# Factors Affecting Contractor Performance on Public Construction Projects

Rateb J. Sweis, Sharaf M. Bisharat, Lorina Bisharat, Ghaleb Sweis (Corresponding Author)

The University of Jordan, Amman, Jordan 11942
E-mail: gsweis@ju.edu.jo

**Abstract:** The construction industry, which has a huge effect on national economies, features several major players who both improve social living standards and develop the construction sector. These players are contractors, consultants, and owners. Each player's project performance is affected by factors that impact every aspect of a construction project. This study identified a host of factors affecting contractor performance on public projects and classified them according to Drewin's open conversion system. The most common factors were evaluated by using both the data collected through a survey conducted on construction project consultant engineers, contractors, and owners and interviews with senior professionals and managers in the field. Everyone had unique thoughts on the subject, which enhanced the questionnaire. Most correspondents agreed that financial difficulties faced by the contractor, manpower shortages (of skilled, semi-skilled, or unskilled labor), and excessive owner change orders are the leading factors directly affecting contractor performance on construction projects. Changes in government regulations and laws, contractor violations of safety rules, and modifications to materials specifications ranked among the least important factors.
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## 1. Introduction

A contract is a legally binding agreement between two or more parties to exchange something of value. Construction is considered one of the industries on which national prosperity depends (Ejaz et al., 2013). Usually based on monetary exchanges, building contracts impose both contractual and legal obligations on both parties that are difficult or impossible to change (Thomas and Ellis, 2007). A contractor is employed by a client to fulfill a contract and finish a project within a certain time. Sometimes, however, construction projects require resources that contractors are unable to provide; in such cases, subcontractors are used. Thus, one of the main factors in contractor performance is how the contractor cooperates with subcontractors, as Cheng and Huang (2012) found. As competition in the construction industry is increasing daily, every organization must measure its performance (Kulatunga et al., 2005). The measurement of performance has become the "language of progress of an organization" (Rose, 1995). No improvement in any business can be gained unless we measure its performance (Baldwin et al., 2001). Neely (1998) defined performance measurement as the "process of quantifying past actions, where measurement is the process of quantification and past actions determine current performance." In the construction process, we need to measure contractors' performance and the factors affecting it. Project performance can be investigated and evaluated using a large number of performance indicators, expressed by factors such as time, cost, quality, client satisfaction, client changes, and health and safety (Cheung et al., 2004; DETR, 2000). Many studies have investigated the project performance factors that impact contractor performance in developing countries. A shortage of manpower skills, poor supervision and site management, unsuitable leadership, and equipment failure have all contributed to construction delays in the United Arab Emirates, as Faridi and El Sayegh (2006) have reported. Hanson et al. (2003) studied the client dissatisfaction factors in South Africa's building industry and found poor workmanship and contractor incompetence to be the main factors affecting project performance, and thus contractor performance. Furthermore, customer satisfaction was found to be one of the factors affecting contractor performance and reputation in Gharakhani et al. (2013). Zulu and Chileshe (2008) investigated contactor performance in Zambia and found it below expectations, arguing that nothing can be learned from local ongoing projects that have not been completed or have been delayed. They concluded that contractors' poor performance has huge implications on competitiveness. Enshassi et al. (2009) found that the construction industry is complex, as it includes large numbers of parties as owners (or clients), contractors, consultants, stakeholders, and regulators. In a study conducted in Palestine, UNRWA (2006) found that local construction projects suffered from poor performance—especially poor contractor performance—for many reasons, such as the unavailability of materials, excessive amendments to

designs and drawings, poor coordination among respondents, ineffective monitoring and feedback, and lack of leadership skills.

## 2. Problem Statement and Study Objectives

Several factors affect contractor performance in the Jordanian construction industry. Contractor performance is often responsible for either a successful project that reflects strong contractor skills and site management or a failure that reflects the contractor's lack of experience and weak communication skills among the workers. Any factor affecting contractor performance either negatively or positively can be avoided or enhanced using several engineering techniques. This study aims to (a) identify the major factors affecting contractor performance in the Jordanian public construction sector, (b) assess the relative importance of these factors from the consultants', contractors', and owners' perspectives, and (c) identify the weaknesses of and major factors affecting negative contractor performance.

## 3. Literature Review

The construction industry represents the single largest segment of the U.S. economy. This segment represents a wide range of projects conducted every year to meet the diverse needs of owners (Russell, 1991). One of the most important players in the construction process is the contractor. The contractors convert designs and drawings into reality (Xiao and Proverbs). Regarding the factors in contractor performance, Aklnci and Fischer (1998) argued that cost overruns create a significant financial risk for both contractors and owners. Economic growth and the competitive nature of the construction market have forced contractors to reduce their markups to stay competitive (Grogan, 1995). The relationship between clients and their consultants involves a price-based contractor selection process, as Tao and Kumaraswmay (2012) have found. However, choosing the lowest offer often leads to problems such as sub-standard quality, cost overruns, and delays, which can then lead to huge legal and economic problems between project partners, as many researchers have found (Crowley and Hancher, 1995; El Waedani et al., 2006; Kumaraswamy, 2006; Palaneeswaran et al., 2007; Russell and Skibniewski, 1990). Clients and owners also affect project performance. Ahmed and Kangari (1995) argued that clients are frequently critical of contractors and that contractors logically tend to mind their own business within the terms of their contract. General project performance is affected by a number of project characteristics. Dissanayaka and Kumaraswamy (1999) found that time and cost performance factors were influenced by project team performance and the characteristics of the project and of client representations. In construction, the need to improve is clear because clients need better value from their projects, and contractors need reasonable profits to assure their long-term future (Egan, 1998). Improved contractor performance leads to improved client satisfaction, reputation, and competitiveness (Xiao and David). Contractor performance is connected to several defining factors involving time, money, cost, and labor power. Many researchers have conducted detailed investigations of contractor performance. Ireland (1985) investigated the contributions of managerial actions to reducing time and cost and increasing quality, which may help improve project performance. Researchers such as Tam and Harris (1996) have investigated building projects (especially in Hong Kong) to study the underlying factors affecting contractor performance. Hatami and Behsan (2012) found that contractors are more accepting of risks that are mentioned in contracts than of other types of risk. Assaf et al. (1996) studied contractor performance in Saudi Arabia, concentrating on the characteristics of each project, the contractor's degree of involvement, and how that affects contractor performance. Abbasnejad and Moud (2013) found that most projects in Iran suffered from delays, inflicting major damage on contractors, and that these damages were unbearable and deeply affected contractor performance, which has been found to vary among nations for a long time (Flanagan et al., 1986; Sidwell et al., 1988; Levy, 1990; Proverbs, 1998).

