

Factors Affecting Construction Productivity In Saudi Arabia

Abdulaziz Alghonamy

*Engineering College, University of Hail, Hail, Saudi Arabia
alghonamy@yahoo.com*

Abstract

Productivity of various trades in construction is the basis of arriving at estimates for time and cost required to complete a construction process. However, it is sensitive to changing variables such as material, labors, environmental, and managerial. This paper reports on a survey made on contractors of building projects in Saudi Arabia, where an increase in productivity is being sought. Respondents were required to rate using their experience how 38 factors affect productivity. The survey was carried out by a questionnaire. Based on factor source, the 38 affecting factors have been classified into 5 categories: financial, labors, managerial, environmental, and equipments and materials. The results show that the top five factors affecting construction productivity in Saudi Arabia from contractors' perspective are: (1) poor communication and coordination between construction parties, (2) low wages, (3) lack of labor experience, (4) frequent change orders, (5) stoppages because of work being rejected by consultants.

Keywords: labors, productivity, contractors, severity, construction, ranking.

Introduction

Productivity rates are among the most essential data needed in the construction industry. The accuracy of productivity rates is crucial for the determination of direct relationships between these rates and subjects such as estimating, cost control, scheduling, and resource management. The construction projects have experienced great variation in production rate values that affected by series of the influence factors. Researchers have reported that labor costs account for between 30 and 50% of a project's total cost (Al-Saleh, 1995; Harmon et al., 2006; Hanna, 2001), others concluded that poor productivity of construction workers is one of the most daunting problems faced by construction industries, especially those in developing countries and it is one of the main cost overrun and delay causes in construction projects (Mahamid, 2013; Alinaitwe et al., 2007; Liu et al., 2008). Accordingly, efforts should be paid to this driving factor in construction industry to improve the performances in construction projects.

In Saudi Arabia, the construction industry contributed between 30% to 40% of the non-oil productive sectors at the end of each National Development Plan from 1980 to 2000. It is the second largest industry in the Kingdom behind the oil industry in terms of money volume and number of persons employed; around 28% of the work force (Cordsman, 2000). Therefore, any improvement in the construction productivity would produce billions in saving for the country. This study aims at identifying the factors leading to unproductive time in construction projects in Saudi Arabia from contractors' viewpoint. To do so, 32 contractors completed a structured questionnaire survey and the factors were ranked according to their levels of severity. 38 factors were identified through detailed literature review and interviews involving some local construction experts. Based on factor source, the considered factors were classified under 5 groups: financial, labors, managerial, environmental, and equipments and materials.

Literature Review

Many previous studies were conducted to identify the factors affecting labor productivity in construction projects. Rojas and Aramvareekul (2003) did a web-based survey to identify the relative importance of 18 factors affecting labor productivity. A total of 64 responses from owners, consultants, general contractors, electrical contractors, and mechanical contractors were sampled. Factors were categorized under four categories, including management systems and strategies, man power, industry environment and external conditions. The survey results indicated that management systems and strategies had the greatest influence on labor productivity, followed by manpower, industry environment, and external conditions. Liberda et al. (2003) conducted a study to identify the relative importance of 51 productivity factors grouped under the headings of labor, management, and external factors by interviewing 20 industry experts. Management factors, such as lack of detail planning, inadequate supervision, and lack of information, were found to account for half of the most critical 15 factors. Kaming et al. (1997) conducted a study to address the main problems of construction productivity in Indonesia. The study proved that the craftsmen lose time because of internal delays, waiting, extra breaks, relaxation, supervision delay, and lack of skill. They found that the average of non-productive work is estimated to be 18%, and the main craftsmen's productivity problems in Indonesia were identified as lack of material and followed by rework, absenteeism, interference, lack of tools and equipment break downs. The results are consistent with similar studies conducted in the United States found that the average of non-productive work is estimated to be between 30% and 36% (Oglesby et al., 1989; Levy, 1990).

