

IMPROVEMENT OF PROJECT PERFORMANCE THROUGH PLANNING, TEAM CAPABILITY, PROCUREMENT OF MATERIALS, AND WORK SCOPE CASE STUDY IN THE MRO PROJECT

Dulani* and Agustinus Hariadi DP²

^{1,2}Master of Management Programme, Mercu Buana University
Jakarta, Indonesia

*Corresponding Author: Dulani

ABSTRACT

The project must be successful so that the goals expected by both the customer and the project implementer. This research was conducted at one company in Indonesia which is engaged in the electricity sector, especially in the field of Maintenance, Repair & Overhaul (MRO) of power plants. In its implementation there are Maintenance, Repair & Overhaul projects that are overtime, over budget and get complaints, so this research aims to determine the effect of project planning on team capabilities, material procurement and project scope, and to determine the effect of team capabilities, material procurement and scope of work on project performance. The data of this study were collected through a questionnaire of 50 project employee respondents with 21 questions. Data analysis in this study used a partial least squares (PLS) approach. This study concludes that project planning has a positive and significant impact on team capability, material procurement and scope of work. The study also concluded that team capability, material procurement, scope of work had a positive and significant impact on project performance. With these results it can be concluded that project performance can go well, good planning must be carried out, the team has the capability, appropriate material procurement and clear scope of work.

KEYWORDS: Project, PLS, planning, team capability, material, scope, performance.

INTRODUCTION

In the current era, electricity is a primary need for humans, such as telecommunications, transportation, household appliances. Electricity is produced by electricity generating machines with various energy sources including diesel, steam, gas, geothermal, wind, water, solar and others. The generating machines as well as machines in general must be carried out with various types of maintenance such as preventive maintenance, corrective maintenance, predictive maintenance, proactive maintenance and overhaul with the aim that the supply of electrical energy is maintained in accordance with consumer needs. Maintenance of large-scale plants such as overhauls must be carried out properly so that work can be carried out on time, cost and quality.

This research was conducted at one company in Indonesia which is engaged in the electricity sector, especially in the field of MRO (Maintenance, Repair & Overhaul) Services, namely services for

maintenance, repair and overhaul of power plants. In running a MRO project there are projects that time delays, costs that exceed the budgeted and there are complaints from the project owner. This is explained in the table below where there are 2 projects that have delayed completion time and there is 1 project that has budgeted project cost overruns and 1 project that has been compiled from customers.

Table 1. MRO Project review

No	Project Name	Project Time	Project Cost	Complain
1	Simple Inspection Geothermal Power Plant 2018	On time	On budget	0
2	Major Inspection Geothermal Power Plant 2018	Overtime	On budget	0
3	Medium Inspection + Coal Fired Steam Power Plant 2018	On time	On budget	0
4	Simple Inspection Geothermal Power Plant 2019	On time	On budget	0
5	Re tubing Boiler Coal Fired Steam Power 2018	On time	On budget	0
6	Major Inspection Mill A Coal Fired Steam Power 2019	Overtime	Over budget	1
7	Transformator relocation Coal Fired Steam Power 2019	On time	On budget	0

In a study conducted by Shibnai & Salah (2015) states that there are five factors that cause project failure, namely: low productivity of labor, poor communication and coordination between parties, different ways of bribes, financing delay of the project, change orders during work and unskilled labor. In addition to the five indications above Shibnai & Salah (2015) also found five other indications, namely: additional works by the owner, inaccurate review of the plans and contract documents, poor feasibility planning and cost control during work, resource constrains such as (financial budget, lack of reserved resources for the contractors), fluctuation of materials prices. Ruqaishi, M., & Bashir, HA (2015) also found seven factors responsible for causing late projects: poor site management and supervision by contractors, problems with subcontractors, inadequate planning and scheduling of projects by contractors, poor management of contractors' schedules, delays in delivery of materials, lack of effective communication among project stakeholders, and poor interactions with vendors in the engineering and procurement stages. Based on the formulation of the problems presented above, the purpose of this study is to determine the effect of project planning on team capabilities, material procurement and scope of work on MRO projects and to determine the effect of team capabilities, material procurement, scope of work on MRO project performance

Research Question

- 1) Does project planning affect team capability, material supply and scope of work on MRO projects?
- 2) Does the team's capability affect the MRO project performance?
- 3) Does the material supply affect the MRO project performance?
- 4) Does the scope of work affect the MRO project performance?

