Top Ten Similarity Ranking for Project Delay Factors in Construction Industry

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Abstract. Delays that occur on a construction projects can cause project performance inefficiencies and can even add to the project cost. Factors due to project delays consist of many things that can cause project delays. This study aims to find a top ten similarity factor that causes delays in a construction projects based on the results of research in Jakarta construction projects against previous studies in other countries. From a total of 100 distributed questionnaires, 88 (88%) were filled in correctly and returned as data analysis material. The Data from the survey results were analyzed using Statistical Software Package (SPSS) to produce a ranking for Project Delay Factor. The ranking of the study was then re- analyzed based on the similarity of the previous research so that the similar Project Delay Factor Ranking was obtained.

Keywords: Project Delay Factor

1. Introduction
Delay factors in construction projects can be caused by many factors that influence one another. Factors that can cause delays in this project are very crucial and need to be identified to improve and anticipate problems with delays in construction projects. For this reason, a review of the literature on comprehensive project delays was carried out for identifying the anticipation of the risk of factors causing delays in construction projects.

Jackson and Steven (2001) conducted an analysis of the causes of delays in construction projects in Ilorin using a questionnaire survey and found that the main factor of delay was “price fluctuations in material or labor”; “irregular orders”, “late employee salaries”, “lack of proper analysis in the process of project bidding”, “selection of contractors who are less competent”, “bidding on improper project prices and ever-changing requests from clients”.

Jackson (2002) investigated the causes of late construction projects in the United Kingdom through survey questionnaires and found results of research that delays were caused by “additional costs at the time of design changes”, “design change factors”, “information availability”, “estimation methods”, “project management and design team performance”.

Chang (2002) wants to research the causes of construction project delays through four project cases to calculate their contribution to engineering design projects in America. The results of this
A study found that the main factor of the delay in construction projects was “the request of the owner to increase the scope of work and additional work”.

Frimpong et al. (2003) conducted a research survey using a questionnaire consisting of 26 factors to obtain the main contributor to the delay in the Groundwater Drilling project in Ghana. Based on the 26 factors tested, 10 main factors were “payment difficulties”; “poor contract management”; “material procurement”; “inflation”; “financial difficulties from contractors”; and “escalation of material prices”; “payments during construction, planning and poor scheduling”; “bad weather and preparation of incorrect project cost estimates”.

Koushki et al. (2005) conducted a study of the delay in housing projects funded by the private sector in Kuwait. There were 3 main factors that caused delays, including problems related to the contractor, material and financial difficulties of the owner.

Omoregie and Radford (2006) found that the main factor in delays in infrastructure projects in Nigeria was “price fluctuations”; “financing and payments from completed work”; “poor contract management”; “schedule delays”; “changes in conditions on the ground”; “inaccurate estimates”; “material shortages”; “additional work”; “design changes”; “subcontractors and supplier nominations”; “weather”; “non-compliance with the conditions of the work contract”; “errors and differences in the conditions of the employment contract”.

Azhar et al. (2008) conducted an investigation into the delay in construction projects in Pakistan. Research studies were carried out using a questionnaire consisting of 42 factors showing that the 10 main factors in delay were fluctuations in “material prices”; “high costs for engine maintenance”; “too low supply”; “procedures for procurement of goods and materials”; “procurement phase”, “methods of improper cost estimates”, “additional work”, “improper planning”, “inadequate government policies”.

Le-Hoai et al. (2008) investigated the causes of delays in construction projects in Vietnam using questionnaire surveys. Investigations involved 21 factors and 5 general factors including “field management and poor supervision”; “poor project management”; “financial difficulties from the owner”; “financial difficulties from contractors and design changes”.

Enshassi et al. (2009) conducted a questionnaire study survey consisting of 42 factors to investigate the main causes of delays in construction projects in Gaza among contractors, consultants and clients. The results of the study show that the 10 main factors that cause delays received by 3 parties (contractors, consultants and clients) are increases in material prices, late construction, material and equipment supplies by contractors, fluctuations in construction material prices, exchange rates against the US dollar, monopoly of project material by several material providers, source constraints: funding and lack of preparation from related parties, lack of funds in planning or supervision during the contract stages before and after, improvements to drawings during the construction phase, design changes and lack of accuracy in taking quantities material.

