IDENTIFYING THE IMPORTANT CAUSES OF DELAYS IN BUILDING CONSTRUCTION PROJECTS

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ABSTRACT: Construction project delays can be a big concern for contractor businesses, resulting in expensive disagreements and bad relations between project participants. Project delays can occur for a variety of reasons. The many forms of uncertainty connected to operations during the construction process are the main causes. The purpose of this study was to identify the major reasons behind Indonesian construction project delays. A questionnaire survey with 23 respondents from small contractors and 89 respondents from major contractors was conducted. The respondents were prompted to rate the degree to which the 31 potential delays had an impact on their respective projects. Six main groups were formed from the delay-related factors. For both the large and small contractors, the relevance of the delay variables and the groups was calculated and rated. To further explain the answers, individual interviews were done. Using Spearman Rank Correlation Coefficients, the agreement between the ranks of the delay causes of two groups of contractors was evaluated. According to the findings, both big and small contractors rate the individual delay variables in order of significance. Yet, the outcome indicated that there is no agreement between the two groups of contractors when it comes to the categories of the delay variable. For large contractors, the professional management group received the greatest rating, while the external groups received the lowest rating. Smaller contractors, however, gave the implementation group the lowest rating and the design and documentation group the best.

KEYWORDS: Delay, building projects, contractor, Indonesia.

1. INTRODUCTION

Indonesia's national plans place a high priority on construction projects. Following the effects of the 2000 economic crisis, consumers began to demand greater service from the construction sector as the economy began to recover in the middle of 2001. However, a recent survey by Alwi (2002) of 99 participants in the building project revealed that Indonesian contractors are having issues with scheduling delays. A major issue in construction is project completion delays. Delays can sometimes lead to expensive disputes and bad relations between clients, consultants, contractors, subcontractors, and suppliers who are all involved in the project (Al-Khalil and Al-Ghafly, 1999).

The difficulty of resolving delay issues has recently been a source of concern for both small and major contractors. The fundamental cause is that the contractors lack the capacity to recognise the significant factors for delays to arise during the construction process. Project managers can identify the most critical delay factors by ranking their relevance, which helps them find the best alternative solutions.

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This essay has two goals. First, it is vital to pinpoint the major reasons why building construction projects in Indonesia are delayed. The second goal is to ascertain if major and small contractors concur or disagree with the ranking of delay variables in multi-story building projects. Even though it is impossible to eliminate all reasons of delay, it makes sense to pinpoint the key factors so that the right steps can be taken to control the causes.

3. CAUSES OF DELAY

Projects can be delayed for a large number of reasons and usually impact on cost and time. The causes of delay in the construction industry in Indonesia are influenced not only by labour, but also by other factors such as equipment, materials, construction methods, site management and professional management (Alwi, 2002). An investigation into the causes of delays on 130 public projects in Jordan was conducted by Al-Momani (2000). Projects investigated in this study included residential, office and administration buildings, school buildings, medical centres and communication facilities. Results of this study indicated the main causes of delay are poor design, user changes, weather, site conditions, late deliveries, economic conditions and increases in quantity. In addition, Hampson et al. (2001) stated that destructive conflict resolution leads to additional costs and delays to a project. Similarly, Chan and Kumaraswamy (1997) found that the five principal and common factors of delays to be poor risk management and supervision, unforeseen site conditions, slow decision making involving all project teams, client-initiated variations, and necessary variations of works.

4. METHODOLOGY

Initially, an exploratory survey was carried out to identify the major factors that could cause delay in multi-storey building projects with an average of 13 levels. The total of 31 variables that could cause delay were selected from the literature and pilot studies. These variables were grouped into six categories: People, Professional Management, Design and Documentation, Materials, Execution and External.

