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The Evaluation of Education ERP System Implementation in University Using CSF and TAM

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***Abstract*— the objective of the research is to evaluate the implementation of the Education ERP system in the university and identify the factors that influence the success in its implementation. The analytical method used is the Structural Equation Model (SEM) with a software tool SMARTPLS 3. The results of this research can identify the critical success factors (CSFs) in the implementation of the education ERP system in university and its relationship with the Technology Acceptance Model (TAM) and user satisfaction variables. The object of this research is the education ERP system called BINUS Campus Solution (BCS) that is implemented at BINUS University. The conclusions that are obtained are CSFs from the implementation of the education ERP system in the university are training, technology selection & adaptation, vendor relationship, and strategy fit. The ease of use has significant effect on benefits and user satisfaction. The benefits and strategy fit have a significant effect on user satisfaction. The training and vendor relationship have a significant effect on ease of use. All CSFs when combined together significantly affect the ease of use, benefits, and user satisfaction.**

Keywords—evaluation, education ERP system, university, TAM, CSF

I. INTRODUCTION

The rapid technological developments of today have changed the role of technology in the management of the organization that, at first, was a support transformed into a strategy. Almost all the operations of the organization require technology to execute them, even the use of these technologies can help the organizations to obtain a competitive advantage. An enterprise-wide information system and an integrated application is the enterprise resource planning (ERP) system. ERP integrates all functions and business processes within the organization from planning, marketing, production, sales, operations, customer service, accounting and finance, human resources, etc. [1], also for universities [2]. ERP provides various benefits in terms of functionality, many organizations believe that ERP systems can provide a strategic competitive advantage. Therefore, many organizations have adopted the ERP system [3]. But, on the other hand, ERP is a complex and expensive system that requires careful planning and monitoring, and is generally done in stages during its implementation. Each stage needs to be evaluated so that the implementation of the next phase can work better. A common evaluation is to observe its Critical Success Factors (CSF) [1][4]. In addition to CSFs, the evaluation also sees the ease of use of a system, perceived benefits and user satisfaction of the system [1][5].

Enterprise-scale systems or known as enterprise software technology, there are 3 types, namely, Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) and Supply Chain Management (SCM). ERP is a system used by internal organizations because it integrates all functions and business processes within the company. While CRM is a system used by organizations to connect with their customers. And, SCM is a system used by organizations to connect with suppliers. Therefore, the CSFs for these three systems are almost identical [4][6][7].

This research was carried out at BINUS University with the employees surveyed using the education ERP system, ie Oracle Campus Solution called BINUS Campus Solution (BCS). This research has a problem to be answered is "What are the critical success factors that can influence the successful implementation of the education ERP system in the university and how much does it affect?" The objectives of this research are (1) to evaluate the implementation of the education ERP system in the university, and (2) to identify the critical success factors (CSFs) that influence the success in the implementation.

II. THEORETICAL FOUNDATION

A. Enterprise Resource Planning (ERP)

The Enterprise Resource Planning (ERP) system is a general terminology of a series of activities supported by multi-module application software that helps organizations to manage their resources [8]. ERP began in 1960 as materials requirements planning (MRP) that was later developed to be called MRP II. Today, the latest generation of ERP systems

is more sophisticated and more effective in managing various business units, including sales and operational planning, inventory management, manufacturing, purchasing, ordering, accounting and finance, human resources, customer relationship management, etc. [4]

B. Critical Success Factors (CSFs)

Critical success factors (CSFs) are a limited number of areas in which satisfaction results will ensure the success of competitive performance for individuals, departments or organizations [9]. CSFs are some of the key areas in which "things must go right" for businesses to grow and managers can achieve the targets. CSFs for ERP implementation provide concepts that help organizations to identify critical issues that can affect the implementation process [4].

