The 6th International Seminar on Science and Technology (ISST) 2020
July 25th 2020, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

Analysis of the Factors Affecting Delay in Housing Projects in XYZ Group)

Panji Bawono Saputro and I Putu Artama Wiguna
Departement of Technology Management, Institut Teknologi Sepuluh Nopember, Surabaya
e-mail: panbws@gmail.com

***Abstract*—Success in completing projects on time is one of the essential goals, both for the owner and the contractor. XYZ Group, a holding of several companies in the real estate, has delayed more than 53% of housing projects. The impact of delays is time overrun, cost overrun, deviations in the quality, disputes, negative social consequences, arbitration, and idling resources. This paper studied a list of construction delay causes gathered from the literature. It starts by exploring factors causing project delays from the research and finding 48 causative factors, followed by distributing preliminary questionnaires to expert respondents to obtain 23 causes for housing project delays. The primary survey held on 55 respondents consisting of technical directors, project managers, project engineers, quality control, logistics, and project planners. Relative Importance Index (RII) calculated, and according to the highest values, the top five delay causes of housing projects are determined. Objectives of project delays from the owner and contractor are "Late issuing of approval of design documents by the owner," and "Changing government political/economic situation or policy." The cause of project delays from the owner is "Shortage of labour from the contractor," "Changes to work completed by the owner," and "Failure of the contractor to complete the work." Meanwhile, "Slow delivery of resources required by the contractor," "Changes in details by the owner," "Rework due to quality and final results by the contractor," is the cause of project delays from the contractor.**

***Keywords*—Cause of Delay, Contractor, Housing, Owner, Project Delay.**

I. INTRODUCTION

XYZ Group is a holding of several companies which have main activities in real estate services. The main activity of these companies is the construction of residential areas and public facilities in residential locations in East Java. Based on data from the engineering department, in January 2016 - September 2019, there were more than 53% of the delay in completion of housing project work. Different definitions of delay were found, and the delay is the most common, costly, complicated and risky problem encountered in construction projects. Delay is the time overrun either beyond the completion date specified in a contract or beyond the date that the parties agreed upon for delivery project, Assaf and Al-Hejji [1].

Kikwasi, Sambasivan and Soon in research on the impact of delays in construction projects in Tanzania and Malaysia, explain the impacts of delays such as time overrun, cost overrun, dispute, negative social impact, arbitration, total abandonment, litigation and idling resources [2-3]. The purpose of this study is to identify and analyze factors that are thought to cause delays in the implementation of housing projects in the XYZ Group.

Proboyo explained 45 factors causing a delay which was divided into several aspects, namely planning and scheduling, scope and work documents, organizational system, coordination and communication, preparedness/resource prepared, inspection system, control and evaluation work, and other (outside the ability of owners and contractors) [4].

Marzouk and El-Rasas focused on the causes of construction delays in the Egyptian construction industry [5]. The main objective of the research is to identify and rank the major causes of delays for engineering projects. The research was used interview and questionary survey to 33 experts in Egypt, identified 38 delay factor and classified under seven groups: owner, consultant, contractor, material, labour and equipment, project, and external.

Aziz and Abdel-Hakam in exploring delay causes of road construction projects in Egypt, identified 239 factors and determined the most significant factors [6]. It was classified under the following 15 primary classifications. Main factors of delays are owner financial problems/client finance/financial ability for the project, shortage in equipment/insufficient numbers, inadequate contractor experience (work) causing an error, shortage (availability) in construction materials, and equipment failure (breakdown).

Fallahnejad explored delay causes in Iran gas pipeline projects [7]. The researcher examined the previous 24 projects, including contract documents, correspondence, progress reports, minutes of meetings and final contractor reports regarding delays. It has identified 43 delay factors that divided into nine groups: the low ability of the contractor to provide imported material, unrealistic contract durations imposed by the client, slow delivery of material by the client, slow land expropriation due to resistance from occupants, clients' change orders, large quantities of extra work, type of project bidding and award, delays in contractor's payment by the client, obtaining permits from governmental organization, delays in suppliers and subcontractors' work, and contractor's poor cash flow management.

