01-014

FACTORS INFLUENCING CONSTRUCTION PROJECTS DELAY: AN EXPLORATORY STUDY AT A JORDANIAN PUBLIC UNIVERSITY

Aladayleh Jameel, Khaled [(1)]; Ferrer Gisbert, Pablo S. [(2)]; Fuentes Bargues, José Luis [(3)]

[(1)] Mut'ah University, [(2)] Dto. Proyectos de Ingeniería (Univ. Politècnica de València), [(3)] Universitat Politècnica de València

Construction delay is a common problem in engineering projects, particularly in Jordan, that has been widely studied. According to the literature, many indicators were identified that could cause project delay, and this study focuses on identifying the main factors that can be extracted from these indicators. To achieve this objective, a pilot study would be carried out at Mut'ah University in Jordan. The researchers will develop a questionnaire, based on previous studies in the same field, which will be refined by presenting it to a group of academics at Mut'ah University and other universities in Jordan, in addition to a group of practitioners in the field (e.g. project managers, project engineers, contractors, etc.). The data collected will be subjected to exploratory factor analysis to determine the latent dimensional in the data set. The resulted measurement model will serve supervisors, project managers, decision-makers, as well as academics to highlight the critical factors that influence the delay of the projects. Finally, this measurement model could be used for further future studies related to the impact of these factors on project success.

Keywords: project handover; public Jordanian universities; facility management; exploratory factor analysis

FACTORES INFLUYENTES EN EL RETRASO DE LOS PROYECTOS DE CONSTRUCCIÓN: UN ESTUDIO EXPLORATORIO EN UNA UNIVERSIDAD PÚBLICA JORDANA

El retraso en la construcción es un problema común en los proyectos de ingeniería, particularmente en Jordania, que ha sido ampliamente estudiado. En la literatura científica se han identificado muchos indicadores que podrían causar el retraso del proyecto, y este estudio se centra en la identificación de los principales factores que se pueden extraer de estos indicadores. Para lograr este objetivo, se llevará a cabo un estudio piloto en la Universidad de Mut'ah en Jordania. Los investigadores elaborarán un cuestionario, basado en estudios anteriores sobre el tema, que será refinado presentándolo a un grupo de académicos de la Universidad de Mut'ah y otras universidades de Jordania, además de a un grupo de profesionales del sector (directores e ingenieros de proyectos, contratistas, etc.). Los datos recogidos se someterán a un análisis factorial exploratorio para determinar la dimensión latente del conjunto de datos. El modelo de medición resultante podrá servir a supervisores, directores de proyecto, decisores y académicos para poner de manifiesto los factores críticos que influyen en el retraso de los proyectos. Dicho modelo podría ser utilizado para futuros estudios relacionados con la influencia de estos factores en el éxito del proyecto.

Palabras clave: fase de entrega de proyectos; facility management; universidades públicas jordanas; análisis factorial exploratorio

Correspondencia: Pablo Ferrer Gisbert pferrer@dpi.upv.es

1. Introduction

Although the construction industry has grown significantly in Jordan, delays and cost overruns have become a hallmark of public university projects, where there are many projects notorious for the delay (Assaf et al., 2006). The main goals of any construction project are time, cost, quality, and safety (Barry et al., 2011). Unfortunately, the delay phenomenon negatively affects all parties involved within the project like the owner (university), consultant (engineering office department in the university), and contractor. Extending the time leads to additional expenses that increase the cost of the project (Mahamid, 2011). In order to ensure projects are completed within the time budgeted, the reasons for the delay must be identified first. Once these factors are clear, parties can take steps to avoid such delays. Therefore, understanding and identifying these factors are very important, as it helps to achieve project objectives in terms of time, cost and quality (Mahamid, 2011).

Data were obtained from Mut'ah University campus (south of Jordan), specifically from the engineering office (engineering office department - Mut'ah University), which represents the engineering consulting office. Fifteen projects were studied during the previous two decades to confirm the duration of the contract. It was found that there are eight projects were delayed, which represents 53% of the total projects that are late for delivery in university campus. Two of these projects were delayed due to the bankruptcy of the contractor, forcing the university to change the contractor. As a result of this termination, the new contract was signed by other contractors with additional expenses to complete the remaining work, which affected the participants and the main function of the university.