The variables found as critical success factors (CSF) in this research were

- *Leadership,* including the support and involvement of top management, and funding for the implementation of ERP. ERP projects must be approved and endorsed by top management before they can be implemented, as they also involve multiple stakeholders in the organization [4][10].
- *Strategy fit*, the selection and development of appropriate ERP strategies are considered as one of the critical factors for a successful implementation. Companies that adopt an ERP system should choose an ERP package that suits to their business practices and processes because ERP is considered as an integration project between technology, business, and organization [11][12][13].
- *Culture*, several studies have suggested a cultural relevance for the implementation of ERP embedded to the organizational culture [14][15]. The different values, beliefs and norms in each country will affect the organizational culture, which will affect the practices of professional activities, including the implementation of the ERP [15].
- *Budget and project management*, the use of the budget is a matter that must be controlled and checked carefully during implementation, since the increase in cost is directly proportional to the delay in the implementation time. ERP implementation funds are generally very large [6][7]. Effective project management becomes a major problem for the successful implementation of ERP, which includes a combination of hardware, software and organizational issues [16][17].
- *Communication*, clear and effective communication is required at all levels within the organization both in the previous stage and during the implementation of ERP [4][10]. Ref [18] found that effective communication is one of the success factors that affect the acceptance of technology in the ERP implementation environment.
- *Knowledge management*, knowledge management plays a very important role in the successful implementation of ERP because the same knowledge for each employee / staff within the company will greatly assist the company in the operation of its business. This knowledge must be made / searched / collected, shared and used appropriately and correctly [6][7].
- *Training*, one of the most cited factors for the successful implementation of ERP systems is training. Many ERP projects fail due to inadequate training [13][19]. The training gives users a complete picture of the system and knows how it fits into the entire organization [20].
- *Technology selection and adaptation*, focus on the company's readiness to provide and implement ERP technology within the company, including the technology selection process that suits the business of the company, preparation of infrastructure, facilities and infrastructure, adjustment of technology to business processes, etc. [6][7].
- *Vendor relationship*, There are many ERP vendors in the market. The selection of adequate ERP vendors is very important, good vendors can provide full support from technical assistance to training [17][21]. Organizations can reduce implementation costs, obtain other benefits from partnering with vendors and use customized tools from vendors [17]. In practice, the criteria for evaluating a vendor are the vendor's reputation, financial strength, technical capabilities and the company's vision and objectives [22]. ERP vendors are one of the critical problems in the successful implementation of ERP within the company [4].

C. Ease of Use

Ref [23] defines Ease of Use (EoU) as "the extent to which a person believes that using a particular system will have no effort". TAM believes that perceived EoU affects the perceived benefits. Ref [24] have found that EoU has a positive impact on ERP user satisfaction.

D. Benefits/Usefulness

Benefit or Usefulness is defined as "the extent to which a person believes that the use of a particular system will improve the performance of his work" [23]. According to [23], users are more likely to accept a useful application. Ref [25] found that perceived usefulness is a significant determinant of user satisfaction and ERP systems.

E. User Satisfaction

User satisfaction is a common attitude expressed by users as a result of accumulated experience through behavior in the use of ERP systems [26]. Satisfaction has been used as a substitute measure to evaluate the success of SI in general [5]. Other researchers have used satisfaction as an important measure for the success of ERP [25][27].

F. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a theory adopted from Fishbein and Ajzen (TRA) by [24] to explain the potential of the intention of user behavior to use technology that is always innovating. The purpose of this tool model predicts acceptance and identifies the changes that must be applied to the system for the user to accept it. TAM is used to understand how users test a new technology. This model shows that the acceptance of the information systems by the user is determined by two factors, namely, the

usefulness and the ease of use of the system. The perceived benefit of the user defines how much the user believes that the system will benefit to improve their performance. Ease of use refers to the user's belief that the use of the application will make the work easier [28][29].