Each building is unique. Xiao and Proverbs show that construction processes differ from one project to another because of variations in factors such as the physical and economic environment, the team of workers involved, and the duration and location of the project. Cultures are separated by huge gaps defined by traditions and principles; these may hinder comparisons of contractor performances across countries, as seen in the attempt in Flanagan et al. (1986) to compare nine projects of similar types and scales in the UK and the U.S. in order to determine the design and construction differences between the nations. Proverbs (1998) used a hypothetical project in order to compare among the performances of contractors in the UK, France, and Germany. We have focused on international studies of contractor performance that have investigated many factors.

The main purpose of this research is to propose guidelines by which any organization dealing with a contractor may know what does and does not affect contractor performance in the public sector and thus what to do and not to do. This study can be used to

help firms improve contractor performance: knowing what is wrong with contractor performance enables the appropriate reshaping of the relevant factors. Understanding that there are several viewpoints on contractor performance—the contractor's, consultant's, and owner's—will make it easier to determine which factors affect performance positively and negatively.

A statistical analysis was conducted on the factors that may affect contractor performance, revealing agreements and disagreements among groups concerning which factors have the ultimate effect. This study shows the differences among the working segments in Jordan's construction industry regarding that issue.

## 4. Research Design and Survey Methodology

The questionnaire design was based on the open conversion system proposed by Drewin (1985).

According to Drewin, the conversion process in construction is complex, especially regarding the role of contractor, and is influenced by technology and many other factors such as government regulations, weather, unions, and economic conditions and by various internal environment components (sees Fig. 1). We enumerated the factors that may affect contractor performance and those presented in Drewin's open conversion system to arrive at a clearly structured questionnaire covering most of the major potential factors. A total of 45 potential performance factors were grouped into three major categories:

-Input Factors (IF): Labor (L), Materials (M) and Equipment (E)

-Internal Environment (IE): Contractor, Owner and Consultant

-Exogenous Factors (EF): Weather and Government Regulations

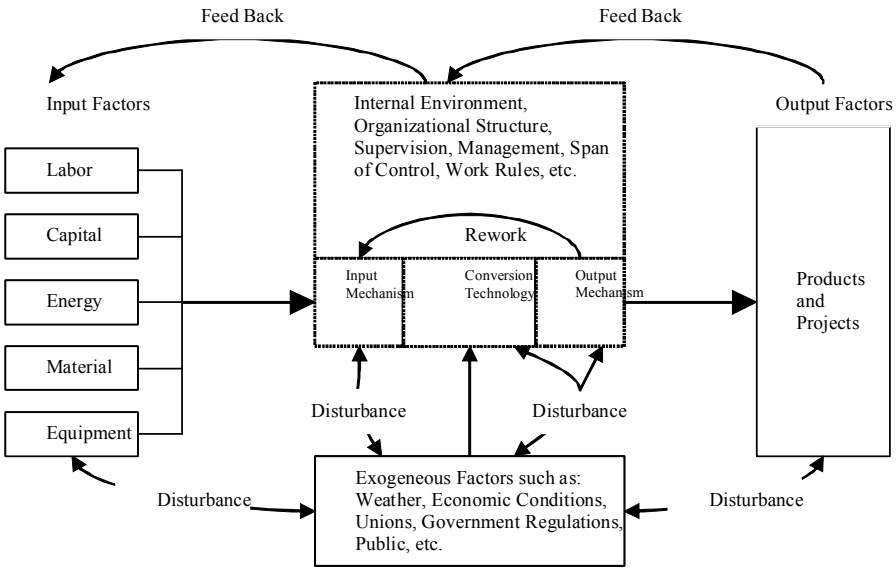


Figure 1. Drewin's Open Conversion System

Due to the huge role that the contractor plays in the construction process, the researchers developed a survey questionnaire to assess the perceptions and opinions of the contractors, consultants, and owners about the relative importance of the contractor performance factors and to measure differences in the collective perspectives and any possible popular misconception or prejudice that clearly indicates agreement or disagreement between these parties.

The questionnaire was distributed to a random sample of consultants, contractors (hired by the owner), and owners working in public construction projects in Jordan. Responses to the questionnaire were then collected and analyzed using software.

The responses of consultants, contractors, and owners were ranked according to their frequency (see Appendix A). We used SPSS software in our analyses, employing a one-way ANOVA (used to compare two or more group means to check for significant differences between them), one sample test (T-test), and a posthoc test (or a Tukey test, a single-step multiple comparison statistical test used in conjunction with an ANOVA to find means that are significantly different from each other). These

were performed on the means of the three groups' responses for each performance factor to identify any significant differences among the respondents' perceptions. Discussion of the results occurred through personal interviews conducted to clarify the responses. The interviewees were experts from the Ministry of Housing and Public Works, the Ministry of Transportation, the Association of Construction Contractors, and many other private construction company employees with long experience.

