



An Exploration of Enterprise Resource Planning Systems Success Measurement Model

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Abstract

The aim of this research is to explore and confirm whether the measurement instrument proposed by Ifinedo was a better fit for assessing ERP success in Indonesia using the factor analysis. Data analysis was performed using 6 dimensions with 47 variables tested. The results show that 4 dimensions do not match the evaluation. Elimination and retesting are needed to build a new assessment instrument. The results of this study are expected to help organizations choose the most ideal measurement model of their ERP systems.

Kata kunci:

*Analisis Faktor
Enterprise Resource Planning
Pengukuran Keberhasilan ERP*

Abstrak

Tujuan dari penelitian ini adalah untuk mengeksplorasi dan mengkonfirmasi apakah instrumen pengukuran yang diusulkan oleh Ifinedo lebih cocok untuk menilai keberhasilan ERP di Indonesia menggunakan analisis faktor. Analisis data dilakukan menggunakan 6 dimensi dengan 47 variabel diuji. Hasilnya menunjukkan bahwa 4 dimensi tidak sesuai dengan evaluasi. Eliminasi dan pengujian ulang diperlukan untuk membangun instrumen penilaian baru. Hasil penelitian ini diharapkan dapat membantu organisasi memilih model pengukuran paling ideal bagi sistem ERP mereka.



1. Introduction

The business world today has very tight competition, this does not only happen to large, but also small and medium scale companies [1]. This competition is mostly about producing high quality products and following consumer's desires. Company that successfully survives competition must have advantages such as low selling price, availability of goods, and promotion [2]. Therefore, companies need to have valid

information to make the right decision.

However, valid information is hard to get due to business environment becoming more complex with functional units requiring more inter-functional data flow. All of that data flow is needed for decision making, timely and efficient procurement of manufacturing parts, management of inventory, accounting, human resources, and also distribution of goods and services [3]. It means that the existence of data becomes

very important for companies to produce high quality information.

All of the stated conditions can be improved by advances in technology and information systems, because the use of these things can help companies to monitor and assist business processes so as to provide great benefits for the company [4]. One information system that provides these benefits is Enterprise Resource Planning (ERP).

ERP is an integrated and comprehensive computer software application system. ERP is developed based on functional modules that cover all aspects of resources within a company [5]. Thus, it can be said that ERP is a business, that in its implementation requires a strong commitment and cooperation from top management to system users.

ERP implementation is a very complex process. Implementing the system requires a large investment of money, time and expertise [6]. The success of the implementation can provide enormous benefits for the company, while the failure would be a nightmare [7]. The large number of implementation failures shows that the ERP project is one of the most complex system development projects that requires fundamental organizational changes [8]. Therefore, ERP goes live is not the final goal of the ERP implementation project. The main thing in this system implementation process series is as a starting point to start continuous improvement in the organization. This requires organizations to conduct Post-Implementation Review (PIR) to measure the success of ERP implementation. PIR is not easy considering the complexity of information technology systems in ERP [9].

We adopt Ifinedo's model to measure ERP success factors. Ifinedo extends Gable and Steward's model which is contains of six dimensions, which are System Quality (SQ), Information Quality (IQ), Individual Impact (II), and Organizational Impact (OI). Then he adds two critical dimensions: Vendor/Consultant Quality (VQ) and Workgroup

Impact (WI) to measure ERP system success [10].

Ifinedo thinks that vendor quality is a very important factor in determining the successful implementation of a system. This is because many organizations depend on consultants from the beginning of the implementation of an ERP system implementation. Moreover, he tried to include the Workgroup Impact dimension based on previous research which showed a positive relationship between workgroup impact and the success of ERP implementation. In addition, the impact on this working group is also considered relevant to the company's system because ERP technology has been proven capable of integrating various functions of organizationals and departments [10].

The discourse shows that the ERP implementation process does not just stop until a system goes live. The main thing that must be done after the implementation is to conduct the assessment and evaluation of the success of ERP. Therefore, we examine the measurement model of ERP system implementation success compiled by Ifinedo to explore and confirm whether this measurement model is suitable for use in Indonesia using factor analysis. Ifinedo's system success measurement model may or may not prove suitable for Indonesia since each country possesses unique characteristics.

