



## Project managers competency on project performance of green toll road development project in Indonesia

Mairizal<sup>1,2\*</sup>, Rahmat Alifiardi<sup>1,3</sup>, Gilang Ardi Pratama<sup>2,4</sup>, Mohd Zaimi Abd Majid<sup>1</sup>, Shek Poi Ngian<sup>1</sup>

<sup>1</sup>School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Malaysia

<sup>2</sup>Department of Industrial Engineering, Faculty of Engineering, Universitas Pamulang, Indonesia

<sup>3</sup>Department of Civil Engineering, Faculty of Civil Engineering and Design, Universitas Bung Hatta, Indonesia

<sup>4</sup>Department of Civil Engineering & Environment, Faculty of Engineering, Universitas Indonesia, Indonesia

### Abstract

The Green Road Construction development program is a program that has the potential to reduce carbon emissions from road construction. Currently, the Government of the Republic of Indonesia through the Ministry of Public Works and Public Housing together with the Toll Road Business Entity continues to strive to provide the best service to the community using Toll Roads that are applied to all Toll Roads in Indonesia, especially Green Toll Roads. At the implementation stage, it has not been able to run smoothly because there are several constraining factors such as social and environmental aspects. For this reason, this study aims to find out what factors are needed by a Project Manager who carries out the construction. References are taken from various journals and articles that discuss green toll roads around the world and in Indonesia. This research is a combination of qualitative and quantitative (mixed methods) by distributing questionnaires to several respondents. The results of the factor analysis show that the Project Performance factor (Y) is strongly influenced by the determinant factors namely Knowledge (X1) in terms of Time (X1.3), Cost (X1.4) and Procurement (X1.7). Henceforth, project performance (Y) is also influenced by Knowledge (X1), Skill (X2), and Tools & Techniques (X3). Meanwhile, on the other hand, the Project Performance factor (Y) is also influenced by the Green Toll Road (Z).

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### Corresponding Author:

Mairizal  
Industrial Engineering  
Department, Universitas  
Pamulang, Indonesia  
School of Civil Engineering,  
Faculty of Engineering,  
Universiti Teknologi Malaysia,  
Malaysia

Email:  
[dosen01742i@unpam.ac.id](mailto:dosen01742i@unpam.ac.id)

## INTRODUCTION

According to Rothenberg et. al [1] stated that there has been a lot of literature discussing the benefits of a new transportation network, but we know very little about the value of road maintenance. This research sheds new light on the welfare impact of upgrading and maintaining toll roads in Indonesia. They are also stated that road maintenance and construction in Indonesia will always increase in the future. Therefore, the negative impacts of road construction activities, namely increased carbon emissions of greenhouse gas emissions, need to be reduced, because they

are very influential to climate change. This emission reduction is expected to significantly reduce the negative impact of the road infrastructure works. Indonesia will experience many significant losses due to climate change because Indonesia is an archipelagic country. A longer dry season will increase the frequency of extreme weather, and more frequent heavy rains will increase the chance of flooding.

According to research Djalante et.al. [2] stated that Road construction projects can have a direct impact on environmental degradation by causing emissions, pollution and congestion. The green road rating is a tool to measure the

performance of green practices and the degree of greenness in road development projects. However, the implementation of tools to identify the extent to which green concepts are applied in road construction projects is still lacking in Indonesia. So, it is necessary to make some policies or strategies such as regulations concerning material standards and planning related to road design based on the local context.

In research by Willy and Winoto [3] which was tested based on the Determination test of the competency factors of the Green Building Project Manager, namely Knowledge, Attitude, and Skill, it showed a positive relationship. It can be seen that each factor has a positive influence and among them the dominating factor is the Attitude factor of 80.6%. For this reason, more extensive research is needed in this study. The study includes Competency for a Project Manager in addition to these attitudes which include elements of Knowledge and Skill.

The purpose of this research is to see how far the Toll Road Project Manager is competent in implementing the Green Toll Road Concept in Indonesia. This is because the Project Manager Competence is very influential in the implementation of environmentally friendly concepts in Green Toll Road Works with various criteria, policies, strategies and regulations that need to be implemented. The role of the Project Manager is highly demanded to master all component aspects of Project Management in carrying out their duties to implement the real Green Toll Road Development Concept.