Hwang, Zhao, & Ng on the research in critical factors affecting schedule in public housing projects in Singapore, identified 18 causes of a delay from the questionnaire from 115 respondent consist of the contractor, consultant and owner [8]. Top five causes of delays are site development, finance by contractor, coordinating parties, planning and scheduling, contractor experience.

Sweis et al explored the causes of delay in construction projects in Jordan [9]. Data on the study variables have been

Table 1.
Categorized groups that cause delay in projects

S/N	Stage	Category group item	Related cause ID	Total number of causes
01	Planning	Planning and scheduling related cause group	01:06	6
02	Procurement	Scope and work documents (contract) related cause group	07:10	4
03	Construction	Resource prepared related cause group	11:17	7
04	Control and Monitoring	Organizational system, coordination and communication related cause group	18:31	14
05	External	Inspection system, control and evaluation work related cause group	32:41	10
		Other (outside the ability of owners and contractors) related cause group	42:48	7

collected through a structured questionnaire from 30 construction, consultant firms and owner located in Jordan. Significant causes of delays are bad planning and scheduling, lack of finance by contractor, change order from the owner, poor of labour skill and lack of competency by an engineer.

Sambasivan and Soon in causes and effects of delays in the Malaysian construction industry, identified 28 causes of a delay from the interview and questionnaire surveys from 30 consultants, owner and contractor [3].

Primary causes are contractor's improper planning, contractor's poor site management, inadequate contractor experience, client's finance and payments for completed work, problems with subcontractors, shortage in material, labour supply, equipment availability and failure, lack of communication between parties, mistakes during the construction stage.

Based on the synthesis of previous studies, 48 causes of delays were obtained and were divided into six (6) major groups and stages according to the project cycle, as shown ini Table 1 that causes delay in construction project, which are used in this paper, as follows; (1) Uneffective and unrealistic project schedule by owner; (2) Incomplete identification of work by the contractor; (3) Uncontrolling sequence work planning by the owner; (4) Unrealistic duration of work by owner; (5) Owner and contractor`s improper planning; (6) Ineffective construction method by the contractor; (7) Incomplete/conflicts of design drawings details and specifications; (8) Slow in design by owner; (9) Late issuing of approval of design documents by the owner; (10) The disagreement on design between contractor and owner; (11) Slow delivery of resources required by the contractor; (12) Shortage of labour from the contractor; (13) Shortage of material for contractor; (14) Shortage in equipment/insufficient numbers by contractor; (15) Financing by contractor during construction; (16) Owner financial problems; (17) Lack of material or equipment by owner; (18) The slowness of the owner decision-making process; (19) Difficulty of coordination between various parties (contractor and subcontractor) working on the project by owner; (20) Late land handover by owner/slow site clearance; (21) Insufficient communication between the owner and contractor or other parties; (22) Accidents during construction – labor injuries – infectious disease; (23) Unlimited pending by owner; (24) Additional order by owner during construction; (25) Changes to work completed by the owner; (26) Delay by sub-contractor from the contractor; (27) The contractor does not schedule the submission of sample material; (28) Delay in request and approval material samples by owner; (29) Slow permit by owner; (30) Changes in details by the owner; (31) Changes in scope of work by owner; (32) Slowly material test by owner; (33) Failure of the contractor to complete the work; (34) Rework due to quality and final results by the contractor; (35) Slowness progress evaluation by owner; (36) Inadequate supervision and regulation work by the owner; (37) The low productivity level of labours; (38) Poor qualification of the contractors technical staff; (39) Inefficient inspection and control of work by the owner; (40) Owner`s personal managerial skill and qualification; (41) Skill and motivation labour`s by contractor; (42) Unforeseen site conditions; (43) Restricted access at site; (44) Act of God (Fire, flood, storm, earthquake); (45) Labour demonstration; (46) Riot, plague, war; (47) Vandalism by third party; (48) Changing government political/economic situation or policy [3-9].

This research aimed to identify the most important cause of delay that affects housing projects in XYZ Group, from owner and contractor perspective based on Relative Importance Index (RII) analysis.