2. Methodology

In this study, we process data using factor analysis. Factor analysis is a statistical method for summarizing data so that relationships and forms can be easily understood and interpreted. This factor analysis can be used to regroup variables that have an attachment to a limited new cluster. Therefore, factor analysis helps isolate a construction and concept [11].

We use SPSS as a tool to analyze factors. First, validity and reliability test conducted at the beginning of the test to

measure that data used are valid, precise, consistent, and can be trusted to be used as a data collector. Then, we did factor analysis to the data used with several steps: 1) formulate the problem; 2) construct the correlation matrix; 3) determine the number of factors; 4) rotate factors, and 5) interpret factors [12].

In this paper, we identified 51 subjects from 5 manufacturing firms in Indonesia. These five companies are PT JCSM produces concrete reinforcing steel; Seng Fong Resources Group who is a recognized market leader in the wood-based flooring industry; PT Domusindo Perdana that is a Indonesia furniture manufacturer; PT Central Proteina Prima that is the dominant integrated aquaculture shrimp and foods producer company; and PT Bukit Muria Jaya as the world's number one partner for specialty paper and packaging materials in the cigarette industry. All companies sampled in this study have implemented ERP for five years or more and the number of implementation teams is between 10 and 20 team members. Variations from various types of companies above are expected to represent this research.

The survey to obtain data on this study was conducted from October to December 2018. We decided to choose a sample of companies based on the information they had conveyed on the company's website for which they had implemented ERP. Of the many companies, we chose different types of companies and recorded them as sources of research data in previous studies. Furthermore, the company was chosen by our ability to get ERP implementation team contacts in each company.

In order to ensure and manage the data used is valid and reliable, then two individuals with different levels in the ERP implementation project are chosen as respondents (i.e., the project manager and project team members). Project management is an important part in software development; therefore it is necessary to sharpen the project in implementing a system or software

design [13]. These two individuals were chosen because they were considered to be directly involved in the implementation process starting from the beginning of the ERP system which is planning until the ERP system go live in each organization. They completed filling out the questionnaire before sending it back to us. Their comments help us to improve the quality of this research.

Respondents in our survey showed agreement to the Ifinedo's measurement model with statements using a 5-point Likert-type scale, where 1 shows a very low level of agreement and 5 vice versa, shows a very high level of agreement. Respondents can give a score of 1 to 5 depending on the extent to which they agree with the measurement instrument that offered by Ifinedo compared to their ERP system which they run. The higher of score given indicates that the Ifinedo measurement model fits for assessing ERP success in Indonesia, and vice versa.

3. Results and Discussions

We divided group testing based on their dimensions, which consists of six dimensions. Moreover, every dimension has a different number of variables. Then, we discussed the result of factor analysis one by one of the dimensions.

Correlation Matrix. The results of correlation matrix showed that all of the variables in different test group after elimination passed the test of KMO and Bartlett's Test of Sphericity because their value of KMO is > 0.5 with significantly < 0.05 . The division of groups here is based on the six dimensions that is proposed by Ifinedo. Furthermore, some variables have been eliminated due to the fact that the value of Measures of Sampling Adequacy (MSA) < 0.5 . After elimination, we repeated the test from the first step, and the KMO and Bartlett's Test result showed a better result.

In Group 1, we eliminated two variables which are "ERP is flexible" (x102) and "ERP is reliable" (x105), because their MSA values are 0.457 and 0.453. Moreover, we forced to

put out variable "ERP provides prompt information to users" (x301) in Group 3, because the value of its MSA is less from the criteria. In addition, we eliminated two variables in Group 4 which are "ERP enhances individual creativity" (x401) and "ERP enhances organizational learning and recall for the individual worker" (x402). Nevertheless, we have not eliminated variable in Group 2, Group 5 and Group 6, because their MSA are already meet the requirement.

Number of Factors Formed. Variables that have been grouped into factors should have a strong relationship between variables, however, how strong the relationship is characterized by the communality's values higher or smaller than 0.5.

