The Analysis of Sap Project System Module's Implementation on Data Accuracy as Net Benefit for Infrastructure Projects

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Abstract

Projects with high complexity have a high risk of increasing construction costs, data accuracy is needed regarding cost control so that these problems do not occur. SAP S/4 HANA module Project System (PS) is an ERP system-based application that contains data ranging from planning, procurement, control, and payment. Previously, there was no study on the implementation of SAP S/4 HANA specifically for the PS module on infrastructure projects. It is necessary to analyze the implementation of the SAP S/4 HANA PS module on data accuracy as a net benefit. This study aims to analyze the factors that influence the implementation of the SAP S/4 HANA PS module on data accuracy as net benefit in infrastructure projects. This research method used descriptive statistical methods, causal correlation analysis and factor analysis. Data collection techniques were carried out by expert validation and questionnaires given to the infrastructure project team using the SAP S/4 HANA PS module. The results showed that the ease of use, the speed of accessing information (system quality), data reliability and data validity (information quality), had a positive effect on data accuracy (net benefit). This research can be used to improve data accuracy and report quality with SAP PS module.

Keywords
SAP S/4 HANA, PS Module, data accuracy, net benefit, infrastructure project

1. Introduction
Last five years in Indonesia, infrastructure projects have become one of the most massive developments, as evidenced in the list of national strategic projects (PSN) regulated in Presidential Regulation Number 109 of 2020 concerning the Acceleration of Implementation of National Strategic Projects, there are 65 toll roads, 8 projects airports, 15 railway transportation development projects, 48 dam projects, 9 irrigation projects, 17 industrial estates and many others.

Projects with high complexity have a high risk of increasing construction costs, as According to Braeckmann et. al., 2019, the higher the level of project complexity, the greater the potential for cost overruns and schedule overruns, which need to be managed carefully. Therefore, it is necessary to control costs so that these problems do not occur. According to Kadar (2011) the Earned Value method represents that the project budget is related to the Work Breakdown Structure (WBS) of the work, and the WBS becomes the basis for implementing the Enterprise Resource Planning (ERP) system.

System Application and Product in Processing (SAP) S/4 HANA is an ERP system-based application that contains data ranging from planning, procurement, control, and payment. Several construction service providers have used an ERP system with SAP S/4 HANA. There have been several studies measuring the implementation of SAP S/4 HANA. However, based on the problems and previous research, there are no specifics in previous studies that discuss the analysis of the application of SAP S/4 HANA specifically for the Project System (PS) module on infrastructure projects in terms of data accuracy as a benefit in infrastructure projects. Therefore, it will be investigated how the analysis of the use of the implementation of the SAP S/4 HANA application in the process of monitoring the evaluation of projects contained in the PS module on data accuracy.

1.1 Objectives

The objectives of this research are to identify the factors that can affect the implementation of the SAP S/4 HANA PS module on infrastructure projects and to analyze the factors that influence the implementation of the SAP S/4 HANA PS module on data accuracy as a benefit for infrastructure projects.)

2. Literature Review

This research includes descriptive statistical research, measurement methods, the use of structured questions, making measuring instruments, and scales that can be analyzed with statistics. Researchers use causal correlation research, where researchers will know the factor analysis of the implementation of SAP on data accuracy as a benefit. The data collection method is carried out by expert validation and questionnaires that produce primary data

SAP S/4 HANA

The SAP application is one of the applications in the ERP system, namely Enterprise Resource Planning. SAP S/4 HANA is an information system intended for companies whose role is to integrate and automate business processes related to aspects of operations, production and distribution. There are four types of modules in SAP S/4 HANA, namely Sales and Distribution, Project System, Material Management, and Finance and Accounting modules.

1. SD (Sales and Distribution) Module
   SD Module is a module from the production section that contains sales and contracts, contains to create contract data documents (NK, contract no, period, owner, source of funds, and method of payment). This module is also used to create documents or billing documents for operating income, term receivables, and UM & Retention which will then be billed by the Finance department.