## MATERIAL AND METHODS

In supporting research needs, it will be described according to previous research on competency, project manager, project performance and green toll road as described here.

### Competency

Approaches to defining the concept of competency are diversified in the related literature, whereby diversified approaches have contributed to the development of constantly new competency definitions that are fundamentally different from one another [4]. Based on [5][6] states that knowledge and skills are considered the "surface" of competency, because they can be easily identified and developed through training. In addition [7] and [8] in [6] explain that competency builds knowledge, skills and attitudes acquired through basic academic education and initial professional training and perfected through professional practice.

In addition, competence is defined as ability or skill. It is a set of related but distinct behaviors organized around an underlying construct, which we call "intentions". Behavior is an alternative manifestation of intention, which is appropriate in various situations or times. In other words, if a competency is an "underlying characteristic of the person that leads to or causes effective or superior performance" [9], then: an emotional, intelligence competency is an ability to recognize, understand, and use emotional information about oneself that leads to or causes effective or superior performance; a social intelligence competency is the ability to recognize, understand and use emotional information about others that leads to or causes effective or superior performance; and a cognitive intelligence competency is an ability to think or analyze information and situations that leads to or causes effective or superior performance [9].

### Project Manager

A Project Manager is an individual who applies knowledge, skills, tools, and techniques to describe, supervise, and control the organization of various project processes. In this case it confirms that the roles and responsibilities of the Project Manager differ from one company to another. It is very important to understand what the role of a particular Project Manager is in a particular company or organization. In addition, a Project Manager is the person who has overall responsibility for making the planning and execution of the project successful. He must also possess a combination of skills such as the ability to ask questions, detect unstated assumptions and resolve conflicts, as well as more general management skills [10, 11, 12] in [6].

### Project Performance

In project management according to [13] and [14], there are studies conducted to identify aspects of competency that characterize effective or high-performing Project Managers. The research is based on the opinion of project management practitioners. Research and publications in project management aspects tend to focus more on reviewing practical experience and literature, as opposed to some interesting papers on empirical data and even theoretical and model-based contributions [6].

### Green Toll Road

The development of the concept of ordinary toll road infrastructure has been directed to become a sustainable toll road as part of the business transformation in the toll road sector developed by the Ministry of Public Works &

Public Housing (PUPR), so that all PUPR infrastructure development, both carried out by contractors and investors, pays attention to environmental sustainability in order to become environmentally friendly infrastructure [1].

Green roads are an umbrella concept focused on research and development of sustainable road development projects [2][15]. The green road aspect focuses on: (1) watershed and watershed management, (2) energy and emission reduction, (3) recycled materials, which can be reused and renewable, (4) conservation and ecosystem management, and (5) social benefits [16] which the developer continued in his research [2].

The definition of the green environmental protection construction concept is a standardized, low carbon, low energy consumption, environmentally friendly and efficient technical scheme, process or method [17], where the impact is aimed at reducing carbon emissions, reducing energy consumption, and strengthening environmental protection [18][19]. It can also improve overall economic efficiency. It is also an important embodiment of the development of green roads in our country and the implementation of strong roads [20].

Jaralee et.al. [21] defines a green road as a road project that is designed and constructed at a sustainable level that is higher than current practice. According to the opinion [22], that a green road is a road that is designed and built by following the requirements and applying the green road criteria according to the principles of sustainable construction. In addition, according to [23], that sustainable roads have the principles of efficiency, mobility, accessibility, safety, comfort, community participation, emission restrictions, natural resources, habitats, and ecosystems. Overall, the green road is an integration of transportation and technology functions by realizing the goal of sustainable transportation in a natural and humane way [24].

## Methods

This study uses two types (mixed methods) of approaches in the statistical analysis process, namely starting with the data collection process and continuing with data processing. In addition, the approach used is a quantitative

approach method and a qualitative approach method [25], [26], [27]. Referring to the two types of approaches used (mixed method research), they have several different methods and techniques as seen from the form of objectives, basic concepts, research approaches, data collection methods, data analysis processes, and sampling [26, 28, 29, 30, 31]. From several forms of references related to the competency factors of Project managers are collected and how they perform in various toll road projects in Indonesia which have also been discussed by many previous researchers to be used as follow-up studies. The various forms of reviews that are carried out are not only limited to a number of articles published in peer-reviewed journals, but also from a number of papers published by various well-known publishers, various types of theses, various kinds of dissertations, and various basic theory books.