Table 1. Communalities

Variable	Initial	Extraction	Variable	Initial	Extraction
x101	1.000	0.719	x201	1.000	0.806
x103	1.000	0.820	x202	1.000	0.724
x104	1.000	0.917	x203	1.000	0.856
x106	1.000	0.559	x204	1.000	0.856
x107	1.000	0.806	x205	1.000	0.747
x108	1.000	0.856	x206	1.000	0.746
x109	1.000	0.911	x207	1.000	0.856
x110	1.000	0.780	x208	1.000	0.819
x111	1.000	0.688	x302	1.000	0.661
x303	1.000	0.731	x504	1.000	0.759
x304	1.000	0.554	x505	1.000	0.824
x305	1.000	0.656	x506	1.000	0.913
x306	1.000	0.829	x507	1.000	0.866
x307	1.000	0.704	x601	1.000	0.597
x403	1.000	0.724	x602	1.000	0.785
x404	1.000	0.853	x603	1.000	0.856
x405	1.000	0.633	x604	1.000	0.819
x406	1.000	0.856	x605	1.000	0.610
x501	1.000	0.746	x606	1.000	0.747
x502	1.000	0.934	x607	1.000	0.790
x503	1.000	0.892	x608	1.000	0.845

Table 1 showed the communalities' value of all the variables. Communalities are the variance of a variable that can be explained by existing factors. All variables have communalities greater than 0.5, thus it can be concluded that they have a strong relationship between variables in the same factors.

In this research, we determine the number of factors formed based on eigenvalues that are shown from the Total Variance Explained table. The new factor will be formed if the eigenvalues are

producing value that is higher than 1. Moreover, inside the table, there are column "Cumulative %" that showed the factors explained by the cumulative percentage of variance. If the factors formed a value that is higher than 1, the SPSS, the software that helped the researcher with the data computation, would rotate Sums of Squared Loadings automatically. It caused the proportion of the data diversity described each component looks more smoothly than before rotation.

The result of the analysis factor that conducted in Group 1 formed two factors of 9 variables that have been tested. One factor formed with eigenvalues 5.929 and another was 1.127. The first factor has 65.88% variance that is explained by the factor formed, while the second factor is explained by 12.53%. After rotation, this percentage of variance changed, becoming 41.43% and 36.98%. As a result, these two factors explained 78.41% variance of all the variables.

Furthermore, Group 2 to Group 6 formed only one factor in each group. Group 2 formed one factor with eigenvalues 6.621, and this factor explains approximately 68.22% variance of all variables. Eigenvalues of Group 3 were 3.736, with a cumulative 62.27% of variance explained by the factors. One factor also formed in Group 4 with eigenvalues 3.066. Factor formed in Group 4 explained approximately 76.66% variance of all variables. The value of 5.934 eigenvalues in Group 5 also formed one factor, and this factor reflected 84.78% variance of seven variables that have been tested in this group. The last one was Group 6, which is also formed one factor with eigenvalues of 6.048. The factor formed in this group explained approximately 75.60% of the cumulative variance. Finally, from 6 groups at the beginning, seven new groups are formed after going through a series of tests and the elimination process of several variables before.

Component and Transformation Matrix. From 9 variables in Group 1 have been formed two factors, rotation is necessary to clarify which variables that goes into every factor. Almost all loading factor changed after rotation to be higher or smaller. Rotation results presented in Table 2 below:

Table 2. Rotated Component Matrix of Group 1

	Component	
	1	2
x101	.770	.355
x103	.353	.834
x104	.090	.953
x106	.557	.499
x107	.553	.707
x108	.765	.519
x109	.945	.130
x110	.838	.280
x111	.453	.695

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 a. Rotation converged in 3 iterations.

Table 2 showed that the variables in which came into Factor 1 were x101, x106, x108, x109, and x110. Moreover, variable x103, x104, x107, and x111 came together into Factor 2. In addition, the diagonal factors for component 1 and 2 have a value greater than 0.5, which is shown in Table 3. It proved that both factors (components) which are formed were correct because they have a high correlation.

