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Analysis of the Influence of Knowledge Management and Lean Management on the Performance of Construction Projects

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Abstract:- The construction industry is growing rapidly with highly competitive pressures. In today's global competition, construction companies must be able to compete to meet customer demand and satisfaction. Responding to the fierce competition in the construction industry in Indonesia, the Ministry of SOEs formed a Project Management Office (PMO) consisting of 6 state-owned companies. The formation of a PMO in a SOE company is expected to be able to increase its competitiveness which is "estimated" to be achieved through the application of Knowledge Management and Lean Management. Cost, Quality, Time or commonly called the "iron triangle" is an instrument that is often used as evaluation material in the construction industry to measure the productivity of a construction project. The lean management approach is expected to increase productivity in terms of Cost, Quality and Time. On the other hand, the knowledge management process in the organization is able to increase core competencies, accelerate innovation and time-to-market, and be able to build a sustainable competitive advantage. This study aims to analyze the effect of knowledge management on construction project performance, analyze the effect of knowledge management on lean management, analyze the effect of lean management on construction project performance and analyze whether lean management mediates the influence between knowledge management and construction project performance.

In this study questionnaires were used for the collection of primary data. Research variables and indicators are obtained through in-depth literature review. The questionnaire was distributed to project managers and construction practitioners of state-owned companies' members of the PMO then the data obtained were analyzed using PLS-SEM (Partial Least Square – Structural Equation Modelling). The results showed that the knowledge management variable did not have a significant influence on the performance variables of construction projects, however, the knowledge management variable has a positive and significant influence on the lean management variable, then the lean management variable has a positive and significant influence on the construction project performance variable and the lean management variable as an intervening variable is able to mediate the influence of knowledge management on the construction project performance variable.

Keywords:- *Knowledge Management, Lean Management, Construction Project Performance, Partial Least-squares Structural Equation Modeling (PLS-SEM).*

I. INTRODUCTION

As a developing country, construction projects are an important priority for the Indonesian government, based on data first quarter 2021 release by Central statistics Agency (BPS) [1], the construction industry's contribution to the Indonesian economy is in fourth order, and 10.80% of Indonesia's Gross Domestic Product (GDP) in the first quarter of 2021. The construction industry in Indonesia is growing rapidly with highly competitive pressures.

In response to the fierce competition in the construction industry in Indonesia, the Ministry of SOEs formed a PMO (Project Management Office) consisting of 6 state-owned companies, which specifically aims to improve the finances of SOEs and generally aims to:

- Standardizing the project management process (project management) that can make projects more effective and efficient in terms of time and cost in carrying out projects.
- Provide quality assurance for all projects.
- Equip project resources for specific project activities such as project planning in advance, project monitoring and measuring project performance success.
- Provide training to Project Managers and project team members
- Addresses the need for a "central repository" for project management knowledge, best practices, and other resources.

So that the formation of the PMO in this STATE-OWNED company is expected to be able to increase its competitiveness. Where the above goals are "estimated" to be achieved through the application of Knowledge Management and Lean Management which are "estimated" to be used as tools to increase the construction productivity of PMO member STATE-OWNED companies. construction productivity of PMO member STATE-OWNED companies.

On the other hand, based on research by [2] conducting an analysis of the application of knowledge management at PT. Wijaya karya (Persero) Tbk, which is a member of the PMO (Project management office), shows that PT. Wijaya karya (Persero) Tbk has implemented knowledge management, but its implementation has not gone well due to several obstacles such as lack of desire to

share experiences, low interest in reading and the site has not run well.

On the other hand, PT. PP (Persero) Tbk.as one of the members of the PMO (Project management office) seeks to develop human resource management, one of which is through the company's Knowledge management by increasing various knowledge sharing activities including project sharing (Pro-share) and executive exploration (Ex-Plore), community of practices (CoP) and the PP Awards award event.

In addition to developing human resource management through knowledge management, PT. PP (Persero) Tbk. also implemented Lean construction which later became a Pioneer in BUMN Karya as the first to implement Lean Construction which was then followed by 5 other SOE Karya members of the PMO, which aimed to increase effectiveness and efficiency by eliminating waste and losses and increasing value.

So that knowledge of lean management is needed at the beginning because it is related to lean culture which involves many aspects, especially humans. In addition, the existence of a PMO (Project management office) in BUMN karya gives a sign that lean construction is one of the aspects of concern in the Indonesian construction world, especially for practitioners who can provide more value to profit achievement or more generally the impact on cost, quality and time.

