



# Risk matrix for factors affecting time delay in road construction projects: owners' perspective

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## Abstract

**Purpose** – The aim of this study is to identify the risk matrix for factors causing time delay in road construction projects in the West Bank in Palestine from owners' viewpoint.

**Design/methodology/approach** – In total, 43 factors that might cause delays of road construction projects were defined through a detailed literature review. The factors were tabulated in a questionnaire form, which was sent out to a total of 25 public owners asking their contribution in identifying the risk matrix for the 43 factors in terms of impact and probability of occurrence. Three zones were used in the matrix according to the degree of factors' severity on the projects' time delay; they are: green, yellow, and red.

**Findings** – The analysis of 43 factors considered indicates that six factors are located in the green zone, 29 factors are located in the yellow zone, and eight factors are located in the red zone.

**Originality/value** – The paper identifies the risk matrix for factors affecting time delay in road construction projects in the West Bank in Palestine from the owners' perspective.

**Keywords** Risk management, Road construction, Time delay, Risk matrix, Construction management, Construction operations, Risk analysis, Palestine

**Paper type** Research paper

## 1. Introduction

The construction industry has changed rapidly over the past ten years; companies are faced with more risk and uncertainty than before. Clients are more likely to engage in litigation when things go wrong. Risk in construction has been the object of attention because of time and cost overruns associated with construction projects. Many projects experience extensive delays and thereby exceed initial time and cost estimates. In addition to imparting the economic feasibility of capital projects, extensive delays provide a fertile ground for costly disputes and claims (Odeh *et al.*, 2002).

The construction industry is a key activity in any economy, it influences and is influenced by the gross domestic product of any country (Enshassi *et al.*, 2006). The construction sector in Palestine contributes to 33 percent to the Palestinian GDP. This is a large proportion covered by this sector, thus it strongly affects various economic, social, educational, and vocational sectors, and this is why this study is important.

In the West Bank, no studies have investigated time overrun in construction projects, but the general observations indicate that time overrun is a common phenomenon in construction projects. This study presents the findings of a survey aimed for identifying some of the most important delay causes in road



construction projects in the West Bank from owners' perspective. It is hoped that these findings will guide efforts to enhance the performance of the construction industry.

## 2. Literature review

Cost and time overruns are common in infrastructure and building construction projects. The history of the construction industry worldwide is full of projects that were completed with significant time and cost overruns (Amehl *et al.*, 2010). Researches on construction projects in some developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30 percent (Al-Momani, 1996).

Battaineh (1999) evaluated the progress reports of 164 building and 28 highway projects constructed during the period 1996-1999 in Jordan. He found that delays are extensive: the average ratio of actual completion time to the planned contract duration is 160 percent for road construction projects and 120 percent for building projects.

Assaf and Al-Hejji (2006) found that only 30 percent of construction projects in Saudi Arabia were completed within the scheduled completion dates and that the average time overrun was between 10 percent and 30 percent.

A number of studies have been conducted to identify the causes of delay in construction projects. Enshassi and Abu Mosa (2008) concluded that the owners in the Gaza Strip have considered awarding the design to unqualified designer to be the most important risk factor within building construction, followed by defective design and occurrence of accidents because of poor safety procedures.

Odeh *et al.* (2002) found that contractors and consultants agreed that owner interference, inadequate contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and subcontractors are among the top ten most important causes of construction delay in Jordan.

Assaf and Al-Hejji (2006) discussed the delay in large construction project in Saudi Arabia. A total of 73 causes of delay were identified during the research. They concluded that the most common cause of delay identified by the contractors, the consultants and the owners is "change orders".

Mezher *et al.* (1998) conducted a survey of the causes of delays in the construction industry in Lebanon from the viewpoint of owners, contractors and architectural/engineering firms. It was found that owners had more concerns with regard to financial issues; contractors regarded contractual relationships the most important, while consultants considered project management issues to be the most important causes of delays.

Koushki *et al.* (2005) conducted a study in Kuwait to study the causes of time overrun in construction projects. A person-interview survey of 450 randomly selected private residential project owners and developers have been done. They concluded that the main causes of delays are changing orders, owners' financial constraints, and owners' lack of experience.

Several researchers have investigated effects of delay in construction projects and concluded that cost overrun is one of the main effects of delay (Sambasivan *et al.*, 2007; Aibinu *et al.*, 2002; Faridi *et al.*, 2006; Kaliba *et al.*, 2009).

