

Study and Assessment of Causes and Effects of Delay in Large Public Construction Projects in Jordan

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Abstract

In Jordan, the construction industry is considered as one of the most important economic sectors. This industry suffers many deficiencies among them is time overrun.

The aim of this research is to identify the most significant delay causes in large-scale public projects in Jordan and discover the effect of these delays on the achievements of these types of projects. This objective was achieved through a comprehensive literature review, site visits and interviews and questionnaire. This field study was utilized to discover the perception of the participants contributing to the subject of the study.

The questionnaire consists of three divisions. The first was concerning the characteristics of the sample contributed to the survey and to explore their opinion about the amount of delay already exist in the industry. The second part included 55 causes of delay distributed to four groups. The third part concentrated on the influence of delay causes on the achievements of the large scale public projects. Replies were received from 146 engineers representing parties involve in the construction process.

The analysis of the questionnaire revealed the ranking and significance of each delay factor included in the survey. Also the analysis showed the influence of delay on the achievements of the projects.

Keywords: Delay causes, importance index, project's performance, public construction projects, Jordan.

INTRODUCTION

Globally, considerable amount of construction projects suffer time overrun. The effect of this time overrun may be of great magnitude on the overall performance of the project. To minimize overrun and effects, the reasons of the occurrence should be recognized.

The delay in construction projects could be defined as excess time beyond the actual time stipulated in the contract parties agreed upon for the accomplishment of the project [1]. Other definitions are by [2] and [3] as the difference between the actual finish time and the estimated one. Other researcher [4] defined delay as the period during which the part or the project, as a whole, has been extended or not finished due to unforeseen situations. Therefore, the delay in construction projects can be expressed as the additional time more than the contracted time or the time agreed upon by parties.

The construction industry in Jordan

The construction industry in Jordan is one of the most important economic sectors. According to the Ministry of Planning in Jordan, the uniqueness and complexity makes this industry quite different than other economic sectors in terms of sensitivity to changes due to economic, social and demographic factors [5]. The country's Gross Domestic Product, GDP grew by 7% in 2011 after recording a growth rate of 7.7% in 2010. The construction industry came in third place after the manufacturing with a growth of 12% and retail and whole sale, restaurants and hotels with a growth of 9.9% [6].

OBJECTIVE OF THE STUDY

The aim of this research work is to find the significant reasons for time overrun in large-scale public buildings and civil engineering projects in Jordan. This study distinguishes the reasons from the opinion of the parties responsible for the implementation of the construction projects.

TYPES OF CAUSES OF DELAY

Delays in construction work can be classified in different manners. Delays can be categorized as internal causes (related to participants of the contract) and external causes (causes outside the contract) [7]. On the other hand they were classified by another researcher [8] into three items. These are: inexcusable, excusable without compensation and excusable. Also [9] categorized delay into three classes. These are: excusable, non-excusable and composition of two or integrated causes.

LITERATURE REVIEW

Delay causes

In both developed and developing countries, considerable amount of research works were carried with respect to causes of delay in construction projects. Jordan is a developing country, so more concern is given to the studies implemented in these countries.

In Saudi Arabia, [10] carried out a study about delay in large scale buildings. They considered 56 factors allocated to nine groups. The study included the main players participating. i.e. owner/client, designer/consultant and contractors /subcontractors. Another study in this country [1] which included different types of projects and 73 factors were

considered. Another two studies were carried out in Egypt. The first [11] studied the role of consultants to limit the amount of delay in large projects. The second [12] considered the analysis of causes in order to reduce the amount of delay. In Jordan, two papers were cited [13] and [14]. The first concentrated on traditional contracts and the later considered the residential project. In developing countries, there are considerable number of research work carried out. Among these are [15] in Thailand, [16] in Kuwait, [17] in Indonesia, [18] and [19] in Malaysia, [20] in India, [21] in Hong Kong, [22] in Libya and [23] in Saudi Arabia.