The delay in the projects is a common problem and becomes a reason to complete the project with significantly exceeding the cost (requires a budget higher than estimated), extended time, poor quality delivery and contract termination (Ramanathan et al., 2012). For the university (owner), the delay in construction is a loss of revenue, a decrease in productivity, depending on existing buildings, and an impact on the university's function. The delay in construction projects is due to various factors or causes. These causes lead to a delay in the handover of the building, and this delay ultimately leads to negative impacts on all parties involved. If the major factors that affect the delay of projects executed in Jordanian universities were identified, the level of management could effectively plan to implement an effective performance development plan in terms of project success, proportional with the mission and vision of universities.

1.1 Literature review

In construction, the delay can be defined as "the additional time consumed to complete a project beyond the originally stipulated contractual date agreed by the parties to deliver the project" (Ramanathan et al., 2012). There is a lack of studies in projects executed on public universities' campus. Various articles have discussed the causes of delays in construction projects in many ways; some studies have identified the main causes of delays in many countries and different types of projects, while other studies have discussed ways to analyze delays and proposed ways to alleviate them. Al-Momani (2000) researched construction projects in Jordan and found that delays happened in 106 (82%) out of 130 public projects evaluated. Al-Momani (2000) mentioned that there have been seven main causes of construction delay as the designers, user changes, climatic changes, site conditions, late deliveries of material, economic conditions, and increase in the quantity. Sweis (2008) identified as the most common causes the financial difficulties a contractor faces and many variation orders by the owner. The weather conditions and changes in government regulations and laws are among the least important reasons for the construction industry delays in Jordan. Samarah and Bekr, (2016) identified the 55 important factors of delay in Jordan which had hardly affected by time overruns and expansion of cost. They surveyed to identify the critical factors of delay which reduced the performance of Jordan construction in which 146 respondents were involved. According to Samarah and Bekr, (2016), the ten most important factors causing delays in public sector projects in Jordan are 1 inadequate management and supervision by the contractor, 2 owner's changes in design, 3 insufficient planning, and control by the contractor, 4 using the lowest bid that leads to decreased performance, 5 changes in the scope of the project, 6 errors in design and contract documents, 7 progress payments are not made promptly by the owner, 8 rework due to errors during construction, 9 changes in the original design, and 10 low level productivity. Likewise, Odeh and Batinah (2002) also surveyed construction contractors and consultants to examine the main causes of delays in construction projects in Jordan. They concluded that the most important factors were the intervention of the owner, insufficient contractor experience, financing and payments, work productivity, slow decision-making, improper planning, and subcontractors.

In the case of developing countries, in Saudi Arabia, Assaf et al. (2006) researched time overrun (delay) in numerous sorts of construction projects within the state. They noted that only 30% of construction projects were meted out within the time while 70% of construction projects time overrun. In this research, 73 factors of delay were identified and grouped into nine categories. It concluded that all factors related to the labour, contractor, project, owner, and consultant are on the highest rank and all three parties agreed to the factor of a change order. In other works (Assaf and Al-Hejji, 2006; Pourrostam et al., 2011; Kumar 2016; Samarghandi et al., 2016) the financial problems, inflation, late payments, change orders by the client, planning and programming errors, slowness in the decision by the client, etc., were the most common causes in developed countries. Numerous papers have been published on the topic of the project delay, but universities have not received sufficient researches on the reasons for delaying their projects, and no specific study on the construction delay in the higher learning institutions has been conducted yet, but studies on the general construction have been reported. Tawil et al. (2014) found that there lots of causes of delay that contribute to slowing down the construction sector in high educational facilities in Malaysia. According to this research, these factors were as follows: financial difficulties faced by contractor, poor monitoring by the contractor, lack of consultants experience, changes in design, too many variation orders by the owner, delay in making decisions by the project owner, and delays in delivering materials on site. Most delay factors are internal factors group responsibility of the contractor and the management, so the management of the construction supposed to put plans for delay elements and besides that, they should prepare for such delays like simulating several delay scenarios before beginning to build the construction project (Ramanathan et al., 2012).

