sum_{i=1}^{10} X_i\right]\times 100$		

Notes: x=rating given by each respondent; f=frequency of rating; i=range (e.g. 1–10); R=sum of ratings by respondents; J=total number of ratings given; X=arithmetic mean.

effectiveness by indicating the mean rating for each criterion (MRC) and the normalized weighting for each factor (NFW).

Further sections of the questionnaire asked experts about the existing effectiveness of the SE (relating to delay). A Likert scale, probably the most common scale for obtaining respondents' opinions (Fellows and Liu, 2003) was used for most questions. While the number of items used in such a scale can be arbitrary (Oppenheim, 1992) the principal consideration is determining the extent to which respondents agree or disagree with a particular statement or view (Cormack, 2000). Accordingly, a simple five-point scale was used. Likert scales yield ordinal data but some statisticians are of the view that it can be treated as interval data (Labovitz, 1970). This view is controversial and so advice was sought from a statistician before the responses were transposed on to a 0 to 4 rating scale. The responses to these questions were then used to calculate the mean ratings for existing effectiveness in each criterion in the same way as for ideal effectiveness. Once again, ratings were weighted for each factor and normalized. This enabled the compilation of Table 3 which shows in column 6 the current degree of SEs' efficiency against each of the criteria and factors, as assessed by the sample of experts.

Discussion of findings—the effectiveness of Libyan supervising engineers

Table 3 provides a summary of the results of the assessment of Libyan SEs. The table shows that, in general, the respondents agree that the characteristics and skills identified from the literature are important. Column 4 indicates the arithmetic mean ratings for

Table 3 Assessing the overall effectiveness of Libyan supervising engineers

Factor no.	Criterion no.	Factors and criteria	Ideal	Existing	%
1		**Obtained scientific, technical and legal knowledge at university**	**9.8**	**3.4**	**34.4**
	1.1	Knowledge of schedules and their preparation	7.6	2.3	30.4
	1.2	Studying various construction problems	7.2	2.1	29.6
	1.3	Study of construction project management	7.5	2.7	35.9
	1.4	Knowledge of the various types of contracts and forms	7.0	2.9	41.4
	1.5	Knowledge of regulations and administrative contracts	6.5	2.3	35.1
2		**Previous experience**	**10.2**	**3.8**	**37.2**
	2.1	Theoretical background	7.6	2.8	37.3
	2.2	Practical experience on site	7.5	3.5	47.8
	2.3	Training course	7.2	1.8	26.0
3		**Study of contract**	**9.1**	**4.8**	**52.7**
	3.1	Legal background	5.6	2.8	50.7
	3.2	A check, review and study of the contract	7.1	4.6	64.0
	3.3	Determination of roles, rights, responsibilities and party relationships	7	3.1	44.9
	3.4	Analysis of delay clauses, penalty and possibility of extension	6.8	3.6	53.9
	3.5	Determination of activities that may be delayed and prepared for delay	6.7	3.3	49.2
4		**Knowledge and use of modern techniques**	**10.2**	**3.8**	**37.3**
	4.1	Learning ability	7.8	3.5	45.3
	4.2	The intention and ability to improve skills	7.8	3.6	46.8
	4.3	Consideration of new technology	7.8	2.8	36.7
	4.4	Use of computer to perform his/her tasks	8.1	2.5	31.2
	4.5	Knowledge to review the contract programme (schedule)	7.4	3.1	42.9
	4.6	Use of modern techniques to modify, adjust and update the programme	6.9	2.8	41.4
	4.7	Use of modern techniques to determine and measure delay	6.8	2.1	30.9
	4.8	Use of modern techniques to deal with concurrent delay	6.9	1.5	21.8
5		**Knowledge in dealing with delay**	**11.1**	**4.4**	**39.9**
	5.1	Predicting the delay and making a decision to prevent such delays occurring	7.8	3.3	42.2
	5.2	To notice, determine and deal with delay	7.8	3.5	45.8
	5.3	Make the right decision and take action when the delay occurs	8.5	2.7	32.5
6		**Knowledge in dealing with delay claims**	**9.7**	**3.5**	**36.3**
	6.1	A knowledge about the claims and how to determine the responsibility	7.5	3.9	36.8
	6.2	Delay cost estimation and assessment	6.9	1.7	25.7
	6.3	Preparing for claims	6.8	2.0	30.3
7		**Application of documentation and MIS**	**9.8**	**4.3**	**43.8**
	7.1	Knowledge of documentation and MIS systems	6.5	3.1	47.5
	7.2	Applying a good documentation system and keeping full records on site	8.3	3.9	47.1
	7.3	Use of previous project records	6.5	2.3	35.9
8		**Dealing with changes in design, management, plans, regulations and environment**	**9.8**	**3.9**	**40.2**
	8.1	Ability to predict and cope with unforeseen circumstances	7.2	2.8	39.8
	8.2	Decision making and the ability to suggest remedies and solutions	7.7	3.9	51.5
	8.3	Crises management	6.8	2.0	30.4
	8.4	Evaluation of the change in design and cost	7	2.6	37.5
9		**Communication skills**	**9.7**	**3.1**	**32.6**
	9.1	English language	7.4	2.4	32.8
	9.2	International management	6.4	1.4	22.6
	9.3	Cultural barriers, social factors, interpretation and representation	6.8	1.7	25.0
	9.4	The ability to negotiate and resolve the conflict	7.7	3.6	47.6
10		**Other characteristics**	**10.2**	**5.5**	**54.3**
	10.1	Highly motivated, energetic, proactive and enthusiastic	7.6	3.7	48.8
	10.2	Committed, conscientious and reliable	7.1	4.3	60.1
Total—effectiveness of supervising engineers			**100**	**40.8**	

