Developing of a Multi-Project Planning and Control System for Risk-Based Precast Concrete Procurement to Increase PT. XY's Competitiveness

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Abstract.
Multi-project planning and control must be part of the precast concrete industry to achieve more efficient project performance and impact obtaining better contract values. It requires a clear and detailed understanding of the project's scope and the risks in project planning. This research aims to analyze the risk factors that influence ongoing multi-project procurement and carry out risk-based development to increase the Competitiveness of PT XY. This research uses a methodology to study related literature, previous research, and PT Company Operational Standards. XY. The results of this study indicate that 7 out of 37 variables have high-risk values, while the remaining 30 are classified as having moderate Risk. The Risk of wage and material price increases represents the highest Risk in developing a multi-project planning and control system for precast concrete procurement to enhance the Competitiveness of PT. XY.

Keywords: *Control System, Risk, Precast Concrete, Multi-Project, and Competitiveness.*

I. INTRODUCTION

Along with the development of the world of infrastructure in Indonesia, construction companies in the precast concrete sector must adapt quickly to remain viable in the construction industry[1]. Regarding BUMN Karya, almost all of them have subsidiaries in the precast concrete sector, plus the private sector, which is also growing. A decrease in Competitiveness due to several causes certainly creates a big problem for the continuity of a company. This causes the company's performance to decline, and if the cause of the problem is not immediately resolved, then the company will be threatened with stopping.Projects can be planned and implemented in one unified form using resources to obtain benefits[2]. According to Larson, translated by Dimyati & Nurjaman (2014, p.3), the project's primary goal is to satisfy customer needs[3]. Similarities aside, the characteristics of a project help differentiate it from others in the organization. According to Kerzner (2009), a construction project is a series of activities to achieve a goal (building or construction) within a certain time, cost, and quality limits[4]. Risk can be interpreted as a state of uncertainty, where an undesirable situation can cause a loss.In ISO 31000 (2009:73), the definition of risk management is coordinated activities to direct and control an organization in handling risks[5]. This definition provides meaning regarding the breadth and depth of a risk that is the object of an assessment.

According to Tampulonon (2004), risk management is a directed, proactive management activity or process to accommodate the possibility of failure of one or part of an instrument[6]. Risk management needs to be considered in a construction project because it can increase effectiveness and efficiency during construction work and affect costs, time, quality of work, technical work, and evaluation of the project[7]. In the last few years, Indonesia has rapidly developed infrastructure using precast concrete, such as residential houses and multi-story buildings for flats, offices, apartments, bridges, and others. Precast concrete is very popular in Indonesia because it is more economically profitable, with better and guaranteed product quality, durability, and environmental friendliness[8]. This is due to stricter supervision in the fabrication process. In its physical implementation, the completion time for precast concrete installation is faster than for conventional concrete.As with PT. XY, precast concrete-producing companies are currently faced with implementing more than 100 construction projects running at one time, termed "Multi Projects". PT. XY has eight sales areas; for this research, we took sales area III, which has PT. XY concrete product factories are in various regions and have varying production capacities to support projects in the DKI Jakarta, West Java, and Banten regions.

PT. XY concrete product factories can produce precast concrete with various product types. PT. XY is engaged in precasting concrete procurement for construction projects in BUMN Karya, Private Enterprise, and Government Agencies.There are fluctuations in PT. XY contract values for the 2018-2022 period. The strongest indication of this decline is the COVID-19 pandemic, where many construction projects have been delayed due to the increasingly massive spread of the virus, so orders for precast products have also decreased[9]. After the pandemic subsided, contract values occurred. Gradual increase. However, this fluctuation could also be caused by competition between developing precast companies, where several BUMN Karya have formed companies similar to PT. XY. With the development of this multi-project planning and control system to improve the competitive performance of PT. XY and predicted problems can be minimized or even eliminated. Therefore, risk management is essential and must be implemented by PT. XY, based on data on project acquisitions in the last six years, which have decreased. If these things are left unchecked, the company will experience significant losses.