In construction claims, the expression “delay” is employed to mean two different but related issues. The delay is often used to mean the time during which some parts of the construction project have been extended to what was originally planned due to various unexpected circumstances (Barry et al., 2011). A delay is often an occurrence that affects the performance of an activity, with or without affecting the completion, the fulfillment of the project, while disruption is an interruption in the planned work sequence or the workflow (Ramanathan et al., 2012). The delay is characterized by the fact that the period of work activities or general achievement may not be extended. The disturbance is a specific productivity loss resulting from changes in the working conditions in which this activity is carried out (Acharya et al., 2006). Lost productivity is an inevitable consequence of disruption because in the end more work and equipment are needed, not to mention working hours to do the same work (Tawil et al., 2014). It is generally recognized that building delay is the most common, costly, complex and risky issue you face in construction projects. Because of the extreme importance of time to both the owner and the contractor, it is the source of recurrent disputes and claims that lead to lawsuits. The delay can be caused by several unexpected events during construction, which increases the time needed to complete the work or increase the work that must be completed within a specific period. In this arrangement, construction delays can be categorized according to their source and timing (Acharya et al., 2006).

2. Objective

The main objectives of this study include the following:

1. To identify the various factors which are mostly influencing the delay of projects in the universities' campus.
2. Develop valid and reliable measurement scale for the most appropriate factors influencing the delay of universities' campus projects.

3. Research methodology

This section focuses on the methodology used, presenting the study population and sample, data collection tools, reliability and validity of the measurement model. It also shows the main study factors and statistical tools used. This chapter also presents the results of data analysis related to the exploratory study. The data were analyzed using SPSS statistical software version 22. The data analysis included the sample description in addition to the exploratory factor. This study adopted the descriptive approach to describe the study sample, in addition to the analytical approach with the aim of building a measurement tool characterized by valid and reliable indicators of the factors.

3.1 Study instruments and sampling

The researcher pooled several items from literature in order to measure factors that cause the delay in project delivery on time. Several previous studies were used to develop the dimensions and items of the questionnaire. The initial questionnaire included 85 items. The questionnaire was presented to several experts in the field of project management, their observations were considered in order to ensure the credibility of drafting items. The questionnaire was presented to a group of academics at the College of engineering and College of management in order to ensure face and content validity. Modifications were made upon their recommendation; the questionnaire was settled 70 items to measure 13 factors. The study population also consists of engineers working in the engineering office department in Jordanian universities as a consultant and resident engineer. The number of public Jordanian universities is 10 and the researcher has not been able to determine the size of the study population accurately. So, the researcher adopted a purposive sampling method to serve the objective of the study. Four public Jordanian universities were visited, and the engineers responsible for the projects were targeted. The questionnaire was distributed to them before that, factors that cause project delay delivery were explained to each respondent, in addition to the items that concern each factor. 5-point Likert scale ranging from "Strongly disagree=1" to "Strongly agree=5" was used. Most of the questionnaires were distributed directly or by email. Table 1 displays the demographic characteristics of the study sample.

Table 1: Demographic characteristics of respondents

Category	Classification	Freq.	%
Organization role in construction industry	Consultants	13	11.6
	Clients/Owner	22	19.6
	Contractors	77	68.8
Years of experience	Less than 5 year	58	51.7
	6-10 year	6	5.4

	11-15 year	14	12.5
	16-20 year	30	26.8
	Above 20 year	4	3.6
Working group	Project manager	16	14.3
	Site engineer	52	46.4
	Designer engineer	7	6.2
	Quantity surveyor	12	10.7
	Resident Engineer	16	14.4
	Administrative manager	9	8
Professional project manager certification (PMP)	Yes	5	4.5
	No	107	95.5

3.2 Exploratory factor analysis (EFA)

Exploratory factor analysis was used to develop an appropriate scale to measure the dimensions of the study, and to verify the reliability of the study instrument using Cronbach's Alpha for the scale items with the following ranges: Cα>0.9 denotes excellent, 0.9>Cα>0.8 as good, 0.8>Cα>0.7 as acceptable. Exploratory factor analysis was used to evaluate the latent dimensions in the dataset. Likewise, an exploratory analysis was used to determine which items are most appropriate to measure those factors and how these items converge to the study factors, and to verify their consistency. For this purpose, the researchers used a sample consisting of 123 responses from engineering who worked in the projects at universities. 11 questionnaires were excluded because they were not valid for analysis, as the number of unanswered questions (missing values) exceeded 20% (Rubin, 1987). The number of questionnaires valid for analysis were 112 responses and the exploratory study reflected the opinions of project managers regarding the dimensions of the study (table 2).

The main objective of the exploratory analysis is to determine the level of appropriateness of the items for each latent dimension, this will lead to an increase in the reliability of the measurement scale by eliminating inappropriate items, as well as increasing the convergent validity. Additionally, eliminating items that have multiple loads on more than one factor will help to achieve discriminant validity as indicated by Hair et al. (2010). Before starting the exploratory factor analysis, descriptive statistics such as mean and standard deviation for answers were calculated. In addition, it was confirmed that the sample responses have important statistical characteristics such as normal distribution, where the normal distribution of the sample data was tested using the skewness and kurtosis measure (Kim, 2010).