A questionnaire survey incorporating these selected variables was design and sent to the members of contractors associations: AKI (Indonesian Contractors Association) and GAPENSI (National Contractors Association of Indonesia), within five large cities in Indonesia. The Indonesian contractors are normally classified into four different formal Qualifications: A, B, C1 and C2. Qualification A indicates the largest capabilities whereas Qualification C2 indicates the smallest. The company qualifications relate not only to the limitation of capital cost of projects that can be undertaken, but also to the performance of contractors including availability of resources such as financial capital, equipment and number of skilled personnel. All of the respondents are from Qualification A (representing large contractors) and Qualification B (representing small contractors). Companies from Qualification C1 and C2 were excluded from the study because they normally act as subcontractors.

The survey targeted projects that had completed within the last five years. 112 questionnaires from 36 large contractors and 23 small contractors were returned - representing an average return rate of nearly 40%. After generating the data from the questionnaire survey, interviews with the people who work both at management and operational levels during the construction process were conducted. The interviews aimed to clarify responses arising from the questionnaire. The interviewees included Project Managers, Site Managers, Supervisors, Foremen and Labourers.

5. METHOD OF DATA ANALYSIS

The collected data was analysed using an Importance Index (Ip.I). The Importance Index was computed using the following formula:

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$$Ip.I = \frac{\sum_{i=1}^{5} a_i x_i}{W.100} \quad \text{……..(5.1)}$$

Where *Ip.I* = importance index:

- a_i = constant expressing the weight of the i^{th} response, where i = 1,2,3,4,5;
- x_i = level of the response given as a percentage of the total responses for each variable;
- i = response category index where i = 1,2,3,4,5; and
- W = the highest weight (5).

To assist respondents in identifying the level of effect of each variable that could cause delay, respondents were asked to rank on a scale of 1 (not at all or not relevant) to 5 (most relevant). Using these indices, the rank of the variables can be determined. These rankings were used to compare the relative importance of the variables as identified by the different group of contractors.

In order to examine the agreement in ranking of the important variables between large and small contractors, the Spearman Rank Correlation Test was conducted. The degree of agreement is expressed as a "correlation coefficient". The rank correlation coefficient (*r*s) is calculated as follows (Mendenhall et. al., 1993):

$$rs = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \quad \text{……(5.2)}$$

where "d" is the different between the ranks indicated by large contractors and by small contractors for an individual variable, and "n" is numbers of delay causes (n = 31).

According to Mendenhall et. al. (1993), the Spearman Rank Correlation Coefficient may be employed as a test statistic to test an hypothesis of no association/no agreement between pairs of measurements from two populations. For a given value of alpha (level of significance) and for a two-tailed test, the rejection region of null hypothesis (Ho) occurred if $rs \geq ro$ or if $rs \leq -ro$, where *r*o is the critical value of Spearman's Rank Correlation Coefficient (Mendenhall et al., 1993, p.1006).

6. RESEARCH FINDINGS AND DISCUSSION

A summary of the importance index and ranking of the variables that could cause delay identified by large and small contractors is presented in Table 1. Using the formula shown in equation (5.2), the rank correlation coefficient (*r*s) for the delay variable is 0.500 for large and small contractors. The critical value (*r*o) of Spearman's Rank Correlation coefficient at the level of confidence of 95% is 0.301 (Mendenhall et al., 1993). This indicates the rejection of the null hypothesis that there is no agreement between the large and small contractors on the ranking of the importance of delay variables. Therefore, large contractors and small contractors generally agree on the ranking of the individual importance of delay variables.

Table 2 shows a summary of the index and ranking of the groups of delay that indicated by large and small contractors. The rank correlation coefficient (*r*s) for the groups of delay is 0.657 for large and small contractors. According to Mendenhall et. al. (1993), the critical value of Spearman's Rank Correlation coefficient (*r*o) at the level of confidence of 95% is 0.829.

