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Dilemma of Saudi Arabian Construction Industry

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Abstract: Currently, the Kingdom of Saudi Arabia (KSA) is the epicentre of building services engineering encapsulating the construction industry. On rise of technological advancements, engineers have the ease to thoroughly investigate engineering aspects. Not only engineers, but other stakeholders, tender related people, financial analysts work in parallel as well. However, there are some factors that are stumbling blocks in the way of progression including delaying factors in the construction industry. The paper provides deep insights of delaying factors regarding public building projects of the KSA. Collection of primary data was carried out by conducting a survey which comprised of 63 chief delay factors. Professionals related to construction industry were asked for ranking the factors in terms of their frequency of occurrence and degree of impact. Seven groups of risk factors are categorized and a correlation analysis is performed by identifying the correlation amongst the variables. Finally, 31 leading delay factors are extracted and reported.

Keywords: Construction Industry, Correlation Analysis, Delay Factors, KSA

I. INTRODUCTION

Escaping from financial constraints by finishing the projects punctually is the major confront for construction companies (Sweis et al. 2007). Large scale investments are being carried out by the KSA government through which 40 percent runs its economy (Cordsman, 2000). The last decade of the 19th century (1990 to 2000) represents the investments of $234 billion in the construction industry in Saudi Arabia. Adverse issues are on the verge among companies regardless of huge investments including time and money factors which is proved by Assaf and Al-Hejji (2006) by illustrating a major hold-up of 70 percent public sector projects. Correspondingly, from 1985 to 1995 from a total of 76, 45 sewage and water projects were delayed with a total of 110 percent postponement in 20 other projects (Al-Ghafly and Al-Khalil, 1995).

Sadly, delayed construction industry of KSA is an old problematic issue that downfall the image of the whole industry (Sweis et al., 2007). Consequently, this paved a way which leads towards investigation for the researchers to resolve this issue (Assaf and Al-Hejji., 2006; Sweis et al., 2007; Al-Kharashi and Skitmore, 2009). In 2011, it was concluded that nearly $147 billion is at stakes due to the delayed public projects (Arab News, 2011). On the other hand, construction parties are now seriously concerned about the delays in mega structural projects in the KSA which is considered as a hub for the field of construction engineering.

II. BACKGROUND

Worldwide researchers are now considering the factors which delay the construction projects. Total 56 aspects that play a vital role in holdup of the construction industry were identified in 1995 by Assaf and colleagues. Among these aspects payment, delays and alteration in design and shop drawings were top notched. In addition to these factors bureaucracy matters, time consuming decision making, a difference of opinion between consultant and contractor, financial issues, and infrastructural faults were highlighted in the KSA construction industry. Al-Khalil and Al-Ghafly (1999) stated that cash flow hitches, tendering system and permit issuance from governing authorities take over the delaying features in the construction industry.

Apart from KSA, decelerating factors of building projects in the UAE were also observed by Faridi and El-Sayegh (2006). These incorporate: a lack of command and control, manpower, rapid decision making and planning, drawing preparation and approval and majorly administrative issues. Jordan also faced the identical issues comprising of inadequate planning by the contractor, unskilled labour, insufficient finances and majorly amendments done in orders (Sweis et al., 2007)

Not only KSA, UAE, Jordan, but Egypt's industry also experienced the identical issues. These comprise of inappropriate planning, economic issues, insufficient labour and amateurish contractors (Razek et al. 2008). Besides these countries, construction industry of Ghana is also affected through delay in money-related matters and variation in the scope of the projects (Frimpong et al. 2003). The Asian market is also influenced by the parallel features, including acquiring permits from authorities, economic restrictions from the contractor and being behind the schedule for delivering raw materials and

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drawings (Doloi et al. 2011). The studies reveal that postponement in construction projects is a chief issue hovering upon the Middle East over a prolong time. In spite of a diverse set of causes in each country, the result is similar which includes time and cost overrun, hurdling in the way of a successful economy of respective country.

III. Causes of Delay

The current research takes into account 63 major causes of delay extracted from the literature review. All of the reasons are further categorised accordingly, including external aspects as well as issues related to consultant, contractor, and client. An endeavour was made to list down and observe all issues related to delayed construction projects, inclusive of environmental health and safety, finance and budgeting, labour force, administrative problems, contractual concerns and material delivery.