Starting from the first stage is to collect a number of references published in the last 20 years, in which to see and explore various significant impacts and at the same time reveal new findings. In the second stage, the factors or aspects related to the impact of the competency of the Project Manager on the construction of toll roads in Indonesia are collected. All the factors obtained were distributed in the form of interviews with several respondents using purposive sampling method.

A number of respondents were selected from various parties related to toll road project management in Indonesia who have experience in toll road work activities in various toll road projects in Indonesia. All respondents were given a form to fill out containing data in the form of general information and respondents' background as well as data on the importance of Project Manager Competencies in the performance of green toll road implementation in Indonesia which have been identified through the literature as taken from Table 1. Refer to three components above, namely Competency (X), Performance (Y) and Green Toll Road (Z) along with their elements will show a direct and indirect relationship between the 7 hypotheses as shown in Figure 1.

Table 1. Project Manager Competency and Performance of Green Toll Road Project

Factor	Sub-Factor	Author
Competency (X)	<b>Knowledge (X1)</b> - Integration (X1.1) - Scope (X1.2) - Time (X1.3) - Cost (X1.4) - Quality (X1.5) - Resources (X1.6) - Procurement (X1.7) - Risk (X1.8) - Communication (X1.9) - Stakeholder (X1.10)	[4]; [5], [6], [7], [8], [9], [10], [11]
	<b>Skill (X2)</b> - Communicating (X2.1) - Leading (X2.2) - Managing (X2.3) - Cognitive ability (X2.4) - Effectiveness (X2.5) - Professionalism (X2.6)	[4]; [5], [6], [7], [8], [9], [10], [11]
Performance (Y)	<b>Tools &amp; Techniques (X3)</b> - Expert judgement (X3.1) - Data analysis (X3.2) - Meeting (X3.3)	[4]; [5], [6], [7], [8], [9], [10], [11]
	- Schedule (Y1) - Cost (Y2) - Quality (Y3) - Safety & Health (Y4) - Environment (Y5)	[5], [12], [13]
Green Toll Road (Z)	- Watershed (Z1) - Energy reduction (Z2) - Emission reduction (Z3) - Recycle materials (Z4) - Conservation (Z5) - Ecosystem (Z6) - Social benefit (Z7)	[14], [15], [16], [17], [18], [19], [20], [21], [22], [23]

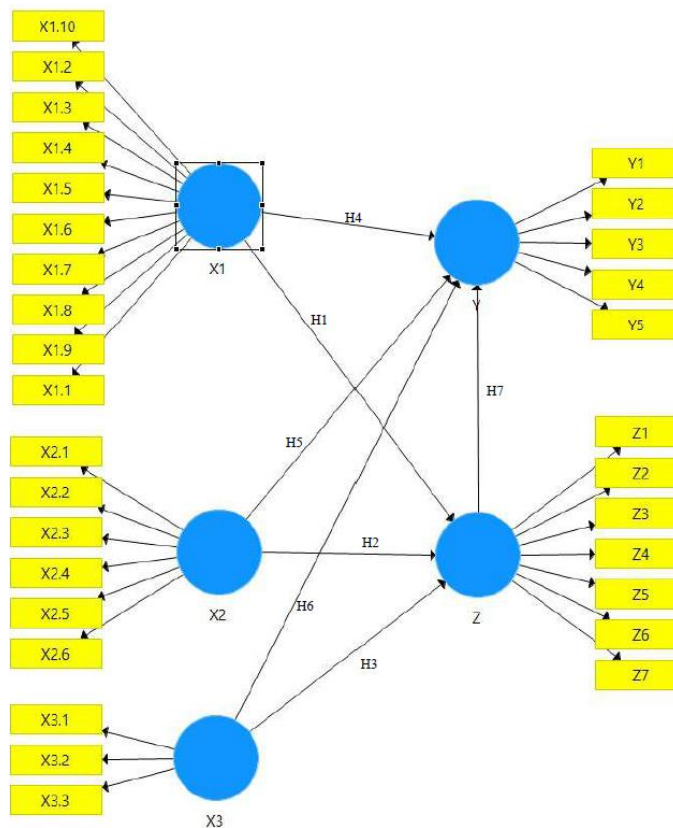


Figure 1. Hypothesis Model between Competency of Project Manager, Green Element & Performance

