Analysis of Dominant Causative Variable for Project-Based Work Delay at PT. XYZ

Hutomo Kusmamadi Broto[1,*] Muslim Efendi Harahap[2]

[1] *Universitas Indonesia*
[2] *Universitas Indonesia*
Corresponding author. Email: kusmamadi@gmail.com

ABSTRACT

Project delays are common problem for project-based work at PT. XYZ. This paper analyzed which variables that become dominant for causing project-based works delay. Data variables were collected from previous study and analyzed based on actual case study at PT. XYZ (EPC company). The research was conducted using questionnaire survey that results index risk ratio for each risk variable. After the survey was conducted, primary data (index risk ratio) were tested for reliability and validity using principal component analysis (PCA) and Cronbach's Alpha method. Invalid and unreliable data were removed from primary data and further analysis was carried out to determine rank of causative variable. The dominant causative variables then were analyzed to identify how to manage them. The output of this paper will become a performance measurement and as a basic preventive action that can be applied at PT. XYZ or another company in common.

Keywords: information technology, organizational climate.

1. INTRODUCTION

1.1. Background

PT. XYZ is an EPC company that constructs factory production lines such as electroplating line, painting line, electro disposition line, and cleaning line. They give their best shot to complete customers' needs whereas as time goes by, their needs become more complicated along with its production system. This challenge becomes one of the biggest company's approaches to lead the market.

Companies need more improvement for their operational strategy to mitigate the risk and problems that occur at previous project. Based on the internal operation data, in 2017 and 2018 project in time achievement fell below standard. Internal standard requires projects to be delivered in time >90% projects, but in fact, approximately just 30% projects were in time.

To complete the improvement, they need to identify risk and problems that cause project-based works delay. Risk and problems will be acknowledged as causative variables that can damage project schedule and project

delay as a result. This research present how to identify, analyze, and mitigate those causative variables.

1.2. Related Study

Many studies have been done before in many countries in the world including Indonesia. Those studies started in early 1980's and a lot of studies still have been conducted until today. This paper referred to some of those studies in order to continue the previous study and consider time efficiency for completing the study.

Reference [1] have studied the project delay factors in United Arab Emirates, while [2] has studied the causes delays for Chinese building projects. Those two researches have been done with national scale. The other research done with company scale in Indonesia was conducted by [3].

Those three researches are considered as main reference for this research. Boundaries, survey method, test method, and analyze method has adapted from those three researches.

The other researchers conducted in many countries, such as by [4] in Egypt, [5] in Malaysia, [6] in Nigeria,

[7] in Hong Kong, [8] in India, [9] in Turkey, [10] in Kuwait, and [11] in Iran.

1.3. Project Management

Project is a temporary activities in order to create a product, service, or unique result [12]. Project management is needed to achieve project goals. There are many project goals that company have created such as financial goal, time delivery target, and good and services quality. Project management is an application from knowledge, tools, ability, and technique into an activity [12] to fulfill project requirements.

Project requires resources such as manpower, financial, materials, and other resources. Those resources need to be managed to achieve project goals. Project management starts from initiation phase through closing phase.

1.4. Project Management Process

Managing process from initiation through closing consists of some steps, namely initiation phase, planning phase, execution phase, control and monitoring phase, and closing phase [13]. In initiation process, a project needs to be defined and forecasted for resources needed.

In this phase, engineering and marketing team are integrated to create budget and design forecasting. Project manager and team also should be appointed at this phase. After initiation phase have completed, planning phase will start where every projects element plans their scope and get ready to execute it.

After planning completed, execution team is appointed to execute the plan, thus monitoring and control team starts to follow project process and activities. After all project process and activities has been done, project manager should close project to shut down every projects element and every resource used in the project to get ready for the next project.

1.5. Project Risk Management

Every project has its risk and to achieve project goals, those risk must be managed and mitigated. Risk must be acknowledged, identified, and evaluated [14]. There are some practices and technique to be applied at project risk management that consist of six steps, namely risk identification, risk evaluation, planning actions against risk, risk monitoring, communication and integration, and management support task [13].

Those steps could be applied with some risk management tools such as risk breakdown structure (RBS), reliability analysis, action and mitigation plan, risk report, and periodic meeting.

1.6. Risk Qualitative Analysis

Risk should be managed to achieve lower level of risk [13] but before, the level of every identifiable risk variable should be known. To calculate the level, risk index level are used [2]. To calculate risk index, the magnitude of every risk variables and how often the risk could occur should be measured. Risk index is frequency of the risk multiplied by its severity. To make it simply, an equation has been made and can be seen in (1).

$$RI = f \times s \tag{1}$$

Where RI = risk index, f = risk frequency, and s = risk severity.

The level of risk then could be analyzed qualitatively which follows the Boston Qualitative Risk Assessment Matrix as seen at Figure 1.