II. RESEARCH METHODS

The methodology of this paper is listed as the following items; (1) Gathering the causes: The thoroughness of the literature review gathers several of 48 causes; (2) Defining the causes into groups: Different numbers of groups were found in the literature review, and it was found that for a particular cause, it can be placed in research in a group different from the other research; (3) The questionnaire survey: For the 48 different delay factors were identified. The questionnaires were developed into two major: Preliminary survey and main survey; (4) Distribute a preliminary survey and interview with six experts; (5) Distribute the primary survey, to get significant factors that cause delays in housing project XYZ Group. A 55 respondent that consist of technical directors, project managers, project engineers, quality control, logistics, and project planners. A five-point Likert scale ranging from 1 (not important) to 5 (extremely important) was used to categorize the importance of causes; (6) Take an instrument test: validity and reliability test; (7) Data are gathered and computing by using a RII, taking in view of owner and contractors. Agreement on the ranking of the importance of the causes of delay between the parties is analyzed.

III. RESULT AND DISCUSSION

A. The Preliminary Survey

The preliminary survey is held to eliminate the irrelevant causal factor found in the literature, which indicated never

Table 2.
Preliminary survey expert data

ID	Position	Last Education
Expert 1	Technical Director	Bachelor Engineering
Expert 2	Project Managers 1	Bachelor Engineering
Expert 3	Project Managers 2	Bachelor Engineering
Expert 4	Project Managers 3	Bachelor Engineering
Expert 5	Project Managers 4	Bachelor Engineering
Expert 6	Project Planner	Master Engineering

Table 3.
Result of preliminary survey

ID	Indicator
X1	Owner and contractor`s improper planning
X2	Slow in design by owner
X3	Late issuing of approval of design documents by the owner
X4	The disagreement between working drawings between contractor and owner
X5	Slow delivery of resources required by the contractor
X6	Shortage of labour from the contractor
X7	Shortage of material for contractor
X8	The slowness of the owner decision-making process
X9	Changes to work completed by the owner
X10	Delay by sub-contractor from the contractor
X11	The contractor does not schedule the submission of sample material
X12	Delay in request and approval material samples by owner
X13	Slow permit by owner
X14	Changes in details by the owner
X15	Failure of the contractor to complete the work
X16	Rework due to quality and final results by the contractor
X17	Inadequate supervision and regulation work by the owner
X18	The low productivity level of labours
X19	Inefficient inspection and control of work by the owner
X20	Unforeseen site conditions
X21	Changing government political/economic situation or policy
X22	Religious holiday
X23	Rice planting season

happened and caused delays in the XYZ Group, involved six experts with working experience is more than 15 years in XYZ Group. Expert data can be seen on Table 2. From 48 causal factor that found, 27 factors eliminated dan adding two elements (Table 3). It can be seen in Table 3.

B. The Main Survey

A number of 55 respondents (technical directors, project managers, project engineers, quality control, logistics, and project planners) were distributed and valid responses valid responses were obtained. The collected data were analyzed through Relative Importance Index (RII) method. The analysis included ranking the different causes according to the relative importance indices. The analysis revealed the most contributing factors causing delays.

The causes of delay in housing projects will be looked at from different perspectives. Respondents profiles are included in the following Table 4 about the professionalism. The owner and contractor`s data are shown in Table 5 and Table 6.

C. Validity Test

Validity test conducts to assess the validity of the questionnaire variables represented the measuring function of research. It using Pearson Product Moment Correlation 2-tailed, significant factor 5%, rtable: 0,2656.

Table 4.
Profession of respondent

S/N	Profession of respondents	Number of respondents	Percentage (%)
1	Owners	25	46
2	Contractors	30	54
Total		55	100

Table 5.
Owner respondent data

S/N	Category		Number of respondents	Percentage (%)
1	Age	≤ 30 years old	4	16,00
		31 – 45 years old	17	68,00
		≥ 46 years old	4	16,00
2	Last Education	Senior high school/ below	11	44,00
		Diploma/Bachelor degree	12	48,00
		Master/ Doctorate degree	2	8,00
3	Years of Experience	≤ 5 years	5	20,00
		6 - 10 years	10	40,00
		11-20 years	9	36,00
		≥ 21 years	1	4,00

Table 6.
Contractor respondent data

S/N	Category		Number of respondents	Percentage (%)
1	Age	≤ 30 years old	3	10,00
		31 – 45 years old	15	50,00
		≥ 46 years old	12	40,00
2	Last Education	Senior high school/below	17	56,67
		Diploma/Bachelor degree	13	43,33
		Master/ Doctorate degree	0	0,00
3	Years of Experience	≤ 5 years	3	10,00
		6 - 10 years	10	33,33
		11-20 years	11	36,67
		≥ 21 years	6	20,00