Based on description above, the focus of this research is to analyze the influence of Knowledge and Lean Management on the performance of construction projects in state-owned companies the work of PMO (Project management office) members. Where this research is a type of confirmatory factor analysis research and in this study a structural model is proposed that is formed through exogenous variables and endogenous variables which are measured by several indicators. This research needs to be carried out to test previous research theories and test the proposed structural models.

II. LITERATURE REVIEW AND HIPOTHESIS DEVELOPMENT

A. Knowledge Management

According to [3] Knowledge Management can simply be defined as doing what is necessary to get the most out of the source of knowledge and according to [4] Knowledge Management is about sharing and collaborating on what you know, capturing what you know, and reusing that knowledge so as not to reinvent the wheel and/or combine it with other ideas to drive innovation. Meanwhile according to [5] Knowledge Management enables individuals, teams, and entire organizations to collectively and systematically create, share, and apply knowledge to achieve their strategic and operational goals. Knowledge Management contributes to improving the efficiency and effectiveness of operations on the one hand and innovating and changing the quality of competition on the other. The goal of knowledge management is to generate knowledge from information and turn this knowledge into a continuous competitive advantage that can be measured as success in business.

B. Lean Management

According to [6] Lean is Combining methods to optimize or improve the process. The lean principle summarizes methods suitable for this purpose. However, Lean is more than just a collection of methods and principles. Lean is primarily concerned with corporate strategy and culture, and Lean Management is understood as a management approach characterized in particular by the basic principles of decentralization and simultaneities, pursuing goals both within and throughout the company to generate greater customer orientation while consistently reducing costs for the entire management of the company [7]. Briefly according to [7] Lean management describes a holistic system that, based on the basic philosophy and with the help of various principles and tools, aims to increase efficiency while at the same time increasing employee and customer satisfaction. This is achieved mainly through the economical and efficient use of all resources.

According to [8] Lean systems in the construction industry provide tools that involve new approaches to integrated project management, one of which is called the Last Planner System that achieves deadline optimization by carrying out complete project planning along with all the resources involved in the game. Participation and involvement in this decision process from the earliest stages, minimizing time and reducing cost uncertainty. With this methodology, the performance of the planning and control system is measured and improved periodically, thus achieving greater self-management, since each team must reach a compromise through consensus.

C. Contruction Project Performance

According to [9] Productivity in a construction project is a comparison between the project output produced and the inputs given in a series of project activities. Productivity in construction projects is stated to have increased if the output produced by a series of project activities has increased when compared to before, while productivity decreases if there is a decrease in output produced when compared to before. The size of the productivity produced in construction projects is influenced by many factors, including: 1. type of work 2. Resources 3. Working environment conditions 4. Terms of the contract and 5. Working method, and according to [10] the performance of construction projects is often measured by how to efficiently and economically apply the required resources to realize facilities built with acceptable quality in a budgeted time frame and cost. the phrase "on time and within budget." Recently, the concept of quality as a requirement has become an increasingly important aspect of the construction process. So that the performance of construction projects is often associated with success in managing Cost, Quality and On Time – Delivery.

So that it can be concluded that the performance of a construction project can be defined as the success rate of an organization in implementing the resources needed efficiently and economically which is measured by the

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results of work that can be accepted by the employer both in terms of quality, time and budgeted costs.

The framework of this research is shown in figure 1 below.

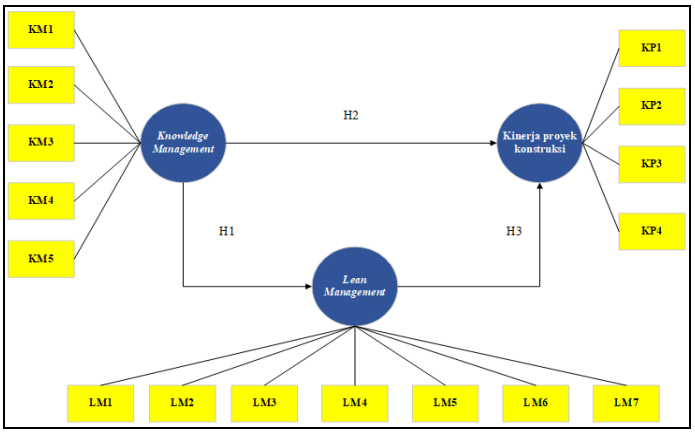

Fig. 1: Research framework

Source: Author (2022)

The hypotheses proposed in this study are:

H1: Knowledge management has a significant effect on the performance of construction projects.

