The application of the factor analysis method to determine the performance of IT implementation in companies based on the IT balanced scorecard measurement method

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Abstract. The purpose of this paper is to provide an overview of how to measure the performance of information technology implementation in a company by using factor analysis and regression analysis methods. From the resulting mathematical model, it can be used to make predictions and make strategies in the implementation of information technology in the future. The concept was developed from the IT Balanced Scorecard (IT BSC) theory which was developed by constructing each of the existing perspectives to obtain indicators which are then used as a research instrument in the form of a questionnaire. Data were collected by distributing questionnaires to 75 respondents, but only 70 questionnaires were complete and valid for this study. The data obtained were then analyzed using the factor analysis method. The analysis shows that there are four factors that affect the performance of IT implementation, namely: IT Competency, IT Service Capability, Business Continuity, and IT improvement.

1. Introduction

Factor analysis is a technique used to look for factors that can explain the relationship or correlation between various independent indicators that are observed. Factor analysis is an extension of principal component analysis. It is also used to identify a number of relatively small factors that can be used to explain a large number of interrelated variables. So the variables in one factor have a high correlation, while the correlation with the variables in other factors is relatively low. Each group of variables represents a basic construction called a factor. To increase the power of factor interpretation, the transformation should be performed on the loading matrix. The transformation is carried out by rotating the matrix with the varimax, quartimax, equamax, quartimin, biquartimin and covarimin methods. On the other hand, the application of the factor analysis method can be implemented to find out whether a company in carrying out its operations is in accordance with the plans that have been set and in accordance with its objectives is to know the performance of the company. [1] revealed that the goal of each measurement system is to motivate all managers and workers to carry out business unit strategies successfully. Companies that can translate strategies into measurement systems will be far more able to implement strategies because they can communicate their goals and objectives. Basically performance measurement is an assessment of personal behavior in carrying out their duties to achieve organizational goals. In general, performance measurement is a way to measure the direction and speed of change. Performance measurement plays an important role later in the company’s performance evaluation process. Performance evaluation is the process of comparing actual performance and targets that have been planned by management, to identify the corrective actions that need to be taken to ensure the achievement of company goals and to communicate them to the authorities. When the gap between the performance target and performance realization is to be known,
the factor analysis method can be used as an alternative solution and analyze the causal factors.

2. Methodology

Performance measurement system is very useful to know the extent to which the company has succeeded in achieving its objectives through a predetermined strategy. Until the early 1990s Robert S. Kaplan and David P. Norton developed a concept to make comprehensive measurements in order to find out how the organization achieved progress through its strategic goals and the concept was called the Balanced Scorecard. This method explains how intangible assets are mobilized and combined with tangible assets to create different customer value propositions and superior financial results. The Balanced Scorecard (BSC) is a management concept [2], as a development of the concept of performance measurement that measures company performance. Kaplan sharpens the concept of performance measurement by determining an effective "balanced" approach in measuring the performance of a company's strategy. The approach is based on four perspectives: financial, customer, internal business processes and learning and growth.

Creating a Balanced Scorecard must start from translating the company's strategy and mission into specific targets and benchmarks. In its development, the Balanced Scorecard was then developed to link business benchmarks with corporate strategy. According [3], the Balanced Scorecard is a management framework that translates missions and strategies into various goals and measures, which are organized into four perspectives consisting of financial, customer, internal business processes and learning and growth. The Balanced Scorecard model created by Kaplan and Norton is divided into four perspectives. Figure 1.

![Figure 1. Balanced Scorecard Model (Traditional BSC). Sources: Kaplan and Norton, 1992](image)

In 1997, Van Grembergen and Van Bruggen adjusted the Balanced Scorecard [3] for use in information technology. They note that the IT department is an internal service provider, so the four perspectives are adjusted to the changes that occur. According to Van Grembergen and Van Bruggen IT BSC is a method of measuring the performance of IT departments within a company to conduct evaluations that provide a comprehensive picture and are in accordance with their respective core businesses. IT BSC provides executives with an overall framework, where the vision and business strategy of the company is tailored to the vision and IT strategy in it [4], [5], [6], [7]. The Balanced Scorecard model created by Grembergen also divided into four perspectives. Figure 2.
Based on the theory or concept of the IT balance scorecard, it can then be followed up by building a research instrument that is in accordance with the conditions of each company, because the best respondents are all communities that are related to the company. Table 1 show how the research instrument was built.