2. PS (Project Sytstem) Module
   PS module is a module from the production department that contains project planning information from work breakdown structure (WBS) to cost analysis. This module is also used to make work progress per each WBS and the duration of the work. And the monitoring process for controlling costs is carried out on the Project System (PS) module. In the PS module there are features such as project information, budget and status reports, cost commitment reports, actual cost & stock reports, project progress reports, historical budget revision reports, budget approvals, cost evaluation reports per project, project cost evaluation reports per project. items, submission of the master budget for the implementation of the work, as well as a summary of the evaluation of the entire project.

3. MM (Material Management) Module
   The MM module is a module from the procurement & logistics section, for transactions in the form of Purchase Req, Purchase Orders, as well as transactions for receiving materials from the warehouse & their use, and making hospitalization transactions for wages, equipment rental, and subcontractors.

4. FI (Finance) Module
   The FI module is a module from the finance department for expense transactions (General Administration Fees, other indirect costs), as well as for making receivables collection documents to owners and making debt invoice documents to partners.

The Information System Success Model

The information system success model is a theory developed by DeLone and McLean in 1992, which seeks to provide a comprehensive understanding of the success of information systems by identifying the relationship between the six components that determine the success of information systems. This theory was refined by DeLone and McLean in 2003 in Figure 1. on the feedback received by other researchers. The following are the components of the information system success model:

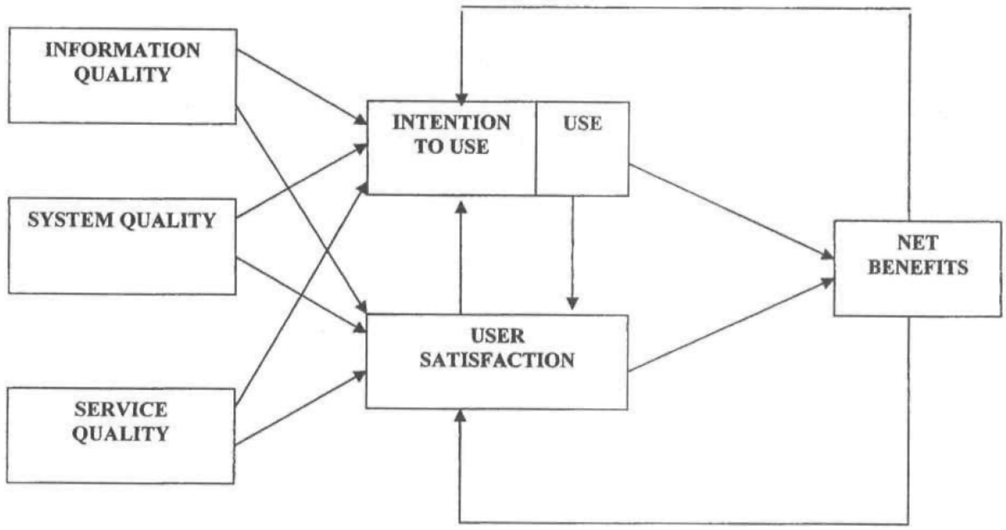

Figure 1 Information System Success Model

The hypothesis to be tested in this study, shown in Figure 2, is in accordance with the research, namely:

a. Information quality (KI) affects usage (PEM)
b. System quality (KS) affects usage (PEM)
c. Quality of service (KL) affects usage (PEM)
d. Information quality (KI) affects user satisfaction (KP)
e. System quality (KS) affects user satisfaction (KP)
f. Service quality (KL) affects user satisfaction (KP)
g. Usage (PEM) affects user satisfaction (KP)
h. Usage (PEM) affects net benefits (NB)
i. User Satisfaction (KP) affects net benefits (NB)

X - Variable

A variable is a more concrete concept that can be observed and measured further. There are two types of variables based on their relationship, namely the independent variable and the dependent variable. (table 1)

Table 1 X-Variable

X-Variable		Indicator	
X1	Information Quality	X1.1	Completeness of Data
		X1.2	Data Validity
		X1.3	Data Reliability
		X1.4	Data Update
		X1.5	Ease of data to be printed/sent with other applications
		X1.6	Ability to send data / information to other sections

