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Analysis of Determining Factors for the Success of the Design and Construction Project of Luwuk – Toili Ring Road in Banggai Regency, Indonesia

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Abstract
The design-build project procurement method seems to be one of the solutions and choices for public project procurement in Indonesia. This is because the process and time of work are fast, and costs are easy to control compared to conventional methods. The use of this method is not only for building projects, but can also be practiced on road projects. The purpose of the study is to determine the determining factors for the success of the Luwuk-Toili ring road project and explain the relationship between the determining factors for the success of the project. The research method uses a questionnaire, the research sample is proportional, data analysis uses factor analysis, and Kendall's correlation to determine the relationship between factors using SPSS ver. 26. The study uses 7 (seven) main factors and 28 sub-factors. . The results of the study show that from the 7 (seven) main factors, 6 factors are formed, one of which is the Owner's ability to communicate project management

Keywords: *Analysis, Factors, Design, Project, Road,*

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I. INTRODUCTION

Design-build is an old method that has been used in the construction sector. At the beginning of its operation, contractors were not only construction service providers but also planning services [1][2][3]. However, this condition is in line with the development of construction technology, the selection of design-build methods has also increased dramatically[4][5]. The design-build method is increasingly in demand for use abroad in all types of construction. This is because the design-build method has advantages compared to the project implementation system with conventional methods[6][7][8].

In Indonesia, the design-build project delivery method is the main alternative choice for implementing public projects.[9] This is because the nature of the project is urgent, the completion time is fast, the costs are more controlled, the service provider and planner contracts are made in one contract. This contract method can make the project implementation process more effective for types of projects with a short duration[10][11]. So that the design-build method is often found for large construction projects with financing from the private sector, including toll roads and other construction projects within the scope of national strategy projects[12][13][14].

Road projects are one of the construction projects that have a high level of complexity because they have to use various types of tools, work methods, materials, controls, human resources, both project owners, contractors and consultants. These problems are often found in public projects in the road sector, including problems with development objects and problems with subjects who will carry out development[15][16][17]

1.1. Project Success Factors

Previous research or studies explained that there are several critical success factors (CSF) which are simplified into six factors, namely project procedures, project characteristics, project work atmosphere, project environment, project strategy and project participants[18][19]. From a construction management perspective, project success factors are significantly influenced by the characteristics, conditions or variables in the project environment [20][21][22].

The determining success factor is the type of owner/client (government or private party). The type of owner is an influential factor, because the policies, rules and budgeting of the private and government parties are different. The determinants of project success based on the stages of the toll road design and construction project life cycle can be grouped into three parts, namely (1) making documents and basic drawings (2) construction stage (3) post-construction[23][24][25][26].

1.1.1. Project Concept, Basic Drawing and Pre-Construction Variables

project scope factor, with a regression coefficient of 0.162. This shows that if the project scope factor is handled better by all parties involved, then project success will increase by 16.2%. This condition is greatly influenced by several things, including the availability of basic design with complete specifications, good regulations, land legality, readiness of soil investigation data, and integrated coordination between various interests, Design criteria and design concepts that must be prepared, namely: road geometry; pavement structure; structural design (bridges, flyovers, interchanges); drainage networks; geotechnical handling; building equipment and infrastructure, special specifications and Scope of Work[27][28].

In practice, the Design Build team has the ability to compress the project procurement schedule, by creating overlap between design and construction activities or starting the construction process before the design is completed. This is the main advantage of Design Build compared to the conventional Design Bid Build Project system, where the design and construction phases must be carried out sequentially[29][30].