## RESULTS AND DISCUSSION

Furthermore, for data processing carried out in this study, SPSS version 24.0 was used and referred to Supriyadi [27]. From the sampling method using purposive sampling, questionnaires were distributed to 50 respondents who had at least a Bachelor of Engineering degree and had more than 15 years experience in Toll Road Development Project Management and came from various toll road development companies in Indonesia. All questionnaire answers have been received from a total of 50 respondents with a return rate of 100%. Factor measurement is carried out using a Likert Scale consisting of five points to measure project performance (Y) based on 3 components of the Project Manager competency factor (X1, X2 and X3) and green/environment friendly factor components (Z1, Z2, Z3, Z4, Z5, Z6 and Z7). All data received were analyzed using the Statistical Package for Social Sciences (SPSS) and shown on Table 2. The calculated reliability value was found to be on a scale of 0.990-0.991 (Cronbach's Alpha above 0.700), while the validity value was obtained between 0.714 - 0.984 which must exceed the "r" value in the reference table (result of r table = 0.367 for N-2 at 5% level of significant). From all these results, the highest factor value will be the determining factor for the Competency Aspect of Project Managers in carrying out the construction of Toll Road projects based on Green elements which have an impact on the performance of Green Toll Road Projects in Indonesia.

The next stage is carried out by processing data using structural equation modeling (SEM) with Smart PLS version 3.7 tools, to see the relationship between the Competency Aspects of Project Managers (X), Green Elements (Z) and Project Performance (Y) and produce reliability and validity values. which is still above the provisions. The final stage is data processing with Bootstrapping from Smart PLS as shown in Figure 2 and Table 3.

From Figure 2 will show 7 hypotheses, including the following:

1. Hypothesis-1 (H-1): direct relationship between Knowledge Competence (X1) and Green Element (Z).
2. Hypothesis-2 (H-2): direct relationship between Competency Skills (X2) and Green Element (Z).
3. Hypothesis-3 (H-3): direct relationship between Competency Tools & Techniques (X3) and Green Element (Y).
4. Hypothesis-4 (H-4): direct relationship between Knowledge Competence (X1) and Project Performance (Y).
5. Hypothesis-5 (H-5): direct relationship between Competency Skills (X2) and Project Performance (Y).
6. Hypothesis-6 (H-6): direct relationship between Competency Tools & Techniques (X3) and Project Performance (Y).
7. Hypothesis-7 (H-7): a direct relationship between Green Element (Z) and Project Performance (Y) which has been influenced by 3 Competency components (X1, X2 & X3).

Table 2. Reliability & Validity Test

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
X1.1	120.6600	562.025	.895	.990
X1.2	119.9600	575.304	.714	.991
X1.3	119.9800	551.326	.921	.990
X1.4	119.8800	561.455	.928	.990
X1.5	120.0600	564.956	.909	.990
X1.6	120.3800	546.526	.984	.990
X1.7	119.9800	551.326	.921	.990
X1.8	120.3800	546.526	.984	.990
X1.9	120.2000	543.143	.957	.990
X1.10	119.7600	551.941	.874	.990
X2.1	119.8800	561.455	.928	.990
X2.2	119.8800	561.455	.928	.990
X2.3	119.8800	561.455	.928	.990
X2.4	120.3600	560.847	.872	.990
X2.5	120.5000	556.337	.821	.991
X2.6	120.1000	553.316	.892	.990
X3.1	120.3600	560.847	.872	.990
X3.2	120.3800	546.526	.984	.990
X3.3	119.7800	571.767	.790	.991
Y1	120.0600	564.956	.909	.990
Y2	120.2800	556.736	.914	.990
Y3	119.9600	575.304	.714	.991
Y4	120.2600	544.809	.879	.990
Y5	120.2600	544.809	.879	.990
Z1	120.2600	544.809	.879	.990
Z2	120.4800	536.500	.981	.990
Z3	120.4800	536.500	.981	.990
Z4	121.1200	538.638	.953	.990
Z5	120.7000	528.541	.960	.990
Z6	120.7000	547.806	.823	.991
Z7	120.2800	556.736	.914	.990