Each factor that causes a delay in the primary survey calculated by Eq. 1.

$$\mathbf{r} = \frac{n \sum XY - \sum X \sum Y}{\sqrt{(n \sum X^2 - (\sum X)^2)(n \sum Y^2 - (\sum Y)^2)}} \quad (1)$$

Where *r* is Pearson Correlation; *n* is the total number of respondents; X is Independent Variable (score for each question); Y is the Dependent Variable (total score for every question). The result of validity test can be seen on Table 7. Value of Pearson Correlation each factor computed and compared to $r_{table.}$ If the value of the Pearson Correlation is less than r_{table}, this factor becomes not valid and will be eliminated from this research.

Validity test eliminates two invalid factors (X13 and X23) because Pearson Correlation/r less than r_{table}. There are 21 delay factors for this research (Table 7).

D. Reliability Test

Reliability test using a Cronbach-alpha method. Twenty-one factors from validity test, compute using Eq. 2 and result of reliability test can be seen on Table 8.

$$r = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum \sigma_t^2}{\sigma_t^2}\right) \quad (2)$$

Table 7.
Result of validity test

ID	Pearson Correlation/r	Result	Conclusion	Mean
X1	0.4535	$r > r_{table}$	Valid	3.3273
X2	0.3774	$r > r_{table}$	Valid	3.3636
X3	0.3381	$r > r_{table}$	Valid	3.6364
X4	0.4928	$r > r_{table}$	Valid	3.0000
X5	0.4922	$r > r_{table}$	Valid	3.2364
X6	0.4297	$r > r_{table}$	Valid	3.3636
X7	0.5983	$r > r_{table}$	Valid	2.9091
X8	0.4497	$r > r_{table}$	Valid	3.0364
X9	0.5627	$r > r_{table}$	Valid	3.2909
X10	0.4253	$r > r_{table}$	Valid	3.2182
X11	0.4104	$r > r_{table}$	Valid	2.9273
X12	0.3851	$r > r_{table}$	Valid	3.0182
X13	0.1158	$r < r_{table}$	Not Valid	3.4727
X14	0.4905	$r > r_{table}$	Valid	3.1455
X15	0.4714	$r > r_{table}$	Valid	3.1273
X16	0.3530	$r > r_{table}$	Valid	3.4000
X17	0.4836	$r > r_{table}$	Valid	2.8727
X18	0.5820	$r > r_{table}$	Valid	3.0727
X19	0.3346	$r > r_{table}$	Valid	2.9636
X20	0.3114	$r > r_{table}$	Valid	3.0182
X21	0.4331	$r > r_{table}$	Valid	3.4182
X22	0.3382	$r > r_{table}$	Valid	2.7818
X23	0.0061	$r < r_{table}$	Not Valid	2.6909

Where r is Cronbach-alpha; n is the total number of question item; $\sum\sigma_t^2$ is the total score of variances each item; σ_t^2 is total variance. If alpha score > 0.60, variable in this questionnaire is reliable, if alpha score > 0.60, variable in this questionnaire is not reliable. The reliability test found that 21 factors are reliable and these factors used on research (Table 8).

E. Ranking of Delay Causes

To provide a degree of importance for each delay cause, an important index was calculated in the same way as shown in Eq. (3).

$$RII = \sum_{i=1}^{N} WiFi/(A * N) \quad (3)$$

Where RII is Relative Importance Index of each factor for each group of respondents; Wi is the weighting given to each factor by the respondents (ranging from 1 to 5); Fi is the frequency of respondent for each weight; A is the highest weight and N is the total number of respondents.

This formula was used by Aziz and Abdel-Hakam, Gebrehiwet and Luo, Aibinu and Odeyinka and Doloi et al. [6, 10-12]. The result of analysis Relative Importance Index (RII) can be seen on Table 9.

1) Ranking of Delay Causes Under Each Group

RII analysis was conducted on 25 respondents from the owner and 30 respondents from the contractor. RII calculation is done on 21 variables divided into several stages of the project to get the highest-ranking factor to the lowest.