Influence of delay on the efficiency of the projects

The influence of delay on the efficiency of construction projects can be represented in different forms. Time and cost overruns, disputed, arbitration, litigation and even total abandonment of the project can be examples of this influence. These effects were studied by many authors. Some of these studies are [24] in Nigeria, [25] in Pakistan.

The influence can also be classified into direct and indirect. These relationships were investigated by many researchers. In Nepal, [26] connected the causes related to materials with its influence on time and cost overruns. The other [1] investigated the labor-related with time overrun in Saudi Arabia. Another author [14] linked causes with disputes and negotiations among different parties involved in construction projects in Jordan.

RESEARCH METHODOLOGY

To accomplish the objectives of this study, a quantitative approach was utilized to get knowledge about the perception of the construction's professionals in Jordan towards factors affecting construction delay at large public projects in this country. This is accomplished through a site survey. This survey is established according to the literature review. A questionnaire was prepared to access to opinion of participants involved in the process of construction with respect to the most important causes and effects in the large public projects in Jordan.

The questionnaire set contained three main divisions. The first is the general part included the characteristics of the respondents and the approximate percentage they experience with respect to the delay and their frequency and the level of severity. The causes were categorized into four groups. These are Client's/ Owner's related, Consultant's/ Designer's related, Contractor's/ Subcontractor's related and factors related to external circumstances. Total of 55 factors were included in this survey. The third division of the questionnaire included the effects of the delay on the performance of the projects. Six effects were included based on the literature review, experience of the researcher and the interviews carried out with leading project managers in Jordan.

The questionnaire was designed so for each delay cause, the respondent can choose from 1 to 5. This is for both the

frequency of occurrence and the level of severity. The number 1 indicates very low level of frequency or very low level of severity, while the number 5 represents very high level of frequency or high level of severity. Before the agreement of final form of the questionnaire, a pilot study was carried out through five experienced expertise and their comments were considered in the final form adopted. The collected information was analyzed using SPSS V17 package. The frequency index, severity index and the importance index were calculated for each cause of delay together with their ranking. The analysis of these data revealed the conclusions and recommendations for decreasing the amount of delays for future projects.

Data analysis

The information gathered from the survey was analyzed and the "Importance Index- I.I." was determined using equations 1, 2 and 3 [23].

$$\text{Importance Index (I.I) (\%)} = [\text{F.I (\%)} * \text{S.I (\%)}] / 100 \dots\dots(1)$$

Where "Frequency Index – F.I." reflects the frequency of occurrence revealed out of the survey using equation 2:

$$\text{Frequency Index (F.I) (\%)} = \sum a (n/N) * 100 / 5 \dots\dots\dots (2)$$

"Severity Index – S.I." means the intensity as given by the respondents who take part in the survey. This is calculated using equation 3.

$$\text{Severity Index (S.I) (\%)} = \sum a (n/N) * 100 / 5 \dots\dots\dots (3)$$

Where (a) is constant demonstrates the weight to each reply for frequency and severity = 1 to 5, n= the frequency or severity of the answer and N represents the total number of respondents contributed to the study.

The significant factors within each group were selected as those with Importance index higher than the mean I.I. of the group.

PRESENTATION OF THE SURVEY OUTCOMES

Characteristics of the participants

Structured questionnaire survey was carried out by distributing a total of 240 questionnaire sets, 146 was received representing 50 Clients/ Owners, 44 Consultant/ Designers and 52 Contractors/ Subcontractors. All the participants were involved in large public construction projects (large housing complexes, roads, airports, irrigation projects, etc.). All the participants had experience in the mentioned projects for more than 10 years.

The amount of delay suffered by large public projects

Figure 1 shows that the vast majority of the respondents (95%) agreed that previous large public construction projects in Jordan suffered of delay. Also the figure presents results of the survey with respect to the amount of delay. It can be seen that more than 50% of the project suffered 10% - 30% of delay in the mentioned type of projects.