X-Variable		**Indicator**	
		X1.7	Ease of making decisions based on data
X2	System Quality	X2.1	Easy to input data
		X2.2	Ease of interacting with other sections
		X2.3	Speed of accessing information
		X2.4	There is a facility to correct data
		X2.5	Comfortable feeling when using
		X2.6	Easy-to-understand language/terms
		X2.7	Ability to combine data with other sections
X3	Service Quality	X3.1	Feeling safe when accessing and transmitting data
		X3.2	There is an opportunity to provide input
		X3.3	Ability to adapt application to needs
		X3.4	Ability to develop applications according to job demands
X4	Usage	X4.1	Frequency of use in general
		X4.2	Ability to access in various places
		X4.3	Frequency of use in a day
X5	User Satisfaction	X5.1	Satisfaction with the data and information obtained
		X5.2	Satisfaction with the system as a whole
X6	Net Benefits	X6.1	Completion of work becomes faster
		X6.2	Performance improvement
		X6.3	Effectiveness at work
		X6.4	Ease of working
		X6.5	Useful in solving problems with other apps
		X6.6	Synchronization between binding parts
		X6.7	Ease of reporting jobs
		X6.8	Usage
		X6.9	User Satisfaction

3. Methods

The following is a flow chart for research work

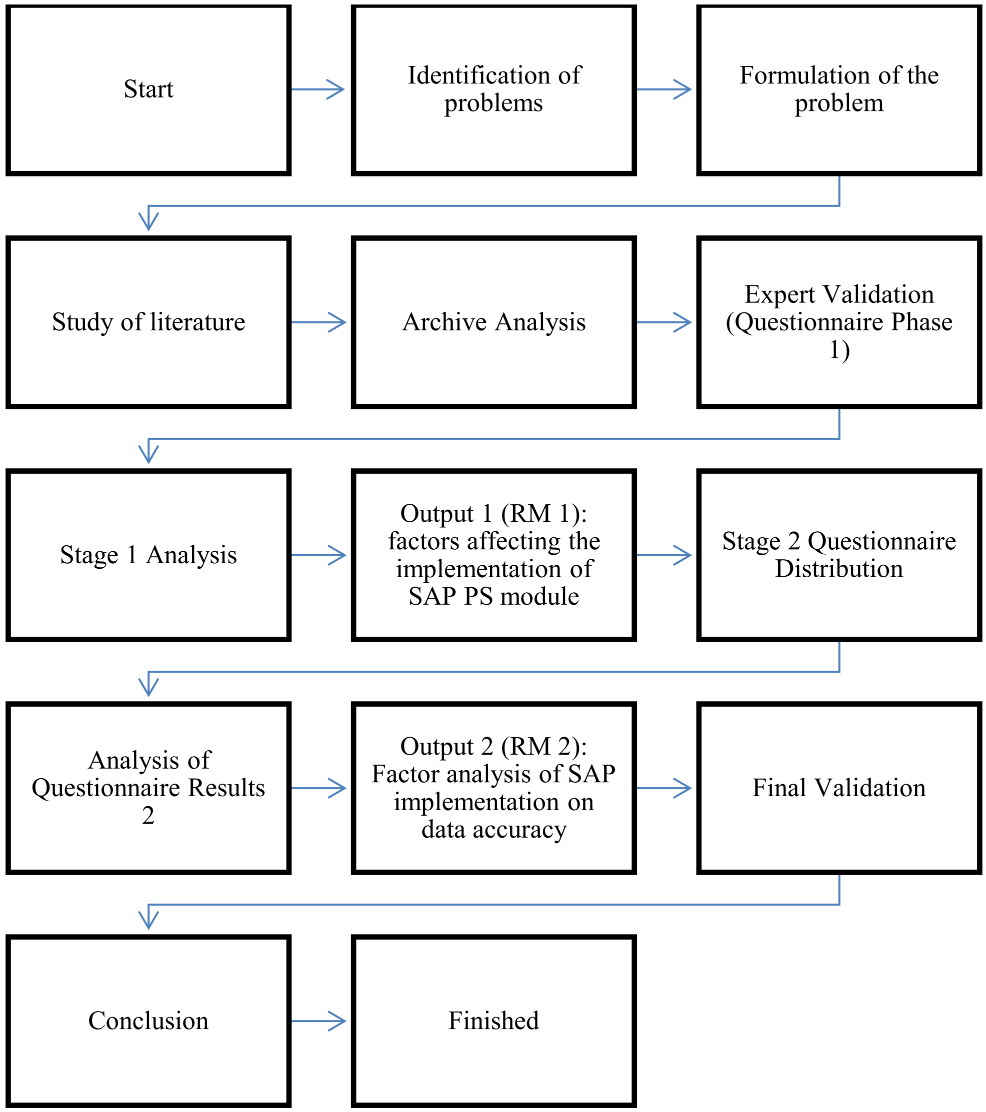

Figure 2 Research Method Flowchart

4. Data Collection

Data collection in the early stages starts from collecting data through existing literature and project data. The results of the data collection became the X variable contained in the table. To obtain answers to the Formulation of Problem I, the data was then compiled in a questionnaire. The questionnaire will be used for the validation of variable X by the expert. The provisions that were asked for opinions in the first phase of data collection were 10 respondents, respondents had a minimum education of S1 Engineering, respondents had a degree of expertise and/or were practitioners in the construction field and had a minimum of 10 years of professional experience.

Stage 2 data collection comes from variable X which has been validated by experts in stage 1. This data collection is done by distributing online questionnaires through the Google Form application. As for the provisions that were asked for opinions on data collection phase 2, 210 respondents were respondents, respondents were practitioners as service providers who worked on national strategic projects and used SAP as Project Manager, Site Manager, and