II. METHODS

Research methodology is defined as a scientific process or method for obtaining data that will be used for research purposes[10]. The methodology contains scientific methods, their steps, and types up to the limits of the scientific method. Meanwhile, research is an effort to obtain knowledge through factual evidence using specific critical and controlled scientific work procedures[11]. Sugiyono (2017) states that research methodology is a scientific way to obtain data with specific purposes and uses.The research process starts by defining the problem, followed by a literature review. Next, findings from the literature review are validated by experts through a questionnaire before conducting the central survey with primary respondents. Expert validation may introduce additional indicators necessary for accurate measurement based on field conditions. The survey is then implemented according to the validated results and analyzed to determine the approach for risk management. From the stages described previously, a flow diagram is obtained as follows:

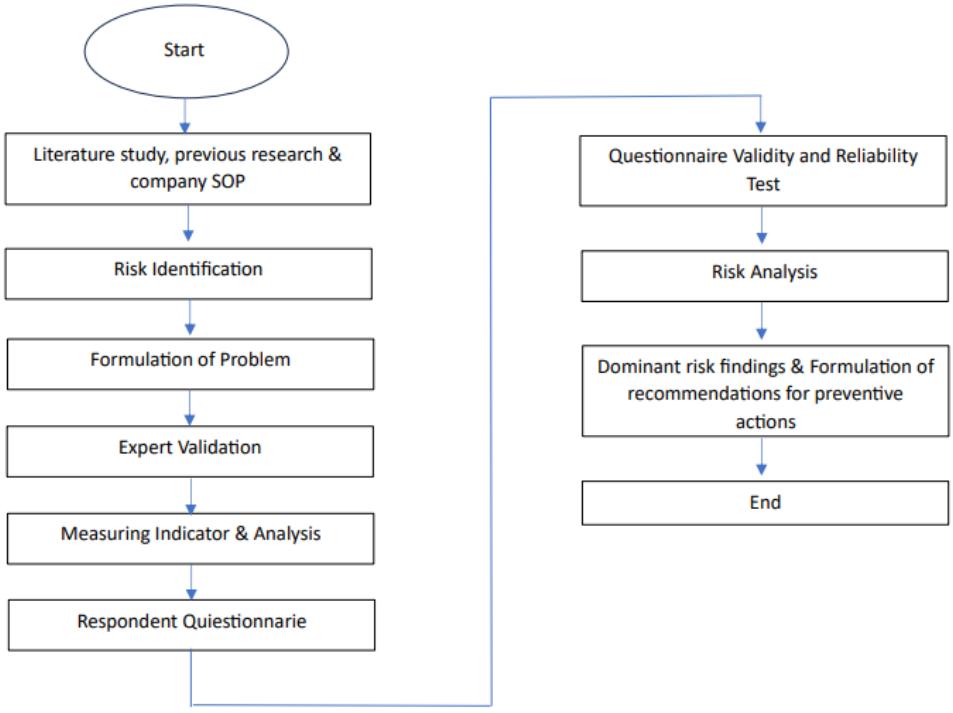

Fig 1. Research Flow Diagram

A variable is an image, perception, or concept that can be measured[12]. In this research, variable Y (dependent variable) is the performance of increasing the value of PT. XY contracts specifically emphasize planning and controlling multiple precast concrete projects. Meanwhile, variable X (independent variable) consists of risk variables from each indicator of PT XY's planning and control process. The primary data for this research is gathered from respondents who are stakeholders supporting projects at PT. XY. The respondents are company employees with permanent status, hold a position of assistant section head or

higher, and have at least three years of experience at PT. XY. These qualifications ensure that the respondents understand the actual conditions of knowledge management implementation at PT. XY. According to the book Risk Management by Leo J. Susilo and Victor Riwu Kaho, in ISO 31000 for Non-Banking Industries, the level of Risk is proportional to each of its components (impact and frequency). The risk function is essentially a multiplication, systematically formulated as follows:

Risk = Consequences x Frequency

Using the following consequences and frequency measurement scale matrix as follows:

Consequences			Frequency		
Scale	**Description**	**Value**	**Scale**	**Description**	**Value**
1	Insignificant	0,05	1	Very Low	0,1
2	Minor	0,1	2	Low	0,3
3	Moderate	0,2	3	Moderate	0,5
4	Major	0,4	4	High	0,7
5	Extreme	0,8	5	Very High	0,9

Table 1. Matrix Consequences and Frequency Scale

Risk values are determined as follows: if the risk value is between 0.01 and 0.05, it is classified as low Risk; if the risk value is between 0.06 and 0.24, it is classified as moderate Risk; and if the risk value is above 0.25, it is classified as high Risk.

III. RESULT AND DISCUSSION

All research variables obtained through the literature review will undergo verification, clarification, and expert validation via a questionnaire. This step is necessary to gather expert opinions on whether the variables are appropriately structured and whether any should be added or removed concerning their influence on PT. XY's planning indicators. The respondents for this expert validation questionnaire are five individuals, consisting of practitioners and business professionals in Project Risk Management with over 10 years of experience. Their expertise allows them to provide input, feedback, comments, and corrections on irrelevant risk variables. The results of the expert validation questionnaire analysis are presented in Table 1 below:

No	PT XY Planning Indicators	X	Identify Risk Variables	Description	Reference
1	Develop a Project Management Plan				
X1	Create business plans and project feasibility studies	X1.1	Risk of errors in identifying and determining market segmentation at the start of the project	Influential	[13]; [14]
		X1.2	Risk of errors in estimating Project HR needs	Influential	
		X1.3	The Risk of a project being assessed as unfeasible or less feasible by investors	Influential	
		X1.4	Risk of decreasing customer purchasing power	Influential	
		X1.5	Risk of determining land location and land prices at the start of project opening	Influential	
		X1.6	Risk of rising wages and material prices	Influential	
		X1.7	Risk of projects being built on problematic/disputed land	Influential	
X2	Create an RAB project related to legality, licensing, construction, and marketing.	X2.1	Risk of fees, budget increases and unexpected costs when processing land legality or project permits	Influential	
		X2.2	Risk of delays in processing project permits	Influential	
		X2.3	Risk of errors or carelessness in determining promotional costs	Influential	
X3	Create and develop activity plan project	X3.1	Risk of errors in detailing material and equipment requirements	Influential	
		X3.2	Risk of shortage of contractor implementing workforce	Influential	
		X3.3	The risk of an increase in the scope of work that cannot be controlled	Influential	
		X3.4	The risk of claims occurring outside the contract due to errors or lack of detail in drafting clauses	Influential	
2	Planning Scope Management				
X4	Determine	X4.1	Risk of failure or delays in completing critical (main)	Influential	[15]; [16]

No	PT XY Planning Indicators	X	Identify Risk Variables	Description	Reference
	condition project from aspect business, legality, licensing, construction and marketing		work		
X5	Create activity plans and project implementation activities in accordance with the project scope	X5.1	Risk of additional work and project costs when construction errors occur	Influential	
X6	Plan activity project marketing according to business targets	X6.1	Risk of losing potential buyers due to construction delays	Influential	
		X6.2	Risk of home sales not meeting targets	Influential	
X7	Create a budget plan for each project activity	X7.1	Risk of lack of funds to complete the work	Influential	
3	Collecting Requirement				
X8	Collecting internal company business requirements	X8.1	Risk of additional time, cost overruns, or failure in the project implementation phase	Influential	[17]
X9	Collecting scope of requirements land legality (cartification)	X9.1	Time risk or delay in the land certification process	Not Influential	
		X9.2	Risk of disputes with land owners	Influential	
		X9.3	Risk of late payments from creditors (Banks)	Influential	
		X9.4	Risk of disputes with consumers regarding land legality	Influential	
X10	Collecting scope condition appropriate construction design and planning	X10.1	Risk of increasing the scope of work outside the established plan	Influential	
		X10.2	Risk of delays or errors in construction work due to a shortage of implementing personnel	Influential	
X11	Collecting and determine terms to make	X11.1	Risk of price increases, project cost budget plan is invalid, extreme changes & adjustments of project cost budget plan.	Influential	
X12	Collecting technical requirements and methods	X12.1	Risk of delays in work handover activities	Influential	
X13	Collecting requirements related to project marketing	X13.1	The risk of obstacles or miscommunication occurring in marketing activities between consumer expectations and Construction progress Realization.	Influential	
4	Definiting Scope				
X14	"Determine design scope and planning project"	X14.1	Risk of obstacles in submitting a site plan or the site plan being rejected by the relevant department	Influential	[18]; [19]
		X14.2	Risk of errors in making Project cost budget plan.	Influential	
		X14.3	risk of additional work items	Influential	
X15	Determine scope appropriate construction with planning project	X15.1	Risk of additional construction time, costs, materials or labor	Influential	
		X15.2	Additional risks of work that have not been included in the design	Influential	
X16	Determine scope project marketing	X16.1	Risk of home sales decreasing or not reaching target	Influential	
5	planning schedule management				
X17	Project Scheduling Planning	X17.1	Risk of project delays, exceeding the contract time	Influential	[20]
		X17.2	"Risk of repair, dismantling, repair or other construction rework"	Influential	

