Project delay analysis of highrise building project in Jakarta

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Abstract. Highrise building construction in Jakarta continues to increase over time. The complex characteristics of highrise building work present challenges for contractors to be able to complete projects on time. Many factors cause delays in highrise building projects and these factors differ from every country. A survey used questionnaires that have conducted in Jakarta, Indonesia obtained ten dominant factors which were then grouped into two main variables: (1) changes in the scope of work and (2) weak planning and controlling. Changes in the scope of work have a direct impact on changes in project costs. The development of the contractor team's ability to coordinate and communicate with other parties involved in construction, likewise the development of the contractor team's ability to plan is expected to overcome project delays in highrise building projects. Improving the capability of the contractor team project is needed to support sustainable competitiveness in the construction sector.

Keywords: project delay, highrise building, contractor, analysis factor

1. Introduction

The common thing that occurs in the implementation stage of construction projects is the delay in real completion time against the time of the project completion plan [4]. Project delays are a major cause that contributes to project cost overruns [3]. Project delays are also often a source of disputes between owners and contractors and create project owner dissatisfaction. Therefore the importance of meticulous scheduling to avoid disputes and also the project can be completed on time [20]. Considering how multifaceted and complex the construction project is, a reliable management function is needed, particularly planning activities, implementation activities, and controlling activities. A project is categorized as successful if it fits on cost/budget, appropriate on quality, and on time. These three constraints are a measure of a successful construction project.

The causes of delays in Indonesia construction projects are often observed but in different construction projects as a whole (infrastructure and building). This study aims to determine the dominant factors that cause delays in highrise building projects only and examine the effect of the delay on the construction costs. By knowing the dominant factors that influence delays in highrise building projects, contractors expected can minimize these factors so the project can be completed on time.

Tall buildings are buildings that have tall structures. Tall buildings based on several standards range from 75 feet to 491 feet (23 m to 150 m). While buildings over 492 feet or 150 m are called skyscrapers. The average height of one level is 13 feet or 4 m, so buildings as high as 79 feet or 24 m have 6 levels. Characteristics of multi-storey buildings according to Mulyono (2000) are grouped into...
1. Low-rise buildings, with the number of floors 1-3 floors, height <10m 2. Medium-rise buildings, with the number of floors 3-6 floors, height <20 m 3. High-rise buildings, with the number of floors> 6 floors, height> 20 m [21].

As far as the eye can see, Jakarta City has been crowded with high rise buildings [8]. According to [2], 189 high-rise buildings will be as crowded as Jakarta until 2019. High rise building has its characteristics such as: generally facing the problem of limited land both in planning parking areas and installation site. High rise building projects have many work items, involve many parties, the duration of completion should be longer, high risks, high safety requirements, high uncertainties, and involve many disciplines, the implementation schedule is very tight and the volume of work is large. Quite a lot of building projects experienced delays because the schedule plan is not sufficient and a strict implementation schedule. [8].

2. Cause Of Delay Theory and Previous Research

Many things cause delays in a construction project, as summarized from the previous research [6];

1). Labor (lack of labor expertise, lack of labor discipline, Lack of Work Motivation of Workers, Number of Workers In Accordance with existing work activities is inadequate, high employee turn over, lack of communication between workers and their supervision, working accidents)

2). Material (Late Delivery of material, Lack of Construction Materials, Poor Material Quality, Material Damage in Storage, Material Changes in Shape, Function, and Specifications, Scarcity due to Job Specificity, Inaccurate Order Time, Amount of Material sent by Suppliers did not fit specification),

3). Equipment (Late Delivery / Provision of Equipment, Equipment Damage Occurred, Lack of Availability of Equipment that Is Adequate / As Needed, Equipment Productivity Is Not Good, lack of Foreman or Operator that able To Operate Equipment,