Shehata and El-Gohary (2011) conducted a case study in construction project in Egypt to provide a guide for necessary steps required to improve construction labor productivity and consequently, the project performance. They stated that "the main problems of the construction industry are: its declining rate of productivity and lack of productivity standards. Mahamid (2013) conducted a study aims at identifying the factors affecting labor productivity in building construction projects in the West Bank

in Palestine from contractors' viewpoint. 31 factors were considered in a questionnaire survey. The results revealed that the top five factors negatively affecting labor productivity in building construction are: rework, lack of cooperation and communication between construction parties, financial status of the owner, lack of labor experience, and lack in materials. In UAE, Ailabouni et al. (2007) concluded that the main factors affecting labor productivity in construction projects include: proper work timings giving a balance between work and time for family, leadership skills of supervisors, technical qualifications, whether they are well paid or not and on time, security of job, transparency and accountability of management, payment of overtime, whether materials are available, procedures, policies, work method statements are available, personal skills, competency of supervisors and knowledge of work on an individual level.

Ng et al. (2004) conducted a questionnaire survey in Hong Kong to identify the demotivating factors influencing the productivity of civil engineering projects from craft workers perspectives. They concluded that overcrowded work areas and rework are the most negatively affecting factors on the productivity of workers in civil engineering projects in Hong Kong. Alinaitwe et al. (2007) conducted a study to identify the factors negatively affecting labor productivity in construction projects in Uganda. The study reported on a questionnaire survey made on project managers of building projects. Respondents were required to rate using their experience how 36 factors affect productivity with respect to time, cost and quality. They found that the top ten factors affecting labor productivity are: incompetent supervisors, lack of skills from the workers, rework, lack of tools/equipment, poor construction methods, poor communication, inaccurate drawings, stoppages because of work being rejected by consultants, insecurity, tools/equipment breakdown, and harsh weather conditions.

Abdul Kadir et al. (2005) from Malaysia did survey of 100 respondents consisting of 70 contractors, 11 developers and 19 consultants. They used relative importance index method to carry out the ranking of criteria affecting labor productivity as per their study critical factors were :(1) technology, (2) human or labor, (3) management, and(4)external. Jarkas and Bitar (2012) carried out a survey in Kuwait. The objective of this research was to identify and rank the relative importance of factors perceived to affect labor productivity on construction sites. To achieve this objective, a statistically representative sample of the contractors was invited to participate in questionnaire survey, comprising 45 productivity factors. As per their finding important factor were: (1) Clarity of technical specifications, (2) Extent of variation/change orders during execution, (3) Coordination level among various design disciplines.

Research Method

The methodology of the study is as follows:

1. Thirty eight (38) factors that might affect construction productivity in Saudi Arabia were identified through literature review and discussion with some construction experts. The similar factors were grouped under one main group; the factors were divided into 5 groups: financial, labors, managerial,

environmental, and equipments and materials. The factors were tabulated in a questionnaire form.

2. Questionnaire consisting of two parts was developed. In Part I personal Information of the respondent (for e.g. work experience, organization, annual volume of construction work) was asked. Part II was aimed to obtain information about factors affecting construction productivity. Respondents were asked to rate the extent to which the identified factors affecting the construction productivity on a five-point Likert scale. The respondent has to choose one of the categories very high, high, moderate, low and very low (on 5 to 1 point scale).
3. A survey was conducted through personal interviews in which respondents were asked to score the identified factors according to their experience. Forty (40) contractors were approached for these surveys out of which thirty two (32) responses were received with the response rate of 80%. On average, the respondents have more than 5 years experience in construction projects.
4. The Following formulas have been used to determine the importance index:

(a) Severity index:

$$\text{Severity Index (S.I)} = \frac{5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \quad \text{Eq. (1)}$$

Where

n_1 = number of responses for “Very severe” degree of severity

n_2 = number of responses for “Severe” degree of severity

n_3 = number of responses for “Neutral” degree of severity

n_4 = number of responses for “Not Severe” degree of severity

n_5 = number of responses for “Strongly Not Severe” degree of severity, and n_1 , n_2 , n_3 , n_4 , and n_5 each have a weight of 5, 4, 3, 2, and 1 respectively.

- (b) The group index was calculated by using the average of the severity indexes of the factors under each group.

Results and Discussion

In this study, 38 factors influencing construction productivity were identified and ranked by measurement of severity index according to Eq. (1). These factors were classified into five groups: labor, managerial, environmental, materials and equipments, and financial.