H2: Knowledge Management affects Lean Management

H3: Lean Management affects the performance of construction projects.

III. RESEARCH METHODOLOGY

This research uses quantitative research methods. In this study, a type of confirmatory factor analysis research was used, where this analysis method was used to test the structural model proposed in this study, and the data analysis in this research using the Structural Equation Model - Partial Least Square (SEM-PLS). The object of this research is project managers and construction practitioners, who work in state-owned companies that are members of the PMO (Project Management Office), where there are currently 6 (six) members of the SOE PMO, namely: 1. PT. Hutama Karya (Persero) ; 2. PT. Wijaya Karya (Persero) Tbk; 3. PT. ADHI Karya (Persero) ; 4. PT. PP (Persero) Tbk; 5. PT. Waskita Karya (Persero) Tbk; 6. PT. Brantas Abipraya (Persero). The sampling technique used in this research is purposive sampling, and the sample of this research is 60 people at different position levels who worked in state-owned companies' members of the PMO (Project Management Office). The reasons for determining this position as a research samples are: they are practitioners who have high involvement in the construction process in Indonesia, personnel who have a high involvement in the application of lean and knowledge management and personnel who have an exposure to project performance

The data collection technique in this study was carried out using questionnaires. The data collection technique in this study was carried out using questionnaires. While questionnaire measurements in this study used the likert scale and the likert scale used in this study using 5 points of the likert scale from 1 (Strongly disagree) to 5 (Strongly agree). In this research model, knowledge management is an exogenous variable, construction project performance and lean management variable are endogenous variable.

Where the instruments used in this study there are three main parts, namely the first is used to assess Knowledge Management, there are 3 dimension and 20 indicators used that refers to [11], [12], [13], [14], [15], the second is used to assess the Lean Management, there are 6 dimension and 20 indicators used that refers to [16], [17], [18], [19], [20] then the third is used to assess the performance of construction projects adopted from [21], [16], [22], [15] which consists of 3 dimensions and 4 indicators.

IV. RESEARCH RESULT

In this study, hypothesis testing using partial least square (PLS) analysis techniques using the SMART PLS 3.0 program, the research model framework tested using the SMART PLS 3.0 program in this study is shown in figure 2.

A. Convergent validity Testing

Table 1 shows the test results after which the indicators have outer loading values in the interval range of 0.4 - 0.7 Thus, the indicator meets convergence decent validity criteria.

B. Discriminant validity

Table 2 shows the results of the discriminant validity test, the results show that the research model meets the convergence of validity, where the results of the cross-loading analysis show the value of the outer loading indicator in the related construction is greater than all the outer loading values in other constructions.

C. Construct Reliability

Table 3 shows the result of composite reliability test, the result show that output of composite reliability and Cronbach alpha value is above 0.70. thus, it can be concluded that all constructs have good reliability.

D. Model Fit

The fit model in this study used Standardized Root Mean Square Residual (SRMR). According to [23] a model is considered to have a good fit if the value of the Standardized Root Mean Square Residual (SRMR) is below 0.08, but the SRMR value below 0.1 is still acceptable. Based on table 4, it is known that the Standardized Root Mean Square Residual (SRMR) value of 0.095 is below 0.1, this result shows that this research model is good fit.