Based on Table 9, there is a common perception between the owner and the contractor based on RII's calculations about the cause of the delay in housing projects in the XYZ Group on the planning stage. From the owner and contractor, the essential cause is filled by variable X3, namely "Late issuing of approval of design documents by the owner" with a calculated RII (Relative Importance Index) value of 0.760 from the owner's side and a calculated RII value of 0.700 of contractor side.

Table 8.
Result of reliability test

Cronbach's Alpha	N of items	Conclusion
$\frac{Alpha}{0.7949}$	21	Reliable

Table 9.
Result of RII on planning stage

Cause		Owner		Contractor	
		RII	Rank	RII	Rank
Delay group: planning and scheduling					
X1	Owner and contractor`s improper planning	0,712	3	0,693	2
Delay group: scope and work documents (contract)					
X2	Slow in design by owner	0,728	2	0,660	3
X3	Late issuing of approval of design documents by the owner	0,760	1	0,700	1
X4	The disagreement between working drawings between contractor and owner	0,664	4	0,547	4

Table 10.
Result of RII on procurement stage

Cause		Owner		Contractor	
		RII	Rank	RII	Rank
Delay group: resource prepared					
X5	Slow delivery of resources required by the contractor	0.672	2	0.673	1
X6	Shortage of labour from the contractor	0.704	1	0.667	2
X7	Shortage of material for contractor	0.664	3	0.560	3

On Table 10, there are differences between the owner and the contractor regarding the most influence the cause of the delay. From the owner, the most crucial cause is filled by variable X6, namely "Shortage of labour from the contractor" with the calculated RII (Relative Importance Index) value of 0.704. Whereas from the contractor, it was the X5, " Slow delivery of resources required by the contractor " with a calculated RII (Relative Importance Index) of 0.673.

As seen in Table 10, there are differences in perceptions between the owner and the contractor regarding the delay in housing projects in XYZ Group based on the results of RII calculations. From the owner's point of view, an essential cause is filled by variable X9, namely " Changes to work completed by the owner " with a calculated RII (Relative Importance Index) value of 0.672. Whereas from the contractor's point of view, it was found that the variable X14, namely " Changes in details by the owner," was the most crucial cause with the calculated RII (Relative Importance Index) value of 0.660.

As seen in Table 11, found differences between the owner and the contractor regarding an essential cause of the delay based on analyzing of RII. From the owner, the most crucial cause is X15, "Rework due to quality and final results by the contractor" with a calculated RII of 0.744 (Table 12). While from the contractor, it was found that the X16, "Performing rework related to quality and final results by the contractor," was the most crucial cause with RII calculation value of 0.627.

Table 11.
Result of RII on construction stage

Cause		Owner RII	Rank	Contractor RII	Rank
Delay group: organizational system, coordination and communication					
X8	The slowness of the owner decision-making process	0.616	4	0.620	3
X9	Changes to work completed by the owner	0.672	1	0.653	2
X10	Delay by sub-contractor from the contractor	0.656	3	0.620	3
X11	The contractor does not schedule the submission of sample material	0.544	6	0.600	6
X12	Delay in request and approval material samples by owner	0.608	5	0.607	5
X14	Changes in details by the owner	0.664	2	0.660	1

Table 12.
Result of RII on control and monitoring stage

Cause		Owner RII	Rank	Contractor RII	Rank
Delay group: inspection system, control and evaluation work related cause group					
X15	Failure of the contractor to complete the work	0.744	1	0.580	5
X16	Rework due to quality and final results by the contractor	0.728	2	0.627	1
X17	Inadequate supervision and regulation work by the owner	0.568	5	0.613	2
X18	The low productivity level of labours	0.632	3	0.593	3
X19	Inefficient inspection and control of work by the owner	0.616	4	0.593	3

There is a common perception between the owner and the contractor based on the results of RII calculations, according to Table 13. The essential cause is variable X21, "Changing government political/economic situation or policy" with a calculated RII value of 0.712 from the owner's side and a calculated RII value amounting to 0.640 from the contractor Based on the results of the RII analysis found eight dominant factors causing delays in housing projects in the XYZ Group, both from the perspective of the owner and from the contractor. All these factors are presented in Table 14.