III. Research Methodology

A. Research Model

This research model uses the Critical Success Factors (CSFs) approach from the implementation of ERP and the Technology Acceptance Model (TAM), which can be seen in Figure 1. The use of CSF to see the factors that greatly affect the success of the implementation of the ERP system in the field of education so that these factors can be considered by the implementers. CSF adopted in this research is CSF to implement ERP systems in general, not specifically for education. Meanwhile, the use of TAM to see to what extent the ERP system can be accepted by users in the field of education in order to motivate users so that they can receive and use the system.

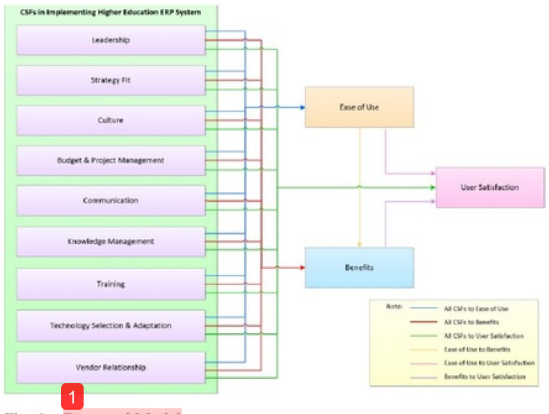

Fig. 1. Proposed Model

B. Research Instruments

The research instruments used in this research were close-ended questions written in Bahasa Indonesia. Respondents were asked to express their agreement on the questions using a 6-level Likert scale, where scale 1 means really disagree, and scale 6 means completely agree.

C. Data Collection

Those who responded to this research are employees of the BINUS University of users of the BCS system. The population of BCS users is 140 people and all were included in the sample because this research is a comprehensive evaluation of all users. Out of 140 questionnaires distributed back and valid, they amounted to 122 respondents.

D. Data Analysis

This research uses the SEM-PLS (Structural Equation Model - Partial Least Square) method with the SmartPLS 3 software tool.

IV. Results and Discussion

A. Respondent Demography

Table 2 below shows that the majority of respondents are women (74%), while according to the age of majority, respondents are between 26 and 30 years old (49%). According to the level of education, the majority of the respondents have bachelor degree education level as much as 81%. Main users of the BCS application in the staff position (88%). While the most widely used work area of the BCS application is Academic Operations and Student Services as much as 37% and 43%. The users of this BCS application have experience in the use of this application for 1 to 2 years (47%).

TABLE I. Respondents' Demographics

Work area	%-age	Gender	%-age
Study Program's Administrative	3	Male	26
Scheduling & Registration	5	Female	74
Academic Operations	37	**Age**	**%-age**
Student Services	43	≤ 25 y.o.	20
Rectorate Administrative	2	26 – 30 y.o.	49
Academic Resources	10	31 – 35 y.o.	18
Position	**%-age**	36 – 40 y.o.	9
Manager	3	41 – 45 y.o.	2
Section head/supervisor	5	46 – 50 y.o.	1
Officer	4	>50 y.o.	1
Staff	88	**Experience**	**%-age**
Education Level	**%-age**	< 1 year	31
Senior High School	2	1 – 2 years	47
Diploma 3	4	2 – 3 years	18
Bachelor Degree	81	> 3 years	4
Master Degree	12		

B. Results

The validity test is performed by measuring the convergent validity by observing the value of the outer loading. If the value of the outer loading is high in a construct, it means that the indicators have many similarities that are capable of representing a construct [31]. Ref [32] explain that the value of outer loadings must be greater than 0.7. In table 2 we can see that almost all the indicators have outer loading values higher than 0.7, this means that the indicators in this research have a great contribution to explain the latent construct. Only one indicator has an outer loading value below 0.7 with a value of 0.675, the EoU6 indicator that describes the Ease of Use (EoU) construct, and is the smallest value in table 2. However, the value of 0.675 is not removed by [31], which explains that the outer loading results between 0.4 - 0.7 in each indicator should not be eliminated immediately unless the elimination of the indicator leads to an increase in the composite reliability. However, if the outer loading value is below 0.4, then the indicator must be eliminated.