Kaliba et al. (2009) conducted a study to determine the contributors to the late construction of flat road construction projects in Zambia. The results of the study show that the main cause of delays is the change in construction costs caused by weather caused by heavy rains and floods, changes in the scope of work, protection of the environment and mitigation of costs, schedule delays, strikes from labor, technical challenges, inflation and local government pressure.

Ameh et al. (2010) investigated the causes of construction delays in 53 telecommunication projects in Nigeria through questionnaire surveys. The survey results show that 7 main factors are “inexperienced contractors”; “material prices”; “fluctuations in material prices”; “repeated design changes”; “economic stability” and “high interest rates on loans imposed on contractors”; “types of payments”; “loans and payments”.

Ade Asmi et al. (2016) investigate the factors that have been identified in the literature review study where these factors cause delays in the construction industry. A comprehensive review of 46 articles produced 78 general factors from construction delays that were used in the investigation of factors that caused construction delays in the construction industry in Indonesia.
2. Analysis

Based on previous research (Ade Asmi et al 2016), this study identifies general factors that cause delays; and to assess in a hierarchical manner the causes of delays in construction projects in Jakarta. This research is based on two approaches to research methodology including mapping literature reviews and questionnaires. Both of these methods act as supplements to each other which make data collection more comprehensive. From the factors that have been identified, through the literature review literature from previous research. Then a structured questionnaire was drafted and randomly designed and distributed to obtain the ranking of the study results. The top ten results of the study are as follows:

Table 1. Top 10 Project Delay Factors (Ade Asmi et al 2016)

| Project Delay Factor                                      | Mean Rank Value | Ranking |
|-----------------------------------------------------------|-----------------|---------|
| Frequent design changes                                   | 39.05           | 1       |
| Financial difficulties of owner                          | 37.14           | 2       |
| Delay in progress payment by owner                       | 36.92           | 3       |
| Schedule delay                                            | 36.16           | 4       |
| Incompetent subcontractors                                | 36.08           | 5       |
| Late delivery of materials and equipment                  | 34.98           | 6       |
| Poor design and delays in design                         | 34.34           | 7       |
| Delay in material                                         | 34.19           | 8       |
| Labour productivity                                       | 34.16           | 9       |
| Delay preparation and approval of drawings                | 34.12           | 10      |

From the results of Table 1, project delay factors will be analyzed based on the similarity ranking of the results of the project delay factors research from other countries as shown in Table 3 and Table 3 as follows.

Table 2. Delay factors of Project by Country (a)

| No  | Author                        | Project Delay by Country                  | Delay Factors                                                                                           |
|-----|-------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 1   | Ogunlana S.O et al.,(1996)    | High rise building construction project: Bangkok, Thailand | • “Shortages of construction materials”; “Shortage of site workers”; “Frequent changes by owners”        |
| 2   | Chan and Kumaraswamy (1997)   | Time overrun in construction projects, Hong Kong | • “Poor site management”; “Unforeseen ground condition”; “Low speed of decision making”; “Client-initiated variation”; “Necessary variations of works” |
| 3   | Al-Khalil M and Al- Ghafly (1999) | Public utility projects, Saudi Arabia     | • “Cash flow and financial difficulties”; “Difficulties in getting work permit”; “Practice of assigning contract to lowest bidder”; “Underestimate project duration”; “Effect of surface condition”; “Changes in scope of projects”; “Ineffective planning and scheduling by contractors”; “Shortage of manpower”. |
Table 2. Delay factors of Project by Country (b)