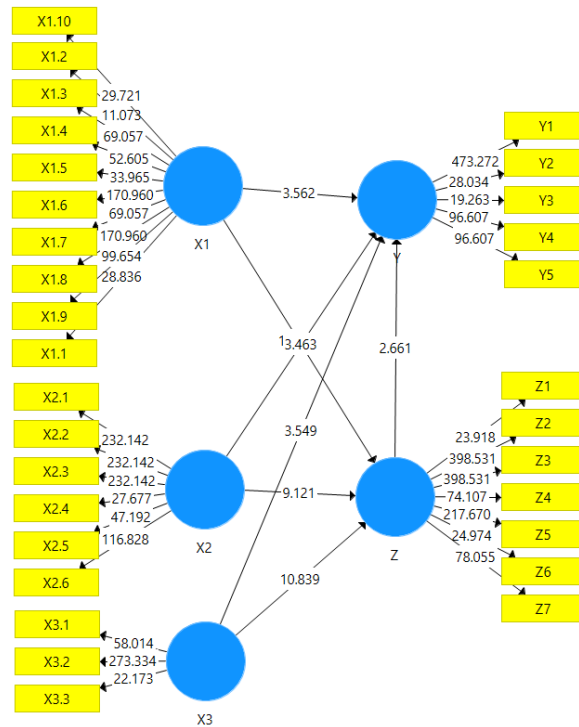


Figure 2. Results of the Hypothesis Model between Competency of Project Manager, Green Element & Performance

Table 3. Path Coefficient by Bootstrapping

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (IO/STDEVI)	P Values
X1 → Z	0.982	0.982	0.051	13.463	0.0000
X2 → Z	-0.638	-0.644	0.070	9.121	0.0000
X3 → Z	0.650	0.655	0.060	10.839	0.0000
X1 → Y	3.854	4.111	1.082	3.562	0.0000
X2 → Y	-2.329	-2.552	0.673	3.463	0.0001
X3 → Y	2.189	2.387	0.617	3.549	0.0000
Z → Y	-2.777	-3.122	1.044	2.661	0.0000

To obtain the value of the results of the hypothesis, it must refer to the level of confidence used is 95% or in other words, the inaccuracy limit ( $\alpha$ ) = 5% = 0.05 and must also produce a t-table value of 1.96 or more. Referring to Figure 2 and Table 3, an explanation of the results of the hypothesis can be given as follows:

1. X1→Z: means that Green Element Factors (Z) are strongly influenced by the Knowledge Factors (X1) with t-statistic value = 13.463 > 1.96 and p-value = 0.000 < 0.05.
2. X2→Z: means that Green Element Factors (Z) are strongly influenced by the Skills Factors (X2) with t-statistic value = 9.121 > 1.96 and p-value = 0.000 < 0.05.
3. X3→Z: means that Green Element Factors (Z) are strongly influenced by the Tools & Techniques Factors (X3) with t-statistic value = 10.839 > 1.96 and p-value = 0.000 < 0.05.
4. X1→Y: means that Performance Factors (Y) are influenced by the Knowledge Factors (X1) with t-statistic value = 3.562 > 1.96 and p-value = 0.000 < 0.05.
5. X2→Y: means that Performance Factors (Y) are influenced by the Skills Factors (X2) with t-statistic value = 3.463 > 1.96 and p-value = 0.001 < 0.05.
6. X3→Y: means that Performance Factors (Y) are influenced by the Tools & Techniques Factors (X3) with t-statistic value = 3.549 > 1.96 and p-value = 0.000 < 0.05.
7. Z→Y: means that Performance Factors (Y) are influenced by the Green Toll Road Factors (Z) with t-statistic value = 2.661 > 1.96 and p-value = 0.000 < 0.05.

Apart from the seven main hypotheses, it can also see the sub-hypotheses for all the sub-factors shown in Table 4.