Factors ranking

Labor group

Table 1 and Figure 1 show the ranking of factors under labor group. 10 factors are identified under this group. The results show that the top three severe factors are: lack

of labor experience, misunderstanding between labors and superintendents, and craft turnover.

Table 1: Ranking of factors under labor group

Factor	S.I	Rank
Lack of labor experience	78.44	1
Misunderstanding between labors and superintendents	62.31	2
Craft turnover	59.09	3
Labor personal problems	57.78	4
Labor disloyalty	51.89	2
Bad labor relations	50.89	6
Overmanning	48.11	7
Lack of competition	47.89	8
Lack of labors in the market	38.65	9
Labor absenteeism	35.08	10

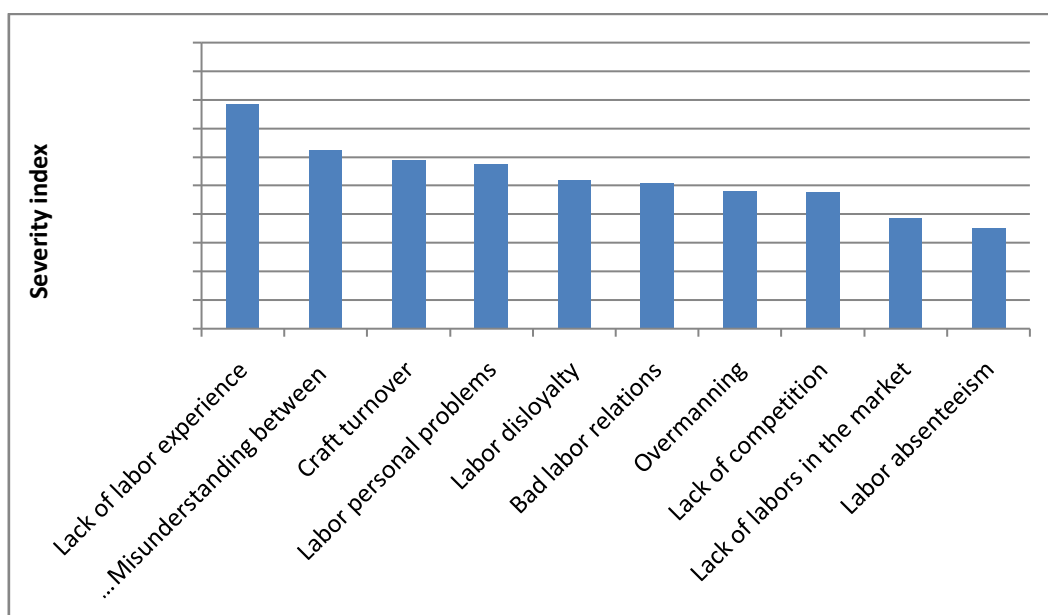


Figure 1: Severity scores of factors under labor group

Managerial group

Table 2 and Figure 2 illustrate the ranking of factors under managerial group. 14 factors are identified under this group. The results show that the top three important factors negatively affecting labor productivity under this group are: poor communication and coordination between construction parties, frequent change orders, and stoppages because of work being rejected by consultants.

Table 2: Ranking of factors under managerial group

Factor	S.I	Rank
Poor communication and coordination between construction parties	83.40	1
Frequent change orders	78.16	2
Stoppages because of work being rejected by consultants	76.14	3
Rework	73.60	4
Poor site management	71.67	5
Lack of training sessions for labors	66.40	6
Bad relations between labors and management team	66.40	7
Lack of labor surveillance	62.89	8
Incomplete drawings	61.00	9
Misuse of time schedule	59.81	10
Lack of supervisors experience	52.80	11
Poor construction method	49.12	12
Mistakes in design	48.23	13
Inspection delay	43.45	14