TABLE II. Outer Loading

IND	OL	IND	OL	IND	OL	IND	OL
L1.1	0.746	BPM1	0.852	TSA2	0.828	EoU5	0.887
L1.2	0.772	BPM2	0.904	TSA3	0.872	EoU6	0.675
L2	0.713	BPM3	0.874	TSA4	0.780	B1	0.878
L3	0.831	BPM4	0.857	V1	0.926	B2	0.925
L4	0.757	Cn1	0.920	V2	0.881	B3	0.952
L5	0.805	Cn1	0.886	V3	0.922	B4	0.939
SF1	0.914	KM1	0.796	V4	0.891	B5	0.951
SF2	0.935	KM2	0.891	EoU1	0.897	B6	0.938
Ce1	0.942	T1	0.895	EoU2	0.902	US1	0.937
Ce2	0.926	T2	0.896	EoU3	0.886	US2	0.964

Ce3	0.910	TSA1	0.858	EoU4	0.935	US3	0.946

Ref [31] describe that AVE provides evidence of convergent validity. In table 3 it can be seen that all AVE values are above the minimum requirement value of 0.5. The AVE value of 0.50 shows the construct that explains more than half of its indicator variance [31][33]. The lowest AVE latent variable value is 0.698 for leadership (L) while the largest is 0.9 for user satisfaction (US). Therefore, the convergence validity test has been completed.

After testing the validity, reliability will be tested by looking at the value of Cronbach's Alpha and the value of the Composite Reliability. Ref [31] affirm that the value of the composite reliability and Cronbach's Alpha 0.6 - 0.7 is acceptable in the exploratory research, while a value of 0.7 to 0.9 can be considered satisfactory. Table 3 shows that all indicators have an Cronbach's Alpha value greater than 0.7. while the value of the composite reliability is also greater than 0.7. Both indicate that all indicators are reliable.

TABLE III. AVE, CA, AND CR

VAR	AVE	CA	CR
L	0.596	0.865	0.898
SF	0.855	0.832	0.922
Ce	0.858	0.917	0.948
BPM	0.760	0.895	0.927
Cn	0.815	0.775	0.898
KM	0.714	0.607	0.833
T	0.802	0.753	0.890
TSA	0.698	0.855	0.902
V	0.820	0.927	0.948
EoU	0.753	0.932	0.948
B	0.866	0.969	0.975
US	0.900	0.945	0.964

R^2 is a measure of the predictive accuracy of the model. R^2 represents the combined effect of exogenous variables in the endogenous variable (s). The value 1 denotes perfect predictive accuracy, substantial 0.75, moderate 0.50 and 0.25 weak predictive accuracy levels [33][34][35]. In Table IV there is a R2 value for each endogenous latent variable. The results of the values for all the endogenous variables show moderate to substantial categories with a substantial category dominance. The influence model of L, SF, Ce, BPM, Cn, KM, T, TSA and V against B gives a value of 0.841. This means that the variability of construct B is explained by the variables L, SF, Ce, BPM, Cn, KM, T, TSA and V of 84.1% and 15.9% explained by other variables outside the research. The influence model L, SF, Ce, BPM, Cn, KM, T, TSA and V against EOU gives a value of 0.712. This means that the variability of the EOU constructs can be explained by the variables L, SF, CE, BPM, Cn, KM, T, TSA and V of 71.2% and 28.8% explained by other variables outside the research. The influence model of L, SF, Ce, BPM, Cn, KM, T, TSA, V, EOU and B against US gives a value of 0.842. This means that the variability of the US construct can be explained by the variables L, SF, CE, BPM, Cn, KM, T, TSA, V, EOU and B of 84.2% and 15.8% explained by other variables outside the research.