4). Site Characteristics (Surface and Sub-Surface Conditions (Including Groundwater Surface), Poor Environmental Response, Physical Characteristics of Buildings Around Inhibited Project Sites, Storage Sites / Materials Far from the Project, Access to Project Sites that are Difficult, Spaces Motion to Do Less / Narrow Work, Project Locations that are Hard to reach),

5). Finance: Difficulties in Funding at Contractors, Difficulty in Payment by Owners, Material Prices Tending to Rise, Absence of Intensive Money for Contractors, if Completion Time Is Out of Schedule, Error in Estimated Costs, Late Payment of Contractors to Suppliers and Labor, National Economic Situation Moderately Poor, Rupiah Value Fluctuations Against the Dollar

6). Situation: High Intensity of Rainfall, Unforeseen Occurrence such as Fire, Flooding, Severe Weather, Stormy / Storms, Earthquakes and Landslides, Social and Cultural Factors That Hinder

7). Changes: There was a Design Change by the Owner, a Design Error was Made by a consultant, an Error in the Investigation of the Land, There were New Regulations that Requires Time to be Implemented

8). Scope and Contract / Job Documents: Incorrect / Incomplete Planning (Drawings / Specifications), Change of Work Scope at the Time of Implementation, Delay in Making Owner's Decisions, Many Added task, There Are Requests for Changes to Completed Work, Disagreement between Making Work Drawings between Consultants and Contractors, Changes in Work Schedule.

9). Planning and Scheduling: Determination of Inaccurate Working Time Duration, Incorrect Construction Methods, Incomplete Identification of Type of Work, Working Order Plans that Are Not Well Arranged / Integrated, Working Plans of Frequently Changing Owners.

10). Job Inspection, Control and Evaluation System: Differences in Sub-Contractor and Contractor Schedule in Project Completion, Unscheduled Submission of Sample Materials by Contractors, Process Approval of Sample Materials with Long Time by Owner, Delays in Inspection and Material Test Processes, Sub-Contractor Failures In Carrying Out Work, Many Work Results That Must Be Repaired / Repeated Due to Defect , Long Process and Procedures for Evaluating Progress of Jobs, long and convoluted Preparation of Licensing and Shop Drawing.
11). Managerial: Lack of Field Manager Experience, Lack of Communication between Deputy Owners and Contractors, Lack of Communication between Consultants and Contractors, Lack of Supervision of Subcontractors and Suppliers.

12). Government Relations Factors: Obtaining Permits from the Government, Convoluted Bureaucracy in Project Operations.

[18] conducted a study of the factors that caused project delays in all types of construction projects, and the results showed different groups of factors from one country to another that caused project delays and cost overruns. Also, studies specifically on high rise building projects unfold different causative factors. The following are the results of research conducted in various countries:

a. Research conducted in India (Jape and Saharkar. 2017) found that the dominant factors affecting project delays were Change in Design, Incorrect financial & payment methods, Complexity of Project.

b. Haslinda et al (2018) conducted a study in Penang Malaysia. The results revealed that the most predominant causes for time overrun were due to design changes, inadequate planning, and scheduling and poor labor productivity.

c. Bhatti et al. (2018) conducted a study in Dubai and concluded that the dominant factors affecting project delays there were difficult for the contractor to finance a project, lack of coordination among stakeholders, improper scheduling and planning.

d. Aza (2019) reviewed the top ten severe delay causes for the USA are: change orders during construction by the owner (77.33%), severe weather conditions (77.14%), mistakes and errors in design and drawing documents (76.0%).

3. Research Method

The study was conducted with a survey using a questionnaire and distributed by random sampling. The questionnaire originally consisted of 12 main variables: labor, material, equipment, place characteristics, finance, situation variables, finance, changes, scope, and contract/work documents, planning and scheduling, managerial, government relations, inspection systems, control, and job evaluation. The 12 variables consist of various factors which have been explained in the literature review section above.

After testing the reliability and validity with the Cronbach's Alpha test, all factors are reliable but 13 factors are invalid and are deleted because based on the value of "Corrected Item Total Correlation" it can be seen that the coefficient value is less than 0.3.