The scope of this research includes all construction industry sectors in Jordan, especially the building and government road widening sectors. Sampling was necessary because it would have been practically impossible to rank contractors' performance factors according to all the elements of the population through a census due to the huge volume of this sector. The population consists of all the consultants, contractors, and owners in the Municipality of Amman and in the other Jordanian municipalities that were actively involved in the public construction sector at the time of the study. The researchers chose to follow a simple random sampling to assure that each element in the population had an equal chance of being included. This technique was deemed most appropriate given the relatively large size of the population of consultants, contractors, and owners. The sample was selected based on the knowledge of the researchers and specialized experts, taking into consideration the low variance or homogeneity of the population elements, as in Seymour (1976). Finally a sample of 58 consultants, 48 contractors, and 49 owners was drawn, a size proportional to the population, as in Zikmund (2003).

Of the returned questionnaires, 54 were consultants', 44 were contractors', and 47 were owners'. The respondents were asked to express their perceptions of the frequencies of the performance factors mentioned in the questionnaire, which was constructed based on the compiled list of factors. The respondents used a five-point Likert scale (a psychometric scale commonly used in research employing questionnaires) to measure the severity of the factors affecting contractor performance. The scale and the weights given to each response are shown in Table 1.

Table 1. Frequency weighting scale in the research survey

| **Frequency Scale** | | | | |
|---|---|---|---|---|
| **Continual** | Frequent | Occasional | Rare | Never |
| **5** | 4 | 3 | 2 | 1 |

## 5. Data Analysis and Results

The ranking of the contractor performance factors was determined by taking the average scores of the reported data for all respondents. The resulting averages and corresponding ranks are presented in Appendix (A).

All average values above 3 are considered "accepted results" and are approved as indicators of contractor performance; the corresponding performance result is a critical factor in contractor performance for the group in question. The values are ranked according to their averages in descending order, from the highest average among the groups' response.

- The consultants' responses classified the following three performance factors as the most critical:

1. Shortage of manpower (i.e., skilled, semi-skilled, and unskilled labor)
2. Poor planning and scheduling of projects by contractors
3. Contractors' financial difficulties

- The contractor claimed that the following were the critical top three performance factors:

1. Too many change orders from owners
2. Contractors' financial difficulties
3. Owners' financial constraints

- The owners viewed the following three performance factors as the most critical:

1. Contractors' financial difficulties
2. Contractors' use of unacceptable construction techniques
3. Owners' financial constraints

## 6. Discussion of the Results

The following discussion will highlight the most important factors in contractor performance as decided by the three parties and by the experts during the post-results interviews.

- Financial difficulties faced by contractors were considered the primary and most frequent factor affecting contractor performance in Jordanian construction projects by the owners, the second most important according to the contractors, and the third most important according to the consultants. Most expert interviewees claimed that the financial difficulties faced by the contractor are a natural result of the competitive nature of the industry and that this competitive market either raises income for contractors or leads to huge losses. Furthermore, most Jordanian construction contractors, especially residential contractors, are independent, small, have limited resources and experience, and often resort to underbidding rivals to win contracts, clear evidence of the competitive nature of the market. Contractors in Jordan also have little access to credit. Together,

these factors are a recipe for cash flow problems, which eventually lead to financial difficulties. Both the contractors and the consultants clearly supported the owners' claim about contractors' financial difficulties by ranking it the second and third most important factor, respectively. Moreover, the contractors indirectly blamed their financial difficulties on the owners by ranking too many change orders from owners as the most and owners' financial constraints as the third most important contractor performance factors. Economic considerations play an important role in winning contracts and helping contractors during construction.

- Too many change orders from owners was the most important performance factor for the contractors and the fourth for the consultants. Many experts agree that excessive change orders have a tremendous effect on the financial performance of construction projects and a huge effect on their progress: they may cause delays, possibly leading to financial and legal problems. Change orders can make or break a job; changing an order can cause serious damage if the change is incorrect or poorly studied; on the other hand, it may protect the project from unseen future problems and reduce extra costs. The average cost of change orders on construction, as a percentage of the original project budget, is from 5 to 10%, according to many of the expert interviewees. The contractors clearly support the view that change orders is a major performance factor by ranking slow decision making by owners as the fifth highest performance factor.

Furthermore, contractors partly blame the consultants for the extensive change orders, as shown by the relatively high rank (seventh) given to the "ambiguities and mistakes in specifications and drawings" performance factor. We also notice, however, that both the consultants and owners blame the excessive change orders partly on the contractors' use of unacceptable techniques by ranking this factor fifth and fourth, respectively.

- Poor project planning and scheduling by contractors was ranked by both owners and consultants as one of the most important factors. Many researchers have found that a lack of communication in and planning for construction projects and a failure to prepare tasks in a well-organized manner deeply affect firm performance and cause project delays. The critical importance of this factor can clearly be seen in the relatively high ranks given by both consultants and owners to the performance factors relating directly and indirectly to "poor planning and scheduling of the project by the contractor," as noted in Table 2.

Table 2. Highly ranked factors relevant to poor planning and scheduling

| Performance cause | Ranked by consultant | Ranked by owner |
|---|---|---|
| 1. Shortage of technical professional in the contractor's organization | 11th | 17th |
| 2. Insufficient coordination among the parties by the contractor | 5th | 16th |
| 3. Ineffective quality control by the contractor | 24th | 9th |

- Manpower shortage was ranked the fourth most important performance factor by contractors, the first most important factor by consultants, and the seventh most important factor by owners. Manpower shortage (of skilled, semi-skilled, and unskilled workers) has been a serious performance factor affecting contractors working in Jordan's public construction projects because dealing with worker shortages or untrained workers on construction sites causes many project delays, which affect contractor performance in every way (e.g., financially, legally, and reputation-wise). The Middle East has been experiencing a construction boom, as warfare and the high price of oil have produced an access liquidity and thus a higher demand for investment opportunities. The Jordanian residential construction boom has been accompanied by shortages in foreign manpower, leading to higher wages and thus adding to the financial burden on contractors. This explains contractors' reliance on cheap, unskilled labor and the high ranks given by the consultants and the owners to "poor project planning and scheduling by the contractor" and "incompetent technical staff assigned to the project," respectively.