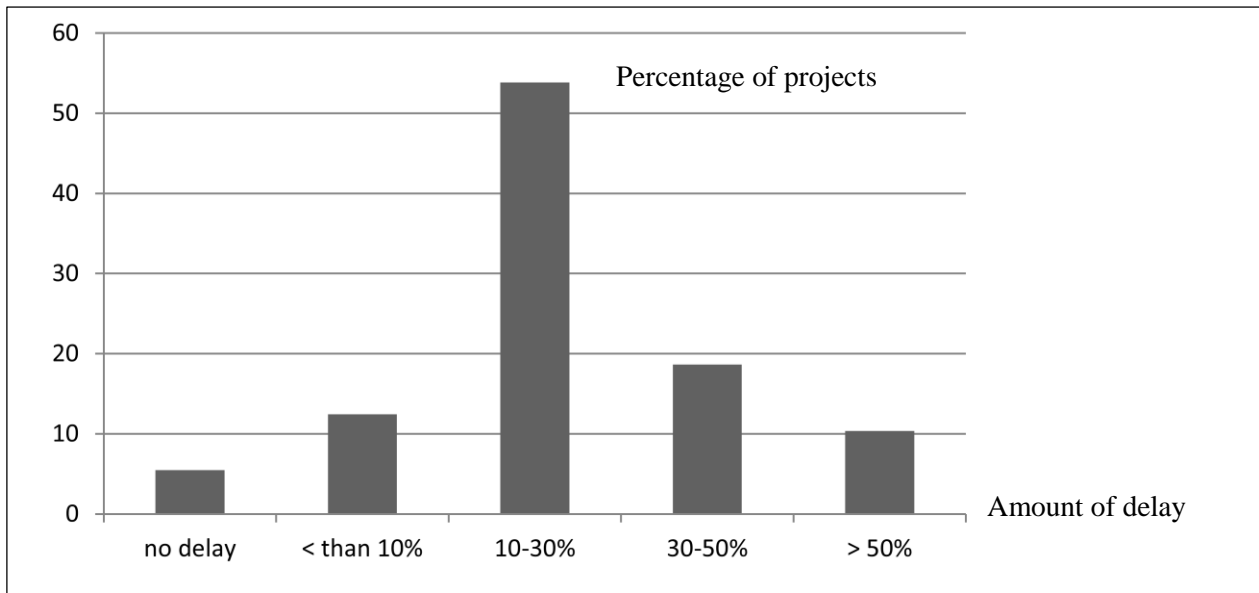


Figure 1. The amount of delay suffered by large public projects in Jordan

Delay causes related Clients/ Owners

The study included seventeen causes of delay related to Clients/ Owners. The study revealed that the average I.I. = 47.05 for this group. The analysis showed that the most crucial factors in this group is “Client’s changes to the design”. This factor ranked at first position due to the importance index rating 64.99. The other significant factors related to Clients/ Owners group which are causing delay problems are: using lowest bid tendering system, changes in the extent of the project, delay of progress payments, and shortage of cooperation between owner/client and contractor/subcontractor and delay in approval of contractor’s submittals. The results concerning this group are shown in table 1.

Table 1. Ranking of significant client-related delay causes factors

Sources (groups) of delay Av. I.I = 47.05	F.I		S.I		I.I	
	Index	Rank	Index	Rank	Index	Rank
Client's changes of the design	78.82	3	82.46	1	64.99	1
Using lowest bid that lead to low performance	79.63	2	80.28	2	63.93	2
Changes in the extent of the project	81.24	1	76.79	4	62.38	3
The client is not making the progress payments on time.	76.82	4	77.26	3	59.35	4
Lack of cooperation between client and contractor	71.08	5	73.66	5	52.36	5
Delay in approval of contractor submittals	70.08	6	67.33	6	47.18	6

Consultants/ Designers related factors

Eleven factors included in the survey which relate to Consultants/ Designers with average I.I. = 44.13. “Errors in design and contract documents” was selected as the most influencing factor among them with I.I = 59.63. The other significant factors were: changes of the original design, drawings are not efficient enough and the consultant’s staff is not always available on site. The results of the survey are shown in table 2.