Site Officer. Of the total 210 respondents, respondents came from 68 PSN Infrastructure projects, and 5 production divisions of service providers, respondents consisted of 90% of D4/S1 graduates and S2 graduates, 91% of respondents had experience of more than 5 years, respondents consisted of 82 % have positions in Site Manager, Project Manager, and Production Manager

5. Results and Discussion

5.1 Numerical and Graphical Results

After collecting respondent data, data analysis is carried out in the next stage, as follows. Statistical analysis was performed using SPSS V26 and Microsoft Excel.

Validity Test

In this study, the validity was tested (table 2) using SPSS 26. Each variable was measured per indicator and compared with the rtable score. The rtable value for 5% significance and n=210 is 0.194. The results of the validity test on all item variables exceed r table so it can be concluded that all variables are valid and can be used in further analysis.

Table 2 Validity Test

Indicator	Test Result (r count)	R table (0,05, n=210)	Description
KI.1	0,779	0,194	Valid
KI.2	0,775	0,194	Valid
KI.3	0,807	0,194	Valid
KI.4	0,809	0,194	Valid
KI.5	0,746	0,194	Valid
KI.6	0,826	0,194	Valid
KI.7	0,784	0,194	Valid
KS.1	0,800	0,194	Valid
KS.2	0,811	0,194	Valid
KS.3	0,774	0,194	Valid
KS.4	0,703	0,194	Valid
KS.5	0,787	0,194	Valid
KS.6	0,754	0,194	Valid
KS.7	0,799	0,194	Valid
KL.1	0,823	0,194	Valid
KL.2	0,850	0,194	Valid
KL.3	0,841	0,194	Valid
KL.4	0,826	0,194	Valid
PEM.1	0,867	0,194	Valid
PEM.2	0,856	0,194	Valid
PEM.3	0,882	0,194	Valid
KP.1	0,910	0,194	Valid
KP.2	0,908	0,194	Valid
NB.1	0,814	0,194	Valid
NB.2	0,864	0,194	Valid
NB.3	0,834	0,194	Valid
NB.4	0,862	0,194	Valid
NB.5	0,869	0,194	Valid
NB.6	0,877	0,194	Valid
NB.7	0,808	0,194	Valid
NB.8	0,819	0,194	Valid
NB.9	0,813	0,194	Valid

Reliability Test

The limit value used in the reliability test is the Cronbach Alpha value 0.7. The results of the calculation of the Cronbach alpha value were obtained using SPSS 26 software and are presented in the following table:

Table 3 Reliability Test

Variable	Cronbach Alpha	Description
KI	0,894	Very High
KS	0,887	Very High
KL	0,852	Very High
PEM	0,837	Very High
KP	0,790	High
NB	0,947	Very High

Analysis of Structural Equation Modelling

After the reliability test was carried out, the structural equation modeling analysis was carried out. The following figure is a description of the Loading Factor value in each path