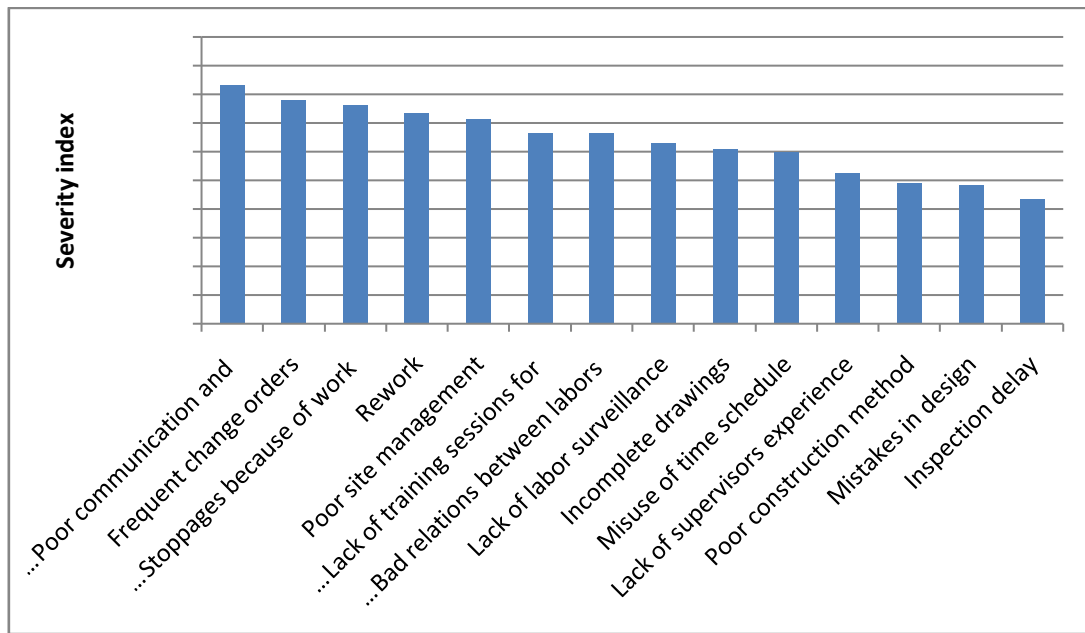
**Figure 2:** Severity scores of factors under managerial group*Environmental group*

Table 3 and Figure 3 show the ranking of factors under environmental group. 4 factors are identified under this group. The factors are ranked as follow: project size (ranked first), project conditions (ranked second), project location (ranked third), and weather (ranked fourth)

Table 3: Ranking of factors under environmental group

Factor	S.I	Rank
Project size	61.68	1
Project conditions	56.50	2
Project location	46.33	3
Weather	41.98	4

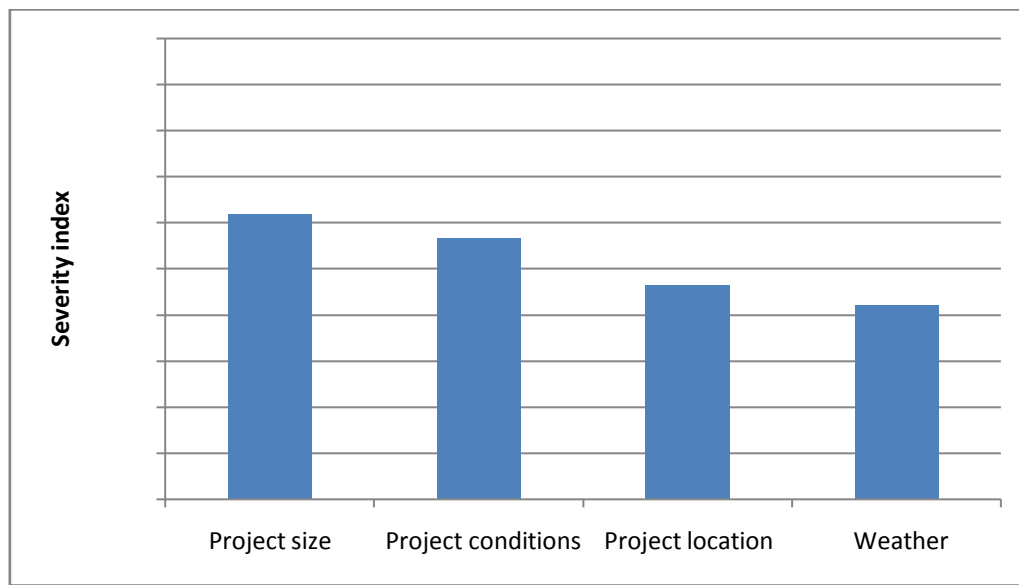
**Figure 3:** Severity scores of factors under environmental group*Materials and equipments group*