Table 1. Development of research instruments for the basis of questionnaires

| x | Perspective | Objective | Indicator | Measures | Reference |
|---|-------------|-----------|-----------|----------|-----------|
| 1 | CORPORATE CONTRIBUTION | Strategic Alignment | Leadership | Communication | Management, Dowling, A., & Daft, R. (2010). |
| 1 | CORPORATE CONTRIBUTION | Strategic Alignment | Quality Standard | Understanding of Business Plan to achieve organisational objective | Quality Standard (2010). |
| 1 | CORPORATE CONTRIBUTION | Strategic Alignment | Value and Risk | Lack of innovation, slow quality standard | Value and Risk (2010). |
| 1 | CORPORATE CONTRIBUTION | Strategic Alignment | Value and Risk | Cultural and educational level and IT initiatives | Value and Risk (2010). |
| 2 | Value Delivery | Operational Services | Operation and maintenance of infrastructure | Help desk, contingency planning, security and back-up, training, consultancy, systems analysis and systems design | Perpetual, Inc. (2000). |
| 2 | Value Delivery | Application Services | Help desk, contingency planning, security and back-up, training, consultancy, systems analysis and systems design | Help desk, contingency planning, security and back-up, training, consultancy, systems analysis and systems design | Perpetual, Inc. (2000). |
| 2 | Value Delivery | Auxiliary services | Assortment of application services | Help desk, contingency planning, security and back-up, training, consultancy, systems analysis and systems design | Perpetual, Inc. (2000). |
| 3 | Management of IT Investment | IT’s cost-effectiveness | Actual vs. Budgeted Expenditure | Actual vs. Budgeted Expenditure | Dand, Kosmid, C. (2000). |
| 4 | Risk Management | IT security initiatives and security breaches | Number of new implemented IT security initiatives and security breaches | Number of new implemented IT security initiatives and security breaches | Resource, Shah, et al. (2013). |
| 4 | Risk Management | Disaster Recovery Plans | Adoption of Disaster Plan | Adoption of Disaster Plan | Resource, Shah, et al. (2013). |
| 2 | USER ORIENTATION | Service level performance | Percentage of applications and operation services meeting SLAs | Percentage of applications and operation services meeting SLAs | Van Grembergen, Hans, Umeda, A. (2009). |
From the results of the distribution of questionnaires to respondents, there can be obtained a number of data which can later be processed and analyzed using the factor analysis method to reinforce a number of variables or factors that are representative of the results of the respondents’ filling in the questionnaire given.

As a method, factor analysis has a series of steps or stages. There are five important steps in the process, namely formulating the problem, making a correlation matrix, determining the number of factors, factor rotation and factor

3. Results

In the factor analysis method, Kaiser’s MSA figure shows the correlation of each variable and to measure the level of problem caused by the value of the variable. The smaller the mean of the MSA indicates that the higher the level of the problem. Using a scale of 0.5 to 0.9, the MSA value of 0.5 is bad and the value of MSA 0.9 is very good. From the results of data processing by researchers using SPSS, the KMO was obtained from the Barlett test as the feasibility or not factor analysis can be done. Obtained KMO value is 0.782 then the index is declared high and the analysis factor is feasible. Furthermore, the significance value is 0.000 which shows that the data collected can be processed using the analysis factor because it is less than α 0.05.