Probability Factor (Likelihood)						
	Very Likely	5	5	10	15	20	25
	Likely	4	4	8	12	16	20
	Possible	3	3	6	9	12	15
	Unlikely	2	2	4	6	8	10
	Rare	1	1	2	3	4	5
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Catastrophic
			Impact Factor (Consequence)				

Figure 1. Risk Assesment matrix

Qualitative range for risk index as risk assessment matrix are:

- Risk index valued 1 through less than 6 is considered as low risk ($1 \leq RI < 6$)

- Risk index valued 6 through less than 15 is considered as medium risk ($6 \leq RI < 15$)

- Risk index value d15 through 25 is considered as high risk ($15 \leq RI \leq 25$)

2. METHODS

2.1. Research Approach

Research approach and method were adopted from several previous studies with some modification to comply with the condition of PT. XYZ. All causes of delay were referred from previous studies because variables that caused delay at project must be considered to all variables [2]. However, certain filtration needed in order to achieve variables that applicable and comply with PT. XYZ. Filtration was applied by conducting several interviews with professionals in PT. XYZ. Professionals refers to person who has experience in managing project for more than 15 years and at least has completed bachelor's degree study. After interview has conducted, filtered variables

were tested with statistical method with data collected from questionnaire.

2.2. Interview and Questionnaire

Interview was conducted with 5 professionals from internal PT. XYZ. Variables from previous studies were questioned to them for its applicability to company. Respondent were President Director, Director, Consultant Company (2 person), and Operational General Manager. Variables were then reviewed by interviewee with question from interviewer "Are these variables applicable and comply to affect project delay at PT. XYZ?". Based on the interview, 19 variables were not applicable and comply with PT. XYZ and removed from research.

Questionnaires were distributed to 32 respondents to achieve sample size for normal distribution (central limit theorem) [15]. Respondents were PT. XYZ employee involved directly in project management. Respondent project management experience ranged from <5 years, 5 to 10 years, and >15 years and from different departments that involved in projects. Questionnaire has 55 potential causative variables to project delay (risks) and respondent must give their answer about risks frequency level (occurrence) and impact level (severity) in Likert scales. The frequency scales ranged from 1 to 5 which indicating 1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high. The impact level scale ranged 1 to 5 which indicating 1 = insignificance, 2 = minor, 3 = moderate, 4 = Major, 5 = Catastrophe.

2.3. Research Variable

In this research, independent and dependent variable were used. On time delivery achievement were assigned to dependent variable and potential causative variables were used as independent variables. Variable on time delivery achievement depended on variable potential causative.

Dependent variables showed the level of delay of PT. XYZ projects. Similar with frequency and severity, level of delay was measured in Likert scale ranged from 1 to 5 indicating 1 = late level <20%, 2 = late level 20% to 35%, 3 = late level 36% - 50%, 4 = late level 51% to 65%, 5 = late level > 66%.

Potential causative variables that have been filtered by interview consist of 55 risk variables and clustered into 7 risk group (see Table 1).

Table 1. Potensial Causative Variable

No.	Risk Group/Delay Causes
Client Related	
PC1	Client interference
PC2	Client variations/changes of scope
PC3	Delay in awarding construction contract
PC4	Delay in progress payments by client
PC5	Delay to furnish and deliver the site to the contractor by

No.	Risk Group/Delay Causes
	the client
PC6	Slowness in decision-making process by client
PC7	Unavailability of the site access area
PC8	Unrealistic client requirements
Engineer Related	
PC9	Delays in providing design information and approval of contractor submission
PC10	Delegating insufficient authority to engineer by client
PC11	Inaccurate bills of quantities
PC12	Inadequate experience of consultant
PC13	Necessary variations/impossibility
PC14	Poor site management and supervision by consultant
Contractor Related	
PC15	Delay caused by domestic subcontractor
PC16	Difficulties in financing project by contractor
PC17	Ineffective planning and scheduling of project by contractor
PC18	Inexperienced contractor
PC19	Poor communication and coordination by contractor with other parties
PC20	Poor qualification of the contractor's technical staff
PC21	Poor workmanship
PC22	Rework due to errors during construction
PC23	Unsuitable leadership style of contractor's construction manager
Human Behavior Related	
PC24	Adversarial/confrontational/controversial culture
PC25	Delays in the response of project teams for potential dispute resolution
PC26	Labor disputes and strikes
PC27	Lack of communication
PC28	Personal conflicts among labors
PC29	Personality clash between contractor agent and resident engineer
PC30	Poor relationships between various stakeholders (client, engineer, contractor and subcontractor)
Project Related	
PC31	Buildability
PC32	Design errors made by designers
PC33	Designers' delay in work approval
PC34	Legal disputes between various parts
PC35	Original contract duration is too short
PC36	Type of construction contract (turnkey, construction only)
PC37	Unforeseen ground conditions
External Factor	
PC38	Changes in government regulations and laws
PC39	Cost escalation
PC40	Difficulty in claiming indemnity
PC41	Environmental restrictions
PC42	Inclement weather
PC43	Natural catastrophes (earthquakes, flood, etc.)
PC44	Traffic control and restriction at job site
PC45	Unavailability of utilities in site (such as, water, electricity, telephone, etc.)
Resource Related	
PC46	Delay in material delivery
PC47	Inadequate resources due to contractor/lack of capital
PC48	Lack of skilled labor/technical person
PC49	Late procurement of materials
PC50	Low level of equipment-operator's skill
PC51	Low productivity and efficiency of equipment
PC52	Shortage of construction materials in market
PC53	Shortage of equipment
PC54	Shortage of labors
PC55	Unqualified workforce