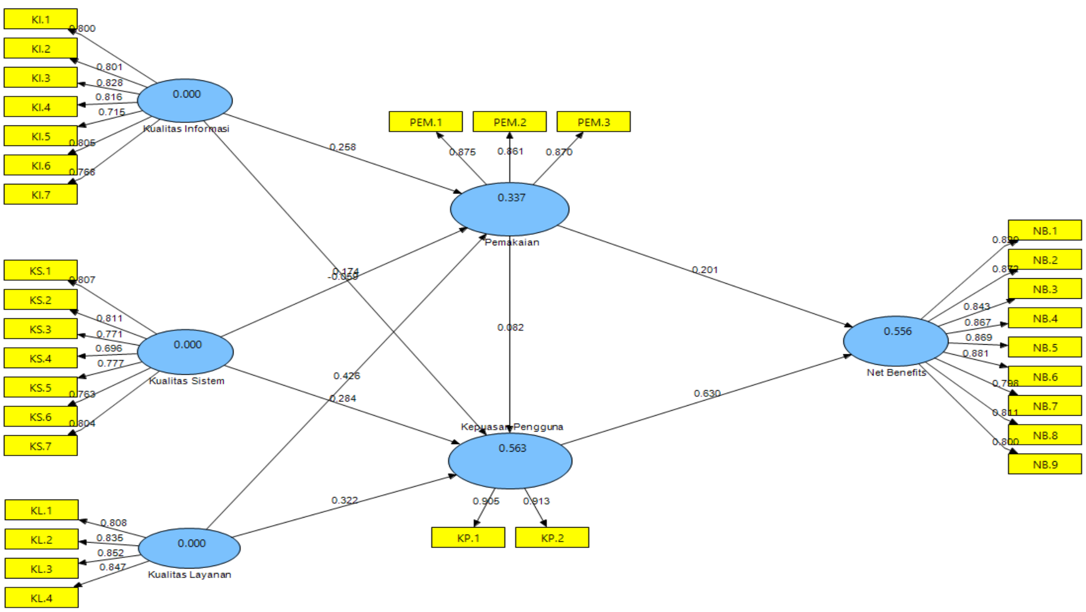

Figure 3 Analysis Structural Equation Modelling

Convergent Validity Test

Furthermore, the AVE value is determined based on convergent validity. The AVE value from table 4 can be seen that all indicator variables have a loading factor value greater than the AVE value. It can be said that all indicators reflect the variable X.

Table 4 Convergent Validity Test

Description	LF	AVE
KI.1 ← KI	0.800323	0.626183
KI.2 ← KI	0.801350	
KI.3 ← KI	0.827575	
KI.4 ← KI	0.815574	
KI.5 ← KI	0.715337	
KI.6 ← KI	0.805148	
KI.7 ← KI	0.768499	
KS.1 ← KS	0.807101	0.602885
KS.2 ← KS	0.811146	
KS.3 ← KS	0.771139	

Description	LF	AVE
KS.4 ← KS	0.695856	
KS.5 ← KS	0.776860	
KS.6 ← KS	0.762680	
KS.7 ← KS	0.804213	
KL.1 ← KL	0.808402	0.698492
KL.2 ← KL	0.835193	
KL.3 ← KL	0.852237	
KL.4 ← KL	0.846522	
PEM.1 ← PEM	0.874652	0.754246
PEM.2 ← PEM	0.860502	
PEM.3 ← PEM	0.870205	
KP.1 ← KP	0.905483	0.826338
KP.2 ← KP	0.912566	
NB.1 ← NB	0.820416	0.706836
NB.2 ← NB	0.871677	
NB.3 ← NB	0.842519	
NB.4 ← NB	0.867287	
NB.5 ← NB	0.869051	
NB.6 ← NB	0.880753	
NB.7 ← NB	0.798052	
NB.8 ← NB	0.811372	
NB.9 ← NB	0.800257	

Discriminant Validity Test

After knowing the loading factor value and AVE value, then the discriminant validity test (table 5) is carried out as follows. The results of the validity discrimination test for all indicator variables are of good value because the cross loading correlation with the latent variable is greater than the correlation with other latent variables.