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Project Management

According to Dimiyati & Nurjaman (2014) a project is a task that needs to be formulated to achieve concrete stated goals and be completed within a certain period using limited human resources and tools. According to Project Management Institute (2013) Project is a unique activity in order to produce a product both goods and services to meet the needs of related parties that are limited by resources and time. While project management is a project management activity that includes planning, execution, organizing, controlling and monitoring and completing projects. Suharto in Haming et. al., (2011: 78) states that project management is an activity to plan, organize, lead, and control company resources to achieve short-term targets that have been determined by using a system and hierarchy approach, both vertical and horizontal. Phase in Project Management according to Bakhtiyar et.al, (2012: 56), project management is carried out in three stages, namely:

- 1) Planning, activities that include setting goals, defining projects and team organizations.
- 2) Scheduling, this connects between labor, material money used in the project.
- 3) Controlling this activity includes monitoring of resources, costs, quality and budget if necessary revise, change plans, shift or re-manage so that it is timely and costly.

Project Planning

An activity will run well if the planning is done well, as well as with a project. The project will run well and can achieve its objectives if good planning is carried out, good planning must meet all aspects of the project activities as explained by Suharto (1999) The planning process consists of processes carried out to establish the scope, define and improve project objectives, and develop the actions needed to achieve these goals. Then its use should pay attention to the following matters:

- Accuracy in choosing the techniques and methods used.
- Full control by the planner.
- Understanding of its application by supervisors who want to apply it in the field

Planning is the preparation carried out by the project manager covering all elements needed by the project (Meredith and Mantel, 2009). Russell & Taylor (2003) identified seven other planning processes, which included determining project goals, identifying activities, establishing priority

relationships, making time estimates, determining project completion times, comparing project schedule goals and determining resource requirements to meet objectives. Zwikael & Globerson (2004) revealed that project planning has high quality including integration, scope of work, time and human resources. Whereas project planning has moderate quality including costs, procurement of materials and quality, low quality planning is risk and communication.

Project Team Capability

No less important element in a project is the project implementer or project execution team, the success of a project also depends on the team implementing the project. or the quality of the resulting project does not meet the expectations of the project owner. According to Suharto (1999) the project leader and the project team had sufficient educational background and experience before being in charge of managing the project. Each of them brings the concept of the profession from the technical fields and scientific disciplines as well as previous implementation experience employed into the project management area. The project team includes project managers and groups of individuals who act together in doing project work to achieve its goals. The project team includes project managers, project management staff, and other team members who carry out work but do not need to be involved with project management. This team consists of individuals from different groups with specific subject matter knowledge or with special skills to carry out project work. The structure and characteristics of project teams can vary greatly, but one constant is the project manager's role as a team leader, regardless of what authority the project manager may have over its members (Soeharto, 1999).

According to the Project Management Institute (2013) there are several examples of selection criteria that can be used to assess team members displayed as follows:

- Availability, identify whether team members are available to work on the project within the required time period. If there are concerns about availability during the project timeline.
- Costs, check whether the costs of adding team members are within the specified budget.
- Experience, verification that team members have relevant experience that will contribute to the success of the project.
- Capability, verification that team members have the competencies needed by the project.
- Knowledge, consider whether team members have relevant knowledge about customers, similar projects implemented, and nuances of the project environment.
- Skills, determine whether members have relevant skills for using project, implementation, training tools.
- Attitude, determine whether the member has the ability to work with others as a cohesive team.
- International factors, consider the location of team members, time zones and communication skills.