## 7. Difference in Perception Among the Three Groups

A one-way variance analysis was performed among the means of the three groups' responses to check for significant differences among the groups' perceptions of the importance of the contractor performance factors. The mean values for the three groups, the F statistics, and the P values at which a hypothesis of equality of mean values across different groups could be rejected were calculated (see Appendix B). The analysis revealed statistically non-significant differences among the respondent groups for the following factors:

1. Slow decision making by owner
2. Severe weather conditions on the job site

3. Project complexity
4. Delay in materials delivery
5. Contractors' financial difficulties

The results of our ANOVA analysis (see figs. 2 to 6) show that the means of the different groups are not significantly different from one another (Measured F's = 0.01, 0.184, 0.374, 0.412, 0.419) while the tabular critical F value at the 0.05 level for $2^{o}$ and $144^{o}$ of freedom is approximately (2.30), indicating a strong agreement among the three groups. Further analysis through the Duncan Multiple Range Test, Scheffe's test, or Tukey test is necessary to detect where the mean differences lie, since the differences are negligible.

Merging the above result with the highest-ranking factors according to the mean of the averages of the three groups (see Appendix A)—"contractors' financial difficulties," "owners' financial constraints," and "shortage of manpower (skilled, semi-skilled, unskilled labor)" reveals that "contractors' financial difficulties" is, by consensus, the leading contractor performance factor in the Jordanian public construction sector (see Fig. 2). In addition, we note a strong agreement among the respondents regarding the four lowest-scoring factors—severe weather conditions on the job site (see Fig. 3), project complexity (Fig. 4), delays in materials delivery (see Fig. 5), and slow decision making by owners (Fig. 6).

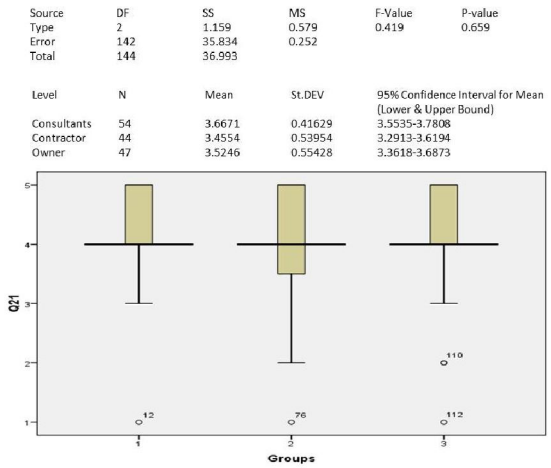


Figure 2. One-way ANOVA for "Financial difficulties faced by the contractor"

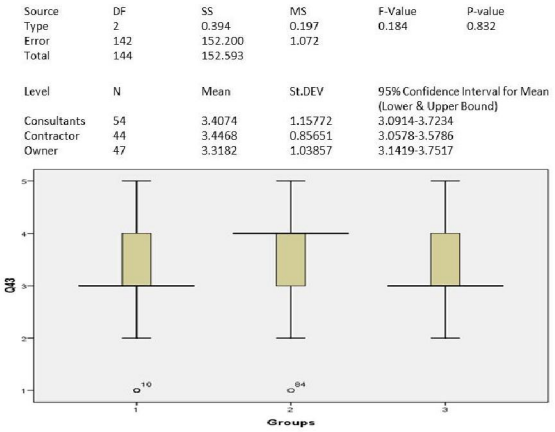


Figure 3. One-way ANOVA for "Severe weather conditions on the job site"

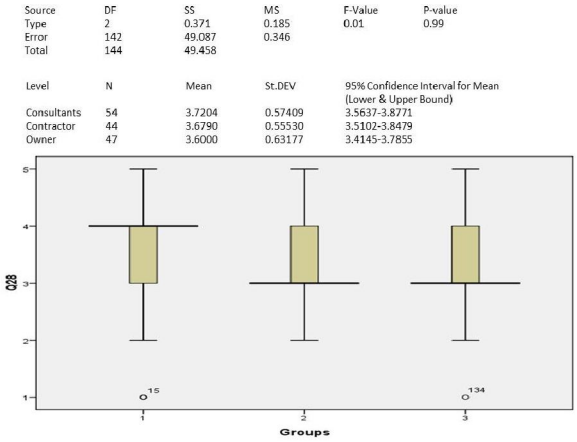


Figure 4. One-way ANOVA for "Project complexity"

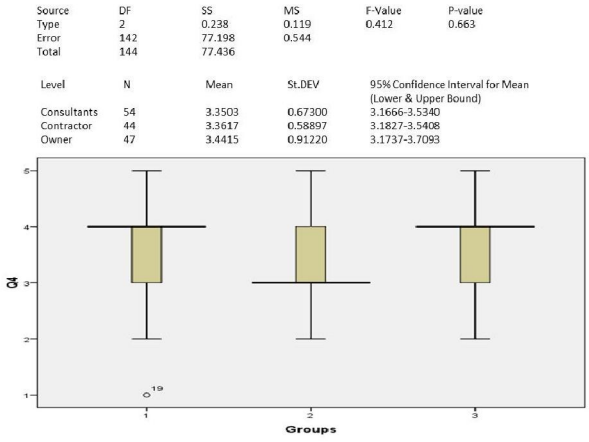


Figure 5. One-way ANOVA for "Delay in materials delivery"