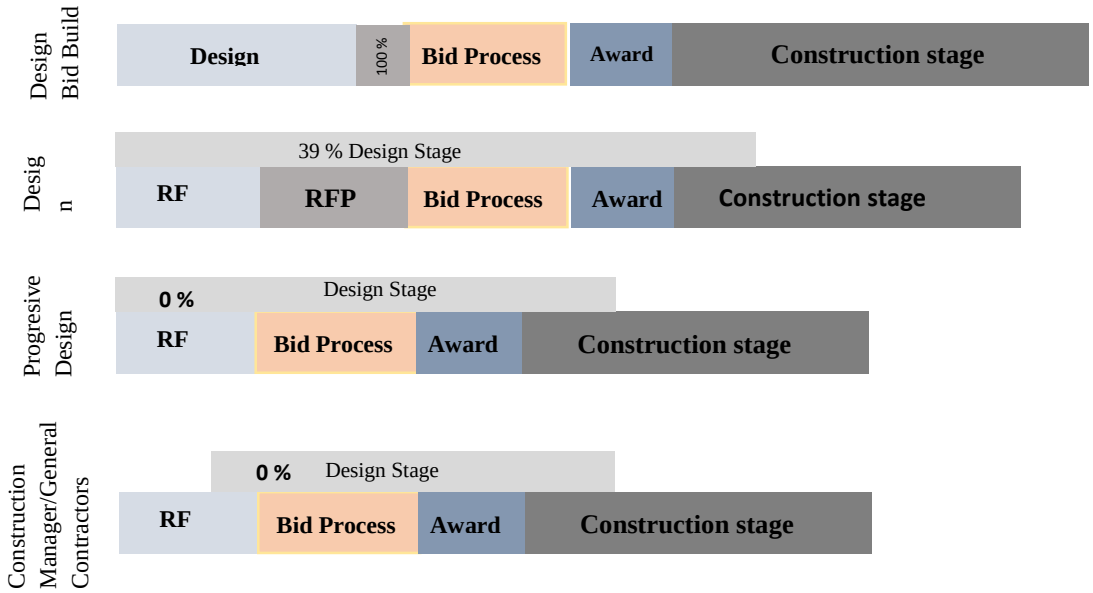

Figure 1, Project Delivery Method Sequence (2019)

1.1.2. Equipment Variables

A survey focused on subcontractors using intensive equipment was conducted in Hong Kong with various construction stakeholders, the results of which were that CSF was grouped into six main components, namely: (i) market position; (ii) factors related to equipment; (iii) human resources; (iv) income; (v) managerial ability to adapt to change; and (vi) factors related to project success. Civil works in general and earthmoving work in particular require the use of heavy equipment and cannot be separated from construction activities.
[8].11] [31][32]

1.1.3. Work Method

Planning equipment for a project that specifically uses heavy equipment, includes the selection stage, the usage stage (application) and the management stage of heavy equipment (maintenance and repair). These three stages are a single, interrelated unit, so that they have a very large influence on the success of the project to be worked on[33][34]

1.1.4. Human Resources

The workforce or resources in a project are one of the important factors in project implementation, especially projects that use the design-build method. Resources and involvement of the workforce are part of determining the smoothness and ease of implementing the design-build project. Grouping of resources or workers can be divided into two:

a. Management, engineering, implementing, and supervisory groups
   The workforce on average has experience in projects, including design-build projects. This group includes a group of special skill workers with a minimum education level of diploma or general high school who have expertise because of their experience. Included in the skill group are contractors and consultants
b. Non-Skilled Worker Group,

The workforce mostly does craftsman work or is not included in the core project team. The workers are needed because there are sub-items of work that require non-skilled work.

1.1.5. Material Factors

Materials are one of the most important things in a construction project activity. In the continuity of project planning activities, material supplies are very important for the success of a project. To make a project a success, it is important for the implementer to supply materials and equipment to the project location, procurement of materials on the project is often difficult with various types of materials and sources available. In building construction projects with reinforced concrete structural systems, the speed and accuracy of calculating the volume of reinforcing steel and concrete material requirements are important issues that need to be resolved.[35][36].

1.1.6. Cost Factors

What the owner must understand is that every decision has cost implications, and that any changes to these decisions can increase costs. Knowing the costs associated with the project in a timely manner will increase the owner's perception of the contractor as an ally - no longer as a party who is always ready to take advantage of the situation to increase profit margins[23][37][38]

1.2.7. Control and Operational Factors

Project management is defined based on the overall success of the project's goals and expectations. These goals and expectations include technical, financial, educational, social, and professional aspects. Project success is the basis for managing and controlling current projects and planning future projects. The life of companies and organizations in the construction sector depends on how they manage projects. Achieving project success is the main goal of project managers. The method for evaluating and controlling project success is to implement project performance management. The construction industry is sometimes considered to be behind, for example, the manufacturing industry. Of course, the manufacturing industry has been familiar with computer-controlled machines long before the construction industry was involved [39][40]