Table 2. Ranking of significant consultant-related delay causes factors

Sources of delay Av. I.I = 44.05	F.I		S.I		I.I	
	Index	Rank	Index	Rank	Index	Rank
Errors in design and contract documents	76.82	1	77.63	1	59.63	1
Changes in the original design	76.42	2	75.63	2	57.80	2
Drawings are not efficient enough	67.38	3	66.52	4	44.82	3
The consultant’s staff is not always available on site.	65.58	4	68.30	3	44.79	4

Delay factors related to Contractors/ Subcontractors

Twenty factors were included in this study which relate to this category. The average I.I. was 47.04. Table 3 presents the most significant factors within this group. It can be noticed that “Inadequate management and supervision” was highlighted as the most significant factor, within this group, causing delay in the Jordanian large-public projects with I.I. = 68.45. The other significant factors are: cash flow problems suffered by the contractor, rework, level of productivity, technical problems,

incorrect construction methods, delay due to subcontractors and shortage of resources.

Table 3. Contractor-related delay causes factors

Sources of delay Av. I.I = 47.04	F.I		S.I		I.I	
	Index	Rank	Index	Rank	Index	Rank
Inadequate expertise by the contractor for the management and supervision	81.76	1	83.72	1	68.45	1
The contractor is suffering of cash flow problems.	81.22	2	79.63	2	64.67	2
Rework due to mistakes during construction	76.85	3	77.05	3	59.21	3
Low level productivity	74.66	5	75.85	4	56.63	4
Technical problems faced by the contractor	75.40	4	74.33	6	56.04	5
Incorrect construction methods followed by the contractor	72.12	6	74.62	5	53.81	6
Delay due to sub-contractors works	72.07	7	70.32	7	50.68	7
Shortage of resources	71.06	8	69.63	8	49.48	8

7.6 External factors related delay causes

The survey included 7 questions resulted to external factors. Only 4 of them proved to be significant as the average I.I. was 38.65. The results of the survey are shown in table 4. It was discovered that “Bureaucracy and changes of government regulations” was the most significant external factor causing delays with I.I. = 46.31. The other significant factors within this group are: Other public works on or near site, effect of local community and activities resources inflated costs.

Table 4. External conditions significant factors

Sources (groups) of delay Av. I.I = 38.65	F.I		S.I		I.I	
	Index	Rank	Index	Rank	Index	Rank
Bureaucracy and changes of government regulations	69.45	1	66.68	2	46.31	1
Other public works on or near the site	64.82	3	68.36	1	44.30	2
Effect of local community	66.35	2	64.65	4	42.89	3
Activities resources inflated costs.	60.58	4	64.75	3	39.22	4

The significant factors of all groups

As mentioned, previously, the questionnaire included 55 delay factors. The study revealed that only 22 of them showed they are of significant effect. These are shown in table 5.