Based on Megantoro (2015) There are also several things to determine whether an employee is

experienced or at the same time as an indicator of work experience, namely the length of time / working period, the level of knowledge and skills possessed and mastery of work and equipment.

Project Material Procurement

Based on the Project Management Institute (2013) Material Procurement includes but is not limited to specifications, desired quantities, quality levels, performance data, performance periods, work locations, and other requirements. Material supply is the availability of material when needed during the project according to specifications and time (Pall et al, 2019).

Based on the American Productivity & Quality Center (2005) that the classification framework delivery process is as follows Complaints of shipping damage, Distribution costs (transportation, warehousing, customer service, administration, inventory carrying), Fill rate (speed of delivery), Freight costs per parts shipment, Frequency of delivery to customers, bill of lading errors not caught in shipping, % incomplete delivery, % misdelivery, % late shipments,% shipping errors,% on time delivery (promised),% on time delivery (requested), Ratio of actual deliveries to scheduled deliveries, Transportation cost per unit.

Project Scope

According to the Project Management Institute (2013) The scope of the project is the work carried out to deliver products, services, or results with the specified features and functions. in general, it can be said that the project always changes in scope. Only, keep in mind that changes in the scope of the project (addition or subtraction) will have a greater impact (Suharto, 1999)

In a project changes to the scope of work can occur, both for changes to the objectives and obstacles in implementing the project, it must be controlled and discussed by all who have an interest in the project to find the best way. Project Management Institute (2013) says requests for a change can be directly or indirectly, initiated externally or internally, and can be optional or mandated by law or by contract, and can include:

- Corrective actions, deliberate activities that realign project work performance with project management plans;
- Preventive actions, deliberate activities that ensure the future performance of project work in line with the project management plan;
- Repair of defects, intentional activities to modify products or product components that are not appropriate; and / or
- Updates, changes to formally controlled documents, plans and projects to reflect modified or additional ideas or content.

Project Performance

According to Schwalbe, quoted from Dimiyati & Nurjaman's book (2014: 21) each project will be limited by scope, time and cost. Project performance is a measure of project achievement expressed in quality, time and cost (Meredith and Mantel, 2009). In a study conducted by Shibnai & Salah (2015) states that there are five factors that cause project failure, namely: low productivity of labor, poor communication and coordination between parties, different ways of bribes, financing delay of the project, change orders during work and unskilled labor. In addition to the five indications above Shibnai & Salah (2015) also found five other indications, namely: additional works by the owner, inaccurate review of the plans and contract documents, poor feasibility planning and cost control during work, resource constrains such as (financial budget, lack of reserved resources for the contractors), fluctuation of materials prices. Ruqaishi, M., & Bashir, HA (2015) also found seven factors responsible for causing late projects: poor site management and supervision by contractors, problems with subcontractors, inadequate planning and scheduling of projects by contractors, poor management of contractors' schedules, delays in delivery of materials, lack of effective communication among project stakeholders, and poor interactions with vendors in the engineering and procurement stages.

RESEARCH MODEL AND MEASUREMENTS

Model

The model in this study is to determine the effect of planning on team capabilities, material delivery and scope of work as well as team capabilities, material delivery and changes in scope of work on project performance as illustrated in Figure 1 below.