No	PT XY Planning Indicators	X	Identify Risk Variables	Description	Reference
		X17.3	Risk of errors in work stages	Influential	

Table 2. Expert Validation Questionnaire Results

Based on the expert validation questionnaire responses analysis, 37 validated variables were identified. These will be used as research variables to be tested with respondents in the second phase of the questionnaire.Subsequently, survey results were collected from 90 respondents based on the approved indicators. This study categorized respondent demographics into four groups according to gender, job position, years of experience, and education level.

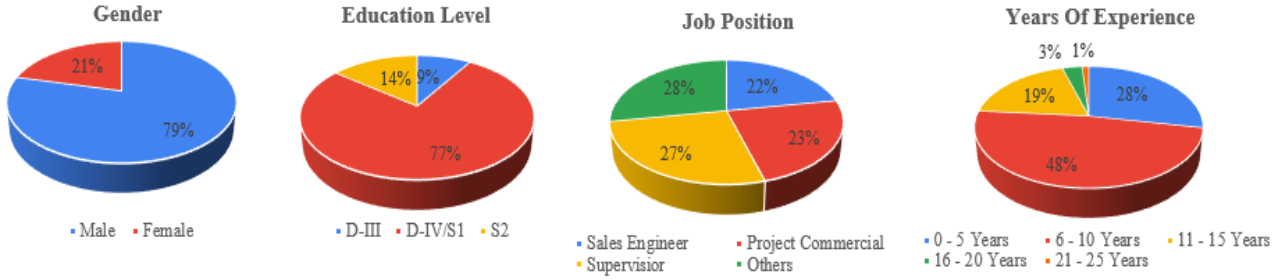

Fig 2. Respondent Demographics Based on Gender, Job Position, Years of Experience, and Education Level

As shown in Figure 2 above, an analysis of the 90 respondents by gender reveals that 79% are male and 21% are female. Regarding their most recent educational qualifications, 77% of the respondents hold a Bachelor's degree, 14% Postgraduate and 9% have a Diploma's degree. In terms of Job Position, the majority (28%) work in roles other than Sales Engineer, Project Commercial, and Supervisor. Meanwhile, most respondents (48%) have 6-10 years of experience in the related field.Next, a validity and reliability test was conducted on the questionnaire responses from 90 respondents using SPSS software, focusing on 37 statements that experts had already validated. In the validity test, the primary objective is to determine the validity of each item statement. An item statement is considered valid if its corrected item correlation (count) exceeds the correlation value from the table (table). With 90 respondents and a 5% confidence level, a significance or table value of 0.2072 was used. The validity test results for the question items, obtained using SPSS software, are as follows:

X	Identify Risk Variables	rcount	rtable	Description
X1.1	Risk of errors in identifying and determining market segmentation at the start of the project	0,572	0,2072	Valid
X1.2	Risk of errors in estimating Project HR needs	0,539	0,2072	Valid
X1.3	The Risk of a project being assessed as unfeasible or less feasible by investors	0,553	0,2072	Valid
X1.4	Risk of decreasing customer purchasing power	0,515	0,2072	Valid
X1.5	Risk of determining land location and land prices at the start of project opening	0,645	0,2072	Valid
X1.6	Risk of rising wages and material prices	0,452	0,2072	Valid
X1.7	Risk of projects being built on problematic/disputed land	0,608	0,2072	Valid
X2.1	Risk of fees, budget increases and unexpected costs when processing land legality or project permits	0,469	0,2072	Valid
X2.2	Risk of delays in processing project permits	0,523	0,2072	Valid
X2.3	Risk of errors or carelessness in determining promotional costs	0,674	0,2072	Valid
X3.1	Risk of errors in detailing material and equipment requirements	0,749	0,2072	Valid
X3.2	Risk of shortage of contractor implementing workforce	0,629	0,2072	Valid
X3.3	The risk of an increase in the scope of work that cannot be controlled	0,702	0,2072	Valid
X3.4	The risk of claims occurring outside the contract due to errors or lack of detail in drafting clauses	0,629	0,2072	Valid
X4.1	Risk of failure or delays in completing critical (main) work	0,770	0,2072	Valid
X5.1	Risk of additional work and project costs when construction errors occur	0,724	0,2072	Valid
X6.1	Risk of losing potential buyers due to construction delays	0,622	0,2072	Valid

X	Identify Risk Variables	rcount	rtable	Description
X6.2	Risk of home sales not meeting targets	0,618	0,2072	Valid
X7.1	Risk of lack of funds to complete the work	0,692	0,2072	Valid
X8.1	Risk of additional time, cost overruns, or failure in the project implementation phase	0,734	0,2072	Valid
X9.1	Risk of disputes with land owners	0,678	0,2072	Valid
X9.2	Risk of late payments from creditors (Banks)	0,660	0,2072	Valid
X9.3	Risk of disputes with consumers regarding land legality	0,749	0,2072	Valid
X10.1	Risk of increasing the scope of work outside the established plan	0,748	0,2072	Valid
X10.2	Risk of delays or errors in construction work due to a shortage of implementing personnel	0,714	0,2072	Valid
X11.1	Risk of price increases, project cost budget plan is invalid, extreme changes & adjustments of project cost budget plan.	0,759	0,2072	Valid
X12.1	Risk of delays in work handover activities	0,717	0,2072	Valid
X13.1	The risk of obstacles or miscommunication occurring in marketing activities between consumer expectations and Construction progress Realization.	0,741	0,2072	Valid
X14.1	Risk of obstacles in submitting a site plan or the site plan being rejected by the relevant department	0,705	0,2072	Valid
X14.2	Risk of errors in making Project cost budget plan.	0,811	0,2072	Valid
X14.3	risk of additional work items	0,653	0,2072	Valid
X15.1	Risk of additional construction time, costs, materials or labor	0,760	0,2072	Valid
X15.2	Additional risks of work that have not been included in the design	0,716	0,2072	Valid
X16.1	Risk of home sales decreasing or not reaching target	0,627	0,2072	Valid
X17.1	Risk of project delays, exceeding the contract time	0,656	0,2072	Valid
X17.2	"Risk of repair, dismantling, repair or other construction rework"	0,759	0,2072	Valid
X17.3	Risk of errors in work stages	0,666	0,2072	Valid

Table 3. Results of Research Variable Validity Test

The validity test results for the 37 question items related to the research variables show that all items are valid, as the count value exceeds the table value. Therefore, all question items are suitable for the subsequent statistical tests.

The reliability test is conducted to assess the consistency of the questionnaire. The reliability test results for the question items related to the research variables using SPSS software are as follows:

Cronbach's Alpha	N of Items
0,965	37

Table 4. Research Variable Reliability Test Results

Table 4 indicates that the Cronbach's alpha value is 0.965 (> 0,6) for the 37 questions confirmed as valid in the validity test. This suggests that each question item is highly reliable and trustworthy for the measurements.