Table 4. Path Coefficient by Bootstrapping (sub)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEVI)	P Values
X1 → X1.1	0.105	0.104	0.003	36.195	0.0000
X1 → X1.2	0.090	0.091	0.008	11.798	0.0000
X1 → X1.3	0.107	0.107	0.001	76.566	0.0000
X1 → X1.4	0.106	0.106	0.001	103.465	0.0000
X1 → X1.5	0.114	0.115	0.003	34.411	0.0000
X1 → X1.6	0.118	0.118	0.004	26.333	0.0000
X1 → X1.7	0.107	0.107	0.001	76.566	0.0000
X1 → X1.8	0.118	0.118	0.004	36.333	0.0000
X1 → X1.9	0.109	0.109	0.002	64.511	0.0000
X1 → X1.10	0.104	0.104	0.003	33.087	0.0000
X2 → X2.1	0.184	0.183	0.004	51.001	0.0000
X2 → X2.2	0.184	0.183	0.004	51.001	0.0000
X2 → X2.3	0.184	0.183	0.004	51.001	0.0000
X2 → X2.4	0.176	0.177	0.008	22.959	0.0000
X2 → X2.5	0.165	0.166	0.009	19.073	0.0000
X2 → X2.6	0.173	0.174	0.003	50.291	0.0000
X3 → X3.1	0.361	0.360	0.013	27.469	0.0000
X3 → X3.2	0.416	0.415	0.016	26.469	0.0000
X3 → X3.3	0.304	0.304	0.015	20.852	0.0000
Y → Y1	0.234	0.233	0.008	28.445	0.0000
Y → Y2	0.219	0.218	0.004	60.882	0.0000
Y → Y3	0.182	0.184	0.010	17.571	0.0000
Y → Y4	0.228	0.226	0.007	31.449	0.0000
Y → Y5	0.228	0.226	0.007	31.449	0.0000
Z → Z1	0.148	0.148	0.002	72.148	0.0000
Z → Z2	0.157	0.157	0.004	43.904	0.0000
Z → Z3	0.157	0.157	0.004	43.904	0.0000
Z → Z4	0.147	0.147	0.004	41.751	0.0000
Z → Z5	0.152	0.152	0.002	71.110	0.0000
Z → Z6	0.139	0.139	0.005	25.985	0.0000
Z → Z7	0.147	0.148	0.003	48.429	0.0000
X2 → Z	-0.638	-0.650	0.080	7.991	0.0000
X3 → Z	0.650	0.652	0.063	10.238	0.0000
X1 → Y	3.854	4.189	1.167	3.302	0.0000
X2 → Y	-2.329	-2.532	0.737	3.161	0.0000
X3 → Y	2.189	2.364	0.711	3.079	0.0000
Z → Y	-2.777	-3.098	1.160	2.394	0.0000

According to Table 4 above, five items very strong relationships between factors and sub-factors can be sorted as follows:

1. X1→X1.4: means that Cost Competency Factors (X1.4) are strongly influenced by the Knowledge Factors (X1) with t-statistic value = 103.465 > 1.96 and p-value = 0.000 < 0.05.
2. X1→X1.3: means that Time Competency Factors (X1.3) are strongly influenced by the Knowledge Factors (X1) with t-statistic value = 76.565 > 1.96 and p-value = 0.000 < 0.05.
3. X1→X1.7: means that Procurement Competency Factors (X1.3) are strongly influenced by the Knowledge Factors (X1) with t-statistic value = 76.566 > 1.96 and p-value = 0.000 < 0.05.
4. Z→Z1: means that Watershed Factors (Z1) are strongly influenced by the Green Toll Road Factors (Z) with t-statistic value = 72.148 > 1.96 and p-value = 0.000 < 0.05.
5. Z→Z5: means that Conservation Factors (Z5) are strongly influenced by the Green Toll Road Factors (Z) with t-statistic value = 71.110 > 1.96 and p-value = 0.000 < 0.05.

## Analysis

From the seven hypotheses generated from the above processing, it can be explained as follows:

1. Hypothesis-1 (H-1) with the results of the analysis between X1→Z: means that Green Element Factors (Z) are strongly influenced by the Knowledge Factors (X1).  
The above hypothesis is supported by the research of Rothenberg et.al. [1] who said that the evaluation results in the development of road construction indicated that road administrators were reluctant to apply new green technologies because they required human resources who had knowledge and were able to implement and be able to monitor its implementation.
2. Hypothesis-2 (H-2) with the results of the analysis between X2→Z: means that Green Element Factors (Z) are strongly influenced by the Skills Factors (X2).  
The above hypothesis is supported by the research of Willy and Winoto [3] who said that on the Skill factor that influences the success

of a construction project, 3 variables are taken with their respective predicates, namely Professionalism, Regulatory Ability, and Project Management Mastery.