Table 5 Discriminant Validity Test

	User Satisfaction	Information Quality	Service Quality	System Quality	Net Benefits	Usage
KP.1	0.905483	0.551798	0.617398	0.564054	0.661264	0.439222
KP.2	0.912566	0.585486	0.637436	0.670692	0.655877	0.415103
KI.1	0.437446	0.800323	0.549514	0.583554	0.517152	0.393825
KI.2	0.511274	0.80135	0.51794	0.61311	0.53444	0.357787
KI.3	0.54491	0.827575	0.560927	0.57015	0.594159	0.418291
KI.4	0.502089	0.815574	0.500862	0.562738	0.594811	0.385823
KI.5	0.473436	0.715337	0.484161	0.534271	0.500673	0.33709
KI.6	0.466376	0.805148	0.44504	0.513561	0.572196	0.401132
KI.7	0.519384	0.768499	0.556376	0.542978	0.609828	0.437058
KL.1	0.493214	0.511756	0.808402	0.586956	0.540551	0.543333
KL.2	0.568098	0.43588	0.835193	0.539216	0.524669	0.468839
KL.3	0.639154	0.57348	0.852237	0.671236	0.617862	0.38462
KL.4	0.605258	0.662384	0.846522	0.66662	0.726758	0.447752
KS.1	0.529396	0.549038	0.580263	0.807101	0.502713	0.348515
KS.2	0.466994	0.589506	0.490865	0.811146	0.549514	0.317276
KS.3	0.474967	0.605709	0.534394	0.771139	0.59832	0.306917
KS.4	0.521189	0.517145	0.501207	0.695856	0.484397	0.33444
KS.5	0.547467	0.471444	0.630666	0.77686	0.571553	0.357235
KS.6	0.612618	0.498659	0.638881	0.76268	0.589797	0.345925
KS.7	0.515525	0.626926	0.602349	0.804213	0.603477	0.356641
NB.1	0.616749	0.606835	0.630985	0.63794	0.820416	0.384386

	User Satisfaction	Information Quality	Service Quality	System Quality	Net Benefits	Usage
NB.2	0.638249	0.621701	0.610432	0.599727	0.871677	0.42813
NB.3	0.621269	0.668807	0.656752	0.690247	0.842519	0.433704
NB.4	0.638326	0.612294	0.624219	0.633667	0.867287	0.410399
NB.5	0.559669	0.586303	0.589659	0.586868	0.869051	0.385534
NB.6	0.61291	0.609094	0.61013	0.57065	0.880753	0.430883
NB.7	0.583986	0.508965	0.513864	0.512046	0.798052	0.421224
NB.8	0.617834	0.592034	0.649663	0.598161	0.811372	0.424649
NB.9	0.581909	0.562271	0.56723	0.602911	0.800257	0.437881
PEM.1	0.473429	0.435332	0.474891	0.421498	0.437284	0.874652
PEM.2	0.392561	0.451776	0.480458	0.374915	0.443443	0.860502
PEM.3	0.351615	0.399851	0.48099	0.339501	0.412882	0.870205

Inner Model Test

Furthermore, testing of the inner model by calculating R2 which is presented in table 6

Table 6 R Square

	R Square
User Satisfaction	0.562680
Net Benefits	0.556281
Usage	0.336584

Recapitulation Outer Model dan Inner Model Test Results

After the loading factor is obtained, then the AVE value is searched, then the discriminant validity test and R Square test are carried out, so that the outer model and inner model test results are obtained as follows:

Table 7 Outer Model and Inner Model Test Results

Test	Criteria	Result
	Outer Model	
Convergent Validity	a. A loading factor value of 0.50 to 0.6 is considered sufficient.	Good
	b. The AVE value must be above 0.50.	Good
Discriminant Validity	c. Cross loading correlation value with latent variables must be greater than the correlation with other latent variables.	Good
Reability	d. Cronbach alpha value is good if it has a value > 0.70.	Good
	Inner Model	
R2 for endogenous latent variable	a. The results of R2 of 0.75, 0.50, and 0.25 indicate that the model is "good", "moderate", "weak"	Weak to Good

Research Hypothesis Test

Testing the research hypothesis is done by comparing the calculated t value between latent variables to the t table value of 1.96. The results of the comparison of t arithmetic with t table are presented in the following table