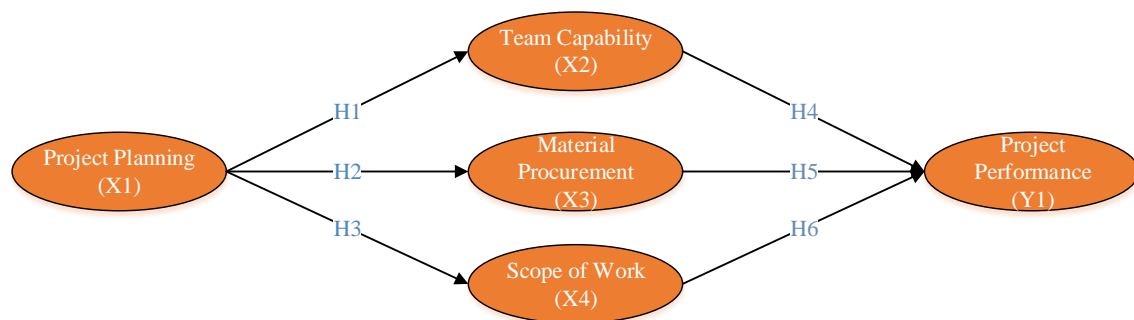


Figure 1. Research Model

Research Design

In completing this research, researchers used a quantitative approach. This means that according to Sugiyono (2016) is a quantitative method that can be interpreted as a research method based on the philosophy of positivism, used to examine populations or specific samples, data collection using research instruments, quantitative / statistical data analysis, with the aim to test hypotheses that have

been set. Collecting data in this study by distributing questionnaires, project reports and previous research. The analysis in this study is to use SEM PLS with SmartPLS 3.2.8 software.

Population and Sample

The population in this study was the entire MRO project team, the sample used was ten times the number of variables to be studied, so the number of samples in this study was 50 people.

Variable and Its Measurement

The variables in this study consisted of 4 independent variables namely project planning (X1), team capability (X2), material procurement (X3), scope of work (X4) and 1 dependent variable namely project performance (Y1), with indicators as in Figure 2 above. The operationalization of this variable uses a 5-point Likert scale consisting of strongly disagree, disagree, neutral, agree and strongly agree, with 21 questionnaire questions to 50 respondents.