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Table 1. Index and Ranking of Individual Delay Causes

No	Delay Causes	Large contractors		Small contractors	
		Ip.I	Rank	Ip.I	Rank
A	**People:**	0.636		0.623	
1	Lack of trades' skill	0.711	3	0.740	3
2	Poor distribution of labour	0.543	30	0.500	26
3	Supervision too late	0.589	28	0.660	12
4	Too few supervisors/foremen	0.621	21	0.620	14
5	Lack of subcontractor's skill	0.664	17	0.660	13
6	Inexperienced inspectors	0.687	8	0.560	19
B	**Professional Management:**	**0.696**		0.640	
1	Poor planning and scheduling	0.694	6	0.680	9
2	Poor provision of information to project participants	0.666	14	0.580	18
3	Poor coordination among project participants	0.703	5	0.620	15
4	Slow in making decisions	0.721	1	0.680	11
C	**Design and Documentation:**	0.660		**0.683**	
1	Poor quality site documentation	0.571	29	0.620	16
2	Unclear specifications	0.667	12	0.600	17
3	Unclear site drawings supplied	0.667	13	0.680	10
4	Slow drawing revision and distribution	0.672	10	0.740	2
5	Design changes	0.719	2	0.760	1
6	Poor Design	0.663	18	0.700	5
D	**Material:**	0.654		0.643	
1	Poor quality of materials	0.663	19	0.700	5
2	Delay of material delivery to site	0.690	7	0.740	3
3	Poor material handling on site	0.613	25	0.540	23
4	Poorly scheduled delivery of material to site	0.665	15	0.700	6
5	Inappropriate/misuse of material	0.677	9	0.560	20
6	Poor storage of material	0.615	24	0.620	15
E	**Execution:**	0.639		**0.587**	
1	Too much overtime for labour	0.616	23	0.540	22
2	Inappropriate construction methods	0.706	4	0.680	8
3	Equipment shortage	0.622	20	0.680	7
4	Poor equipment choice/ineffective equipment	0.620	22	0.540	24
5	Outdated equipment	0.664	16	0.520	25
6	Poor site layout	0.607	26	0.560	21
F	**External:**	**0.592**		0.607	
1	Site condition	0.599	27	0.740	4
2	Weather	0.668	11	0.620	15
3	Damage by other participants	0.507	31	0.460	27

The result indicates the acceptance of the null hypothesis. On other words, these figures suggested that there is no agreement between large and small contractors on the ranking of groups of delay. The group of *professional management* was ranked the highest and the *external* group was ranked the lowest by large contractors. Whereas, small contractors ranked the group of *design and documentation* as the highest and the *execution* group as the lowest. A brief discussion of the differentdelay groups is presented as follows.

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Table 2. Index and Ranking of Delay Groupings

No	Delay Groupings	Large contractors		Small contractors	
		Ip.I	Rank	Ip.I	Rank
A	People	0.636	5	0.623	4
B	Professional Management	0.696	1	0.640	3
C	Design and Documentation	0.660	2	0.683	1
D	Materials	0.654	3	0.643	2
E	Execution	0.639	4	0.587	6
F	External	0.592	6	0.607	5

People

The *people* delay grouping variable was ranked low by both large and small contractors. However, individually, *lack of trades' skill* was ranked quite high by all parties. This indicates that the performance of trades is more critical to the success of any construction project than other variables in the group of people. According to the respondents, contractors are still facing lack of trades' skill to complete the project satisfactorily. In fact, interviewees stated that "skilled" operatives were often not really skilful, having only gained their experience on the job site and learning construction skills through *trial and error*. A general trend was observed with activities on the project that at the moment, labourers are not using their own initiative, and are instead relying on both foremen and supervisors' ability to check and approve the works.

Professional Management

Professional management was ranked the highest by the large contractors and a close third by the small contractors. It seems the contractors acknowledged that *professional management* played an important role during the construction process. *Professional management* includes the ability of the contractors' personnel to plan and to carry out each activity effectively. In other words, this required both the skill of the personnel to cope with problems as soon as possible, and the ability and the flexibility of staff to work as a team with other participants. *Slowness in making decisions*, as one of *professional management* roles, was ranked to be highest by large contractors.