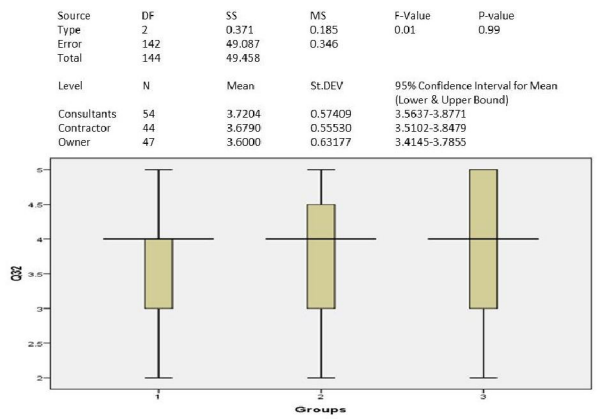


Figure 6. One-way ANOVA for "Slow decision making from owner"

## 8. Conclusion

The outcomes of this research are discussed below, concentrating on the most important performance factors as described in Drewin's open conversion system.

- The factor issuing from the contractor's internal environment, "financial difficulties," is the most important performance factor. All three groups of respondents agree on the severity of this factor, making it one of the most critical performance factors in Jordan's public construction sector. Both owners and contractors ranked "owners' financial constraints" the third most important performance factor; it was ranked fifth according to the mean of the overall averages of the three respondent groups, indicating that the financial factor has a huge effect on all parties in the construction industry. Within the owner's internal environment, "too many change orders" is viewed as the most important performance factor by contractors and as the fourth most important by consultants. This performance factor ranked as the second most important according to the mean of the average ranking of all three respondent groups. However, none of the performance factors concerning the consultant's internal environment is significant according to the overall average means of the three respondent groups.
- The exogenous factors ranked lowest by all three parties were changes in government regulations and laws and severe weather conditions on the job site. There are no significant differences among respondent perceptions regarding these performance factors. Neither government nor weather has a major effect on contractor performance during public construction projects in Jordan. Most changes in government regulations do not directly affect the construction sector, especially contractors, and Jordan's weather is rarely severe. As there is no contact between contractors and the government, except to obtain permits and approvals for construction at the early and late stages of projects, and given the stable weather, those factors have little effect on contractors' performance.
- Among input factors, labor appears to be the most significant. The shortage of manpower (skilled, semi-skilled, and unskilled) was ranked the highest by consultants and fourth highest by contractors, while owners ranked it seventh. Equipment and material were ranked low by all parties.

In sum, contractors' financial difficulties, shortage of manpower, and too many change orders from owners were the major factors affecting the performance of contractors in Jordan. Using the main concepts and terminology of Drewin's open conversion system, we note that the main effects on contractor performance are related to the internal environment of the system, especially for contractors, and to the input factors relating to labor manpower for the owners. Meanwhile, the effects of equipment and material, especially the exogenous factors, have a low or even negligible effect on contractor performance during construction projects.

## 9. How does the outcome of this investigation compare with previous research outcomes conducted in the Middle East?

In this investigation, contractors, consultants, and owners agreed on the most important factors affecting contractor performance as illustrated by the statistical results of the questionnaire. First among these important performance factors are contractors' financial difficulties, shortage of manpower, and too many change orders. These outcomes agree with the results of research conducted in Jordan by Sweis et al. (2007) and a three-year study of contractor performance in Japan, the UK, and the USA by Xiao and Proverbs (2003). The factors affecting contractor performance in the Middle East seem no different from those affecting contractors in other countries.

## 10. Implications and future research and development

This research assessed the factors affecting the performance of contractors in Jordanian public sector construction by grouping the relevant factors according to Drewin's open conversion system. The outcomes have clear implications for both the public construction sector and the construction industry at large. Ranking these factors from the consultants', contractors', and owners' perspectives provides a fresh insight into an old but critical issue in the construction sector, with its large contractor component. This research has provided solid evidence concerning the most, and the least,

significant factors affecting the performance of contractors in the Jordanian construction industry.

Finally, as this study was conducted in Jordan, its results could be applicable to other developing countries whose construction sectors include similar factors. This investigation could be used as a starting point for further study of the contractor performance issue. This study could also be improved, as follows:

- The methodology used in this research could be applied to other developing countries, thereby increasing the data bank available for future studies or for comparisons among several performance factors
- This research could be merged with studies conducted in other countries to find the common and uncommon factors affecting contractor performance so as to enable global research designed to provide guidelines for contractor performance
- This research could be merged with other types of public research conducted by foreign governmental agencies.