In table 2, it was found that most of the skewness coefficients are less than 1.0. The absolute value of the skewness less than 1.0 indicates that the data is distributed normally. Additionally, the critical value of kurtosis (cr) that does not exceed 3.0 is also an indication that the data are normally distributed (Mardia, 1995; Kline, 2010). The results show that the absolute value of the skewness and the critical value of kurtosis came within the required criteria. Hair et al. (2010) pointed out that the normal distribution of data is important in multivariate analysis, and it is very sensitive to data that do not follow the normal distribution, especially for large samples.

Table 2: Descriptive analysis and normal distribution results

Factor	Mean	SD	Skewness	Kurtosis c. r	Min	Max	N
Design and contract related factors	3.353	0.814	-0.718	0.098	1	5	112
Labour related factors	3.104	0.706	-0.789	0.843	1	5	112
Material & Equipment	3.607	0.802	-0.887	0.876	1	5	112
Contractors and sub-contractors related factors	4.515	0.758	-0.894	0.642	1	5	112
Government policy	3.289	0.814	-0.787	0.824	1	5	112
Construction related factors	4.752	0.771	0.824	0.654	1	5	112
Communication and knowledge sharing	3.518	0.786	0.816	0.863	1	5	112
Environmental related factors	4.107	0.822	0.723	0.852	1	5	112
Health & Safety related factors	3.17	0.712	-0.849	0.085	1	5	112
Client related factors	3.76	0.819	-0.712	0.772	1	5	112
Consultant related factors	3.115	0.911	0.815	0.981	1	5	112
Management related factor	3.254	0.961	0.826	0.991	1	5	112
Financial related factors	3.265	0.715	0.725	0.916	1	5	112

An exploratory analysis was carried out several times using the Maximum Likelihood and the VARIMAX-Rotation method to extract a simplified data structure. The researchers excluded the items whose loading factor was less than 0.50. According to Hair et al. (2010), if the sample size exceeds 100 to less than 120 responses, the loading factors that are less than 0.50 should be eliminated. Items with multiple loads on more than one factor were also eliminated (factor loading indicates the correlation of the item with the other factors). Items that composed a single factor are determined based on its eigenvalue that exceeds 1.00 which is the sum of squares of the factor loading. Eigenvalue indicates the importance of the factor in calculating the variance in the measurement scale. The number of factors extracted and the most explanatory for the variation can be inferred by reviewing the Screen Plot, which indicates that the factors that have been retained are 12, as the sample did not see the management related factor as one of the appropriate factors to measure the delay in project delivery. Also, there is an item that converged with the financial related factors which is MRF3. These factors that can be extracted from the data explain 61.279 of the total variances (see table 3). These factors with eigenvalue greater than 1.00 are considered the most appropriate factors in the measurement scale to explain the variance in the responses of the sample. The variance explained indicates high explanatory power of the 13 factors and this value can be considered satisfactory in order to explain the total variance (Hair et al., 2010). After deletion of the low-factor loading items, the multiple-loading items, Kaiser–Meyer-Olkin (KMO) and Bartlett’s test of sphericity had to be evaluated to ensure the adequacy of the samples for exploratory factor analysis.

Kim and Bentler (2002) indicated that factor analysis is considered appropriate if KMO has a value greater than 0.8 and a Bartlett test is statistically significant. The value of KMO was confirmed to determine the level of adequacy of the sample. Bartlett's test of sphericity verified the validity and reliability of factors and assured that the correlations were enough between the items before extracting the factors. The value of KMO was verified as 0.849 and that the results of Bartlett's test were statistically significant, indicating the adequacy of the sample.