Table 4 and Figure 4 show the ranking of factors under material and equipments group. 5 factors are identified under this group. The results show that the top three severe factors are: unsuitable materials storage location, lack of tools/equipment, and low quality of raw materials

Table 4: Ranking of factors under material and equipment group

Factor	S.I	Rank
Unsuitable materials storage location	62.40	1
Lack of tools/equipment	58.03	2
Low quality of raw materials	57.20	3
Tools/equipment breakdown	48.05	4
Material shortages	46.32	5

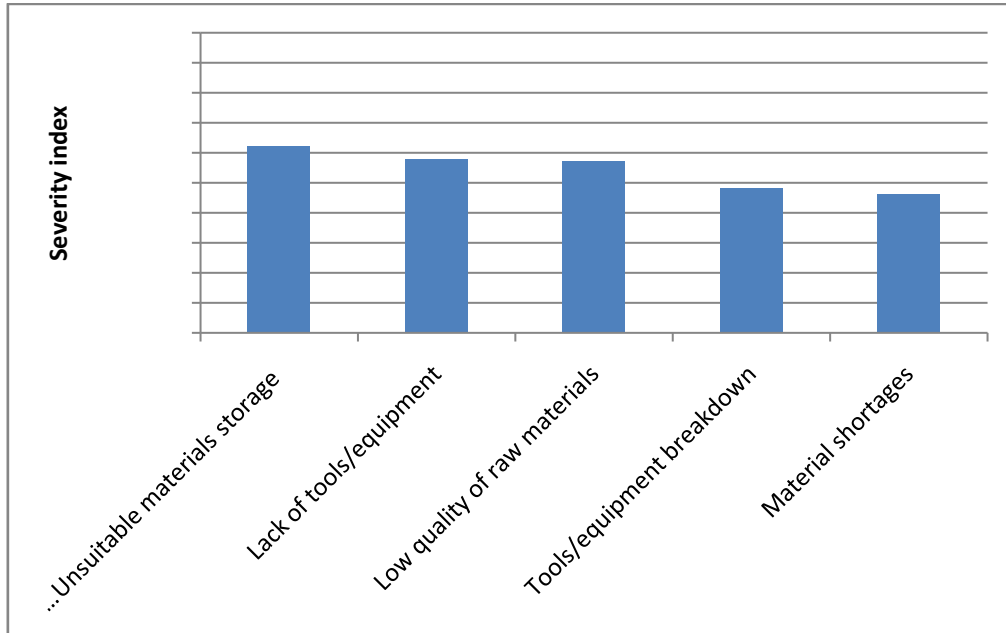


Figure 4: Severity scores of factors under material and equipment group

Financial group

Table 5 and Figure 5 show the ranking of factors under financial group. 5 factors are identified under this group. The results show that the top three sever factors under this group are: low wages, payment delay by the contractor to the labors, and lack of financial motivation system.

Table 5: Ranking of factors under financial group

Factor	S.I	Rank
Low wages	80.12	1
Payment delay by the contractor to the labors	76.14	2
Lack of financial motivation system	67.20	3
Delay payments by the owner	56.80	4
Payment delay by the contractor to the suppliers	55.00	5