Table 4 Rank order of overall effectiveness factors and criteria

Factor no.	Factors and criteria	% effectiveness	Rank order
10	Other characteristics	54.3	1
3	Study of contract	52.7	2
7	Application of documentation and MIS	43.8	3
8	Dealing with changes in design, management, plans, regulations and environment	40.2	4
5	Knowledge in dealing with delay	39.9	5
4	Knowledge and use of modern techniques	37.3	6
2	Previous experience	37.2	7
6	Knowledge in dealing with delay claims	36.3	8
1	Obtained scientific, technical and legal knowledge at university	34.4	9
9	Communication skills	32.6	10

each of the criteria using a scale of 1 to 10 (1=no importance, 10=most important). The lower ratings are for legal background, international management, knowledge of MIS systems, and, perhaps surprisingly, knowledge of administrative contracts, all receiving average scores of 6.5 or less. Highest ratings are for making the right decision and taking action, good documentation/record keeping, and use of computer, all with average ratings over 8.0. A detailed examination of the scores does appear to expose some contradiction in the results and certainly no pattern emerges from the experts' assessment of the relative importance of hard and soft skills. What is apparent from the normalized weightings for each factor (column 4) is that factor 5—knowledge in dealing with delay—is clearly rated as the most significant, with factor 3—study of the contract being the lowest rated. All other factors have ratings which are fairly close. These results perhaps are consistent with the views expressed in the literature—both in terms of the range of skills and attributes necessary, and in the largely indeterminate nature of their relative importance.

The survey indicates that, in total, the effectiveness of Libyan SEs is approximately 41% of the ideal degree of effectiveness. Prima facie this might appear to be quite alarming in that, according to the model and data used in this study, SEs are on average somewhat less effective than might be expected. A 40.8% performance rating would represent a marginal pass mark in most construction-related undergraduate or postgraduate taught programmes of study. Conventional wisdom is that, while there will be a range of achievement within any cohort, the average ought to be between the mid-50s and lower-60s. In the UK for example, HESA (2006) figures show that 90% of engineering and technology graduates in 2005 were awarded a first, upper second or lower second class degree—classifications requiring a profile of achievement representing a minimum average of 50%. However, the assessment in this study is not of a 'cohort' and the assessment process has not been moderated so there are clear limitations to what can be interpreted from the results as they stand in absolute terms. Nevertheless, it can be observed that Libyan SEs are thought to be performing better in some tasks and worse in others: the rank order of performance is shown in Table 4. SEs appear to be particularly lacking in communication skills; obtained scientific, technical and legal knowledge at university; knowledge and dealing with delay claims; previous experience; knowledge and use of modern techniques, since their effectiveness in all these factors is assessed at less than 40%. These results should help to establish the required focus of a continuing professional development agenda and, more fundamentally, the direction of education, training and experiential learning curricula.

Conclusions

There is no existing standard scale to assess the effectiveness of SEs/project managers when dealing with delays during the construction stage of a project. This paper has devised a method for measuring existing performance against an ideal level of performance for SEs. Effectiveness has been determined via a survey incorporating a questionnaire to obtain the opinions of experts in the field. This scale is a common standard of measurement enabling comparisons between the ideal situation proposed by the experts, and the perceived levels of effectiveness in practice.

The conclusions of this study are dependent on the assessment of those included in the sample and are limited to the performance of SEs in the Libyan construction industry. Nevertheless, the factors identified and method of measuring proficiency may have a broader international resonance and relevance. Indeed, the method could be adapted to investigate the performance of SEs and others in a range of factors incorporating for example quality and cost parameters.

When an assessment of Libyan SEs is made by applying the devised method, the results show that the

total degree of effectiveness is around 41% and this is a cause for concern. Further interpretation of the findings indicates key areas for professional development and training, notably in communication skills and scientific, technical and legal knowledge. The method offered in this paper would help Consultant Bureaux in assessing, selecting and appointing SEs and project managers by ascertaining their effectiveness relating to delay, and also in employing new SEs. The model could also be used by Consultant Bureaux to assess existing SEs to determine any deficient areas.

Further research is necessary to assess the role and performance of consultants other than SEs (architects and civil engineers in the Libyan context) in the management of delays. A comparative analysis would then provide the Libyan government with a more complete diagnosis of the effectiveness of project teams in this respect.

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