IV. Research Methodology

In the current study, a positivist research paradigm is followed. Using positivism paradigm, the researcher addressed quantitative research objectives by using a survey method. The explanatory research strategy is followed to explicate the reasons of the delay with their impact on KSA's construction industry. However, the scope of the paper remains under the custody of public building projects. A blend of primary and secondary data is utilised to mark out chief delays in the construction industry of KSA. The nature of the study takes up qualitative as well as quantitative approach. The former results in summing up the outline of construction progression, whereas the second approach makes use of survey for investigating delay factors in detail.

A. Population

Construction contributors take account for population in the current study. These include project managers, contractors, owners and chiefly consultants serving in KSA. The sampling was done upon the professionals of construction, which had experience of more than ten years. The formula (1) used for sampling is as follows where 'S' is the sample size, 'CL' represents confidence level, 'EP' means estimated prevalence of malnutrition, and 'CI' shows the confidence interval.

$$S = \frac{CL^2 \times EP \times (1 - EP)}{CI^2} \quad (1)$$

B. Procedure

Table 1 demonstrates the quantity of questionnaires distributed and received during the survey. The reason behind this survey was to pinpoint the crucial delaying aspects through verifying the opinions of participants with reference to delaying factors in the KSA. As a result, this aided a hand for researchers to outlook construction projects.

TABLE I
Respondents Profile

Participants	Saudi Arabia	
	Distributed	Received
Owner	72	38
Contractor	47	29
Consultant	63	31
Total	182	98

Ranking with respect to the delay factors in accordance with the frequency of occurrence was carried out. A detailed analysis is carried out for the collected statistics with two aspects including deep penetration for delay factors and their ranking. Previous research in this domain shows that the ranking of the factors using standard deviation and means is unsuitable. The reason behind this statement is that correlation between factors cannot be properly assessed in this way (Assaf et al. 1995; Kumaraswamy and Chan, 1998; Iyer and Jha, 2005; Faridi and El-Sayegh, 2006). However, relative index and weighted average involving procedures are reliable and used on a large scale. For grading delay factors on the foundation of frequency and impact, researchers mostly employ Relative Importance Index (IMPI). The formula (2) ~ (4) for IMPI is as follows where 'a' is the frequency of responses, 'A' means total number of responses, and 'c' represents the constant of weighting for each response; (0=unknown, 1=never, 2=low, 3=middle, and 4=high).

$$Importance\ Index = \frac{(F.I. \times S.I.)}{100} \quad (2)$$

$$Freq.Index\ (F.I.) = \sum (c \times \frac{a}{A}) \times \frac{100}{5} \quad (3)$$

$$Severity\ Index\ (S.I) = \sum (c \times \frac{a}{A}) \times \frac{100}{5} \quad (3)$$

Reliability is a key factor that demonstrates the steadiness of a measure. High reliability is expected when identical results are produced under constant states. Reliability, correlation, and factor analyses are three kinds of analysis which lend a hand in quantitative analysis of delay factors. The association and links between the unrelated and related delay factors, as well as pulling out noteworthy factors that cause delays were carried out through correlation and factor analyses. For authenticating the purpose of factor analysis (for its measurement) reliability analysis is performed at the end by means of Cronbach's alpha (Cα) test using SPSS. In statistics, Cronbach's alpha is considered to show the internal consistency. An estimation of the reliability test can be done through Cronbach's alpha for a sample of the population.

V. Results and Discussion

A. Ranking of delay factors

The questionnaire consisted of 63 factors summed up from diverse resources. Each single delay factor was categorised or ranked in accordance to its frequency and

degree of impact by the respondents. A number of approaches are used to categorise delay factors including RII which has previously used by Aibinu and Jagboro (2002), Assaf and Al-Hejji (2006), Sambasivan and Soon (2006), and Doloi et al. (2011)) as well as in the current study. Table 2 shows the top ten delaying factors based on ranking analysis.