Table 5. Ranking of most significant factors of delay

Cause of Delay	I. I	Rank	F.I	Rank	S.I	rank	Group
Inadequate management and supervision by the contractor	68.45	1	81.76	1	83.72	1	Contractor
Client's changes of the design	64.99	2	78.82	5	82.46	2	Client
The contractor is suffering of cash flow problems.	64.67	3	81.22	3	79.63	4	Contractor
Adoption of “lowest bid criteria”	63.93	4	79.63	4	80.28	3	Client
Changes in the extent of the project	62.38	5	81.24	2	76.79	8	Client
Errors in design and contract documents	59.63	6	76.82	7	77.63	5	Consultant
The client is not making the progress payments on time.	59.35	7	76.82	8	77.26	6	Client
Rework due to mistakes during construction	59.21	8	76.85	6	77.05	7	Contractor
Changes in the original design	57.80	9	76.42	9	75.63	10	Consultant
Low level productivity	56.63	10	74.66	11	75.82	9	Contractor
The contractor is facing technical difficulties	56.04	11	75.40	10	74.33	12	Contractor
Construction methods adopted by the contractor are not efficient.	53.81	12	72.12	12	74.62	11	Contractor
Shortage of collaboration between client and contractor.	52.36	13	71.08	14	73.66	13	Client
The contractor is suffering of cash flow problems.	50.68	14	72.07	13	70.32	14	Contractor
Delay due to sub-contractors works	49.48	15	71.06	15	69.63	15	Contractor
No approval of contractor submittals	47.18	16	70.08	16	67.33	18	Client
Bureaucracy and changes of government regulations	46.31	17	69.45	17	66.68	19	External
Drawings are not efficient enough	44.82	18	67.38	18	66.52	20	Consultant
Number and experience of the consultant’s staff on site are not adequate.	44.79	19	65.58	20	68.30	17	Consultant
Other public works on site	44.30	20	64.82	21	68.36	16	External
Effect of local community	42.89	21	66.35	19	64.65	22	External
The variation of resources costs.	39.22	22	60.58	22	64.75	21	External

Table 5 above showed that 8 out of the first 10 factors are related to Clients/ Owners and Contractors/ subcontractors – 4 for each. There are only two factors within the first 10 related to Consultants/ Designers.

Achievement of the project due to delay

The study revealed that there are considerable effects of delay on the delivery of the project. The frequency of occurrence for each for each performance parameters are shown in table 6.

Table 6. Effect of delay on project delivery

Effect Delay Causes	Rank	Occurrence Frequency of
Overrun of the project duration	1	95.55
Overrun of the project cost	2	89.45
Disputes between parties	3	72.56
Arbitration	4	62.44
Abandonment of the project	5	59.62
Litigation	6	54.33

Reliability of factors analysis

A test for Cronbach’s alpha ($C\alpha$) was accomplished on each group of factors to examine the reliability of the factors. This is, mainly, to judge if they were integrated. The range of results of Cronbach’s alpha should be between 0 and 1.0. The standard recommended by [27] for the translation of the magnitude of coefficient was adopted to appreciate the results obtained from the analysis. $C\alpha > 0.8$, 'Excellent'; $0.8 > C\alpha > 0.7$ 'Good'; $0.7 > C\alpha > 0.5$ 'Satisfactory' and $C\alpha < 0.5$ 'Poor'. In this study $C\alpha$ was calculated using statistical software SPSS V17. Table 7 shows the outcome of the analysis and the degree of satisfaction according to the criteria described for all groups of factors.

Table 7. Analysis for Reliability

factors	$C\alpha$	Result
Factors related to Client	0.743	Good
Factors related to contractors	0.678	Satisfactory
Factors related to Consultant	0.863	Excellent
Factors related to external circumstances	0.688	Satisfactory
Factors related to all reasons	0.769	Good

Analysis of correlation

The evaluation of the relationship among variables that have interval data can be carried out using correlation analysis. This analysis was done to evaluate the empirical relationship between the series of causes and effects.

The analysis of correlation is presented in table 8 below.

Table 8. Correlation between items and effects of delays

Effects	Causes of delay			
	client	contractor	consultant	External
Overrun of the project duration	0.555	0.461	0.674	0.767
Overrun of the project cost	0.231	0.548	0.658	- 0.118
Disputes between parties	0.425	- 0.190	0.562	0.133
Arbitration	0.658	0.766	0.468	0.762
Abandonment of the project	0.378	0.492	0.490	0.856
Litigation	0.763	0.246	0.562	0.744

THE CONCLUSIONS OF THE STUDY

The main objective of the study was to find the significant delay causes that affect the performance of large public construction projects in Jordan. The review of the available literature, the interviews and the pilot study revealed four groups and 55 delay factors. These were included in a questionnaire set distributed to the main parties contributing to these types of projects. The parties contributed to the survey had considerable experience in implementing the large scale public works. The analysis showed that about 95% of the projects suffer delay and more than 50% of them have delay between 10-30%.