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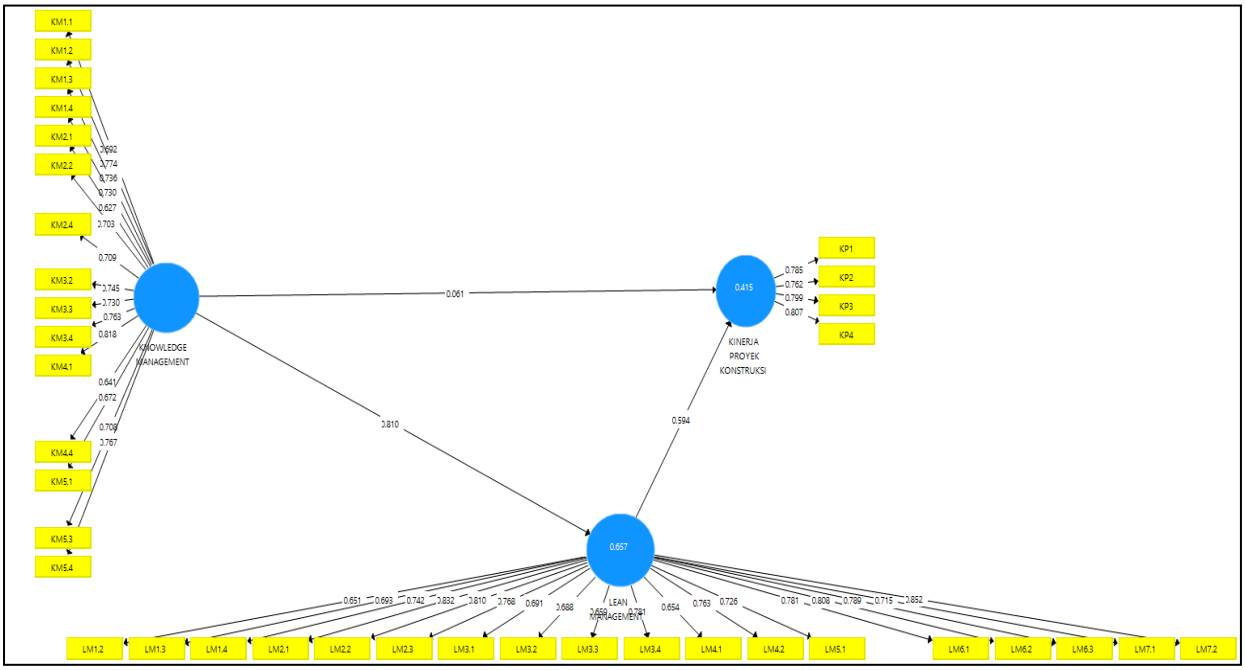

Fig. 2: Research model Framework

Source: SmartPLS 3.0 Program Output, 2022

Variabel	Dimension	Indicator	Outer loading	Remark
Knowledge Management	*Knowledge Creation*	KM1.1	0,692	Valid
		KM1.2	0,774	Valid
		KM1.3	0,736	Valid
		KM1.4	0,73	Valid
		KM2.1	0,627	Valid
		KM2.2	0,703	Valid
		KM2.4	0,709	Valid
	knowledge transfer and storage	KM3.2	0,745	Valid
		KM3.3	0,73	Valid
		KM3.4	0,763	Valid
		KM4.1	0,818	Valid
		KM4.4	0,641	Valid
	Knowledge Application	KM5.1	0,672	Valid
		KM5.3	0,708	Valid
		KM5.4	0,767	Valid
Lean Management	*5S Management*	LM1.2	0,651	Valid
		LM1.3	0,693	Valid
		LM1.4	0,742	Valid
	Just in time (JIT)	LM2.1	0,832	Valid
		LM2.2	0,81	Valid
		LM2.3	0,768	Valid
	Last Planner System (LPS)	LM3.1	0,691	Valid
		LM3.2	0,688	Valid
		LM3.3	0,659	Valid
		LM3.4	0,781	Valid
	Continous improvement	LM4.1	0,654	Valid
		LM4.2	0,763	Valid
		LM5.1	0,726	Valid
	Daily huddle meeting	LM6.1	0,781	Valid
		LM6.2	0,808	Valid
		LM6.3	0,789	Valid
	Visual management	LM7.1	0,715	Valid
		LM7.2	0,852	Valid
Construction Project Performance	*Time*	KP1	0,785	Valid
	Quality	KP2	0,762	Valid
		KP3	0,799	Valid
	Cost	KP4	0,807	Valid