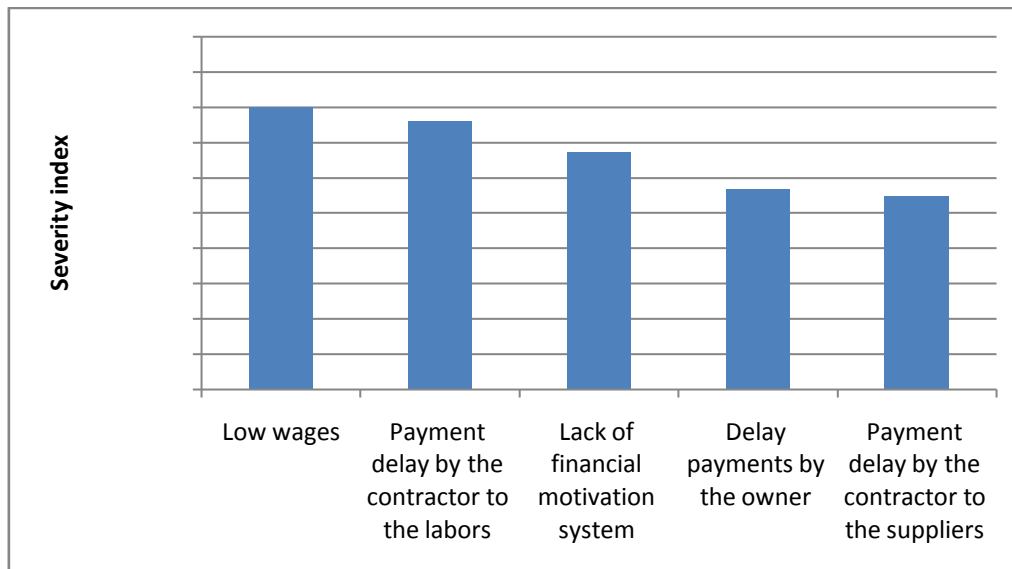


Figure 5: Severity scores of factors under financial group

Overall factors ranking

The severity index and ranking of all investigated 38 factors that might affect construction productivity are listed in Table 6.

Table 6: Overall factors ranking

Factor	S.I	Rank
Poor communication and coordination between construction parties	83.40	1
Low wages	80.12	2
Lack of labor experience	78.44	3
Frequent change orders	78.16	4
Stoppages because of work being rejected by consultants	76.14	5
Payment delay by the contractor to the labors	76.14	6
Rework	73.60	7
Poor site management	71.67	8
Lack of financial motivation system	67.20	9
Lack of training sessions for labors	66.40	10
Bad relations between labors and management team	66.40	11
Lack of labor surveillance	62.89	12
Unsuitable materials storage location	62.40	13
Misunderstanding between labors and superintendents	62.31	14
Project size	61.68	15
Incomplete drawings	61.00	16
Misuse of time schedule	59.81	17

Craft turnover	59.09	18
Lack of tools/equipment	58.03	19
Labor personal problems	57.78	20
Low quality of raw materials	57.20	21
Delay payments by the owner	56.80	22
Project conditions	56.50	23
Payment delay by the contractor to the suppliers	55.00	24
Lack of supervisors experience	52.80	25
Labor disloyalty	51.89	26
Bad labor relations	50.89	27
Poor construction method	49.12	28
Mistakes in design	48.23	29
Overmanning	48.11	30
Tools/equipment breakdown	48.05	31
Lack of competition	47.89	32
Project location	46.33	33
Material shortages	46.32	34
Inspection delay	43.45	35
Weather	41.98	36
Lack of labors in the market	38.65	37
Labor absenteeism	35.08	38

The results show the followings:

- There are 8 factors with severity index higher than 70%; two of them are higher than 80%
- There are 8 factors with severity index higher than 60% and lower than 70%
- The minimum severity index is 35.08%
- The above results indicate that the identified factors are highly relevant to the problem of labor productivity in construction in Saudi Arabia.

The results show that the top five affecting factors are:

1. Poor communication and coordination between construction parties: communication and coordination between construction parties during all project phases is one of the main keys for project success. Poor communication between construction parties may lead to estrangement between parties and misunderstanding satisfying the contract documents requirements which affects the work flow. Thus, this result illustrates the importance of caring about rising awareness among the construction parties to ensure team work climate and to achieve their desires of less hassle working climate. This result is supported by Mahamid (2013) and Alinaitwe et al. (2007)

2. Low wages: labors are considered as a main resource and success key in construction industry. However, their wages is considered to be low and insufficient for living expenses in Saudi Arabia. For example, the labor average monthly wage is about 150 US Dollar. This situation may affect their motivation to work, loyalty, morale, and relation with management team. It should be noted that this factor wasn't concluded by any of the investigated studies as a main factor.
3. Lack of labor experience: it is established fact from learning effects that if the same task or project is repeated more than one time, it will be controlled better with less time and less cost. Depending on low experience labors will lead to the series of negative effects on the construction productivity and work progress, these include: rework, bad labor mood, bad relation between labors and management team, misuse of time schedule, interrupting construction activities, and bad relation between construction parties. This result is in line with many of the investigated studies (Mahamid, 2013; Alinaitwe et al., 2007; Ailabouni et al., 2007)
4. Frequent change orders: late changes and variations could be as a result of poor communication between construction parties as discussed above. This may lead to adversarial relationships and mistrust between construction parties that may affect the work progress and lead to unproductive time in construction projects.
5. Stoppages because of work being rejected by consultants: this could be as a result of poor workmanship and poor communication between construction parties. For example, the work may be done not as per specifications and drawings. This will lead to unnecessary effort of redoing activity that was incorrectly implemented the first time in order to conform to the original requirement. This result is supported by Alinaitwe et al. (2007)