Factor analysis is used to reduce existing factors to be the most dominant factor affecting the delay in highrise building projects. Furthermore, the dominant factors are grouped into variables. Factors that are within one new variable have a large correlation value with that new variable. Multiple regression analysis is used to find out which variable affects project costs.

4. Data and Analysis

After the questionnaire passed through the validity and reliability test, the questionnaire was distributed to the highrise building project in Jabodetabek which was experiencing delays. The study was conducted with a survey using a questionnaire and distributed by random sampling. Of the 19 projects that participated, as many as 16 questionnaires were declared to be eligible for analysis data. The other three questionnaires came from projects that were not delayed. Respondents are a contractor project team consisting of site managers, site engineers, QC, QA.

Factor analysis was performed using SPSS version 25. From the factor analysis, it would be appropriate if the KMO value obtained > 0.50. KMO value of 0.691 indicates that these factors meet
the requirements and can be used for factor analysis. (Sianipar, 2012). Factor analysis was carried out to reduce all factors that caused the project's delays above, becoming the dominant factor. Then group the dominant factors into several new variables. The results of the factor analysis can be seen in Table 1 below.

**Table 1. Dominant factors and new variables formed**

| No | Dominant Factors | New Variables |
|----|------------------|---------------|
| 1  | Material changes in form, function, and specifications | Changes in scope and work document (Xb1) |
| 2  | There was a design change by the owner | |
| 3  | The owner's delay in making decisions | |
| 4  | Submission of sample materials by contractor unscheduled | |
| 5  | The process of approval of sample material for a long time by the owner | |
| 6  | Inadequate number of workers /by existing work activities | Weak planning and controlling (Xb2) |
| 7  | Equipment failure has occurred | |
| 8  | Incomplete identification of the type of work | |
| 9  | Incorrect construction / execution methods | |
| 10 | The long process and procedures for evaluating the progress of work | |

From the factor analysis, ten original factors were extracted into two new factors. The determination of the new factors is based on eigenvalues. Only variables with initial eigenvalues >1 were retained. Variable 1 (Xb1): Changes in scope and work documents has initial eigenvalue 5.802 and Variable 2 (Xb2): Weak planning and controlling has initial eigenvalue 1.369. The ten dominant factors were grouped into two new variables. Factors included in the same variable have a high correlation value (Rotated Component Matrix> 0.6).

**Table 2. Multiple regression analysis result**

| Model | Unstandardized Coefficients | Standardized Coefficients | Collinearity Statistics |
|-------|-----------------------------|---------------------------|-------------------------|
|       | B | Std. Error | Beta | t | Sig. | Tolerance | VIF |
| 1 (Constant) | 0.790 | 0.377 | 2.098 | 0.056 |
| Xb1   | 0.064 | 0.027 | 0.721 | 2.331 | 0.036 | 0.521 | 1.919 |
| Xb2   | -0.024 | 0.035 | -0.216 | -0.697 | 0.498 | 0.521 | 1.919 |
Two new variables that had formed through factor analysis then included as input to the multiple regression analysis to find out whether these variables affect the increasing of construction cost. From the multiple linear regression test obtained by one equation, \( Y = 0.790 + 0.064 X_{b1} \). The value of \( \text{sig} = 0.036 < 0.05 \) (t-test) so that this variable did not affect costs and was not included in the equation.

From this equation, it can be said that the first independent variable \((X_{b1})\), changes in scope and work document, has a positive influence on the use of costs meaning that the increase in the independent variable will cause an increase in the use of costs. Whereas in the second variable \((X_{b2})\), the value of \( \text{sig} = 0.498 > 0.05 \) (t-test) so that this variable did not affect costs and was not included in the equation.