TABLE IV. R^2 VALUE FOR EACH ENDOGEN LATENT VARIABLE

VAR	R-Squared	Description
Benefits	0.841	Substantial
Ease of use	0.712	Moderate
User satisfaction	0.842	Substantial
User satisfaction (simultaneously)	0.828	Substantial
Benefits (simultaneously)	0.809	Substantial
Ease of use (simultaneously)	0.623	Moderate

After performing the R2 test, the next step is to assess the coefficient path, T-Statistics and the conclusion of each hypothesis. Path coefficients represent hypothetical relationships that connect constructs [33]. The path coefficient is the relationship between the dependent variable in the structural model [31]. The coefficients range from -1 to +1. The coefficients close to +1 represent strong positive relationships, and the coefficients close to -1 indicate strong negative relationships [33]. Ref [33] explain that the value of the path coefficient in the range of -0.1 to 0.1 is not significant. The purpose of using t-statistics is to prove statistical significance. If the value of t-statistics above 1.96, there is an assumption that the path coefficient is significantly different from zero at the level of significance of 5% (two tails). The value for the level of significance of 1% (two tails) is 2.57, while the level of significance of 10% (two tails) is 1.65 [31]. Through the SmartPLS 3 bootstrapping procedure, we obtain t-statistics. As a basis to determine if the hypotheses are accepted or rejected, the requirements used are the values of the path coefficient above 0.1 or less than - 0.1 and the value of the t-statistics above 1.96 indicating the level of statistical significance in the hypothesis testing.

TABLE V. HYPOTHESIS TEST RESULT

Hypothesis	Path	T-Statistics	Original Sample (O)	Conclusion
H1a	L → EOU	1.532	0.179	Not significant
H1b	SF → EOU	0.187	0.017	Not significant
H1c	Ce → EOU	0.311	0.038	Not significant
H1d	BPM → EOU	2.361	-0.365	Significant
H1e	Cn → EOU	1.32	0.079	Not significant
H1f	KM → EOU	1.729	0.145	Not significant
H1g	T → EOU	5.102	0.392	Significant
H1h	TSA → EOU	1.582	0.244	Not significant
H1i	V → EOU	2.035	0.206	Significant
H2a	L → B	0.888	0.065	Not significant
H2b	SF → B	0.95	-0.082	Not significant
H2c	Ce → B	1.086	0.111	Not significant
H2d	BPM → B	0.255	0.024	Not significant
H2e	Cn → B	0.613	0.048	Not significant
H2f	KM → B	1.356	-0.116	Not significant
H2g	T → B	0.915	0.09	Not significant
H2h	TSA → B	3.046	0.328	Significant
H2i	V → B	1.788	-0.152	Not significant
H3a	L → US	0.951	0.084	Not significant
H3b	SF → US	2.301	0.189	Significant
H3c	Ce → US	0.189	0.02	Not significant
H3d	BPM → US	0.611	-0.065	Not significant
H3e	Cn → US	0.535	-0.029	Not significant
H3f	KM → US	1.13	0.094	Not significant
H3g	T → US	0.282	0.028	Not significant
H3h	TSA → US	0.192	0.024	Not significant
H3i	V → US	0.449	-0.034	Not significant
H4	EOU → B	8.197	0.641	Significant
	EOU → B (simultaneously)	7.887	0.66	Significant
H5	EOU → US	2.074	0.226	Significant

Hypo-thesis	Path	T-Statistics	Original Sample (O)	Conclusion
	EOU → US (simultaneously)	3.228	0.274	Significant
H6	B → US	4.248	0.461	Significant
	B → US (simultaneously)	4.786	0.447	Significant
All CSFs	CSFs → EOU (simultaneously)	18.735	0.789	Significant
	CSFs → B (simultaneously)	3.679	0.283	Significant
	CSFs → US (simultaneously)	2.809	0.242	Significant