Table 1: Convergent validity test result

Source: Data Processed, 2022

Indicator	Construction Project Performance	Knowledge Management	Lean Management	Remark
KM1.1	0,512	**0,692**	0,51	Valid
KM1.2	0,494	**0,774**	0,626	Valid
KM1.3	0,381	**0,736**	0,565	Valid
KM1.4	0,488	**0,730**	0,556	Valid
KM2.1	0,246	**0,627**	0,454	Valid
KM2.2	0,345	**0,703**	0,589	Valid
KM2.4	0,351	**0,709**	0,548	Valid
KM3.2	0,407	**0,745**	0,513	Valid
KM3.3	0,256	**0,730**	0,553	Valid
KM3.4	0,251	**0,763**	0,619	Valid
KM4.1	0,383	**0,818**	0,62	Valid
KM4.4	0,371	**0,641**	0,609	Valid
KM5.1	0,390	**0,672**	0,539	Valid
KM5.3	0,449	**0,708**	0,707	Valid
KM5.4	0,453	**0,767**	0,691	Valid
KP1	**0,785**	0,488	0,517	Valid
KP2	**0,762**	0,401	0,446	Valid
KP3	**0,799**	0,467	0,538	Valid
KP4	**0,807**	0,35	0,522	Valid
LM1.2	0,552	0,563	**0,651**	Valid
LM1.3	0,438	0,538	**0,693**	Valid
LM1.4	0,528	0,618	**0,742**	Valid
LM2.1	0,611	0,635	**0,832**	Valid
LM2.2	0,520	0,644	**0,81**	Valid
LM2.3	0,482	0,589	**0,768**	Valid
LM3.1	0,384	0,548	**0,691**	Valid
LM3.2	0,378	0,438	**0,688**	Valid
LM3.3	0,346	0,482	**0,659**	Valid
LM3.4	0,424	0,621	**0,781**	Valid
LM4.1	0,284	0,507	**0,654**	Valid
LM4.2	0,470	0,652	**0,763**	Valid
LM5.1	0,522	0,698	**0,726**	Valid
LM6.1	0,442	0,611	**0,781**	Valid
LM6.2	0,496	0,674	**0,808**	Valid
LM6.3	0,580	0,625	**0,789**	Valid
LM7.1	0,390	0,613	**0,715**	Valid
LM7.2	0,640	0,731	**0,852**	Valid

Table 2: Discriminant validity test result

Source: Data Processed, 2022

Variable	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Construction Project Performance	0,798	0,800	0,868	0,622
Knowledge Management	0,934	0,937	0,942	0,522
Lean Management	0,953	0,957	0,958	0,558

Table 3: Construct Reliability

Source: Data Processed, 2022

Model Fit	Saturated Model	Estimated Model
SRMR	0,095	0,095

Table 4: Standardized Root Mean Square Residual (SRMR)

Source: Data Processed, 2022

E. Structural Model (Inner model) Evaluation

In this study, R^2 (Coefficient of determination), Q^2 (Predictive relevance) and hypothesis test (direct and indirect influence) are used to evaluate the structural model.

F. R^2 Coefficient of determination

The value of R^2 for each endogenous latent variable is the predictive force of the structural model [23]. The output values of R^2 are shown in Table 5.

Variable	R Square	R Square Adjusted
Construction Project Performance	0,415	0,395
Lean Management	0,657	0,651

Table 5: R-SQUARE

Source: Data Processed, 2022

The R^2 value in the construction project performance variable is 0.415, which means that knowledge management and lean management can explain the construction project performance variable by 41.5% and others by 58.5% can be explained by other variables or factors that are not included in this study. It can be concluded that the variation in changes in the project performance construct can be explained by the variation in the knowledge management and lean management constructs by 41.5%, so that the predictive model in this study is categorized as moderate because the R^2 value is above 0.33 (Chin in [23]).

G. Predictive relevance (Q^2)

Q^2 value greater than 0 indicates the model has predictive relevance. The results of the predictive relevance can be seen in table 6. The results show that all variables have predictive relevance (Q^2) values above 0, so it can be said that the research model has predictive relevance.

Variable	SSO	SSE	Q^2 (=1-SSE/SSO)
Construction Project Performance	240	185,683	0,226
Knowledge Management	900	900	
Lean Management	1080	699,676	0,352

Table 6: Predictive Relevance (Q2)

Source: Data Processed, 2022

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H. Hypothesis Test

Hypothesis tests are carried out to answer the 3 proposed hypothesis of this study. T-statistics and P-values are used to measure the significance of the model. The hypothesis is accepted if the t-statistics value is greater than 1.96 and the P-value is smaller than 0.05. In this study, there was a direct and indirect influence on each variable, due to independent, dependent and intervening variables. The results of the analysis of direct and indirect influence data processing can be seen in table 7 and 8 respectively.