Design and Construction Method

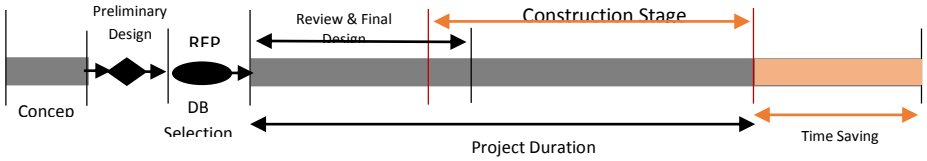

Figure2: Design and Contruction Method

Design – Tender – Build Method

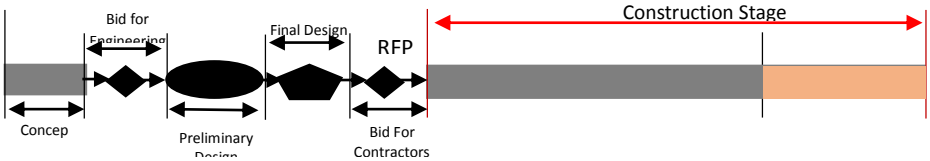

Figure3: Design Tender and Build Method

II. RESEARCH METHODOLOGY

The study was conducted to determine what factors influence the success of the Luwuk Toili ring road design project so that it can be categorized as a successful project, the dominant factors and how strong the relationship is between the determining factors for the success of the design method project. Songer (1998) said that the relationship between each element and success is a direct relationship. To identify these factors, researchers used factor analysis to identify and determine the relationship between the determining factors for the success of the design method project. The steps and stages are:

2.1. Research Respondents

In conducting the study, researchers limited it to the Luwuk - Toili ring road project in Banggai Regency which consisted of the main contractor, sub-contractor and project owner as well as workers directly involved in the project with a target of 35 respondents.

2.2. Data Processing and Instrument Testing.

To obtain the determining factors for the success of the project according to the research objectives, researchers used a factor analysis approach through the SPSS program ver. 26. The questionnaire data were tabulated and processed. The data processing was first carried out by instrument testing, namely validity testing and reliability testing. The validity test aims to determine the ability and validity of a questionnaire that can measure correctly and precisely the variables that have been compiled according to the research objectives. The validity test will measure the level of accuracy and deviation of the data precisely according to the variables studied. While the reliability test is a test using the Cronbach's Alpha method approach> 0.600 with a real level of 5% (correlation coefficient or reliability) which can explain how well the variables in one group are positively correlated with each other,

The research framework is:

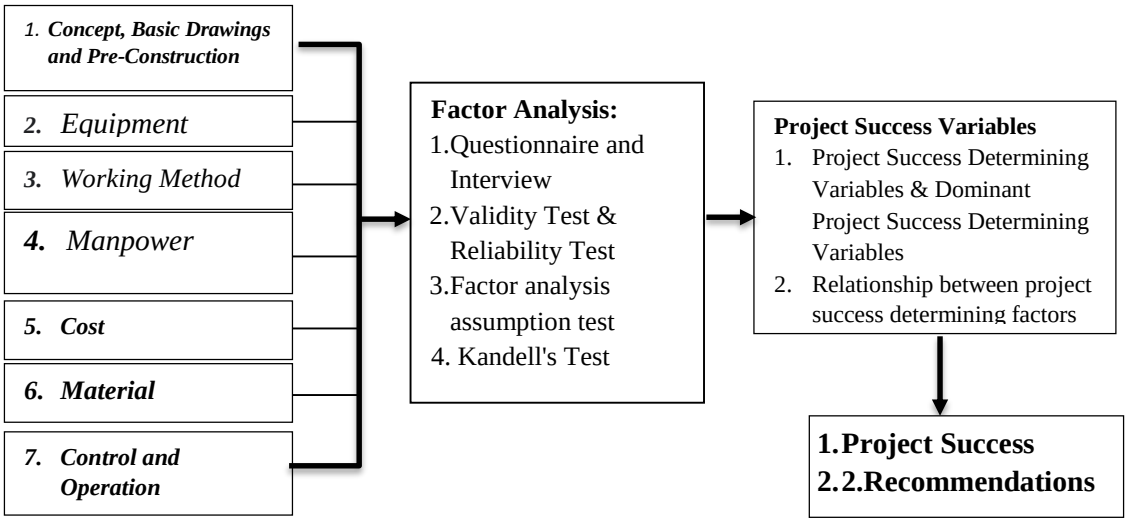

Figure 4, Research Framework for Determining Success Factors of Design and Build Projects

III. RESULT AND DISCUSSION

The research data was taken using a questionnaire to workers directly involved in the Luwuk - Toili ring road project, consisting of project owners, contractors, consultants and sub-contractors. The data was taken based on the position, education and involvement of respondents in participating in the design and construction project.