| No. | Author | Project Delay by Country | Delay Factors |
|-----|--------|--------------------------|---------------|
| 4   | Odeh A.M and Battaineh (2002) | Traditional contracts of Large construction industry, Jordan | “Inadequate contractor experience”; “Owner interference”; “Finance and payments of completed work”; “Slow decision making by owners”; “Labor productivity” |
| 5   | Frimpong Y, Oluwoye J, Crawford (2003) | Groundwater construction Projects, Ghana | “Monthly payment difficulties”; “Poor contractor management”; “Material procurement”; “Poor technical performances”; “Escalation of material prices” |
| 6   | Long N.D, Ogunlana S, Quang T and Lam K.C (2004) | Large construction project, Vietnam | “Incompetent designers and contractors”; “Poor estimation and change management”; “Social and technological issues”; “Site related issues”; “Improper techniques and tools” |
| 7   | Assaf S.A, Al-Hejji S (2006) | Large construction projects, Saudi Arabia | “Change order”; “Delay in progress payment”; “Ineffective planning and scheduling of project by contractor”; “Poor site management and supervision by contractor”; “Shortage of labors”; “Difficulties in financing project by contractor” |
| 8   | Fong N.K, Wong L.Y and Wong L.T (2006) | Fire services installation related contributors of construction delays in building construction work, Hongkong | “Improper site co-ordination management of the electrical and mechanical installation.; Lack of timely decision making of the client; Defects identified during the fire services Inspection” |
| 9   | Sambasivan M, Soon Y.W (2007) | Causes and effects of delays in Construction industry, Malaysia | “Contractor’s improper planning”; “Contractor’s poor site management”; “Inadequate contractor experience”; “Inadequate client’s finance and payments for completed work”; “Problems with subcontractors”; “Shortage in materials”; “Labor supply”; “Equipment availability and Failure”; “Lack of communication between parties”; “Mistakes during the construction stage” |
| 10  | Sweis, G., Sweis, R., Hammad, A.A., and Shiboul, A. (2007). | Delays in construction projects, Jordan | “Financial difficulties faced by contractor”; “Too many change orders by owner”; “Poor planning and scheduling of the project by contractor” |
| 11  | Muhammad Saiful Islam, and Bambang Trigunarsyah (2017) | Construction Delays in Developing Countries | “Improper planning and scheduling”; “Lack of experience”; “Incompetent project team”; “Improper progress monitoring and cost control”; “Inadequate site inspection”; “Inaccurate time and cost estimation” |
| 12  | Mohd Razaki Abdullah, Ismail Abdul Rahman, Ade Asmi Abdul Azis (2009) | Large Mara Construction Projects Based on Project Management Consultant Perspective, Malaysia | “Cash flow and financial difficulties faced by contractors”; “Contractor's poor site management”; “Inadequate contractor experience”; “Shortage of site workers”; “Ineffective planning and scheduling by contractors”; “Escalation of material prices”; “Practice of assigning contract to lowest bidder”; “Problems with subcontractors”; “Lack of communication between parties”; “Poor estimation and change management”; “Material procurement”; “Incompetent designers and contractors”; “Underestimate project duration”; “Low speed of decision making”; “Unforeseen ground condition”; “Changes in scope of projects”; “Frequent changes by owners”; “Owner interference” |
Table 3. Similarity Ranking

| No | Author | (1) Frequent design changes | (2) Financial difficulties of owner | (3) Delay in progress payment by owner | (4) Schedule delay | (5) Incompetent subcontractors | (6) Late delivery of equipment | (7) Poor design and delays in design | (8) Delay in material | (9) Labour productivity | (10) Delay preparation and approval of drawings |
|----|--------|----------------------------|------------------------------------|----------------------------------------|------------------|-------------------------------|--------------------------------------|-------------------------------|-------------------------------|---------------------|-----------------------------|
| 1  | Ogunlana S.O et al.(1996) | ✓                             | -                                  | -                                       | -                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 2  | Chan and Kumaraswamy (1997) | ✓                             | -                                  | -                                       | -                | ✓                             | -                                    | -                             | -                             | -                   | -                           |
| 3  | Al-Khalil M and Al-Ghaffy (1999) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | -                                    | -                             | -                             | -                   | -                           |
| 4  | Odeh A.M and Battaineh (2002) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | -                                    | -                             | ✓                             | ✓                   | ✓                           |
| 5  | Frimpong Y., Ohwunye J., Crawford (2003) | -                             | ✓                                  | ✓                                       | ✓                | ✓                             | -                                    | -                             | -                             | -                   | -                           |
| 6  | Long N.D, Ogunlana S., Quang T and Lam K.C(2004) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 7  | Assaf S.A, Al-Hejji S (2006) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 8  | Fong N.K, Wong L.Y and Wong L.T (2006) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 9  | Sambasivan M, Soon Y.W (2007) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 10 | Sweis, G., Sweis, R., Hammad, A.A., and Shboul, A. (2007) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 11 | Muhammad Saiful Islam, and Rambong Trigunarsyah (2017) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |
| 12 | Mohd Razaki Abdullah, Ismail Abdul Rahman, Ade Asmi Abdul Azis (2009) | ✓                             | ✓                                  | ✓                                       | ✓                | ✓                             | ✓                                    | ✓                             | ✓                             | ✓                   | ✓                           |