Table 8 Hypothesis Result Test

Hypothesis	T Statistics (|O/STERR|)	Description
User Satisfaction → Net Benefits	9.346921	Accepted

Hypothesis	T Statistics (|O/STERR|)	Description
Information Quality → User Satisfaction	2.052886	Accepted
Information Quality → Usage	2.294855	Accepted
Service Quality →User Satisfaction	3.316269	Accepted
Service Quality → Usage	2.924537	Accepted
System Quality → User Satisfaction	2.466405	Accepted
System Quality → Usage	0.427297	Rejected
Usage → User Satisfaction	1.148747	Rejected
Usage → Net Benefits	2.727935	Accepted

5.2 Proposed Improvements and Validation

The test results on the analysis of the Structural Equation Modeling model about things that affect the implementation of SAP on Infrastructure Projects are as follows:

The results of the convergent validity test, of the 30 indicators that exist in the Structural Equation Modeling model, all indicators reflect each X variable. This means that the results of expert validation are in accordance with the convergent validity test.

Of the nine hypothesis tests carried out, there were seven accepted hypotheses and two rejected hypotheses. This means that information quality, service quality and system quality have a positive effect on user satisfaction, then information quality and service quality affect usage. Then user satisfaction and usage have a positive effect on benefits. There are several factors that cause the hypothesis that the quality of the system affects usage is rejected, this happens because the service provider company already has clear procedures regarding SAP and there is an obligation to use SAP applications in each project. So that the users in the project (end users) are less able to know whether the quality of the system used in the project is good and maximal or not, so it does not affect usage. In addition, the use of SAP on the PS module must be carried out in real time every time a construction cost transaction is incurred, so that each user always tries to input data in real time, whether it is constrained by network access or language difficulties.

What can be maximized is to improve the quality of users with training (end user training) so that users of SAP do not experience difficulties in understanding the SAP system and language, and end users can understand well what is inputted in SAP, so that it has an impact on the accuracy of the construction cost evaluation data. on the project.
In addition, there are factors that cause the hypothesis of usage affecting user satisfaction to be rejected, this happens because the use of SAP, as previously explained, is an obligation that must be complied with in service provider procedures, and its use is in real time, it cannot be routinely once a week or once a week. once a month, whenever there is a transaction, the end user must immediately input the data.

With real time usage, but currently the benefits of SAP in service providers are still limited to the accuracy of recording construction costs, not being able to accurately predict the estimated construction costs until completion, a long and continuous SAP development process is needed to be able to predict the estimated construction costs to completion accurately and can increase user satisfaction due to use.

Among the hypotheses that have a positive effect, the one with the greatest value is customer satisfaction with benefits. This is very impactful for service provider companies if SAP development has reached the stage of satisfaction with the quality of the SAP system which can calculate and estimate construction costs to completion accurately, it will increase performance for both projects and corporates. They are able to mitigate the risk of increasing project costs because the calculation of project cost estimates until completion is accurate.

6. Conclusion

Based on the data analysis and discussion that has been carried out, it can be concluded several things, namely as follows:

1. Factors that can affect SAP are information quality, service quality, system quality, usage, customer satisfaction and benefits. There are indicators in these factors. This research supports from previous research, the factors that influence the implementation of SAP used by industry can also be used in infrastructure projects.

2. The implementation of SAP S/4 HANA PS module has a positive effect on data accuracy as a benefit. The influence can be described as follows:

   a. The quality of the system affects customer satisfaction, and customer satisfaction affects the benefits, it is clear that the ease of use of the application can technically minimize the occurrence of human errors in filling out construction cost data so as to increase data accuracy as a benefit.
   b. Data reliability, data validity, and synchronization between parts contained in the quality of information and system quality affect customer satisfaction and affect benefits, this can illustrate that valid SAP S/4 HANA data can improve the accuracy of the data itself.
   c. The speed in accessing information and the existence of facilities to correct those contained in the quality of the system affect the effectiveness in working as user satisfaction. Because filling in the SAP S/4 HANA PS Module in real time and making it easier to trace historical data before there are problems or errors in data input in the future. This of course can improve data accuracy as a benefit.

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