Table 3. Component Transformation Matrix

Component	1	2
1	.736	.677
2	-.677	.736

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

Labeling Factors Formed. We give a new label to each factor according to the variables inside it. There are two new factors that was formed from Group 1, as shown in Table 4. Based on the propensity of the variables that formed a factor together, an appropriate name for Factor 1 is Data Quality and System Quality for Factor 2. We chose the name of the group as Data Quality, because in our opinion the variables selected in Factor 1 tended to discuss ERP success in terms of data quality. Moreover, 4 variables

formed in Factor 2 discuss about the quality of the system.

Table 4. Elaboration of Rotated of Component Matrix Table of Group 1

Data Quality		System Quality	
Variable	Description	Variable	Description
x101	ERP has accurate data.	x103	ERP is easy to use.
x106	ERP allows data integration.	x104	ERP is easy to learn.
x108	ERP allows for customization.	x107	ERP is efficient.
x109	ERP database content is good.	x111	ERP meet users' requirements.
x110	ERP allows for integration with other IT systems.		

Furthermore, from Group 2 until Group 6, each formed one factor. Although there are two groups, Group 3 and Group 4, which should eliminate those variables, their instrument name was not changed. So, we decided to continue using labels similar to Ifinedo (2006), and Gable and Steward (1999). Group 2 is labeled with Information Quality. Also, the other four groups attempt to measure the impact of ERP system implementation. Then, Group 3 is Service Quality. Group 4 is called Individual Impact; Group 5 is labeled as Workgroup Impact, and Group 6 is named Organizational Impact.

Interpretation of Each Factor. All variables were entered on each factor has a positive correlation. That means when a significant increase in variable loading is concerned, the greater growing tendency of respondents to assess that the ERP implementation in their companies is successful.

Data Quality Factor showed basics of ERP data and their convenience that consists of variable: ERP has accurate data (loading 0.770), ERP allows data integration (loading 0.557), ERP allows for customization (loading 0.765), ERP database content is good (loading 0.945), and ERP allows integration with other IT system (loading 0.838). Data integration means that data only have to be entered once, after which they are available for use throughout the organizations. Traditionally, many organizations have had parallel administrations

before they implement ERP. In this situation, it would be possible that every department has its register. The data in this register will enable them to be different and inconsistent. In addition, ERP systems allow organizations to collect and store more data than ever before [14]. Therefore, an ERP system that allows data integration and customization will support the successful implementation of ERP in an organization. Thus, the accuracy of the data can be guaranteed. Complete and accurate data can produce high quality information that leads to the right business decision making and this brings competitive advantage to the business itself [15].

System Quality Factor represented by variables: ERP is easy to use (loading 0.834), ERP is easy to learn (loading 0.953), ERP is efficient (loading 0.707), and ERP meets users' requirements (loading 0.695). ERP system will be used by everyone in the organization, including those who formerly work manually. Therefore, the easiness in the application and learning of an ERP system is an absolute thing to work on electronic data. Furthermore, due to data integration, one standardized source of information is created. The efficiency of data gathering can be improved because obsolete administrations and registrations can be avoided, and it becomes simpler to guarantee the timeliness and completeness of the data. Further, the ERP system should provide information that the user needs. Finally, a system can be said to be good when the system can interact well with the user and can assist the user in achieving a desired goal [16].

Information Quality Factor of ERP can be measured by eight variables: ERP provides timely information (loading 0.913), the information of ERP is understandable (loading 0.726), important (loading 0.689), brief/concise (loading 0.701), relevant (loading 0.783), useable (loading 0.801), available (loading 0.790) dan accurate (loading 0.928). Information quality indicates the quality of the product that produced by the application of the information system and

the information will affect the users and the system [17]. The most important thing from ERP implementation is the quality of information that has been produced. It is caused by the objective of ERP itself to provide integrated and real-time information. Good quality information is represented by the usefulness of the system output obtained that can affect user satisfaction.