**Appendix (A)**

| | Consultants average | Owners average | Contractor average | Overall average |
|---|---|---|---|---|
| **Labor (L)** | | | | |
| **1 Shortage of manpower (skilled, semi-skilled, unskilled labor)** | 4.1481 | 3.7872 | 3.8864 | **3.9517** |
| **2 Presence of unskilled labor** | 3.5370 | 3.7872 | 3.2273 | **3.5241** |
| **Material (M)** | | | | |
| **3 Shortage of material** | 3.3889 | 3.5745 | 3.7500 | **3.5586** |
| **4 Delay in materials delivery** | 3.6667 | 3.4894 | 3.5909 | **3.5862** |
| **5 Materials price fluctuations** | 3.2963 | 3.4043 | 3.1860 | **3.2986** |
| **6 Modifications in materials specifications** | 3.0377 | 3.2979 | 2.9318 | **3.0903** |
| **Equipment (E)** | | | | |
| **7 Shortage of equipments** | 3.6852 | 3.4255 | 3.3864 | **3.5103** |
| **8 Failure of equipments** | 3.4444 | 3.3617 | 2.7955 | **3.2207** |
| **9 Insufficient equipments** | 3.5556 | 3.5106 | 3.0227 | **3.3793** |
| **Internal Environment (IE)** | | | | |
| **Contractor** | | | | |
| **10 Lack of contractor's administrative personnel** | 3.6852 | 3.4043 | 3.2500 | **3.4621** |
| **11 Shortage of technical professionals in the contractor's organization** | 3.8113 | 3.6170 | 3.6744 | **3.7063** |
| **12 Insufficient coordination among the parties by the contractor** | 3.8704 | 3.6596 | 3.5227 | **3.6966** |
| **13 Delay in mobilization** | 3.4074 | 3.3404 | 2.8636 | **3.2207** |
| **14 Safety rules and regulations are not followed within the contractor's organization** | 3.4074 | 3.2766 | 3.0455 | **3.2552** |
| **15 Incompetent technical staff assigned to the project** | 3.7037 | 3.4043 | 3.6818 | **3.6000** |
| **16 Improper technical study by the contractor during the bidding stage** | 3.5926 | 3.7021 | 3.7727 | **3.6828** |
| **17 Poor planning and scheduling of the project by the contractor** | 4.1296 | 3.7826 | 3.8182 | **3.9236** |
| **18 Improper handling of the project progress by the contractor** | 3.7778 | 3.5106 | 3.5814 | **3.6319** |
| **19 Ineffective quality control by the contractor** | 3.6481 | 3.8085 | 3.5455 | **3.6690** |
| **20 Use of unacceptable construction techniques by the contractor** | 3.8148 | 3.8936 | 3.4773 | **3.7379** |
| **21 Financial difficulties faced by the contractor** | 4.0926 | 3.9787 | 4.1591 | **4.0759** |
| **22 Delays in contractor's payments to subcontractors** | 3.7222 | 3.7021 | 3.4091 | **3.6207** |
| **23 Number of new projects/year** | 3.5000 | 3.1915 | 3.0909 | **3.2759** |
| **24 Employee attitudes** | 3.4074 | 3.1702 | 3.3636 | **3.3172** |

**Appendix A *(continued)***

| | Consultants average | Owners average | Contractor average | Overall average |
|---|---|---|---|---|
| **25 Employees motivation** | 3.4815 | 3.2979 | 3.3636 | **3.3862** |
| **26 Application of health and safety factors in organization** | 3.2963 | 3.1739 | 3.1163 | **3.2028** |
| **Owner** | | | | |
| **27 Delays in site preparation** | 3.7963 | 3.4681 | 3.3023 | **3.5417** |
| **28 Project complexity** | 3.4815 | 3.3404 | 3.3488 | **3.3958** |
| **29 Delay in contractor's claims settlements** | 3.5000 | 3.3617 | 3.5227 | **3.4621** |
| **30 Work suspension by the owner** | 3.6667 | 3.3404 | 3.7955 | **3.6000** |
| **31 Too many change orders from owner** | 3.9630 | 3.8085 | 4.2045 | **3.9862** |
| **32 Slow decision making from owner** | 3.8148 | 3.8298 | 3.8409 | **3.8276** |
| **33 Inference by the owner in the construction operations** | 3.7963 | 3.4255 | 3.4091 | **3.5586** |
| **34 Delay in progress payments by the owner** | 3.8519 | 3.8298 | 3.6364 | **3.7793** |
| **35 Financial constraints faced by the owner** | 3.8333 | 3.8723 | 4.0455 | **3.9103** |
| **36 Insufficient coordination among the parties by the owner** | 3.5000 | 3.7234 | 3.6591 | **3.6207** |
| **Consultant** | | | | |
| **37 Ambiguities and mistakes in specifications and drawings** | 3.6296 | 3.8298 | 3.7727 | **3.7379** |
| **38 Poor qualification of consultant engineer's staff assigned to the project** | 3.8148 | 3.8511 | 3.6136 | **3.7655** |
| **39 Delay in the approval of contractor submissions by the engineer** | 3.7222 | 3.5532 | 3.3864 | **3.5655** |
| **40 Poor coordination by the consultant engineer with the parties involved** | 3.7593 | 3.4043 | 3.3409 | **3.5172** |
| **41 Slow response by the consultant engineer regarding testing and inspection** | 3.6111 | 3.3830 | 3.4545 | **3.4897** |
| **42 Slow response by the consultant engineer to contractor inquiries** | 3.7407 | 3.4255 | 3.5227 | **3.5724** |
| **Exogenous Factors (EF)** | | | | |
| **Weather** | | | | |
| **43 Severe weather conditions on the job site** | 3.4074 | 3.4468 | 3.3182 | **3.3931** |
| **Government regulations** | | | | |
| **44 Difficulties in obtaining work permits** | 3.1481 | 3.4681 | 3.3864 | **3.3241** |
| **45 Changes in Government regulations and laws** | 2.9815 | 3.2766 | 2.9773 | **3.0759** |

**Appendix (B)**

| | Overall average | P-Values | F-Values |
|---|---|---|---|
| **Labor (L)** | | | |
| • **Shortage of manpower (skilled, semi-skilled, unskilled labor)** | 3.9517 | 0.133 | **2.043** |
| • **Presence of unskilled labor** | 3.5241 | 0.041 | **3.270** |
| **Material (M)** | | | |
| • **Shortage of materials** | 3.5586 | 0.309 | **1.184** |
| • **Delay in materials delivery** | 3.5862 | 0.663 | **0.412** |
| • **Materials price fluctuations** | 3.2986 | 0.538 | **0.623** |
| • **Modifications in materials specifications** | 3.0903 | 0.215 | **1.555** |
| **Equipment (E)** | | | |
| • **Shortage of equipments** | 3.5103 | 0.343 | **1.078** |
| • **Failure of equipments** | 3.2207 | 0.005 | **5.439** |
| • **Insufficient equipments** | 3.3793 | 0.018 | **4.157** |
| **Internal Environment (IE)** | | | |
| **Contractor** | | | |
| • **Lack of contractor's administrative personnel** | 3.4621 | 0.092 | **2.425** |
| • **Shortage of technical professionals in the contractor's organization** | 3.7063 | 0.571 | **0.563** |
| • **Insufficient coordination among the parties by the contractor** | 3.6966 | 0.145 | **1.959** |