The delay of any construction project affects the direct cost of the project. In the case where the project is a public building or facility, the complications increase as the

client is a government organization. The effects of delay in such cases may include (Al-Kharashi and Skitmore, 2009):

- confusion regarding the public development plans;
- disturbance of the budget execution plan for the government authority involved; and
- public inconvenience resulting from delay of the project.

And from the contractor's viewpoint, delay is simply an additional liability as:

- the construction period becomes longer;
- the longer period results in higher overhead costs and expenses; and
- the entire contractor's working capital may become trapped in one project.

### 3. Research methodology

A total of 43 factors that might cause delays of road construction projects were defined through a detailed literature review. The similar factors were grouped under one main group; the factors were divided into five groups:

- (1) logic and environment;
- (2) managerial;
- (3) consultant;
- (4) financial; and
- (5) external.

The factors were tabulated in a questionnaire form. Then the draft questionnaire was discussed with some local experts in road construction to evaluate the content of the questionnaire. Modifications and changes have been done. The target population is the public owners in road construction projects in the West Bank.

The questionnaire was sent out to a total of 25 public owners asking their contribution in identifying the risk matrix for the identified 43 factors in terms of impact and probability of occurrence. Only a total of 18 completed questionnaires were returned representing a good response rate of 72 percent. Table I shows the scale used to determine the impact of each factor on time delay and its probability of occurrence.

The average value for responses to each factor is calculated to find out its impact level and its probability of occurrence.

Figure 1 and Table II show the standard risk matrix, which is used to determine the risk zone for each identified factor. The matrix is  $5 \times 5$  with impact ranging from VL to VH on the horizontal axis and probability (with the same range) on the vertical axis.

Scale	Impact	Probability of occurrence
< 20%	Very low (VL)	Very low (VL)
20-40%	Low (L)	Low (L)
40-60%	Moderate (M)	Moderate (M)
60-80%	High (H)	High (H)
80-100%	Very high (VH)	Very high (VH)

**Table I.**  
Scale used to identify  
factor's impact and  
probability of occurrence

Three zones are presented in the matrix (The US Federal Highway Administration Office of International Programs, 2007):

- (1) green;
- (2) yellow; and
- (3) red.

The zones have the following characteristics:

- Green zone: risks in this zone are low level, and can be ignored.
- Yellow zone: risks in this zone are of moderate importance; if these things happen, one can cope with them and move on. However, if their probability of occurrence is moderate it should be reduced and if their impact is moderate, it should be controlled and reduced and a contingency plans should be in place just in case they do.
- Red zone: risks in this zone are of critical importance. These are the top priorities, and are risks that a close attention should be paid to them.

4. Results and discussion

4.1 Logic and environment group

Table III and Figure 2 illustrate the risk matrix for factors under logic and environmental group; ten factors are considered under this group. The results indicate that two factors are located in the red zone, six factors are located in the yellow zone and two factors are located in the green zone.

4.2 Managerial group

Table IV and Figure 3 illustrate the risk matrix for factors under managerial group. 15 factors are identified under this group. The results indicate that three factors under this group are located in the red zone:

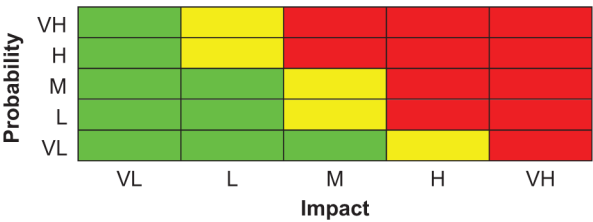


Figure 1.  
Risk matrix

Table II.  
Risk matrix

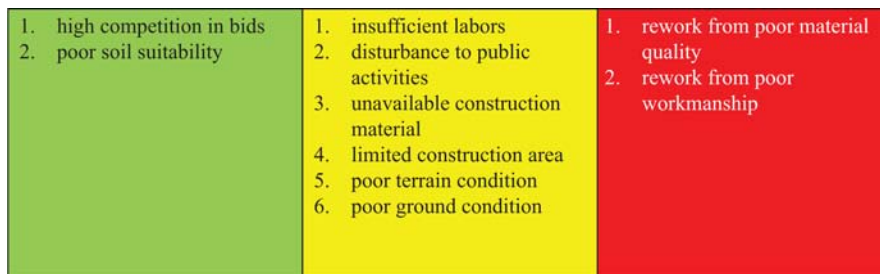
	VL	L	M	H	VH
VL	Green	Green	Green	Yellow	Red
L	Green	Green	Yellow	Red	Red
M	Green	Green	Yellow	Red	Red
H	Green	Yellow	Red	Red	Red
VH	Green	Yellow	Red	Red	Red