TABLE II
DELAY FACTORS

Causes of Delay	Ranking
Low performance of lowest-bidder contractor in tendering system	1
Delay in sub-contractors' work	2
Poor qualifications, skills and experience of contractor's technical staff	3
Poor planning and scheduling of the project by the contractor	4
Delay in progress payments by the owner	5
Design changes by the owner	6
Shortage of qualified engineers	7
Delay in preparation of shop drawings	8
Cash flow problems faced by the contractor	9
Inadequate early planning of the project	10

B. Factor analysis

Strong interrelationship and association among varying variables can be found by factor analysis. Classifying correlated and uncorrelated factors and ruling out their association for a common factor model is the theme followed by Exploratory Factor Analysis, EFA (Doloi, 2009) and is conducted in the current study. A compilation of rows and columns is done in the form of data matrix to assort the delay factors in the first step of EFA ((Reymont and Joreskog, 1993). This step was followed by Kaiser Meyer Olkin (KMO) test for the purpose of calculating the competence of questionnaire data. Strong correlation between factors is represented by the values nearer to one in the KMO test. The current factors' correlation came up with the value of 0.704, hence giving out a "superior" result.

Principal Components or PC method inspects the variances among the items and lends a hand in minimising the correlated delay factors to only fundamental factors (Wenbin, 2008). Through the utilisation of PC method, 31 considerable factors are pulled out and presented in table 3.

TABLE III
FACTOR ANALYSIS

Factor ID	Factor Description	Factor Loading	Var. Explained
Factor I – Machinery and materials			
M37	Delay in materials supply	0.769	10.58%
M58	Rise in the prices of materials	0.759	
M38	Material quality problems	0.741	
M39	Shortage of construction material	0.540	
Factor II – Project and Development			
P1	Inadequate early planning of the project	0.759	10.97%
P36	Shortage of equipment availability	0.744	
P53	Lack of systematic engineering method to identify the time	0.713	
P15	Low performance of the lowest-bidder contractor in the Government Tendering System	0.625	
P35	Poor manpower productivity	0.606	
Factor III – Supplier and contractor			
CT27	Poor site management and supervision by contractor	0.762	10.92%
CT25	Poor communication by contractor with parties involved in project	0.703	
CT19	Poor qualifications, skills & experience of contractor technical staff	0.687	
CT32	Shortage of qualified engineers	0.661	
CT18	Poor planning and scheduling of the project by the contractor	0.608	
Factor IV – Owner			
O9	Lack of coordination with contractors	0.682	11.65%
O6	Delay in the approval of contractor submittals to the owner	0.633	
O7	Changes in the scope of the project	0.632	
O10	Breach or modifications of contract by owner	0.623	
O13	Poor qualifications and supervision of owner's engineer	0.614	
O5	Slow decision making process of the owner	0.609	
Factor V – Consultant			
CN49	Poor qualifications of supervisory staff of the consultant engineer	0.827	10.81%
CN42	Delay in approval of shop drawings	0.806	
CN43	Absence of consultant's site staff	0.722	
CN41	Inadequate qualifications of consultant to the project	0.712	
Factor VI – Design and Scheme			
D45	Design errors by consultant	0.848	8.67%
D44	Design changes by consultant	0.845	
D51	Design errors made by designers due to unfamiliarity with local conditions and environment	0.688	
D11	Design changes by the owner	0.621	
Factor VII – External			
E63	External work due to public agencies	0.834	7.12%
E59	Changes in Laws or regulations by Government	0.743	
E55	Effect of weather conditions on construction activities	0.624	

Overall KMO value = 0.704

C. Discussion on extracted factors

Factor I illustrates the chief subject matters that are linked to materials and machinery which leads to an interruption in the construction industry time and again. Four noteworthy materials-related aspects have been extracted with a variance of 10.58%. Three elements have

more than 0.7 values in between the range of 0.540 to 0.769. For the condition of exceeding the time limit in the construction process, two attributes (first and fourth) including 'delay of material supply' and 'shortage of construction materials' showed their higher impacts. 'Material quality problem' which is the third attribute in the list is also a worth mentioning factor for construction parties. If it is overlooked, construction projects may face a massive downfall (Lewry and Crewdson, 1994). Expenditures of the entire construction projects may be increased due to the 'rise in prices of raw materials' which makes up the second attribute.