| | | | |
|---|---|---|---|
| • **Delay in mobilization** | 3.2207 | 0.016 | **4.239** |
| • **Safety rules and regulations are not followed within the contractor's organization** | 3.2552 | 0.183 | **1.721** |
| • **Incompetent technical staff assigned to the project** | 3.6000 | 0.165 | **1.825** |
| • **Improper technical study by the contractor during the bidding stage** | 3.6828 | 0.644 | **0.442** |
| • **Poor planning and scheduling of the project by the contractor** | 3.9236 | 0.160 | **1.855** |
| • **Improper handling of the project progress by the contractor** | 3.6319 | 0.275 | **1.302** |
| • **Ineffective quality control by the contractor** | 3.6690 | 0.316 | **1.160** |
| • **Use of unacceptable construction techniques by the contractor** | 3.7379 | 0.104 | **2.295** |
| • **Financial difficulties faced by the contractor** | 4.0759 | 0.659 | **0.419** |
| • **Delays in contractor's payments to subcontractors** | 3.6207 | 0.173 | **1.779** |
| • **Number of new projects/year** | 3.2759 | 0.066 | **2.777** |
| • **Employee attitudes** | 3.3172 | 0.408 | **0.903** |
| • **Employees motivation** | 3.3862 | 0.627 | **0.468** |

**Appendix B (*continued*)**

| | **Overall average** | **P-Values** | **F-Values** |
|---|---|---|---|
| • **Application of health and safety factors in organization** | 3.2028 | 0.649 | **0.434** |
| **Owner** | | | |
| • **Delays in site preparation** | 3.5417 | 0.061 | **2.856** |
| • **Project complexity** | 3.3958 | 0.689 | **0.374** |
| • **Delay in contractor's claims settlements** | 3.4621 | 0.660 | **0.417** |
| • **Work suspension by the owner** | 3.6000 | 0.093 | **2.413** |
| • **Too many change orders from owner** | 3.9862 | 0.123 | **2.130** |
| • **Slow decision making from owner** | 3.8276 | 0.990 | **0.010** |
| • **Inference by the owner in the construction operations** | 3.5586 | 0.087 | **2.488** |
| • **Delay in progress payments by the owner** | 3.7793 | 0.475 | **0.748** |
| • **Financial constraints faced by the owner** | 3.9103 | 0.441 | **0.824** |
| • **Insufficient coordination among the parties by the owner** | 3.6207 | 0.424 | **0.863** |
| **Consultant** | | | |
| • **Ambiguities and mistakes in specifications and drawings** | 3.7379 | 0.602 | **0.509** |
| • **Poor qualification of consultant engineer's staff assigned to the project** | 3.7655 | 0.412 | **0.893** |
| • **Delay in the approval of contractor submissions by the engineer** | 3.5655 | 0.224 | **1.512** |
| • **Poor coordination by the consultant engineer with the parties involved** | 3.5172 | 0.050 | **3.059** |
| • **Slow response by the consultant engineer regarding testing and inspection** | 3.4897 | 0.451 | **0.801** |
| • **Slow response by the consultant engineer to contractor inquiries** | 3.5724 | 0.240 | **1.439** |
| **Exogenous Factors (EF)** | | | |
| **Weather** | | | |
| **Severe weather conditions on the job site** | 3.3931 | 0.832 | **0.184** |
| **Government Regulations** | | | |
| • **Difficulties in obtaining work permits** | 3.3241 | 0.241 | **1.439** |
| • **Changes in Government regulations and laws** | 3.0759 | 0.294 | **1.233** |

**Corresponding Author:**
Dr. Ghaleb J. Sweis
Department of Civil Engineering
The University of Jordan
Amman 11942, Jordan
E-mail: gsweis@ju.edu.jo

**References**

1. Abbasnejad, B. and Moud, H.I. (2013), Construction Delays in Iranian Civil Engineering Projects: An Approach to Financial Security of Construction Business, Life Science Journal, Vol. 10 No. 2, pp. 2632-2637
2. Ahmed, S.M. and Kangari, R. (1995), Analysis of Client-Satisfaction Factors in Construction Industry, Journal of Management in Engineering, No. 11, pp. 36-44