C. Discussion

From the result of the test 36 the hypothesis in table V can be seen that there are 22 hypotheses that show the result "not significant". In the hypothesis H1a-H1i there are 6 non-significant hypotheses between the CSF variables with the Ease of Use variable. The "non-significant" CSFs are Leadership, Strategy Fit, Culture, Communication, Knowledge management and Technology Selection & Adaptation. This result was obtained because the user's assumption about the ease of use of CSF in the implementation of BCS is not enough evenly so that this result does not reach the level of significance. Several users of the BCS system stated that the leadership factors that have not been maximized are PICs that can be contacted if there is a problem with BCS only on the BINUS University Anggrek campus, not available on other campuses and the resources available for the progress of the BCS implementation are still perceived less so that these results are contradictory with the results of the research [36]. Several users of the BCS system say that there is not a menu option available to do a job that matches its parts or that it is often done on its part, and if it does exist, the function is not correct. The user has not felt a sufficient match between the BINUS University's business processes and the BCS system, which is contrary to the results of the research [37]. The organization has not yet maximized the process of internalizing the organizational culture to any app users that match the nature of the BCS application, so the results contrary with the research of [37]. Communication is something that has many dimensions, is broad, involves various ways, tends to involve personal preferences and affects many factors, including control. The incomplete communication paths provided and the communication openness are two things that the organization needs to improve based on the contribution of the user and these results are contradictory with the research carried out by [1]. Some users explain that better data management is needed because some data are inaccurate, irrelevant and have not been synchronized, so better knowledge management is needed and these results are not aligned with the reserach of [38]. In terms of technology selection & adaptation, several users explained that the quality of the network and the server uptime need to obtain the attention of the organization so that this result contradicts the research results of [37]. For the hypotheses H2a - H2i, there is only one "significant" hypothesis between the variable CSFs and the Benefits variable, which is the Technology Selection & Adaptation factor. This happens because in general users still feel the lack of benefits received after the implementation of BCS, such as coordination between users with IT departments, business processes that are not adequate, the progress of the implementation status is slow, turnover rate of resources is very high, the data is not synchronized with the data of the legacy applications, the coordination between users and vendors impressed less smoothly, etc. While the H3a - H3i hypothesis shows results in harmony with hypothesis 2 that there is only 1 hypothesis that "significant" between the CSF variables and the user satisfaction variable is the Strategy Fit factor. This indicates that the user generally states that there is a time difference for the completion of work between before and after the BCS implementation at BINUS University, which means that the user is satisfied with the existence of the BCS application, although there are still many improvements to be made. For the hypothesis H4, H5, H6 and all the CSF hypotheses show a significant result among all the variables, either partially or simultaneously, which means that the variables of ease of use give impact to the variable Benefits and User Satisfaction, as well as the variabel Benefits to variable User Satisfaction. Most important in the results of this research are all the CSF variables simultaneously provide a "significant impact" on the variables Ease of Use, Benefits, and User Satisfaction. Comprehensive improvements need to be made to increase user satisfaction considering the ERP system is the backbone for all business processes at the university. This improvement processes must involve the user because user requirements must be based on user needs and need to be explored by the user experience to make the system better.

V. Conclusion

The CSF variable partially gives a "non-significant" impact to the Ease of Use, Benefits, and User Satisfaction variables, but the CSFs show different results when combined in one (simultaneously) and produce a "significant" impact. There are still many improvements that the organization must make in the implementation of this ERP Education system to improve the ease of use and the benefits perceived by the user so that this will increases user satisfaction. CSF that influences the Ease of Use are the factors of budget and project management, training and vendor relationship. While CSF that affects the Perceived Usefulness is only factor of Selection of Technology and Adaptation. There is only one CSF that influences User Satisfaction, that is, the Strategy Fit.

This research has theoretical implications on the science of information systems in terms of user acceptance evaluation against the technology used and also on the design of user interface or user experience (UI/UX) [2][30][35][36]. In terms of practical implications, this research provides input for universities and vendors related to the things that must be considered in the implementation of education ERP system at the university.

The variables used in this research should be tested in different research domains and other variables should also be added to continue this evaluation in the future in order for the organization to improve ease of use, perceived benefits by the user and user satisfaction with the implementation of the ERP education system.

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