Table 3: Total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	9.488	18.247	18.247	8.607	16.551	16.551	3.395
2	3.916	7.53	25.777	3.802	7.312	23.863	3.496
3	3.441	6.617	32.394	3.112	5.985	29.848	2.899
4	3.347	6.436	38.83	3.008	5.784	35.632	5.596
5	3.015	5.798	44.628	2.866	5.512	41.144	2.795
6	2.733	5.255	49.884	2.422	4.657	45.801	5.704
7	2.49	4.789	54.673	2.101	4.041	49.842	5.556
8	2.084	4.008	58.68	1.701	3.272	53.114	4.204
9	1.723	3.314	61.995	1.337	2.572	55.686	2.613
10	1.494	2.874	64.868	1.054	2.028	57.713	3.021
11	1.305	2.509	67.377	0.944	1.816	59.529	6.57
12	1.301	2.501	69.879	0.91	1.75	61.279	3.495

Extraction method: Maximum likelihood.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Finally, the measurement scale was settled on 49 items loaded on 12 factors after deleting 21 items due to the weak coefficient of loading and cross-loading on more than one factor. This means that the sample members agreed that these items are the most appropriate for measuring these factors. Table 4 reveals the pure matrix of factors and the items that measure these factors. It is noted from the table that all the retained items loading exceed 0.50 as indicated by Hair et al. (2010).

Table 4: Factor analysis of components reveals the pure matrix of factors

Nº	Delay related factors	CODE	Factor loading	% variance explained
Factor 1	Design and contract related factors	DCF		18.247
1	Practice of allocating contract to lowest bidder	DCF1	0.503	
2	Mistakes and discrepancies in design documents	DCF2	0.615	
3	Unrealistic contract duration	DCF3	0.603	
4	Late in reviewing and approving of contract	DCF4	0.748	

5	Contract modifications (replace and add new works to the project; change in specifications)	DCF8	0.714	
Factor 2	Labour related factors	LRF		7.53
6	Low productivity of labour	LRF1	0.758	
7	Shortage of technical staff /Shortage of skilled labour	LRF2	0.674	
Factor 3	Material & Equipment	MEF		6.617
8	Delay in material delivery /Poor material handling on site	MEF1	0.555	
9	Inappropriate or low quality of materials	MEF2	0.644	
10	Shortage of materials in the market	MEF3	0.819	
Factor 4	Contractors and sub-contractors related factors	CCF		6.436
11	Contractor's deficiencies in planning and scheduling at the pre-construction stage	CCF1	0.617	
12	Unsuitable management structure and style of contractor	CCF2	0.644	
13	Delay furnishing and deliver the site to the contractor by the owner	CCF3	0.569	
14	Poor site management by contractors	CCF5	0.551	
15	Ineffective coordination between contractors and other parties	CCF6	0.687	
16	Delays in subcontractors work	CCF8	0.628	
17	Conflicts in subcontractors schedule in the execution of the project	CCF9	0.597	
18	Unavailability of incentives for contractor for finishing ahead of schedule	CCF10	0.659	
19	lack of certificate competency of contractor and sub-contractor	CCF11	0.615	
Factor 5	Government policy	GPF		5.798
20	Change in government policy	GPF1	0.592	
21	Commitment of government	GPF2	0.549	
22	Difficulties in obtaining work permits from the authorities	GPF3	0.649	
Factor 6	Construction related factors	CRF		5.255
23	Suspension in construction works	CRF1	0.701	
24	Improper construction method	CRF2	0.568	
25	Work overload and rework due to error during construction	CRF3	0.563	
26	Inappropriate construction methods used	CRF4	0.558	
27	Poor and Ineffective construction project planning and scheduling	CRF6	0.531	
Factor 7	Communication and knowledge sharing	CKF		4.789

28	Insufficient information, missing information and wrong information	CKF1	0.561	
29	Slow information flow between project team members	CKF2	0.696	
30	Poor communication and coordination between parties	CKF4	0.686	
Factor 8	Environmental related factors	ERF		4.008
31	Natural changing in environment	ERF1	0.544	
32	Inclement weather	ERF2	0.563	
33	Natural disasters	ERF4	0.667	
Factor 9	Health & Safety related factors	HSF		3.314
34	Safety constraints	HSF1	0.589	
35	Accidents and injuries	HSF2	0.563	
36	Safety during construction activities	HSF3	0.654	
Factor 10	Client related factors	CLF		2.874
37	Late in approving design documents	CLF3	0.615	
38	Work suspension by clients	CLF4	0.562	
39	Delay by change orders by client	CLF6	0.721	
40	Owner interference	CLF7	0.625	
41	Misunderstanding of owner's requirements by the contractor	CLF8	0.711	
Factor 11	Consultant related factors	COF		2.509
42	Absence or Irregular presence of consultant's site staff	COF1	0.78	
43	Lack of consultant's site staff Experience (managerial and supervisory personnel)	COF2	0.825	
44	Design documentary by the consultants	COF3	0.793	
45	Conflicts amongst consultant with other parties	COF4	0.562	
Factor 12	Financial related factors	FRF		2.501
46	Underestimation of productivity and inadequate review	MRF3	0.819	
47	Budget and cash flow	FRF1	0.809	
48	Financial problems (delayed payments, financial difficulties, and economic problems).	FRF2	0.665	
49	Difficulties in financing project by contractor	FRF3	0.564	

Extraction method: maximum likelihood. Rotation method: Varimax with Kaiser normalization.

a. Rotation converged in 8 iterations.