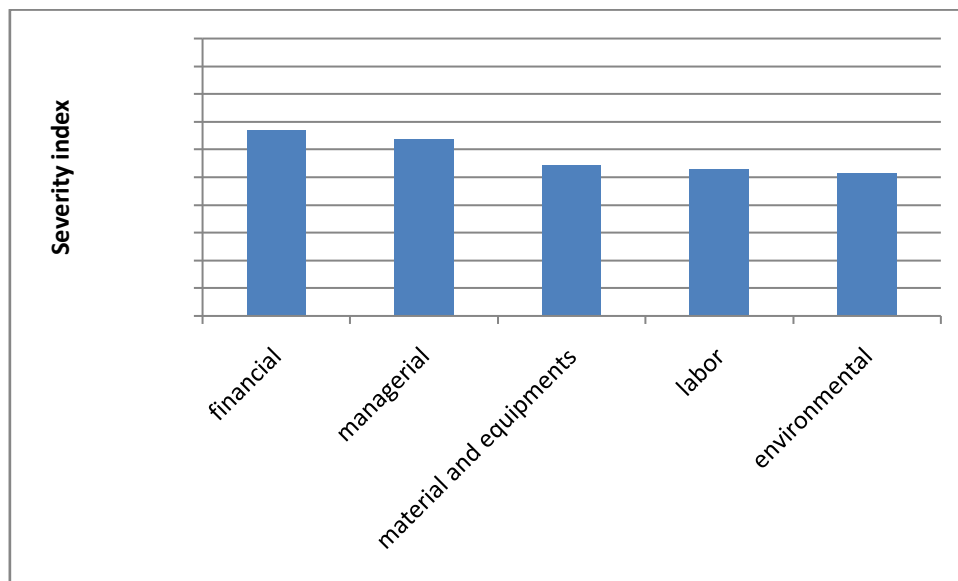
It should be noted that three factors out of the top five affecting factors are related to the managerial group; therefore attention should be paid to this area in order to improve the managerial skills of the construction parties and consequently to improve the construction productivity.

Groups ranking

The identified 38 factors are grouped into five groups. Ranking of these groups associated with degree of severity as assessed by the construction contractors is presented in Table 7 and Figure 6. The contractors indicate that the top important group affecting construction productivity is the financial group, followed by managerial, material and equipments, labors, and environmental respectively. This result might be justified; as well performance of any project can't be achieved without on time financing and proper management.

Table 7: Groups ranking

Group	S.I	Rank
financial	67.05	1
managerial	63.79	2
material and equipments	54.40	3
labor	53.01	4
environmental	51.62	5

**Figure 6:** Severity scores of productivity categories

Conclusion

Productivity rates are among the most essential data needed in the construction industry. The accuracy of productivity rates is crucial for the determination of direct relationships between these rates and subjects such as estimating, cost control, scheduling, and resource management, among others. This paper presents the results of a survey undertaken to determine and evaluate the relative severity of the significant factors affecting construction productivity in Saudi Arabia. The survey covered 38 previously identified factors, which were grouped into five major categories. The main reasons for delays were analyzed and ranked according to different groups: financial, labor, managerial, materials and equipments, and environmental. 32 contractors completed a structured questionnaire survey. The analysis of the identified 38 factors indicates that the top five affecting factors are: poor communication and coordination between construction parties, low wages, lack of labor experience, frequent change orders, and stoppages because of work being rejected by consultants.

The statistical analysis of the gathered data shows the followings: (1) There are 16 factors with severity index between 60% and 83% (2) the minimum severity index is 35.04% (3) the group index is ranging between 51% and 67%. These all indicate that the identified factors are highly relevant to the problem of construction productivity in Saudi Arabia.

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