'Project and development' related features cover the dictionary of Factor II. These features have difficulties and hitches with respect to the level of the construction project. A variance of 10.97% is calculated for five project-related attributes, as mentioned in table 2. 'Inadequate early planning of the project' is the imperative factor leading towards construction delay and majorly is being disregarded by major construction companies (Bramble and Callahan, 2010). Being the first attribute, it showed 0.759 factor value, which is the highest among all the values. 'Lack of systematic engineering method to identify project time' is the third attribute in the list, majorly due to ignorance of project manager and amateurish behaviour of management. Inadequacy of appropriate equipment at the beginning of the project gives rise to the attribute of 'shortage of equipment availability'. In the Middle East, 'low performance of lowest-bidder contractor in tendering system' (fourth attribute) is the highest rated attribute. It is considered to be the most widespread factor that has the grounds upon delaying projects. With no information regarding planning strategies and level of project management, public clients have a preference over lowest-bidder in most developing countries (Agumba and Fester, 2011). 'Poor manpower productivity' is the fifth attribute that has influenced the superiority of the construction project and thus takes its name due to adoption of unqualified labour force and lack of on-site administration.

The deficiency in experience, aptitude, awareness and know-how sums up Factor III which is 'supplier and contractor'. A 10.92% variance has been shown by five contractor related attributes, shown in table 2. 'Poor site management and supervision by the contractor' and 'Poor communication by the contractor' make up the first and second attribute respectively. Both of the above mentioned attributes have an interrelationship. With reference to Potts (2008), time and cost have a direct association with communication skills and supervision in construction projects. 'Poor qualification, skills and experience of the contractor's technical staff' is the third and problematical delaying attribute. The presence of above mentioned attributes can have a devastating result upon the project, as contractors are unable to fight against the intensity of the project which either delays it or face financial overrun. Middle East countries including KSA and UAE are facing serious problems against 'shortage of qualified engineers'. This is also vital attribute as local people are unqualified as compared to the foreign force of engineers which are mostly hired by the hiring agencies. Agumba and Fester in 2011 concluded about the negative impacts of low levelled scheduling of construction projects. This gives rise to 'poor planning and scheduling of the project by the contractor's attribute for inappropriate estimations.

Factor IV forms a circle around owner related issues and problems. With a total of six attributes it occupies 11.65% of total variance. Regulatory steps that are taken by the title holder during and before the construction period are included in this issue. 'Lack of coordination with contractors' is the first attribute that covers this factor and has shown the maximum value of 0.682. This outcome exhibits failure constraint for the construction projects (Doloi et al. 2011). An added factor makes up the second attribute 'delay in approval of contractor submittals' which is also due to lack of synchronisation between contractors and concerned parties. 'Changes in the scope of the project' is the third attribute common in Saudi Arabia for insufficient knowledge of project managers for the design and scope of the project (Kasimu, 2012). This attribute chips in the repetition of already performed tasks and thus causing a hindrance in the construction project. The selection of proletarian contractors with low altitude of knowledge gives rise to the fourth attribute which is the 'breach or modification of contract by owner' (Doloi et al. 2011). 'Poor qualifications and supervision of owner's engineer' is the fifth attribute that proves to be a road-block for goals to be achieved by the owner and other construction parties. Last of all, the sixth attribute 'slow decision making process of the owner' has been placed in the list of top five factors that causes a delay of the construction projects in developing countries by several researchers.

Dilemmas that converse about delays due to consultants are listed under consultant related factors. This makes up four considerable consultant related attributes mentioned above in table 2. All of the attributes give out 10.81% of the total variance of linear components. 'Poor qualification and supervision of staff of the consultant engineer' is the first attribute which is unfavourable for the client in terms of time and cost matters. 'Delay in approval of shop drawings' makes up the second attribute by reason of lack of communication between approval authority and consultant. According to the research of Assaf and Al-Hejji (2006) another attribute takes place by the name of 'absence of consultant's site staff'. The incompetence of consultants due to lack of educational background gives rise to 'inadequate qualifications of consultants to the project' attribute which focuses on employing well educated and trained consultants.

Factor VI covers the 'Design and Scheme' factor including inaccuracy and alterations made by the owners and consultants in the designs of the mega structures. This is due to the reason of insufficient education, communication, dexterity and experience of owners and consultants. 8.67% of the total variance is calculated for this attribute.

External aspects figure out foremost issues are related to the environment. For example, drastic weather change and modification in government policies are covered in this class of factor. 7.12% of the total variance is computed for this factor, revealed in table 2.