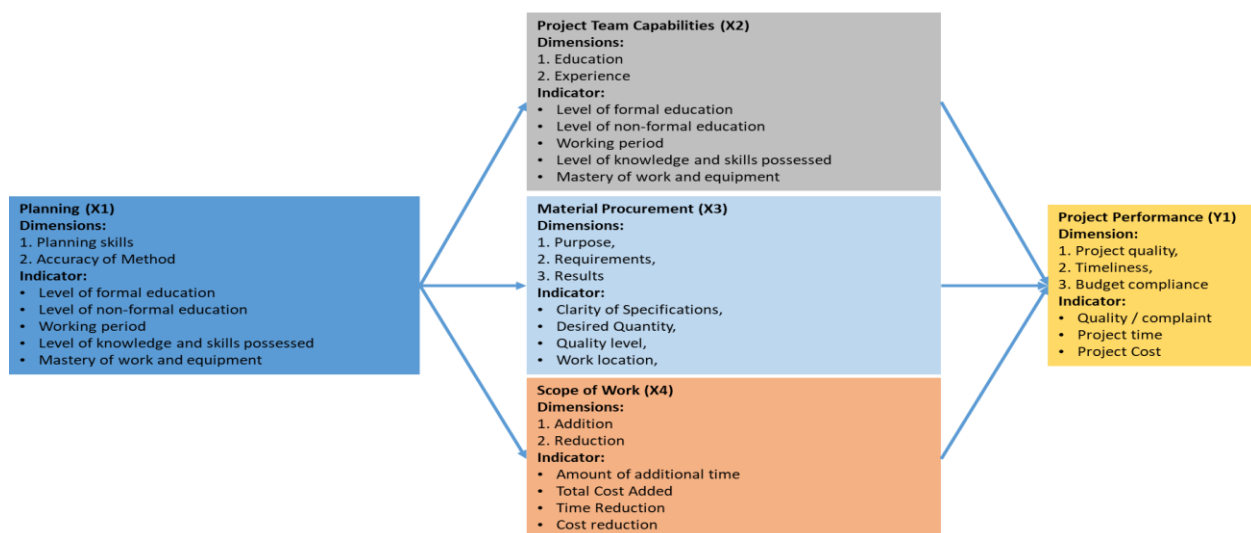


Figure 2. Variable and Indicator

ANALYSIS, RESULTS AND DISCUSSIONS

Analysis

This study aims to determine the effect of independent latent variables consisting of project planning (X1) on team capabilities (X2), material procurement (X3) and scope of work (X4). And the influence of team capability (X2), material procurement (X3) and scope of work (X4) on the dependent latent variable is project performance (Y1). Testing is done by SEM PLS method which consists of two tests, namely the outer model and the inner model. The outer model is used to specify the relationship between latent variables and their indicators. or it can be said that the outer model defines how each

indicator relates to its latent variable. While the inner model is used to test the relationship between latent variabel.

RESULTS

Outer Model

The Outer Model is used to specify the relationship between latent variables and their indicators by looking at the value of the validity and reliability of the indicators of the variables before further testing. The test includes testing for convergent validity, discriminant validity and composite reliability and cronbach's alpha testing. Convergent validity was tested through loading factor parameters and the value of Average Variance Extracted (AVE). Measurements can be categorized as having convergent validity if the loading factor value is more than 0.7 and the AVE value is more than 0.5 (Ghozali, 2008). Discriminant validity is determined by looking at the cross loading of each variable. Measurement can be categorized as having discriminant validity if it has a cross loading value of more than 0.7 (Jogiyanto, 2011).

Table 2. Loading factor

	X1	X2	X3	X4	Y1
X1.1	0,758				
X1.2	0,786				
X1.3	0,838				
X1.4	0,901				
X1.5	0,903				
X2.1		0,474			
X2.2		0,844			
X2.3		0,872			
X2.4		0,873			
X2.5		0,909			
X3.1			0,860		
X3.2			0,846		
X3.3			0,867		
X3.4			0,742		
X4.1				0,745	
X4.2				0,863	
X4.3				0,676	
X4.4				0,826	
Y1.1					0,781
Y1.2					0,877
Y1.3					0,727

From the table above there is a correlation between the indicators with the construct showing the value of loading factor <0.7 , namely at X2.1 and X4.3, meaning that the indicator has a low correlation with

the construct or invalid. Then the next indicator will be eliminated in the PLS-SEM analysis. Then re-testing the loading factor, AVE (Average Variance Extracted) and cross loading.

Table 3. Loading factor and cross loading result

	X1	X2	X3	X4	Y1
X1.1	0,754	0,438	0,271	0,308	0,294
X1.2	0,785	0,566	0,126	0,289	0,214
X1.3	0,836	0,461	0,280	0,394	0,294
X1.4	0,902	0,645	0,315	0,364	0,382
X1.5	0,905	0,654	0,458	0,449	0,433
X2.2	0,567	0,842	0,517	0,442	0,538
X2.3	0,698	0,872	0,574	0,606	0,660
X2.4	0,542	0,885	0,578	0,544	0,612
X2.5	0,534	0,925	0,768	0,602	0,702
X3.1	0,249	0,557	0,860	0,710	0,631
X3.2	0,393	0,685	0,846	0,613	0,642
X3.3	0,358	0,620	0,874	0,713	0,724
X3.4	0,149	0,396	0,742	0,573	0,504
X4.1	0,142	0,448	0,583	0,711	0,573
X4.2	0,450	0,567	0,698	0,898	0,613
X4.4	0,428	0,522	0,657	0,843	0,600
Y1.1	0,234	0,603	0,682	0,532	0,779
Y1.2	0,347	0,622	0,605	0,563	0,878
Y1.3	0,375	0,477	0,525	0,611	0,728

Based on table 3 above, it can be seen that all indicators that make up each variable in this study have met the validity of the loading factor and cross loading values exceeding 0.7.