Factors	Impact	Probability	Matrix zone
Insufficient labors	M	L	Yellow
Rework from poor material quality	H	L	Red
Rework from poor workmanship	H	M	Red
Disturbance to public activities	M	L	Yellow
Unavailable construction material	M	M	Yellow
High competition in bids	L	M	Green
Limited construction area	M	M	Yellow
Poor terrain condition	M	L	Yellow
Poor ground condition	M	L	Yellow
Poor soil suitability	L	M	Green

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**Table III.**  
Risk matrix for factors  
under logic and  
environment group



**Figure 2.**  
Risk zones for factors  
under logic and  
environment group

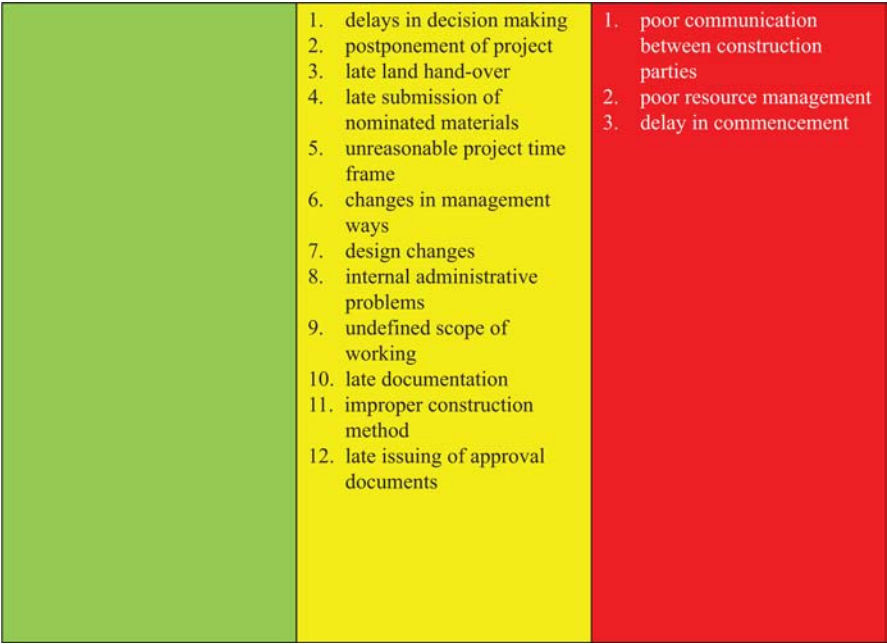
Factors	Impact	Probability	Matrix zone
Delays in decision making	M	M	Yellow
Postponement of project	M	M	Yellow
Late land hand-over	M	L	Yellow
Late submission of nominated materials	M	L	Yellow
Poor communication between construction parties	H	M	Red
Unreasonable project time frame	M	M	Yellow
Poor resource management	H	M	Red
Changes in management ways	M	L	Yellow
Design changes	M	M	Yellow
Internal administrative problems	M	M	Yellow
Undefined scope of working	M	M	Yellow
Late documentation	M	M	Yellow
Delay in commencement	H	M	Red
Improper construction method	M	M	Yellow
Late issuing of approval documents	M	M	Yellow

**Table IV.**  
Risk matrix for factors  
under managerial group

- (1) poor communication between parties;
- (2) resource management; and
- (3) delay in commencement.

The other 12 factors are located in the yellow zone. No factor under this group is located in the green zone.

**Figure 3.**  
Risk zones for factors  
under managerial group



4.3 Consultant group

Table V and Figure 4 show the risk matrix for factors under consultant group; 7 factors are considered under this group. The results show that only one factor under this group is located in the red zone: insufficient inspectors. The other six factors are located in the yellow zone. No factor under this group is located in the green zone.

**Table V.**  
Risk matrix for factors  
under consultant group

Factors	Impact	Probability	Matrix zone
Late design works	M	M	Yellow
Mistake in design	M	L	Yellow
Inappropriate design	M	L	Yellow
Late inspection	M	M	Yellow
Late approval	M	M	Yellow
Insufficient inspectors	H	L	Red
Incapable inspectors	M	M	Yellow

**Figure 4.**  
Risk zones for factors  
under consultant group



#### 4.4 Financial group

Table VI and Figure 5 illustrate the risk matrix for factors under financial group. The results reveal that one factor is located in the red zone: payments delay, two factors are located in the yellow zone and three factors in the green zone.