3.1. Validity Test

This test is intended to determine the extent to which the measuring instrument can be used to measure a questionnaire data. The validity test in this study is intended to determine whether the list of statements prepared is able to measure the variables according to the researcher's target. The validity test is carried out by calculating the correlation between each statement (item) with its construct score. The results of the validity test on the questionnaire in this study were carried out with the help of the SPSS for Windows computer application version 26.0 :

a. Concept Variable, Basic Drawing, and Pre-Construction
   Cost Variable (X1) is represented by 7 statement items. The seven items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table:

Table 1, Client Variable & Base Image Validity Test Results

Statement Items	r- Count	r- Critical	Status
$X_{1.1}$	0.705	0,367	VALID
$X_{1.2}$	0.539	0,367	VALID
$X_{1.3}$	0.756	0,367	VALID
$X_{1.4}$	0.843	0,367	VALID
$X_{1.5}$	0.753	0,367	VALID
$X_{1.6}$	0.718	0,367	VALID
$X_{1.7}$	0.831	0,367	VALID

b. Equipment Process Variables
The Cost Variable (X2) is represented by 2 statement items. Both items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table:

Table 2, Results of the Validity Test of Equipment Variables

Statement Items	r- Count	r- Critical	Status
$X_{.2.1}$	0.851	0,367	VALID
$X_{.2.2}$	0.791	0,367	VALID

c. Process Variables Work Method
The Cost Variable (X3) is represented by 3 statement items. The 3 items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table.

Table 3, Results of Validity Testing of Work Method Variables

Statement Items	r- Count	r- Critical	Status
$X_{.3.1}$	0.660	0,367	VALID
$X_{.3.2}$	0.675	0,367	VALID
$X_{.3.3}$	0.710	0,367	VALID

d. Labor Process Variables
Cost Variable (X4) is represented by 4 statement items. Both items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table:

Table: 4, Results of Validity Testing of Labor Variables

Statement Items	r- Count	r- Critical	Status
$X_{.4.1}$	0.732	0,367	VALID
$X_{.4.2}$	0.773	0,367	VALID
$X_{.4.3}$	0.794	0,367	VALID
$X_{.4.4}$	0.688	0,367	VALID

e. Process Cost Variables
Cost Variable (X5) is represented by 2 statement items. Both items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table:

Table 5, Cost Variable Validity Test Results

Statement Items	r- Count	r- Critical	Status
$X_{.5.1}$	0.716	0,367	VALID
$X_{.5.2}$	0.686	0,367	VALID

f. Material Process Variables
Cost Variable (X6) is represented by 3 statement items. The three items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367, as shown in the following table:

Table 6, Results of the Validity Test of Material Variables

Statement Items	r- Count	r- Critical	Status
$X_{.6.1}$	0.581	0,367	VALID
$X_{.6.2}$	0.630	0,367	VALID
$X_{.6.3}$	0.626	0,367	VALID

g. Operational and Maintenance Process Variables
The Cost Variable (X7) is represented by 7 statement items. The seven items measured are valid because they have a correlation coefficient (r-count) > r-table = 0.367

3.2.Reability Test
The results of the validation test, all instruments in this study were declared valid, then the next reliability test was carried out to determine the level of accuracy, precision, or reliability of this research instrument. After the reliability test was carried out, all statements in this study were declared reliable with a Cronbach Alpha value> 0.60. The reliability test in this study was carried out with the help of the SPSS for Windows version 26.0 computer program. The results of the reliability test on all variables, Based on the table above, it can be

explained that the Cronbach Alpha value of all variables used in the study is greater than 0.60. This means that all constructs or variables can be declared reliable

3.3.KMO and Bartlett's test

KMO and Bartlett's Test is useful to determine the feasibility of a variable, whether it can be further processed using factor analysis techniques or not. The method is to look at the KMO MSA (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) value. If the KMO MSA value is greater than 0.50, then the factor analysis technique can be continued. Based on the output of table 10 below, the KMO MSA value is 0.752> 0.50 and the Bartlett's Test of Sphericity (Sig.) Value is 0.00 <0.05, so the factor analysis in this study can be continued because it has met the first requirement