Table 4. AVE (Average Variance Extracted) result

Variable	AVE result
Project Planning	0.704
Team Capability	0.777
Material Procurement	0.689
Scope of Work	0.673
Project Performance	0.636

From table 4 the AVE (Average Variance Extracted value) is above 0.5 which states that all indicator variables have met the discriminant validity test requirements. From the test results above, it can be concluded that the variables in this study have met the convergent validity, AVE and discriminant validity, thus all indicators have fulfilled the validity value and can be tested next.

Reliability testing can be seen based on Cronbach's alpha value must be more than 0.6 and composite reliability value must be more than 0.7 (Jogiyanto, 2011). The composite reliability value indicates the measure of the true reliability value of a variable while Cronbach's alpha shows the measure of the lowest reliability value of a variable.

Table 5. Composite Reliability dan Cronbach's Alpha

Variable	Composite Reliability	Cronbach's Alpha
Project Planning	0,922	0,894
Team Capability	0,933	0,904
Material Procurement	0,898	0,850
Scope of Work	0,860	0,756
Project Performance	0,839	0,710

Based on the table above shows the value of composite reliability has fulfilled the requirements of more than 0.7 and the Cronbach's Alpha value indicates a value above 0.6 which proves that the measurements in this study are reliable / reliable.

Inner Model

Testing can be done after the data meets the measurement requirements on the outer model, then it can be continued by testing the inner model using the bootstrapping method on SmartPLS 3.2.8. Bootstrapping method is a procedure of repeating new samples as many as N new samples from original data of size n, where for a new sample the sampling points are taken from the original data one by one until n times by taking (Efron & Tibshirani, 1998).

For the simultaneous test T-statistic test is used which is intended to test the significance of the effect of exogenous variables (X) as a whole against endogenous variables (Y). According to Jogiyanto and Abdillah (2008), a measure of the significance of the support of hypothesis can be used to compare T-table and T-statistic values. If the T-statistic is higher than the T-table value, it means that the hypothesis is supported or accepted. T-table values can be determined based on the significance level of 0.05 with the number of observations of 50 namely 1.67591. Path coefficient values in the range of -0.1 to 0.1 are considered insignificant, values greater than 0.1 are significant and directly proportional, and values smaller than -0.1 are significant values and inversely proportional (Hass & Lehner, 2009).

Hypothesis test

Based on table 6 below the results of the t-statistic test between variables with the results of all

hypotheses above the t-table value is 1.67591. t-statistic is greater than 1.67591 which proves that 6 accepted research hypotheses (H1, H2, H3, H4, H5 and H6) and Path coefficient values greater than 0.1 so that all influences are significant and directly proportional.

Table 6. Bootstrapping results

Hypothesis	Relation	Path Coefficient	t- statistic
H1	Project Planning has a positive effect on Team Capability	0,668	4,745
H2	Project Planning has a positive effect on Material Procurement	0,360	2,989
H3	Project Planning has a positive effect on the Scope of Work	0,436	2,765
H4	Team Capability has a positive effect on Project Performance	0,327	2,279
H5	Material Procurement has a positive effect on Project Performance	0,362	2,170
H6	The scope of work has a positive effect on project performance	0,220	1,735

The results of bootstrapping are presented in Figure 3 below where there is a construct value for the variable and a path coefficient between the variables.