Finally, the Cronbach alpha coefficient was calculated for the factors and items in the measurement scale. Reliability in each factor were ranged from 0.715 to 0.889 as, design and contract related factors 0.716, labour related factors 0.846, material & equipment 0.852, contractors and subcontractors related factors 0.715, government policy 0.766, construction related factors 0.726, communication and knowledge sharing 0.811, environmental related factors 0.859, health & safety related factors 0.889, client related factors 0.874, consultant related factors 0.816, financial related factors 0.86. This indicates a consistency in the measurement scale and that gives consistent and reliable results (Nunnally, 1967).

4. Results and discussion

In the result of the extracted factors, the first factor named design and contract related factors explain 18.247% of the total variance of the linear component (factor) and contain five attributes as in table 4. The most common method for university public sector bidding is a design-build contract (Alkilani and Jupp, 2012). In Jordan, it is clear that most construction contracts for public projects tend to have the lowest price for contractors, whether they are fully qualified or do not use a competitive bidding process (Al-Kilani Jubeh, 2012; Odeh and Butina, 2002). Han et al. (2013) explain that design errors and inconsistencies that lead to rework and /or design changes are the main contributors to the delay scheduling. Contract modifications contribute to delay due to rework produced by errors by owner and consultant and is an effect caused by improper design brief and poor coordination between the owner, designer, and engineer.

The second factor is labour related factors, which explain 7.53% of the total variance of the linear component and contain two attributes: shortage of technical staff and the shortage of skilled labour. If workers become more skilled with relevant training, this can increase labour productivity.

The third factor named material & equipment explains that 6.617% of the total variance of the linear component and contains three attributes Delay in material delivery / poor material handling on-site is certainly an issue in the construction industry in public universities in Jordan and it is a result of improper scheduling or lack of understanding of lead time of materials delivery. This case has also similar rank in other researches (Kaming et al.,1997; Odeh et al. 2002; Frimpong et al., 2003; Sambasvian et al., 2007).

Nine attributes have composed the fourth-factor. Contractors and sub-contractors related factors explain 6.346% of the total variance of the linear component. Several studies (Odeh and Battaineh, 2002, Frimpong et al., 2003; Koushki et al., 2005) indicate that this factor is one of the most important delay factors in construction projects. In planning and scheduling at the pre-construction stage, Gibson (2012) indicated that deficiencies and poor planning in the pre-construction phase lead to delays in handing over the construction phases. Conflict in the sub-contractor schedule in the execution of the project leads to poor productivity and quality of work, therefore, major contractors must select an experienced sub-contractor and must adopt appropriate regulations and procedures for their selection, supervision, and management (Hartmann and Caerteling, 2010).

Three attributes have many impacts on construction projects with factor named government policy: (5.798% of the overall variance of the linear component) change in government policy, the commitment of government, and difficulties in obtaining work permits from the authority, because it is usually an obstacle to the owner and also the contractor in obtaining the work permit to avoid the delay during the construction stage. One recent example is what the government implemented to stop all construction work in the face of the Coronavirus pandemic (COVID-19) during March 2020, where this problem is outside the control of the contractor and the owner.

The sixth factor, named construction related factors, explains 5.255% of the whole variance of the linear component and contains five attributes associated with the methods utilized in construction management: suspension in construction works, inappropriate construction methods employed by the contractor, improper construction method, work overload and rework due to error during construction by the contractor, and ineffective construction project planning and scheduling.

The seventh factor, named communication and knowledge sharing factor, explains 4.789 % of the total variance of the linear component, with three attributes related to it. It explains the importance of proper communication and knowledge sharing in construction, which has reportedly been one of the critical influencing factors for construction delay in a university's campus projects.

The eighth factor environmental related factors explains 4.008% of the overall variance of the linear component having three attributes. Swiss (1998) defined natural disaster impact as constituting the direct, indirect, and intangible losses caused by the environmental. Sambasivan and Soon (2007) in Malaysia and Al-Momani (2000) in Jordan considered weather conditions as one of the factors of delay in projects.