5. Discussion

According to the analysis above, highrise building projects in Jakarta in 2019, often experience delays caused by two dominant things, particularly changes in scope and work documents, also weak planning and controlling. Research on the factors causing delays in the high rise building project conducted in 2010 by Kaming et al. also presented the same thing. The cause of the delay in highrise building projects in Indonesia is design changes, poor labor productivity, and inadequate planning. The construction project stakeholder in Indonesia so far are still experiencing the same problem, lack of readiness in responding to design changes and weak in project planning.

Changes in scope and work documents can trigger cumulative impacts from the implementation of construction activities. Sandyavitri 2008 revealed that significant changes to the scope and work documents during the construction phase could have fatal consequences for increased costs and time for project completion. Errors and changes in design, as well as poor coordination between design documents, will cause a lot of rework (Winata and Hendarlim, 2005). To be able to reduce rework, the most effective way is to improve communication and coordination in both the design and construction phase and to estimate and overcome design problems before entering the construction phase. Early planning that has been carefully made and implemented in the field can reduce the risk of construction project delays.

In the construction stage, even though the project was planned carefully, the contractor did not participate in the planning process so some work still needed to be adjusted. Besides, the contractor cannot prevent the preferences of the owner who wants to make changes to the design at the construction stage. Hence, in dealing with design changes required the readiness of the contractor in dealing with changes, the contractor's ability to communicate and collaborate with various stakeholders quickly.

Construction Management is also expected to help the contractor to overcome the project delay due to design changes. Construction Management as a consulting company for the owner must be able to understand and accommodate all input from the owner, then supervise and assist the consultant in pouring it into the design (Kaming & Saputra, 2013). Construction Management also provides convenience because of construction management functions as the interface coordinator between consultants and contractors.

The second factor which is the main cause of project delay was the lack of planning and controlling. Planning and controlling are activities in the management of construction projects. Managing projects involves planning, organizing, executing, and monitoring the project (Ahuja, 1994). The contractor project team in Indonesia needs to improve its capabilities in construction management. The planning includes not only scheduling, but also planning material needs, workers, and tools. The contractor project team needs to get used to planning as detailed as possible, identifying the risks that might occur and how to mitigate them.

In terms of scheduling, it is better to increase the variation of the dependency relationship to produce a shorter construction period with parallel activities. Another solution is to apply a variety of software products effectively and according to procedures to assist in the planning, implementation, supervision and project control processes.
6. Conclusion
The most prominent factor in project delays in Indonesia includes design changes and weak project planning and control. These findings are not much different from research conducted nine years ago. There is no learning and improvement effort carried out in the Indonesia highrise building project. This design change has a direct effect on changes in project costs.

The development of the contractor team’s ability to coordinate and communicate with other parties involved in construction, likewise the development of the contractor team’s ability to plan is expected to overcome project delays in highrise building projects. Improving the capability of the contractor team project is needed to support sustainable competitiveness in the construction sector.

Future research can be carried out in different types of projects such as housing, roads, bridges, industrial areas. Research can also be carried out for the effort needed to improve the system if a design change occurs. Research is needed to inquire whether the use of Construction Management (CM) can assist the contractor in accelerating decision making by the owner regarding design changes.