Model	Original Sample (O)	T Statistics (|O/STDEV|)	P Values	Conclusion
H1: Knowledge management -> Construction Project Performance	0,061	0,295	**0,768**	Rejected
H2: Knowledge management -> lean management	0,81	17,724	**0,000**	Accepted
H3: Lean management -> Construction Project Performance	0,594	2,922	**0,004**	Accepted

Table 7: Direct influence test result.

Source: Data Processed, 2022

V. DISCUSSION

A. The influence of Knowledge management on the performance of construction projects.

The results of this study state that knowledge management has a positive relationship, but does not have a significant influence on the performance variables of construction projects. The results of this study are not in line with previous research from [13]–[15], [24]–[32]. Where in previous research stated that knowledge management has a positive relationship and has a significant effect on performance. [15] in their research found that knowledge management has a positive and significant influence on quality performance. [13] in their research stated, with the increasing implementation of knowledge management, it will increase innovation in the construction sector in Indonesia.

Thus, if it is related between theory and actual conditions in the field, the implication is because respondents do not use knowledge management variables in measuring the performance of construction projects, especially for construction project performance indicators related to Time, Cost and Quality, however, the knowledge management variable has a positive relationship with the performance of construction projects because each respondent in a state-owned company adheres to the principle of "AKHLAK" namely the SOE company program related to corporate culture which has meaning; **Amanah (Trusted)**: Upholding the trust given; **Kompeten (competent)**: Continue to learn and develop capabilities; **Harmonis (Harmony)** : Mutual care and respect for differences; **Loyal (Loyal)**: Dedicated and prioritizes the interests of the nation and state; **Adaptif (Adaptive)**: Continue to innovate and be enthusiastic in moving or facing change and **Kolaboratif (Collaborative)**: Building synergistic cooperation, where this moral principle is in line with the dimensions of knowledge management used in this study, namely knowledge creation, knowledge transfer and storage and knowledge application.

Model	Original Sample (O)	T Statistics (|O/STDEV|)	P Values	Conclusion
Knowledge management -> Lean management -> Construction Project Performance	0,481	2,91	0,004	Full Mediation

Table 8: Indirect influence test result
Source: Data Processed, 2022

B. The influence of knowledge management on lean management.

The results of this study prove that knowledge management variables have a positive relationship and have a significant effect on lean management. The results of this study are in line with previous research from [19], [20], [33] where [19] in his research revealed that new knowledge will promote the effect of lean implementation. Where the focus of lean implementation is on performance evaluation, where periodic problems are found and feasible solutions are proposed to achieve continuous improvement. Continuous evaluation promotes the generation of knowledge, and the accumulation of new knowledge reacts to continuous improvement and improvement of lean.

This is in line with what is implemented by PT. PP (Persero) Tbk.as one of the state-owned company's member of the PMO where PT. PP (Persero) Tbk. develops human resources through knowledge management and PT. PP (Persero) Tbk. was the first to implement lean construction which was then followed by 5 other SOEs by PMO members. In the application of lean construction PT. PP (Persero) Tbk. Involves knowledge management variables where knowledge management is needed at the beginning because it is related to lean culture which involves many aspects, especially human aspects.

C. The influence of lean management on the performance of construction projects.

The results of this study prove that lean management variables have a positive relationship and have a significant effect on the performance of construction projects. The results of this study are in line with previous research from [16]–[18], [22], [34], [35].

[18] in their research revealed that lean management practices and tools can improve overall project management efficiency for highway construction projects.

D. The influence of knowledge management on the performance of construction projects mediated by lean management.

The results of this study prove that knowledge management has a positive and significant influence on the performance variables of construction projects mediated by lean management. Therefore, good implementation of knowledge management will strengthen lean management so that it will improve the performance of construction projects.

VI. CONCLUSION

The research shows that the implementation of knowledge management does not have a significant influence on the performance of construction projects but has a positive relationship. However, the application of lean management is able to mediate the influence of knowledge management on the performance of construction projects. Therefore, the implementation of good knowledge management strengthens the implementation of lean management so that it will improve the performance of construction projects.

VII. RECOMMENDATION

For further research, May involve other independent variables and other relevant intervening variables in the construction sector, such as innovation and total quality management in relation to the influence on the performance of construction projects and It is expected to be applied in general¸ i.e. with the object of research on private main contractors or other specialist contractors and with a larger sample size.

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