The most important factors were ranked based on “Important Index” of each factor and the average of each group of factors. The total number of factors that showed significant effect was 22 out of the 55. These are distributed as: 6 factors related to Clients/ Owners group, 8 factors related to Contractors/ Subcontractors, 4 factors related to each of the Consultants/ Designers and external factors.

The study revealed that “inadequate management and supervision by the contractor” as the first cause (with I.I. = 68.45) responsible for large public construction projects among the 55 causes included in this study. This outcome substantiates the findings of [10 & 12]. This is not surprising because Jordanian construction companies suffer of shortage of expertise suitable for these types of projects.

The second most significant delay factor is “Clients changes of the design” with I.I. = 64.99 which affect the scheduling and cause frequent disruption or sometimes stoppage, of the project. This result agrees with other researchers [14 & 17].

“Cash flow problems suffered by the contractor’s comes in the third most significant cause of delay for the large scale public construction projects in Jordan with I.I. = 64.67. Cash shortage is one of the most significant issue that may show while projects are at the implementation stage. If the contractor does not have any plan for covering the amount of cash shortage, the works will not be able to continue due the shortage of cash for covering overheads and direct cost of activities (labour, material and equipment. Similar results were cited in other studies [22, 10 & 25].

Respondents ranked “Adoption of the minimum offer leads to low achievements” as the fourth most delay factor with I.I. = 63.93. The participants involve in implementing construction projects in Jordan experienced that for contracts awarded according to the lowest bid, high performance will uncertainly be achieved. This is due to the fact that the current economic climate is increasingly likely that construction organizations will submit abnormally low tenders to win new work. The research works [14& 24] agree with the outcomes of this research.

The other important factors are: Changes in the extent of the project, errors in design and contract documents, progress payments are not made in time by the client, rework due to mistakes during construction, changes in the original design

and low level productivity. The study, also, revealed that delay will result in time and overrun of cost, disputes, arbitration, litigation and may be Project’s abandonment.

RECOMMENDATIONS

The significant causes of delay mentioned in table 5 can be utilized by all parties through taking them as a guide and considering actions to lower the amount of time overrun in their projects.

Furthermore, the following theoretical framework shown in figure 2 has been proposed.