References
[1] Ahuja H N, Dozzi S P S, Abourizk M 1994 Project Management: Techniques in Planning and Controlling Construction Projects John Wiley & Sons
[2] Alexander H 2016 189 Gedung bertingkat sesaki jakarta hingga 2019 mendatang https://properti.kompas.com/read/2016/10/13/191157021/189.gedung.bertingkat.sesaki.jakarta.hingga.2019.mendatang?page=all.
[3] Alifen R, Setiaiwan R, Sunarto, A 1999 Analisa what if sebagai metode antisipasi keterlambatan durasi proyek Jurnal Teknik Sipil dan Perencanaan Universitas Kristen Petra.
[4] Ariefasa R 2011 Factor penyebab keterlambatan pekerjaan konstruksi bangunan gedung bertingkat yang berpengaruh terhadap perubahan anggaran biaya pada pekerjaan struktur Skripsi Universitas Indonesia.
[5] Asa E B, Arun B T, Edmund 2019 Construction delays in high-rise building projects in usa and india International Journal of Information Research and Review 06(03) pp.6164-6173
[6] Astina D, Widiawati I A R, Joni IGP 2012 Analysis of the factors causing delay execution of project construction in tabanan district Jurnal Ilmiah Elektronik Infrastruktur Teknik Sipil
[7] Bhatti I A, Nagapan S A, Abd H, Sohu S 2018 Delay in high rise building construction project of Dubai: A Review Engineering science and technology international research Journal 2(2)
[8] Budisuanda 2012 Karakteristik Gedung High Rise Building http://manajemenproyekindonesia.com/?p=1440
[9] Haslinda A N, Xian TW, Norfarahayu K, Hanafi R M and Fikri H M Investigation on the factors influencing construction time and cost overrun for high-rise building projects in penang Journal of Physics: Conference Series Volume 995 conference 1
[10] Haslinda A N, Xian, T W, Norfarahayu K, Hanafi RM and Fikri H M 2018 Investigation on the Factors Influencing Construction Time and Cost Overrun for High-Rise Building Projects In Penang IOP Conf. Series: Journal of Physics Conf. Series 995
[11] Hassan H, Mangare J B, & Pratasis PA 2016 Faktor–faktor penyebab keterlambatan pada proyek konstruksi dan alternatif penyelesaiannya (studi kasus : di manado town square) Jurnal Sipil Statik.4(11) November 2016 (657-664) ISSN: 2337-6732 657-664
[12] Kaming P F, & Saputra A Y 2013 Studi peran konsultan manajemen konstruksi pada tahapan proyek. Universitas Sebelas Maret Press 111-118
[13] Kaming P F, Olomolaiye P O, Holt G D & Harris 1997 Factors influencing construction time and cost overruns on high-rise projects in Indonesia Journal Construction Management and Economics 15(1)
[14] Kaming P F, Olomolaiye P O, Holt G D, & Harris F C 2010 Factors influencing construction time and cost overruns on high-rise projects in Indonesia Journal Construction Management and Economics 15(1) 83-94.
[15] Kim K I 2004 Reform Measures of Korea’s High Rise Building Construction Period CTBUH
SEOUL Conference

[16] Messah YA, Widodo T, Adoe M 2013 Kajian penyebab keterlambatan pelaksanan proyek konstruksi gedung di kota kupang *Jurnal Teknik Sipil*.

[17] Sandyavitri A 2008 Pengendalian dampak perubahan desain terhadap waktu dan biaya pekerjaan konstruksi *Jurnal Teknik Sipil* 9(1) 57 – 70

[18] Shah R K 2016 An exploration of causes for delay and cost overrun in construction projects: a case study of Australia, Malaysia & Ghana *Journal of Advanced College of Engineering and Management* Vol. 2

[19] Sianipar, H. B. (2012). Analisis Faktor-Faktor Penyebab Keterlambatan Penyelesaian Proyek Konstruksi Pengaruhnya Terhadap Biaya *Universitas Sebelas Maret Press* i-77

[20] Unas S E, Hasyim M. H, Negara, K. P. (2012). Antisipasi Keterlambatan Proyek Menggunakan Metode What If Diterapkan pada Microsoft Project *Jurnal Rekayasa Sipil* 8(3) 192-197.

[21] Virama Karya 2018 *Perencanaan dan Pengawasan High Rise Building* [http://sibima.pu.go.id/pluginfile.php/77952/mod_resource/content/1/Perencanaan%20dan%20Pengawasan%20High%20Rise%20Building.pdf](http://sibima.pu.go.id/pluginfile.php/77952/mod_resource/content/1/Perencanaan%20dan%20Pengawasan%20High%20Rise%20Building.pdf)

[22] Winata S & Hendarlim Y 2005 Faktor-faktor penyebab rework pada pekerjaan konstruksi *Civil Engineering Dimension ISSN 1410-9530 print © 2007 Thomson GaleTM* 22–29