**Frequency**

| 8 | 7 | 5 | 10 | 6 | 3 | 4 | 4 | 5 | 5 |

Based on analysis of Table 3 similarity ranking, the Top ten similarity ranking can be obtained as follows:

Table 4. Top ten Similarity Ranking

| Project Delay Factor                          | Frequency | Ranking |
|---------------------------------------------|-----------|---------|
| Schedule delay                              | 10        | 1       |
| Frequent design changes                      | 8         | 2       |
| Financial difficulties of owner             | 7         | 3       |
| Incompetent subcontractors                  | 6         | 4       |
| Delay in progress payment by owner          | 5         | 5       |
| Labour productivity                         | 5         | 6       |
| Delay preparation and approval of drawings  | 5         | 7       |
| Poor design and delays in design            | 4         | 8       |
| Delay in material                           | 4         | 9       |
| Late delivery of equipment                  | 3         | 10      |
Based on Table 4 above, "Schedule delay is ranked first. Factors that have the same frequency similarity ranking will be determined based on the priority of the research ranking (Ade Asmi et al 2016). For example, such as the delay factor "Delay in progress payment by owner" is taken as the number 5 because in the ranking study (Ade Asmi et al. 2016) the ranking is higher than the "Labour productivity" which is ranked sixth. Then for the "Labor productivity" factor, it has a higher rating than the "Delay preparation and approval of drawings" factor so that the "Delay preparation and approval of drawings" factor is ranked seventh. Likewise for the factor "Poor design and delays in design" has a higher rating than the factor "Delay in material" which is ranked eighth.

3. Conclusion
From the results of Table 4, it is clear that the "Schedule delay" factor is a factor that must be considered in project management to avoid delays. So that the absolute ability to manage, monitor, and supervise project schedules is very important especially in maintaining critical path activities. For the factor "Frequent design changes" is a note as a factor that must be considered in running the project to avoid delays. Therefore, it is necessary to minimize the risk of events using the Design and Build scheme to avoid the many design changes in project implementation.

For the "Financial difficulties of owner" factor where the owner faces financial difficulties while the "Delay in progress payment by owner" factor is a condition where the payment is delayed by the owner but the owner does not experience financial difficulties significantly and can still make payments even though it's too late. For the "Financial difficulties of owner" factor and the "Delay in progress payment by owner" factor, we need to watch out for construction practitioners in terms of choosing projects, especially for the project owner itself to avoid this. For example, by checking the track record of the owner, the selection of projects originating from the government or the private sector also needs attention. Factor "Incompetent subcontractors" becomes a matter that needs to be considered to support the main contractor in implementing the project. So that the initial process of selecting a subcontractor is very important. For the "Labor productivity" factor related to resource leveling or management of Human Resource management is very important because the project costs will increase if construction practitioners cannot control "Labor productivity" as expected.

The "Delay preparation and approval of drawings" factor is required for the ability to coordinate preparation and approval of drawings within the project. For Factors "Poor design and delays in design" The need for vigilance and anticipation of design changes causes delays or changes in design by owner. For the "Delay in material" factor Material management capability is needed to anticipate material availability. For the "Late delivery of equipment" factor, it is necessary to manage the equipment settings in the project, especially heavy equipment.

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