Table 7, KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.752
Bartlett's Test of Sphericity	Approx. Chi-Square	952.749
	Df	378
	Sig.	.000

Based on the output of the table above, it is known that the KMO MSA value is 0.752 > 0.50; and the Bartlett's Test of Sphericity (Sig.) value is 0.00 < 0.05, so the factor analysis in this study can be continued because it has met the first requirement. The table above shows that the significance value (r count) < (r table). Or in other words, the Approx Chi-Square value according to the table = 952.749 > 1.00

3.4.Analysis of Extracted Data Process Results

The extraction method used in this study is principal component analysis (PCA). This extraction process is used to determine the number of factors that will be formed. The communalities value in the extraction results table explains the variance of the variables that can be explained by the formed factors. Based on the communalities value, it can be seen that the extraction value obtained by each variable is above 0.5. This means that each factor can explain more than 50% of the variance of each variable. This shows that each variable has a very close relationship with the formed factors. Of the 6 components above, the percentage of variance of each component can be explained as follows, The components formed can also be seen on the screen plot as shown in the image below

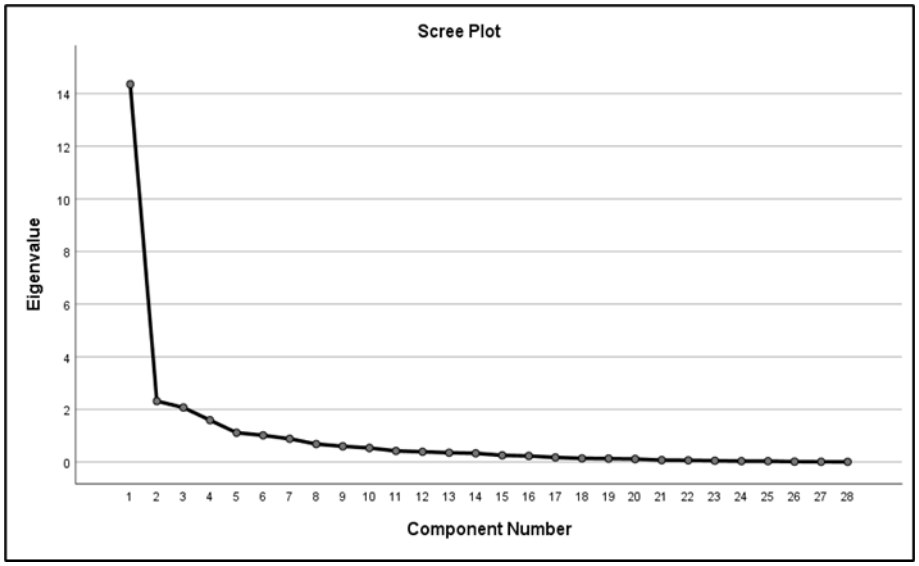

Figure 5, Graph, Eigenvalue Vs Component Number Relationship

Component 1 variance is 51.269, meaning it is able to explain 51.269%, component 2 variance value is 8.269, meaning it is able to explain 8.269%, component 3 variance value is 7.398, meaning it is able to explain 7.398%, component 4 variance value is 5.681, meaning it is able to explain 5.681%, component 5 variance value is 3.980, meaning it is able to explain 3.980%, component 6 variance value is 3.626, meaning it is able to explain 3.626%

The cumulative variance of all factors formed is 80.223. This value is less than 100% because only 6 factors are considered to have differences and the remaining factors are considered the same based on the results.

3.5. Relationship Between Project Success Factors

Based on the results of data processing and analysis above, it can be explained that of the 28 sub-variables used in the study which are divided into project stages or cycles and main variables, it turns out that only 6 components are formed based on eigenvalue > 1. Based on the Rotated Component Matrix table and the grouping table of factor formation components which are the determining factors for the success of the Luwuk-Toili ring road design project, it can be explained as follows:

a. Job risk control (contractors and consultants) focuses on 5 M,This factor has a positive relationship with all factors formed. Against the factor of the design and build contractor has work methods and procedures and K3 procedures in the field (X3) with a coefficient value: 0.541 ** and a sig 2-tiled value: 0.000 < 0.01 the relationship is moderate. While the relationship with other factors is weak with coefficient values: .392 * and .334 * meaning the coefficient value is in the interval 0.20 - 0.399 with a Sig 2-Tiled value