Once the questionnaire data has been confirmed as valid and reliable, the next step is to conduct a risk analysis based on the impact and frequency scale matrix. From the 90 respondent data points, the risk analysis results are as follows:

Variable	Consequences	Frequency	Risk = C x F	Risk Rating	Risk Level
X1.1	0,420	0,464	0,195	23	Moderate
X1.2	0,393	0,408	0,160	35	Moderate
X1.3	0,422	0,456	0,192	25	Moderate
X1.4	0,436	0,468	0,204	20	Moderate
X1.5	0,433	0,446	0,193	24	Moderate
X1.6	0,504	0,549	0,277	1	High
X1.7	0,424	0,589	0,250	3	High
X2.1	0,436	0,479	0,209	17	Moderate
X2.2	0,482	0,518	0,250	4	High
X2.3	0,376	0,351	0,132	37	Moderate
X3.1	0,422	0,500	0,211	16	Moderate
X3.2	0,382	0,368	0,141	36	Moderate
X3.3	0,442	0,470	0,208	18	Moderate

Variable	Consequences	Frequency	Risk = C x F	Risk Rating	Risk Level
X3.4	0,449	0,527	0,236	10	Moderate
X4.1	0,436	0,523	0,228	13	Moderate
X5.1	0,451	0,534	0,241	7	High
X6.1	0,462	0,570	0,263	2	High
X6.2	0,473	0,486	0,230	12	Moderate
X7.1	0,451	0,542	0,245	5	High
X8.1	0,447	0,531	0,237	9	Moderate
X9.1	0,373	0,439	0,164	34	Moderate
X9.2	0,451	0,521	0,235	11	Moderate
X9.3	0,387	0,437	0,169	33	Moderate
X10.1	0,427	0,433	0,185	28	Moderate
X10.2	0,400	0,423	0,169	32	Moderate
X11.1	0,427	0,531	0,227	14	Moderate
X12.1	0,444	0,454	0,202	21	Moderate
X13.1	0,413	0,410	0,169	31	Moderate
X14.1	0,384	0,443	0,170	30	Moderate
X14.2	0,413	0,579	0,239	8	Moderate
X14.3	0,436	0,462	0,201	22	Moderate
X15.1	0,453	0,472	0,214	15	Moderate
X15.2	0,416	0,441	0,183	29	Moderate
X16.1	0,442	0,470	0,208	19	Moderate
X17.1	0,460	0,527	0,242	6	High
X17.2	0,398	0,477	0,190	26	Moderate
X17.3	0,380	0,489	0,186	27	Moderate

Table 5. Risk Analysis

Based on the risk analysis presented in Table 5, seven variables were identified as high-risk. These include the Risk of wage and material price increases (variable X1.6), the Risk of losing potential buyers due to construction delays (variable X6.1), the Risk of the project being developed on problematic or disputed land (variable X1.7), the risk of delays in permit processing (variable X2.2), the Risk of insufficient funds to complete the project (variable X7.1), the Risk of exceeding the planned project timeline (variable X17.1), and the Risk of additional work and costs arising from construction errors (variable X5.1).

IV. CONCLUSION

Based on the findings and discussion of this study, there are 37 risk variables in developing a multi-project planning and control system for procuring precast concrete to enhance the Competitiveness of PT. XY. Experts have validated these variables and confirmed as valid and reliable through questionnaire testing with 90 respondents using SPSS software. Among the 37 risk variables analyzed, 7 were found to have the most dominant risk values and a high-risk level: the Risk of wage and material price increases (variable X1.6), the risk of losing potential buyers due to construction delays (variable X6.1), the Risk of the project being built on problematic or disputed land (variable X1.7), the risk of delays in permit processing (variable X2.2), the risk of insufficient funds to complete the project (variable X7.1), the Risk of exceeding the planned project timeline (variable X17.1), and the Risk of additional work and costs due to construction errors (variable X5.1).

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