3. Hypothesis-3 (H-3) with the results of the analysis between  $X3 \rightarrow Z$ : means that Green Element Factors (Z) are strongly influenced by the Tools & Techniques Factors (X3).

The above hypothesis is supported by the research of Djalante et al. [2] which states that the Indonesian road project needs to be some to create some policies or strategies such as regulation related to standard of materials and planning related to road design based on the local context.

4. Hypothesis-4 (H-4) with the results of the analysis between  $X1 \rightarrow Y$ : means that Performance Factors (Y) are influenced by the Knowledge Factors (X1).

The above hypothesis is supported by Willy and Winoto's research [3] which states that the factors that dominate the success of Construction Projects in each variable are taken from the highest variables on the partial test which are described as: Knowledge, Skill and Attitude.

5. Hypothesis-5 (H-5) with the results of the analysis between  $X2 \rightarrow Y$ : means that Performance Factors (Y) are influenced by the Skills Factors (X2).

The above hypothesis is supported by Willy and Winoto's research [3] which states that the factors that dominate the success of Construction Projects in each variable are taken from the highest variables on the partial test which are described as: Knowledge, Skill and Attitude.

6. Hypothesis-6 (H-6) with the results of the analysis between  $X3 \rightarrow Y$ : means that Performance Factors (Y) are influenced by the Tools & Techniques Factors (X3).

The above hypothesis is supported by the research of Djalante et al. [2] which states that the human value related to the performance of safety needs to be improved in the areas of planning. The achievement on natural goals is supported by more availability of guidelines on the environment, transportation, and construction rather than on materials and pavement technology.

7. Hypothesis-7 (H-7) with the results of the analysis between  $Z \rightarrow Y$ : means that Performance Factors (Y) are influenced by the Green Toll Road Factors (Z).

The above hypothesis is supported by Rotherberg et al. [1] which states that the implementation of green roads is intended to support the implementation of low-carbon

construction, especially in the field of road infrastructure. There is potential to reduce carbon in road construction projects in Indonesia if green road principles or green elements are applied, although this still faces challenges on the ground.

Based on the results of all the hypotheses above, it can be seen that Aspect of Project Manager Competence (X) is quite influential on Project Performance (Y) on the implementation of the Green Toll Road Concept (Z) in Indonesia. The results of the factor analysis show that the Project Performance factors are strongly influenced by the determinant factors namely Knowledge (X1) in terms of Time (X1.3), Cost (X1.4) and Procurement (X1.7). Henceforth, project performance (Y) is also influenced by Knowledge (X1), Skill (X2), and Tools & Techniques (X3). Meanwhile, on the other hand, the Project Performance factor (Y) is also influenced by the Green Toll Road (Z) aspect. Separately, project performance (Y) is strongly influenced by Health and Safety (Y4) and Environment (Y5). Meanwhile, the Green Tool Road (Z) itself is heavily influenced by Watershed (Z1) and Conservation (Z5).

## CONCLUSION

The results of all hypotheses obtained in this study are that the Project Manager's Competency Aspects have quite an influence on Project Performance in the implementation and development of the Green Toll Road Concept in Indonesia. The factors that indicate that the Project Performance factor is strongly influenced by several determinants, such as more detailed knowledge of the Time, Cost and Procurement factors. Meanwhile in terms of Project Performance internally, it is strongly influenced by Knowledge, Skills, and Tools & Techniques factors. What also influences the Project Performance factor is the Green Toll Road Aspect itself. Separately, project performance is greatly influenced by two factors namely Health and Safety and Environment. Meanwhile, from the aspect of the Green Tool Road itself, it is strongly influenced by factors that must be an important concern, namely Watersheds and Conservation.

The suggestions that need to be considered for further research are the seven hypotheses and the five dominant sub-hypotheses so that each implementation of the Green Toll Road can be successfully implemented in Indonesia

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