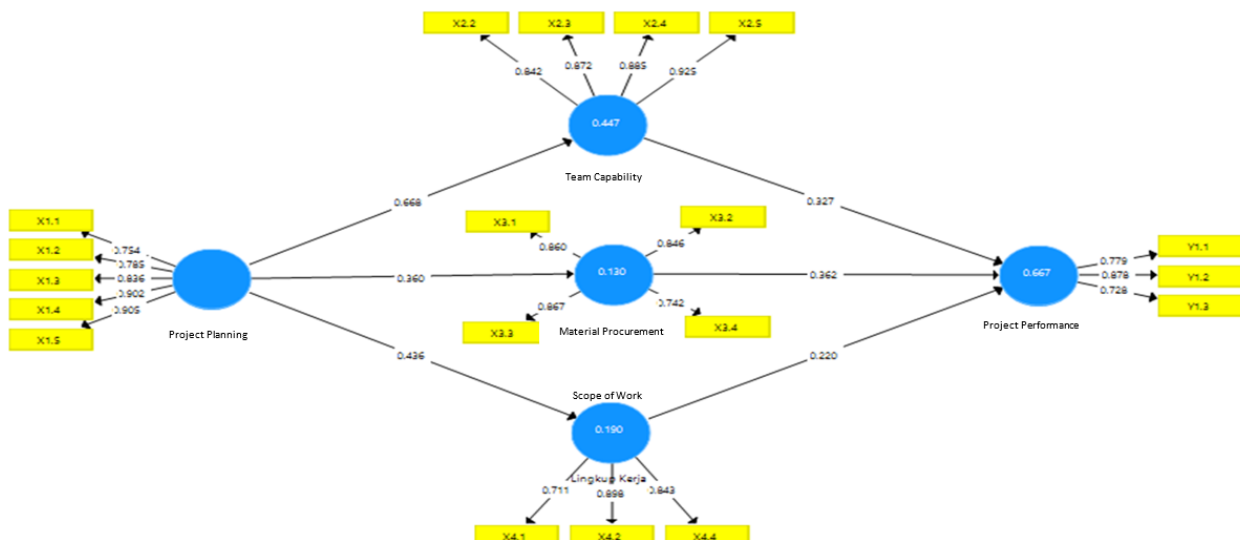


Figure 3. Bootstrapping result

DISCUSSION

Project planning has a significant and positive effect on team capability as shown by t value > 1.67 and path coefficient > 0.1. The capability of the team in project implementation is determined at the planning stage, so that project planning is very influential on the capability of the team that will

execute a project.

Project planning has a significant and positive effect on material procurement as indicated by the value of $t > 1.67$ and path coefficient > 0.1 . As the team's capability, material procurement is also determined at the planning stage, if material procurement is not carried out well planned it will be able to disrupt the course of the project such as: material arrival delays, material shortages, material not according to specifications and others.

Project planning has a significant and positive effect on the scope of work as indicated by the value of $t > 1.67$ and path coefficient > 0.1 . The scope of work becomes one that must be clearly defined at the planning stage, when the scope of work is not well defined at the planning stage then project objectives may not be achieved.

The above as explained by Zwikael & Globerson (2004) revealed that project planning has a high quality of integration, scope of work, time and human resources. Whereas project planning has medium quality including costs, procurement of materials and quality, low quality planning is a risk and communication.

Team capability, material procurement and scope of work have a significant and positive effect on project performance shown by $t > 1.67$ and path coefficient > 0.1 . as explained by Shibnai & Salah (2015) states that there are five factors that cause project failure, namely: low productivity of labor, poor communication and coordination between parties, different ways of bribes, financing delay of the project, change orders during work and unskilled labor. In addition to the five indications above Shibnai & Salah (2015) also found five other indications, namely: additional works by the owner, inaccurate review of the plans and contract documents, poor feasibility planning and cost control during work, resource constrains such as (financial budget, lack of reserved resources for the contractors), fluctuation of materials prices. Ruqaishi, M., & Bashir, HA (2015) also found seven factors responsible for causing late projects: poor site management and supervision by contractors, problems with subcontractors, inadequate planning and scheduling of projects by contractors, poor management of contractors' schedules, delays in delivery of materials, lack of effective communication among project stakeholders, and poor interactions with vendors in the engineering and procurement stages.

CONCLUSION

Based on the results of the study that can be concluded as follows:

1. Project planning has a significant and positive effect on team capabilities, procurement of materials and scope of work.
2. Team capability has a significant and positive effect on project performance.

3. Procurement of material has a significant and positive effect on project performance.
4. The scope of work has a significant and positive effect on project performance.

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