Service Quality Factor showed that the vendor-provided services would affect the success rate of ERP implementation. This factor consist variables: ERP system has a good interface (loading 0.813), ERP has visually appealing features (loading 0.855), ERP provides the right solution to requests (loading 0.744), ERP service provider is dependable (loading 0.506), ERP service provider has up-to-date facilities (loading 0.911), and ERP service provider is experienced and provides quality training and services (loading 0.839). The service quality of a system that is reliable, tangible, empathetic, capturing, and well guaranteed will increase customer satisfaction [18]. In addition, organizations that intend to implement an ERP system will meet three parties: ERP supplier, implementation partner, and an application service provider. Although each large supplier has a complete ERP offering that includes broad functionality, some of the suppliers have better solutions for specific industries than others. Besides that, not all organizations outsource the application services; the internal IT department can also provide them.

Individual Impact Factor consisted of some variables, such as ERP improves individual productivity (loading 0.851), ERP is beneficial for individuals' tasks (loading 0.923), ERP enhances higher-quality of decision making (loading 0.796), and ERP saves time for specific task/ duties (loading 0.925). ERP success concerned with the effect of ERP on the individual because, after implementation, ERP will be used for everyone in the company. ERP systems have been proven to encourage changes in the way

employees work to be more organized and effective [19]. Moreover, Increased use of ERP by end users will have an impact on efficiency and improve the performance of the users themselves [20].

Workgroup Impact Factor summarized some variables that show ERP contributions for workgroup at organization, such as increase workers' participation in the organization (loading 0,864), improve communication in the organization (loading 0.967), improve coordination between departments (loading 0.945), create a sense of responsibility (loading 0.871), improve organizational efficiency (loading 0.908), improve productivity (loading 0.956), and enhances solution effectiveness (loading 0.930). A successful ERP system must have an impact on the workgroup because the contribution made by the workgroup will be directly proportional to work productivity. However, the impact of the ERP system on this workgroup can vary depending on the size of the company. The greater the size of the company, the possibility of working groups between departments or divisions is increasingly needed [10].

Organization Impact Factor represented eight variables which show the impact of ERP implementation on the organization. The eight variables mentioned that ERP: reduces organizational costs (loading 0.773), improves productivity (loading 0.886), enable the company to run e-business/ e-commerce (loading 0.925), brings up competitive advantage (loading 0.905), increases customer satisfaction (loading 0.781), facilities business process change (loading 0.864), supports decision making (loading 0.889), and allows for better use data source of organizations (loading 0.919). ERP implementation has an impact on various levels of management in the organization. In addition to the impacts that have entered into the research variables above, the impact of the implementation of this ERP system includes promoting innovative business growth, fostering

business alliances with other organizations, increasing the process of creating product differentiation and other things that affect the company's external affairs [21].

4. Conclusions

The research results confirmed that several variables do not correlate with other variables. Therefore, some variables have been eliminated and the instrument has been retested. In Group 1, we eliminated two variables which are "ERP is flexible" and "ERP is reliable". Moreover, we forced to put out variable "ERP provides prompt information to users" in Group. In addition, we eliminated two variables in Group 4, which are "ERP enhances individual creativity" and "ERP enhances organizational learning and recall for the individual worker". According to the measure of the success of ERP implementation in Indonesians' organization, six factors that have been ratified by Ifinedo [x] became seven factors. In the previous instrument there were no groups related to data quality. The results of rotation in factor analysis in this research showed that some variables related to data quality had very strong correlations with each other, so the emergence of new factors that we labeled as "Data Quality". Finally, those seven factors are Data Quality (65.88%), System Quality (78.41%), Information Quality (68.22%), Service Quality (62.27%), Individual Impact (76.66%), Workgroup Impact (84.78%), and Organizational Impact (75.60%). Also, the factor most dominant in representing the respondent interpretation of ERP implementation success in their company is Workgroup Impact factor with variance of 84.78% and factor of System Quality with variance as high as 78.41%. The rationales for the results of this study needs to be explored and discussed further to find out the causes of the differences in the instruments proposed by Ifinedo compared to the perspective of ERP users in Indonesia. In addition, it is important to find out the causes

of the mismatch of some variables that cause these variables need to be eliminated if this instrument is used to measure the success of ERP systems in Indonesia. However, this research has contributed some useful insights as a guideline for ERP consultants and corporate managers to achieve a higher success rate in ERP implementations. Future research may consider more dimensions while measuring ERP success and the combined effect of these dimensions in assessing ERP success.

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