#### 4.5 External group

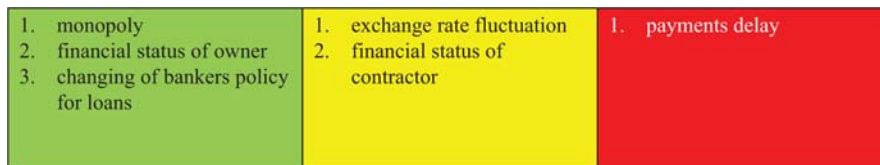
Table VII and Figure 6 illustrate the risk matrix for factors under external group. 5 factors are identified under this group. The segmentation of the West Bank is the only factor under this group that is located in the red zone. Three factors are located in the yellow zone and one factor is located in the green zone.

#### 4.6 Top affecting factors

Table VIII shows the most severe factors that affecting delays in road construction projects and their related groups. It can be seen that two factors are related to managerial group, four factors are related to logic and environment group, one factor is related to financial group, and one factor is related to external group. It is clear that most of the severe factors are human related, meaning that these factors could be

Factors	Impact	Probability	Matrix zone
Payments delay	H	L	Red
Exchange rate fluctuation	M	M	Yellow
Monopoly	L	L	Green
Financial status of owner	L	L	Green
Financial status of contractor	M	M	Yellow
Changing of bankers policy for loans	L	L	Green

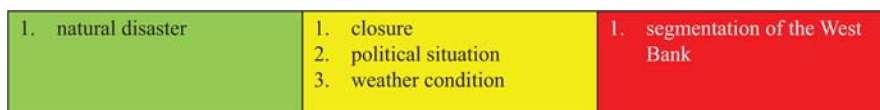
**Table VI.**  
Risk matrix for factors  
under financial group



**Figure 5.**  
Risk zones for factors  
under financial group

Factors	Impact	Probability	Matrix zone
Segmentation of the West Bank	M	H	Red
Closure	M	M	Yellow
Political situation	M	M	Yellow
Weather condition	M	M	Yellow
Natural disaster	L	L	Green

**Table VII.**  
Risk matrix for factors  
under external group



**Figure 6.**  
Risk zones for factors  
under external group

**Table VIII.**  
Top affecting factors and  
their related groups

Factors	Related group	Impact	Probability	Matrix zone
Poor communication between construction parties	Managerial	H	M	Red
Poor resource management	Managerial	H	M	Red
Delay in commencement	Logic and environment	H	M	Red
Insufficient inspectors	Logic and environment	H	L	Red
Rework from poor material quality	Logic and environment	H	L	Red
Rework from poor workmanship	Logic and environment	H	M	Red
Payments delay	Financial	H	L	Red
Segmentation of the West Bank	External	M	H	Red

controlled and reduced by improving the skills of the participants (i.e. contractors, consultants, designers, owners, labors, and suppliers).

### 5. Conclusion

The aim of this study is to identify the risk matrix for factors affecting delays in road construction projects in the West Bank in Palestine from the owners' perspective. The analysis of the identified 43 factors in a questionnaire survey indicates that six factors are located in the green zone, 29 factors are located in the yellow zone, and eight factors are located in the red zone of the risk matrix. The most severe factors that are located in the red zone are:

- (1) poor communication between construction parties;
- (2) poor resource management;
- (3) delay in commencement;
- (4) insufficient inspectors;
- (5) rework from poor material quality;
- (6) rework from poor workmanship;
- (7) payments delay; and
- (8) segmentation of the West Bank

It can be seen that the most severe factors are human related factors that can be controlled and reduced by improving the skills of the construction parties (i.e. managerial skills, labors skills, resources management skills, site management skills, etc.).

The following points can be recommended by the government and Palestinian Contractors Union in order to reduce and control delays in road construction projects:

- The Government should conduct continuous training programs in co-operation with Palestinian Contractors Union to improve managerial skills of construction parties as well as labor skills.
- The Palestinian Contractors Union should cooperate with the Government to modify and improve the regulations and laws to meet the impact of closure and segmentation of the West Bank. Such new regulations are supposed to make it more possible for companies to make profits.



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## Further reading

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