3. Assaf, S.A., Al-Hammad, A. and Ubaid, A. (1996), Factors affecting construction contractors' performance, Building Research and Information, Vol. 24 No. 3, pp. 63-159
4. Akinci, B. and Fischer M. (1998), Factors Affecting Contractors' Risk of Cost Overburden, Journal of Management in Engineering, Vol. 14 No. 1, pp. 67-76
5. Baldwin, A., McCaffer, R. and Osman, I.I. (2001), Project performance in a contracting organization: Analysis, evaluation and development, CIB World congress, Willington, New Zealand
6. Cheng, M.Y., Huang, C.C. (2012), Evaluating Subcontractor Performance Using Evolutionary Gaussian Process Inference Model, Life Science Journal, Vol. 9 No. 2, pp.527-532
7. Cheung, S.O., Suen, H. C. H., Cheung, K. K. W. (2004), PPMS: a Web-based construction project performance monitoring system, Automation in Construction, No. 13, pp. 361-376
8. Crowley, L.G. AND Hancher, D.E. (1995), Evaluation of Competitive Bids, Journal of Construction Engineering and Management, Vol. 121 No. 2, pp.45-238
9. Department of the Environment, Transport and the Regions (DETR), (2000), KPI Report for the minister for Construction by the KPI Working Group, January 2000
10. Dissanayaka, S.M. and Kumaraswamy, M.M. (1999), Comparing Contributors to Time and Cost Performance in Buliding Projects, Building and Environment, No. 34, pp.31-42
11. Drewin FJ. Construction productivity: measurement and improvement through work study. Elsevier; 1985
12. Egan, J. (1998), Rethinking Construction: Report of the Construction Task Force on the Scope for Improving the Quality and Efficiency of UK Construction, Department of the Environment, Transport and the Regions, London
13. Ejaz, N., Hussain, J., Shabbir, F., Shamim, M.A., Naeem, U.A., Tahir, M.F., Ahmad, N. and Frooq, Q.U. (2013), Assessment of Most Critical Success Factors for Mega Construction Projects in Pakistan, Life Science Journal, Vol. 10 No. 10s, pp.255-261
14. El Wardani, M.A., Messner, J.I. and Horman, M.J. (2006), Comapring Procurement Methods for Design-Build Projects, Journal of Construction Engineering and Management, Vol. 132 No. 3, pp. 8-230
15. Enshassi, A., Mohamed, S. and Abushaban, S. (2009), Factors Affecting the Performance of Construction Projects in the Gaza Strip, Journal of Civil Engineering and Management, Vol. 15 No. 3, pp. 269-280
16. Flanagan, R., Norman, G., Ireland, V. and Ormerod, R. (1986), A Fresh look at the UK and Us Building Industries, Buliding Employers Confederation, London
17. Faridi, A. and El-Sayegh, S. (2006), Significant factors causing delay in the UAE construction industry, Construction Management and Economics, Vol. 24 No. 11, pp. 1167-1176
18. Gharakhani, D., Sinaki, M.T., Dobakhshari, M.A. and Rahmati, H. (2013), the Relationship of Customer Orientation, Customer Satisfaction, Customer Loyalty and Innovation in Small and Medium Enterprises, Life Science Journal, Vol. 10 No. 6s, pp. 684-689
19. Grogan, T., Special report: forecast '95. (1995),Engrg. News Rec., Vol. 234 No. 4, pp. 43-46
20. Hanson, D., Mbachu, J. and Nkando, R. (2003), Causes of client dissatisfaction in the South African Building industry and ways of improvement: the contractors' perspectives, in CIDB, South Africa
21. Hatami, F. and Behsan, H. (2012), Evaluation and Investigation of Risk Management in Iranian Construction Industry, Life Science Journal, Vol. 9 No. 4, pp. 387-399
22. Ireland, V. (1985), The role of managerial actions in the cost, time and quality performance of high-rise commercial building projects, Construction Management and Economics, Vol 3, pp. 59-87
23. Kulatunga, U., Amaratunga, R.D.G. and Haigh, R. (2005), Performance Measurement Applications within the UK Construction Industry: A Literature Review, in: 5th International Postgraduate Conference in the Built and Human Environment, the Lowry, Salford Quays, UK
24. Kumaraswamy, M. (2006), Exploring the legal Aspects of Relational Contracting, Journal of Professional Issues in Engineering Education and Practise, Vol. 132 No. 1, pp. 3-42
25. Levy, S.M. (1990), Japanese Construction: An American Perspective, Van Nostrand Reinhold, New York, NY
26. Neely, A. (1998), Measuring Business performance, Economist books, London
27. Palaneeswaran, E., Kumaraswamy, M., Ng, T. and Lam, K. (2007), Reinforcing Lowest Priced-Based Contractor Selections-a Reinvention Perspective, Proceedings of Symposium: Building across Borders Built Environment Procurement, CIB W092

Procurement Systems. Hunter Valley, Australia, 23-26 September, pp. 192-200
28. Proverbs, D.G. (1998), A best practice model for high-rise in situ concrete construction based on French, German and UK contractor performance measures, PhD Thesis, University of Wolverhampton, Wolverhampton
29. Rose, K.H. (1995), A PM model, Quality Progress, pp. 63-66
30. Russell, J.S. (1991), Contractor Failure: Analysis, Journal of Performance of Constructed Facilities, Vol.5 No. 3, pp.163-180
31. Russell, J.S. and Skibniewski, M.J. (1990), Qualifier-1: Contractor Prequalification Model, Journal of Computing in Civil Engineering, Vol. 4 No. 1, pp. 77-90
32. Seymour, S. (1976), Applied Sampling, New York: Academic Press, pp.7-86
33. Sidwell, A.C., Van Metzinger, W.A. and Tucker, R.L. (1988), Japanese, Korean, and US Construction Industry, the University of Texas, Austin, TX
34. Sweis, G., Sweis, R., Abu Hammad, A. and Shboul, A. (2007), Delays in Construction Projects: the Case of Jordan, International Journal of Project Management
35. Tam, C.M. and Harris, F. (1996), Model for Assessing Building Contractors' Project Performance, Engineering, Construction and Architectural Management, Vol. 3 No. 3, pp. 187-203
36. Tao, L. and Kumaraswamy, M. (2012), Unveiling Relationships between Contractor Inputs and Performance Outputs, Construction Innovation, Vol. 12 No. 1, pp. 86-98
37. Thomas, H. and Ellis, R.JR. (2007), What is a Contract?, Interpreting Construction Contracts, pp. 10-16
38. UNRWA, (2006), Projects Completion Reports, UNRWA, Gaza
39. Xiao,H. and Proverbs, D.G. (2003), Factors Influencing Contractor Performance: An International Investigation, Engineering, Construction and Architectural Management, Vol. 10 No. 5, pp.322-332
40. Zikmund, W. (2003), Business Research Methods (Thomson-South-Western), pp.89-388
41. Zulu, S. and Chileshe, N. (2008), the Impact of Service Quality on Project Performance: a Case Study of Building Maintenance Services in Zambia, in Proc. Of the 3rd Built Environment Conference, Association of Schools of Schools of Construction of Southern Africa, Cape Town, South Africa.

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