b. The client's ability factor and project management in controlling, coordinating, and communicating reciprocally to all project workers.This factor has a positive relationship with all factors determining the success of the project. Of all the factors formed, the client's ability factor and the supervision team in communicating, coordinating, directing, controlling external and internal projects have a coefficient value of: .638** and a sig 2-tiled value: 0.000 <0.01. This shows that the relationship between the two is strong. While the relationship with other factors is moderate, weak and very weak, with coefficient values: 0.468**; 0.382*; 0.320* and a Sig 2-tailed: 0.002<0.01; 0.013 <0.05 and 0.038 <0.05. Its relationship with the Concept, Basic Drawing and Pre-Construction has a Coefficient value: 0.235, a Sig 2-tailed value: 0.135> 0.05 meaning the relationship is very weak. 3. Design Method Factors Satisfy Clients, Stakeholders, Communities, and Other Users (X7)

c. This factor has a relationship with all factors that determine the success of the project and is positive. Of all the factors formed, the factors of the client's ability and supervision team in communicating, coordinating, directing, and controlling external and internal projects, and experienced design contractors in designing and executing projects each have coefficient values: 0.456 ** and 0.400 **, the value of a sig 2-tiled each: 0.003 and 0.009 or <0.01 means the relationship is moderate and positive. While the relationship with other factors with coefficient values each: 0.396 * and 0.320 * with a Sig 2-tailed value: 0.010 and 0.038 or <0.05, meaning the relationship is weak; and related to Concept, Basic Drawing and Pre-Construction with Coefficient value: 0.280, a Sig 2-tailed value: 0.071 > 0.05 means the relationship is very weak

d. Client and Supervisory Team Ability to Communicate, Coordinate, Direct, Control External and Internal Projects,These factors have a relationship with all factors that determine project success and are positive. Of all the factors formed, the factor of project management and client ability to control, coordinate, and communicate reciprocally to all project workers has a strong relationship between the two with a coefficient value: 0.638 **; a Sig 2-tailed value: 0.000 < 0.01. While the relationship with other factors is moderate and weak. This is as the coefficient value of each factor, namely: 0.512 ** and 0.456 ** the value of a Sig 2-tailed respectively: 0.001 and 0.003 or <0.01 means the relationship is moderate. While other factors have coefficient values: 0.334 * and 0.347 * with a Sig 2-tailed value: 0.028 and 0.022 or <0.05 are weak. 5. The design and build contractor has work methods and procedures and K3 procedures in the field (X3)

e. This factor has a relationship with all factors determining the success of the project and is positive. Of all the factors formed, the work risk control factor (contractors and consultants) focuses on 5 M, internal and external projects, there is a moderate relationship with a coefficient value: 0.541 **, a Sig 2-tailed value: 0.000 <0.01. While other factors have moderate and weak relationships with each coefficient value: 0.401** and a Sig 2-tailed value: 0.009 <0.01 is moderate, coefficient values: 0.382*; 0.396 and 0.347* with a Sig 2-tailed values: 0.013, 0.010, and 0.022 or <0.05 are weak.

f. Experienced design and build contractors carry out design and execution of design and build projects (X4), This factor has a relationship with all factors determining the success of the project and is positive. Of all the factors formed, the client's ability and supervision team in communicating, coordinating, directing, and controlling external and internal projects has a moderate relationship with a coefficient value: 0.512**, a Sig 2-tailed value: 0.000 <0.01. This is also found in other factors with coefficient values: 0.468**; 0.400xx; and 0.401** with a Sig 2-tailed value of 0.002, 0.009, and 0.009 or <0.01 is moderate, and the coefficient value: 0.392* with a Sig 2-tailed value: 0.011 <0.05 is weak.

IV. CONCLUSION

The design-build method is a project procurement method where the planning contract and the service provider contract are made into one contract. For this reason, it is necessary to further study the relationship or connection between project management, the project team and the coordination and communication methods to

achieve the success of the design-build project. From the results of data processing using the results of factor testing and the discussion above, a conclusion can be drawn. From the 7 (seven) factors tested using factor analysis, 6 factors can be formed as important factors and determinants of the success of the design and construction project on the Luwuk - Toili ring road project. Of the 6 (six) factors formed above, the dominant factor is the Owner and Project Management Ability factor in Conducting Communication with a value of 0.840

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