2.4. Hypothesis

In this research, the hypotheses are:

- H0: Dominant variable cause project-based work PT. XYZ delay

- H1: Dominant variable doesn't cause project-based work PT. XYZ delay

3. RESULTS AND DISCUSSION

To filter invalid and unreliable variables, some statistical method was used. Principal component analysis (PCA) were conducted to test which variables were valid and Cronbach's alpha method were conducted to test which variables were reliable.

Variables with component value <0,5 were deleted [16], and then tested with alpha method. Alpha value within range 0,45 – 0,96 was considered as acceptable [1].

The result of PCA and Cronbach's alpha method can be seen in Table 2 and Table 2.

Table 2. PCA Result

Risk Group	Valid Variables	Invalid Variables
Client Related	PC1, PC3, PC5, PC6	PC2, PC4, PC7, PC8
Engineer Related	PC11, PC12, PC14	PC9, PC10, PC13
Contractor Related	PC18, PC19, PC20	PC15, PC16, PC17, PC21, PC22, PC23
Human Behavior Related	PC24, PC25, PC28	PC26, PC27, PC29, PC30
Project Related	PC31, PC32, PC34, PC35	PC33, PC36, PC37
External Factor	PC40, PC41, PC45	PC38, PC39, PC42, PC43, PC44
Resource Related	PC46, PC48, PC49, PC53	PC47, PC50, PC51, PC52, PC54, PC55

Table 3. Cronbach's Alpha Result

Risk Group	Cronbach Alpha
Client Related	0.59
Engineer Related	0.58
Contractor Related	0.61
Human Behavior Related	0.72
Project Related	0.53
External Factor	0.54
Resource Related	0.61

From statistical test, there are 24 valid and reliable risk variables which are PC1, PC3, PC5, PC6, PC11, PC12, PC14, PC18, PC19, PC20, PC24, PC25, PC28, PC31, PC32, PC34, PC35, PC40, PC41, PC45, 46, PC48, PC49, PC53. Those variables were then analyzed with descriptive statistical analysis to measure risk level and risk rank. Result of descriptive statistical analysis can be seen in Table 4.

Table 4. Statistical Descriptive Result

Variables	Frequency (Mean)	Severity (Mean)	Risk Index	Risk Level
PC1	3,78	4,00	15,13	H
PC3	3,94	2,94	11,57	M
PC5	3,78	4,22	15,95	H
PC6	4,25	4,09	17,40	H
PC11	4,06	4,19	17,01	H
PC12	2,66	2,19	5,81	L
PC14	2,91	2,31	6,72	M
PC18	2,53	2,44	6,17	M
PC19	3,19	3,31	10,56	M
PC20	3,25	3,91	12,70	M
PC24	1,69	1,75	2,95	L
PC25	1,66	1,94	3,21	L
PC28	1,50	2,41	3,61	L
PC31	2,78	3,06	8,52	M
PC32	4,31	4,38	18,87	H
PC34	2,38	2,63	6,23	M
PC35	2,94	2,88	8,45	M
PC40	1,75	2,84	4,98	L
PC41	1,97	3,06	6,03	M
PC45	2,50	3,31	8,28	M
PC46	3,34	3,25	10,87	M
PC48	2,69	2,69	7,22	M
PC49	3,75	3,81	14,30	M
PC53	4,03	4,28	17,26	H

Information: PC = Potential Causative variable

Results of statistical descriptive analysis show that the dominant causative variables that effecting the delay at PT. XYZ are PC32, PC6, PC53, PC11, PC5, PC1, PC49, PC20, PC3, and PC46 (sorted by rank).

Multi regression was used to answer the hypothesis, whether H0 accepted or rejected. The result of multi regression shows that the level of significance is at 0,012 (see Table 5). Standard level of significance for research is 0,05. As the level of significance of research is below standard, then the result is significant. Thus, H0 would be accepted.

Table 5. Multi Regression Result (Spss Ver.24)

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.777	.603	.414	.1.10606	.603	3.190	10	21	.012

Predictors: (Cosntant), PC1, PC49, PC11, PC20, PC53, PC1, PC32, PC6, PC5, PC46

4. CONCLUSION

The dominant causative variables have been identified from 55 filtered variables. The most causative variables were design errors made by designers, slowness in decision-making process by client, and shortage of equipment. These results have been determined by measuring its frequency and severity.

Some limitation must be considered in this research because the conclusions are limited to the scope of internal PT. XYZ. Every different types of construction may have their causes and can be different with this research.

Results of this research could be considered by project manager and other stakeholder in order to manage the dominant causative variables that have been identified in this research.

Future research should focus on how to manage these dominant causative variables.

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