Design and Documentation

The *design and documentation* group was ranked high by both groups of contractors. The small contractors ranked this group most important and the large contractors ranked it second. The result shows that this group is the most critical factor causing delay. Design included lack of either consultants' skill or contractors' skill in providing clear working drawings and detailed specification to be used on site. Documentation focused on contractors' documentation to record all activities during the construction process. These records allowed the contractors to identify their performance in the past by looking at the weaknesses and could be used as a guide to improve their future performance. In respect to this group, *design changes* seem to be the most highly weighted variable causing delay. Interviews confirmed that *design changes* mostly occurred based on owners demands or clients requests for a change in design to meet changing requirements and preferences.

Materials

The *materials* group of delay variable was ranked third by the large contractors and the second by the small contractors. This problem dealt with material management practices during the construction process, and included the quality of the materials, the use of material in the construction projects, the vertical and horizontal movement of material, and the delivery of material to site. In other words, material management should be a planned procedure that includes purchasing, delivery, handling and minimisation of waste with the aim of ensuring the requirements are met. It can be seen in Table 1 that *delay of material delivery to site* was relatively highly ranked by both groups of contractors. All

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interviewees concluded that the reasons for delays of material delivery to site were caused by (1) problems associated with transportation of materials (eg. traffic jams, the weather and other factors);
(2) an unexpected increase in demand, due to poor planning and coordination between contractors and suppliers.

Execution
All parties agreed that the *execution* group was not highly important in delaying construction projects. Of the six variables, *inappropriate construction methods* is the most important variable in causing delay during the construction process. During the execution, certain equipment and labour skills are required to complete the activity satisfactorily. In choosing an appropriate construction method, project managers need to consider the condition of the project such as the level of the difficulty of the project, the site layout, the time available, the possibility in using certain equipment, and the skill of the personnel.

External
All contractors agreed on the ranking of the *external* group of delay variables as somewhat low. This indicates that construction managers believe that external factors do not effectively contribute to the delay of the project. However, interviewees especially from the small contractors, confirmed that during the rainy season in Indonesia, weather could cause flooding in certain areas and subsequent lengthy delays in schedule. This condition may relate to the poor layout of the project site and the poor system of drainage around the project site.

7. CONCLUSION

The importance of delay causes on multi-storey building projects in Indonesia has been identified clearly. The results show that there is an agreement between the large and the small contractors towards individual causes of delay, whereas, the large and the small contractors have little agreement in relation to ranking the groups of delay variables. Variable *design changes* and *lack of trades' skill* were ranked consistently high by both groups of contractors. However, *slow in making decisions* was ranked the highest by large contractors. Although this research was conducted in the commercial building construction sector in Indonesia, the results may also be applicable for similar projects in other developing countries. The identification of important delay causes from this research can focus construction managers' attention to plan preventive actions to keep the building construction project on schedule.

8. REFERENCES

Al-Khalil M.I. and Al-Ghafly, M.A. (1999) "Important Causes of Delay in Public Utility Projects in Saudi Arabia". *Journal of Construction Management and Economics,* Vol. 17, 647-655.

Al-Momani, A.H. (2000) "Construction Delay: A Quantitative Analysis". *International Journal of Project Management,* Vol. 18, 51-59.

Alwi, S. (2002). "Non Value-Adding Activities in the Indonesian Construction Industry: Variables and Causes". *Unpublished Doctoral Thesis,* Queensland University of Technology, Brisbane, Australia.

Chan, D. W. M. and Kumaraswamy, M. M. (1997) "A Comparative Study of Causes of Time Overruns in Hong Kong Construction Projects". *International Journal of Project Management,* Vol. 15, No. 1, 55-63.

Hampson, K.D., Peters, R.J. and Walker, D.H.T. (2001) "Negotiation and Conflict in Innovative Procurement Environments: The National Museum of Australia". *CIB World Building Congress*, April, Wellington.

Mendenhall, W.; Reinmuth, J.E. and Beaver, R.J. (1993) Statistics for Management and Economics. *Duxbury Press,* California.

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