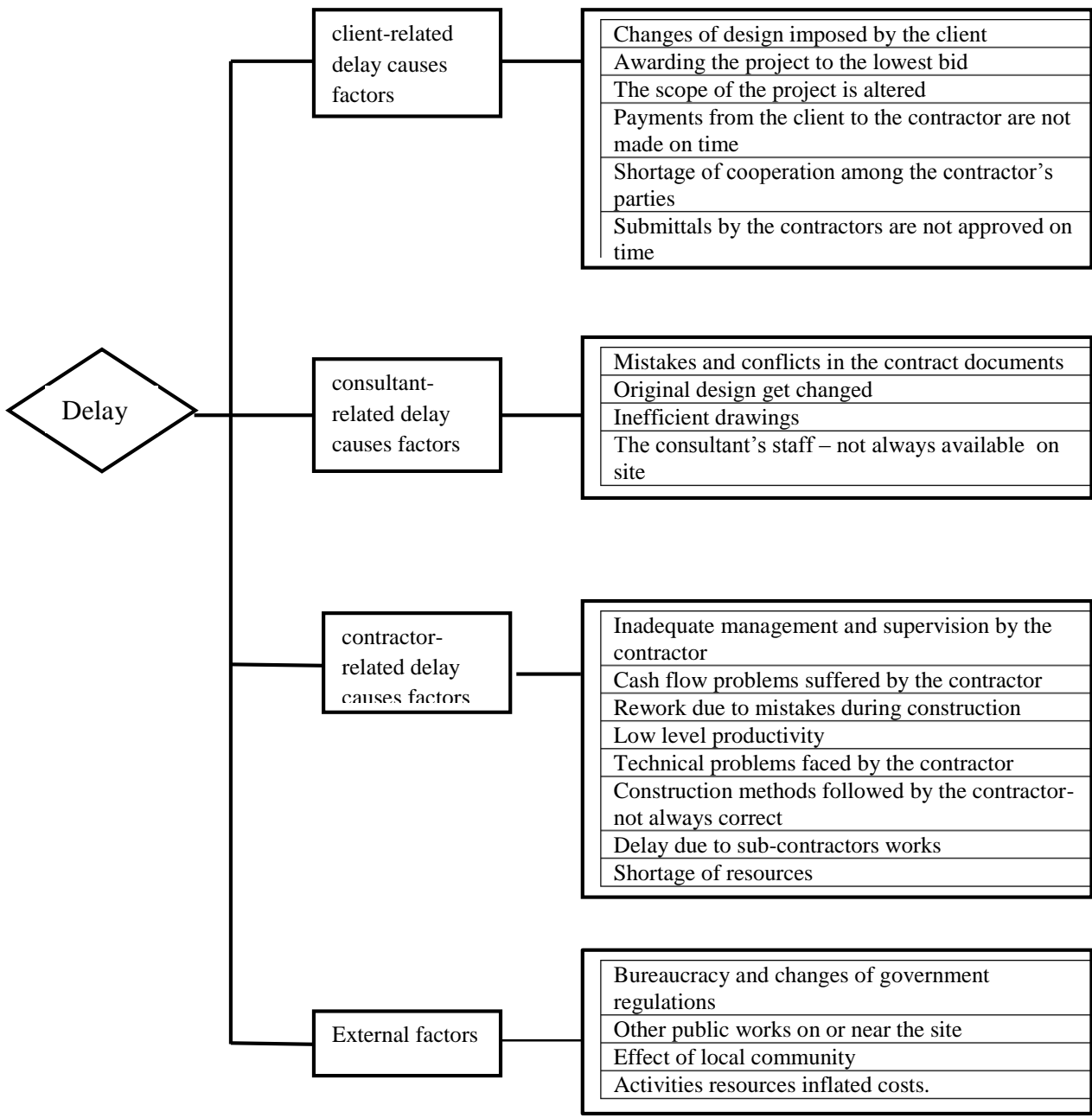


Figure 2. Construction project delays – theoretical frame work

REFERENCES

- [1] Assaf, S.A., Al-Hejji, S. (2006), "Causes of Delay in Large Construction Projects", *International Journal of Project Management*, 24 (4).
- [2] Choudhry, D.K.H., Kog, Y.C. and Loh, P.K. (2004). Critical Success Factors for Different Project Objectives. *Journal of Construction Engineering and Management* 125(3), pp. 142-150.
- [3] Chan, W.M.C. and Kumaraswamy, M.M. (2002) 'Compressing construction durations: lessons learned from Hong Kong building projects', *International Journal of Project Management*, 20, 23-35
- [4] Bramble, B.B, and Callahan, M.T. (1987), "Construction Delay Claims", John Wiley & Sons, Inc., USA.
- [5] DOS, 2014, Statistical year book of Jordan. the Department of Statistics, Amman, Jordan.
- [6] EBRD, 2014, Strategy for Jordan, European Bank of Reconstruction and Development.
- [7] Ahmed, S.M; Azhar, S.; Kappagntula, P.; Gollapudil, D. (2003), "Delay in Construction: a Brief Study of Florida Construction Industry", *Proceedings of the 39th Annual ASCE Conference*, Clemson University, Clemson, SC.
- [8] Bolton, J. (1990), "Types of Claims, Construction and Disruption Claims", *Course Manual*, Portman Inter-continental, London.
- [9] Bramble, B.B., and Callahan, M.T. (1987). *Construction Delay Claims*. John Wiley & Sons, Inc., USA.
- [10] Assaf, S.A., Alkhail, M., and Al-Hazmi, M. (1995), "Causes of Delay in Large Building Construction Projects", *Journal of Management in Engineering*, ASCE, 11 (2).
- [11] Mobarak, M.S. (2004), "Consultation in stumble of large projects", *World Economics*, 146, 96 (in Arabic).
- [12] Amer, W.H., (1994) "Analysis and Evaluation of Delays in Construction Projects in Egypt", Master Thesis, Zagazig University, Zagazig, Egypt.
- [13] Sweis, G., Sweis, R., Abu Hammad, A. and Shboul, A. (2008), "Delays in Construction Projects: The Case of Jordan", *International Journal of Project Management* 26 (6).
- [14] Battaineh1, A. M. O. a. H. T. (2002). "Causes of construction delay: traditional contracts " *International Journal of ProjectManagement* (20): 67 - 73.
- [15] Ogunlana,S.O., Prokuntong, K. and Jearkjirm, V., (1996), "Construction Delays inFast Growing Economy Comparing Thailand with Other Economies", *International Journal of Project Management*, 14 (1).