One of the processes carried out in factor analysis is data reduction, from that process a process of “filtering” components that are suitable to be used as indicators, of course in this study the indicators in question are indicators that can be used to evaluate IT performance. In this study the new factors formed are interpreted against these new factors in accordance with the statement of the variables that cluster on each of the new factors. The following is an overview of the interpretation of the new factors that are formed. Figure 3.
4. Discussion
The first factor consists of Access and authentication indicators that are defined in an IT governance must have access rights and authorization in accordance with needs so that users can do work in accordance with their respective job descriptions; IT-literate namely in IT governance. Top executives & senior managers need to have a basic knowledge of IT in order to support what the IT division will do to improve IT performance; Applications which automate business functions which means the applications provided must be in accordance with the functions and needs of users so as to speed up
and simplify work; Post delivery stage, which means that IT projects that are carried out and that have been completed must be able to be used and meet user needs; Use of IT governance knowledge management system which means that the use of knowledge management systems in the IT division can facilitate users in transforming their knowledge or expertise into a form (documentation) which can later be used as a source of information for new users and those who need it; Quality Standard means that knowledge about products and services is very useful and can improve quality. From the description of these indicators, this factor can be interpreted as IT Competency.

The second factor consists of the indicator IT Function has an understanding that the IT Division must be able to provide IT functions / technology that can adjust / respond to changes in business or organization in the future quickly; Service level performance, which means that the service for applications and operations is carried out quickly and in accordance with the agreed time requirements, Structure and process, which means that the IT division must understand the user's role in the company so that the application is in accordance with the user's role, Auxiliary services where the IT division is expected to solving existing problems (Help desk, contingency planning, security and back-up, training, consultancy, systems analysis and systems design); Planning infrastructure maintenance programs means that maintenance of IT infrastructure is carried out regularly to maintain the quality of IT so that the company can continue to run its business processes well; Operational Services, which means that the existing IT infrastructure (network and internet) must always work well and ensure that business processes can run effectively, Value and belief, which means that in improving IT performance, background / capability in the IT field is very much needed. From the description of these indicators, this factor can be interpreted as IT Services Ability.

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The third factor consists of the Disaster Recovery Plans indicator which means the IT division must implement Disaster Recovery Plans in order to maintain the sustainability of the company's business processes when there is a problem with the infrastructure at the center; Cross-functional business means that members of the IT Division need to have adequate basic knowledge to understand the user's work needs so that if needed it can be done quickly; Service quality means that the IT division provides fast services to users so that it can help improve user effectiveness as well. Application Services means the application system can be used to improve performance and serve the needs of the company's business. From the description of these indicators, this factor can be interpreted as Business Continuity.

The fourth factor consists of the Information quality indicator which means the information provided in the application system must be relevant / according to the user's needs; IT-business partnership means that members of the IT Division need to have adequate basic knowledge to understand the user's work needs so that if needed it can be done quickly; Service quality means that the IT division provides fast services to users so that it can help improve user effectiveness as well. Application Services means the application system can be used to improve performance and serve the needs of the company's business. From the description of these indicators, this factor can be interpreted as Business Continuity.

The fourth factor consists of the Information quality indicator which means the information provided in the application system must be relevant / according to the user's needs; IT-business partnership means that the IT division needs to build cooperation with business partners to match the needs needed in providing services to business functions so that the development of IS / IT can be done well; New and updated technologies means that the IT division needs to have a special section to conduct research on new technologies to improve the effectiveness & efficiency of business processes; Leadership means that communication between stakeholders and the IT Division must go well. From the description of these indicators, this factor can be interpreted as IT improvement.

Thus the relationship between several new factors that influence the implementation of information technology performance can be explained as set out in Figure 4.
In figure 4 shows the factors used to measure / evaluate IT performance in the company. The factors formed are IT Competency, IT Services Ability, Business Continuity and IT improvement. For dominant factors and must be considered, a regression between these factors with the IT performance value according to the respondents contained in the questionnaire in the future research.

5. Conclusion
From the results of experiments that have been carried out based on the theory or concept of IT balance scorecard, this measurement method can be constructed to build research instruments that produce several independent variables. Then the factor analysis method can be used to carry out the process of reducing the independent variables into several new variables formed by the grouping of a number of independent variables and can be represented in accordance with the conditions of the grouping of independent variables. In the process of determining the performance of the resulting information technology obtained factors that influence are IT Competency, IT Services Ability, Business Continuity, and IT Improvement

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