Three attributes compose the ninth factor, health & safety related factors explains 3.314% of the total variance of the linear component. Failure to acknowledge the contractor's commitment to comply with safety rules in every construction project can lead to disputes that delay the project, especially in public universities.

The tenth factor, client related factors explain 2.874% of the total variance of the linear component with five attributes. Late in approving design documents, work suspension by clients, change orders, interference, and misunderstanding of owner's requirements by the contractor, these interventions can come through the administration of the university as the main owner and either intervention within the way of the workflow, because it is often an obstacle to the owner and also the contractor within the construction work and it requires re-work several times, and this results in project delays. This finding agrees with Mahamid (2011) that rework and change orders are the most reasons for project delays that result in conflict between contractors and clients on construction sites.

There are four attributes listed under the eleventh factor, named consultant related factors explain 2.509% of the total variance of the linear component. Poor management and coordination between the contractor and consultants may delay in agreeing to provide submitted shop drawings. Therefore, an issue between the contractor and the owner may arise from the responsibility for the delay. Lack of consultant experience in public universities can delay construction operations due to unconvincing interventions.

Three attributes listed under the twelfth factor named, financial related factors explain 2.501%. Budget and cash flow, difficulties in financing projects by the contractor, which leads to delays in completing the work and activities, and thus delaying project delivery. Financial problems (delayed payments, financial difficulties, and economic problems by the owner), it relates to the financial problems and difficulties facing the governmental university as the owner of the project, for economic reasons within the university, or economic reasons as a result of the government's policy of approving the budget, which end up delaying the financial payments to the contractor and thus delaying the completion of the project at the specified time. Although this factor is weakly loaded in this exploratory study, it is very important, because bids are subject to the government bidding system, which greatly affects project delays on campus due to late of payments.

4. Conclusion and recommendation

This study aimed to explore the factors that lead to delaying projects in Jordanian universities. A total of 13 factors were identified, as well as items that measure these factors were pooled based on scanning the literature. An exploratory study was conducted in the Jordanian universities, where the researcher obtained a sample consisting of 112 experts, project managers, or those related to the project. The data were analyzed using exploratory factor analysis. Results indicated 12 factors that fit in the environment of Jordanian universities whereas the sample evaluated that the management related factor (MRF) couldn't be considered one of the critical factors in delaying the project. Measurement scale validity and reliability have been confirmed, as well as recommendations for decision-makers in the project management environment have also been reported.

The results reflect the situations that are found in public university projects. In order to successfully address time issues over deadlines, cost escalation, and lack of quality, the causative factors must be understood. On the other hand, it is important to ensure the optimization of project implementation and satisfactory improvement factors for clients. The result of the study can help project managers and their owners to monitor their projects carefully by searching in particular for factors with indicators of high importance to projects. This research focuses on investigating the most important factors that lead to project delays, and universities should make efforts in order to avoid projects delays, which leads to the loss of many opportunities. The researchers recommend including larger samples, larger sectors, and focus on the important areas that should be focused on to avoid delaying projects in times of crisis such as the COVID-19 pandemic. Finally, using exploratory factor analysis (EFA) is not considered enough to develop the theoretical foundation for the project delay factors. Therefore, an empirical study must be carried out in order to confirm those factors using confirmatory factor analysis (CFA).

References.

Acharya, N. K., Lee, Y. D., Kim, S. Y., Lee, J. C., and Kim, C. S. (2006). "Analysis of construction delay factor*: A Korean perspective." Proceedings of the 7th Asia Pacific Industrial Engineering and Management Systems Conference, 883–895.*

Alkilani, S.G. and Jupp, J.R. 'paving the road for sustainable construction in developing countries: a study of the Jordanian construction industry'. *Australasian Journal of Construction Economics and Building, Conference series, (2012), 12 (1) 84-93*.

Al-Momani A. H., (2000). Examining service quality within construction processes. *Technovation, 20, 643-651*.

Assaf, S.A. and S. Al-Hejji, Causes of delay in large construction projects. *International Journal of Project Management, 2006. 24(4): p. 349-357.*

Bramble, Barry B. and Callahan, Michael T. (1987) *Construction delay claims*, Wiley Law Publications, 2nd Edition, U.S.A.

Chan DWM, Kumaraswamy MM. Reasons for delay in civil engineering projects—the case of Hong Kong. *Hong Kong Inst Eng Trans 1996;2(3):1–8*.