- [16] Koushki.P.A, Al-Rashid.K and Kartam.N. (2005). Delays and Cost increase in the Construction of Private Residential Projects in Kuwait. *Journal of Construction Management and Economics*, 23 (3), 285-294.
- [17] Kaming, P., Olomolaiye, P, Holt, G., Harris, F. (1997), "Factors Influencing Construction Time and Cost overrun on High-Rise Projects in Indonesia", *Construction Management and Economics*, 15 (1).
- [18] Sambasivan, M. and Soon, Y.W. (2007), "Causes and Effects of Delays in Malaysia Construction Industry", *International Journal of Project Management* 25 (5).
- [19] Alaghbari, W., Kadir, M.R.A, Salim, A., Ernawati, K. (2007), "The Significant Factors Causing Delay of Building Construction Projects in Malaysia", *Engineering, Construction and Architectural Management*, 14 (2).
- [20] Doloi, H., Sawhney, A., Iyer, K. C., &Rentala, S. (2012). Analysing factors affecting delays in Indian construction projects.*International Journal of Project Management*, 30, 479– 489.
- [21] Kumaraswamy, M.M., and Chan, W.M. (1998), "Contributes to Construction Delays", *Journal of Construction Management & Economics*, 16 (1).
- [22] Shebob, A, Dawood, N and Xu, Q (2011), "Analysis Construction Delay Factors; A case study of Building Construction Projects in Libya", *proceedings of the 27th Annual ARCOM conference*, 5-7 September 2011, Bristol, UK.
- [23] Albogamy, A. ; Scott, D. ; Dawood, N. (2012), "Addressing Construction Delays in the Kingdom of Saudi Arabia", *International Proceedings of Economics Development & Research*, Vol. 45, p148.
- [24] Aibinu, A.A., and Jagboro, G.O. (2002), "The Effects of Construction Delays in Nigerian Construction Industry", *International Journal of Project Management* 20.
- [25] Kazaz, A., Ulubeyli, S., &Tuncbilekli, N. A. (2012). Causes of delays in construction projects in Turkey. *Journal of Civil Engineering and Management*, 18, 426-435.
- [26] Kikwasi, G. J. (2012). Causes and effects of delays and disruptions in construction projects in Tanzania. *Australasian Journal of Construction Economics and Building*, Conference Series, 1, 52–59.
- [27] Nunally, J. (1978), *Psychometric Theory*. 2nd Edition, New York: McGraw-Hill.