D. Reliability of factor analysis

Cronbach's alpha (Cα) test is performed for cross checking the dependability upon the factors and attributes. It is a type of psychometric test. This was carried out on each set of factors with attributes as the subset for making out their standards. Cα should vary from 0 to 1, where closer to 1 value shows more accuracy of the result along with high internal consistency. Literally, there are no pre-defined limits of Cα value. On the other hand, following criteria is followed for interrelating Cα (Nunally, 1978); Cα > 0.8 'Excellent', 0.8 > Cα > 0.7 'Good', 0.7 > Cα > 0.5 'Satisfactory', and Cα < 0.5 'Poor'. Following these standards, Cα is calculated and it came under the category of "excellent" with the value of 0.930 shown in table 4.

TABLE IV
RELIABILITY ANALYSIS

Factors	Cronbach's Alpha (Cα)	Result
Material related	0.608	Satisfactory
Project related	0.602	Satisfactory
Contractor related	0.755	Good
Owner related	0.813	Excellent
Consultant related	0.881	Excellent
Design related	0.697	Satisfactory
External related	0.668	Satisfactory
All Factors	0.930	Excellent

E. Correlation analysis

Correlation analysis is done by finding the interrelationship between the attributes and factors and values are loaded in tables 5 to 11. Correlation and amalgamation of variables is observed through following "variable reduction design" as done by Gorsuch (1983). The correlation coefficient 'r' is the Karl Pearson's formula that categorises delay factors with respect to the linear relationships. The seven groups are analysed which showed a statistically significant result of 0.01 and 0.05.

TABLE V
PROJECT-RELATED FACTORS

	P1	P36	P53	P15	P35
P1	1				
P36	.085	1			
P53	-.149	-.086	1		
P15	-.083	-.178	.469**	1	
P35	-.123	.471**	.047**	-.041	1

TABLE VI
CONTRACTOR-RELATED FACTORS

	CT27	CT25	CT19	CT32	CT18
CT27	1				
CT25	.490**	1			
CT19	.638**	.321**	1		
CT32	.192	-.012	.167	1	
CT18	.672**	.357**	.663**	.004*	1

TABLE VII
CONSULTANT-RELATED FACTORS

	CN49	CN42	CN43	CN41
CN49	1			
CN42	.606**	1		
CN43	.518**	.555**	1	
CN41	.612**	.525**	385	1

TABLE VIII
OWNER-RELATED FACTORS

	O9	O6	O7	O10	O13	O5
O9	1					
O6	.350**	1				
O7	.424**	.463**	1			
O10	.375**	.331**	.500**	1		
O13	.268**	.404**	.351**	.215*	1	
O5	.400**	.374**	.224*	.239*	.349**	1

TABLE IX
MATERIAL-RELATED FACTORS

	M37	M58	M38	M39
M37	1			
M58	.548*	1		
M38	.479*	.278*	1	
M39	.217*	.010	.127	1

TABLE X
DESIGN-RELATED FACTORS

	D45	D44	D51	D11
D45	1			
D44	.696**	1		
D51	.471**	.423**	1	
D11	.333**	.437**	.259**	1

TABLE XI
EXTERNAL FACTORS

	E63	E59	E55
E63	1		
E59	.087	1	
E55	.235	.324	1

VI. CONCLUSION

Being the fastest growing fields of engineering, construction industry provides a platform as well as challenge to engineers to dive in new horizons for building construction. The challenge takes into account of the utilisation of technological advancements with respect to the energy sources and minimising all the environmental issues. The problem of postponement of construction projects prevails in developing countries, especially Middle East including the KSA. The study was aimed at specifying the causes in delay in the Saudi construction industry for which a survey was conducted. After spending much time on analysing all the factors through statistical analysis, five chief factors extracted are (i) delay in payments by the owner (ii) low level of planning of the project by the contractor (iii) sub-standard qualifications, lack of dexterity of contractors as well as workers (iv) poor tendering system and the role of low bidders. Concluding the factor and ranking analyses, 31 from a total of 63 factors are found to be most influential upon delaying aspects. Significance of financial resources with regard to time and adequacy cannot be excessively stressed. Epicentre of every project is the finance that is

spent. Hence, focusing upon reducing financial crisis (adequate and timely payments) can lend a hand in accelerating completion of construction projects within the desired time. Moreover hiring competent officials can also help to reduce the delays. For these reasons, all hitches should be attended and tackled immediately by the governing agencies of KSA.

VII. Future Work Direction

In the near future, by the helping hand of risk management, an outline will be made for tackling the issues of the construction industry of KSA. This will also facilitate in maintaining the overall skeleton of the poorly maintained management system of building services engineering.

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