IV. CONCLUSSIONS

Based on analysis of RII, identified eight significant factors cause of delays in XYZ Group. The cause of project delays from the owner and contractor are "Late issuing of approval of design documents by the owner," and "Changing government political/economic situation or policy." The owner has significant factors for delays. It is "Shortage of labour from the contractor,"Changes to work completed by the owner," and "Failure of the contractor to complete the work." The cause of project delays from the contractor is "Slow delivery of resources required by the contractor," "Changes in details by the owner," "Rework due to quality and final results by the contractor."

Table 13.
Result of RII on external stage

Cause		Owner RII	Rank	Contractor RII	Rank
Delay group: other (outside the ability of owners and contractors) related cause group					
X20	Unforeseen site conditions	0.640	2	0.633	2
X21	Changing government political/economic situation or policy	0.712	1	0.640	1
X22	Religious holiday	0.600	3	0.620	3

Table 14.
Result of RII analysis

Stage	Owner	Contractor
A. Planning	Scope and work documents (contract) X3: Late issuing of approval of design documents by the owner, RII: Rank 1	
B. Procurement	Resource prepared RII: Rank 2	X5: Slow delivery of resources required by the contractor, RII: Rank 1
C. Construction	X6: Shortage of labor from the contractor, RII: Rank 1 Organizational system, coordination and communication X9: Changes to work completed by the owner, RII: Rank 1 RII: Rank 2	RII: Rank 2 X14: Changes in details by the owner, RII: Rank 1
D. Control and Monitoring	Inspection system, control and evaluation work X15: Failure of the contractor to complete the work, RII: Rank 1 *RII: Rank 2*	RII: Rank 5 X16: Rework due to quality and final results by the contractor, RII: Rank 1
E. External	Other (outside the ability of owners and contractors) X21: Changing government political/economic situation or policy, RII: Rank 1	

REFERENCES

[1] S.A. Assaf and S. Al-Hejji, "Causes of delay in large construction projects," *International Journal of Project Management*, 2006, pp. 349–357.

[2] G.J. Kikwasi, "Causes and Effects of Delays and Disruptions in Construction Projects in Tanzania." *Australasian Journal of Construction Economics and Building - Conference Series*, 2012, pp. 52-59.

[3] M. Sambasivan and Y. W. Soon, "Causes and effects of delays in Malaysian construction industry." *International Journal of Project Management*, 2007, pp. 517-526.

[4] B. Proboyo, "Keterlambatan Waktu Pelaksanaan Proyek : Klasifikasi Dan Peringkat Dari Penyebab-Penyebabnya". Dimensi Teknik Sipil, Vol. 1, no.1, pp. 49–58, Maret 1999.

[5] M.M. Marzouk and T.I El-Rasas, "Analyzing Delay Causes in Egyptian Construction Projects." *Journal of Advanced Research*, 2014, pp. 49–55.

[6] R.F. Aziz and A.A. Abdel-Hakam, "Exploring delay causes of road construction projects in Egypt," *Alexandria Engineering Journal*, 2016, pp. 1515-1539.

[7] M.H. Fallahnejad, "Delay causes in Iran gas pipeline projects," *International Journal of Project Management*, 2013, pp. 136–146.

[8] B.G. Hwang, X. Zhao and S.Y. Ng, "Identifying the critical factors affecting schedule performance of public housing projects." *Habitat International*, 2013, pp. 214–221.

[9] G. Sweis, R. Sweis, A. Abu Hammad, and A. Shboul, "Delays in construction projects: The case of Jordan," *International Journal of Project Management*, 2008, pp. 665–674.

[10] T. Gebrehiwet and H. Luo, "Analysis of Delay Impact on Construction Project Based on RII and Correlation Coefficient: Empirical Study." in Creative Construction Conference 2017 (CCC 2017), 2017, pp. 366–374.

[11] A. Aibinu and H. Odeyinka, "Construction delays and their causative factors in Nigeria," *Journal Construction Engineering Management*, 2006, pp. 667–677.

[12] H. Doloi, A. Sawhney, K.C. Iyer, S. Rentala, "Analysing factors affecting delays in Indian construction projects", *International Journal Project Management*, 2012, pp. 479–489.