Frimpong, Y., Oluwoye, J., and Crawford, L. (2003). "Causes of delay and cost overruns in construction of groundwater projects in a developing country; Ghana as a case study." Int. *J. Project Management, Vol. 21, pp. 321-326*.

G Edward Gibson, R. B. (2012). Common barriers to effective front-end planning of capital Projects. *Construction Research Congress 2012, 2459-2468*.

Hartmann, A., and J. Caerteling. 2010. "Subcontractor procurement in construction: The Interplay of Price and Trust." *Supply Chain Management: An International Journal 15 (5): 354–362.*

Hair Jr, J. F., Anderson, R. E., Tatham, R. L., & William, C. (2010), *Multivariate data analysis with readings*. New Jersy: Prentice Hall.

Han, S., Love, P., and Pena-Mora, F. (2013). A system dynamics model for assessing the impact of design error in construction projects. *Mathematical and Computer Modelling*, 57(9-10): 2044-2053.

Kaming, P.F., Olomolaiye, P.O., Holt, G.D., and Harris, F.C. (1997). “Factors influencing construction time and cost overruns on highrise projects in Indonesia.” *Construction Management and Economics*, Vol. 15, No. 1, pp. 83-94.

Kim, K. H. (2010). Tests of homogeneity of means and covariance matrices for multivariate incomplete data. *Psychometrika, 67*(4), 609-624.

Kim, K. H., & Bentler, P. M. (2002). Tests of homogeneity of means and covariance matrices for multivariate incomplete data. Psychometrika, 67(4), 609–624.https://doi.org/10.1007/BF02295134.

Kline, R. B. (2010). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: Guilford.

Kumar, D. R. (2016). Causes and effects of delays in Indian construction projects. International *Research Journal of Engineering and Technology (IRJET), 3(4), 1831-1837*.

Mahamid, I. 2011. “Risk matrix for factors affecting time delay in road construction projects: Owners' Perspective.” *Engineering, Construction and Architectural Management 18 (6): 609–617.*

Mardia, K. V. (1995). How to use tests for univariate normality to assess multivariate normality. *American Statistician, 49(1), 64-70*. http://dx.doi.org/10.1080/ 00031305.

N.M Tawil, M. A. Khoiry, N. Hamzah, W.H.W. Badaruzzaman, I. Arshad, A.A. Azrillah and N.B. Idris. Determination of the causes of the construction delay in Higher Learning Institutions in Malaysia using the Rasch Model Analysis. *Life Sci J 2014;11(7):308-316*.

Nunnally, Jum C. (1967), *Psychometric Theory*, New York: McGraw-Hill.

Odeh, A.M. and H.T. Battaineh, Causes of construction delay: traditional contracts. *International Journal of Project Management, 2002. 20(1): p. 67-73*.

Pourrostam, T., Ismail, A., & Mansounejad, M. (2011). Identification of success factors in minimizing delays on construction in IAU Shoushtar-Iran. *Applied Mechanics and Materials, 94(96), 2189-2193.*

Ramanathan C, Narayanan S P and Idrus A B (2012) ‘Construction delays causing risks on time and cost – a Critical Review’, *Australasian Journal of Construction Economics and Building, 12 (1) 37-57*. Available at: http://epress.lib.uts.edu.au/journals/index.php/ajceb/article/download/2330/2811 [Accessed 09 May 2015].

Rubin, J. (Ed.). (1987). *Learner strategies in language learning*. Macmillan College.

Samarah, Ashraf, and Ghanim A Bekr. 2016. “Causes and effects of delay in public construction projects in Jordan.” *(5): 87–94.*

Samarghandi, H., Tabatabaei, S. M., Taabayan, P., Hashemi, A. M., & Willoughby, K. (2016). Studying the reasons for delay and cost overrun in construction projects: the case of Iran. *Journal of construction in developing countries, 21(1), 51-84*.

Sambasivan, M. and Soon, Y.W. (2007). “Causes and effects of delays in Malaysian construction industry.” *Int. J. Project Management, Vol. 25, pp. 517-526*.

Sambasivan, M. and Soon, Y.W. (2007). “Causes and effects of delays in Malaysian construction industry.” *Int. J. Project Management, Vol. 25, pp. 517-526*.

Sweis, G. 2008. “Delays in construction projects : The case of Jordan.” *26: 665–74*.
Swiss Re (1998). *Floods-an insurable risk*?, Zurich, 48 p.