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Paper 3

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Success Measurement Framework for Information Technology Project: a Conceptual Model

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***Abstract*—Measurement of IT projects success commonly focuses on output level (technical) which is seen from the time, cost, and scope. In fact, some IT projects that are technically feasible but did not use it is an example of a failed project. Defining and measuring project outcomes effectively also provide a great opportunity to achieve IT project success. Therefore, it needs framework for measuring the success of the overall project (outputs and outcomes). The development of the framework began by identifying the definition of IT project success. Analyzing the dimensions of success through literature review. The next step is formulating the measurement framework and validating the proposed framework. The result found four dimensions to measure the success of IT projects, namely project technical, stakeholder acceptance, product quality, and organizational benefits. Product technical dimensions, including scope, time, and cost. Stakeholder acceptance dimensions are perceived usefulness and perceived ease of use. Product quality including system, information, and service quality. The organizational benefit dimension is seen from 4 perspectives, namely: financial, customer, internal business, and learning and growth. There are 4 levels of success depending on the fulfilment of the measure of each dimension. Based on model validation, all of framework elements can be mapped to the success definition of an IT project. There are 69% of respondents stated their agreement with the combined framework proposed.**

Keywords—framework, success measurement, output, outcome, IT project.

I. INTRODUCTION

Since the 80s, time, cost, and scope have been used as project evaluation criteria[1][2]. Until now, these criteria are also still used by the Standish Chaos Report to categorize project results[3]. The three criteria are known as iron triangle[4]. The use of these criteria shows that the success of IT projects is only seen from the project management aspect[4]. This means that a project must meet all three criteria to be called successful.

However, based on the results of Przenylow Leh's research[3], it is known that the iron triangle is not enough to evaluate the success of an IT project. Another conclusion is that there is no significant relationship between the budget/schedule criteria and the success of the project also resulted from the study[3]. Some IT projects are technically and economically feasible but were ignored and unapplied are examples of failed IT projects[3]. Likewise, IT projects are debated in their implementation even though they are technically and economically feasible[3]. Another illustration revealed by some researchers is the system that meets all needs, is completed on time, on budget, and is user friendly but does not influence business objectives can't be said to be successful[3].

Related to the issue of the IT projects success measurement, research began to emerge starting in the 90s which concluded that the success of the project was multi-dimensional. A de Wit reveals two dimensions of success, namely project management and stakeholder acceptance[4]. The research conducted by Shrenhar concludes 4 dimensions, namely project management efficiency, customer impact, business success, and future preparation[5]. Atkinson defines the success of the project from 4 dimensions, namely technical, information systems as products, stakeholder acceptance, and benefits to the organization[6]. Van der proposes two dimensions, namely the success of project management and product projects[7]. While Wateridge [8] concludes 3 dimensions which include output (fulfilment of 3 technical project boundaries), stakeholder perspective, and organizational perspective.

On a project success framework, currently, there are several frameworks developed for the success of IT projects. However, it still has a certain focus and time frame. For example, an iron triangle that focuses on project management[7]. Related to stakeholder acceptance there is also a well-known model, TAM[9]. Likewise, the Delone McLean model focuses on the success of information systems (products of the project)[10]. Aspects of organizational goals have also been covered by a framework such as a balance score card[11].

The two conditions above show that (1) the results of the study indicate a shift in defining the success of an IT project, but there is still nothing that summarizes it into a single unit of measure of overall success; (2) there are various models that define the success of information systems but still have a certain focus and time frame; and (3) even if viewed from the initial purpose of implementation, a successful IT project needs to be seen from various dimensions to achieve its objectives.

Based on the conditions that currently exist, it is necessary to develop a new concept that explains the dimensions of overall IT project success. It is important to see the success of IT projects from various sides until the outcome level. Given that one of the studies conducted by Graeme and Walter concluded that organizations that are able to define and measure the outcomes resulting from an IT

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project effectively will be able to obtain greater opportunities to achieve the success of the project[12]. Not only that, but also will be able to utilize resources better[12]. This fact encourages the need to develop a new framework to measure the success of a comprehensive IT project.

This paper aims to propose a framework to measure the success of IT projects to the level of outcomes. These objectives will be achieved by answering four research questions, namely: (1) what are the dimensions to define the success of an overall IT project; (2) what are the indicators for each dimension of IT project success; (3) how to measure each dimension of IT project success; and (4) how to define the level of success of an IT project.

II. Research Methodology

In order to answer the research questions, this study is conducted in four steps (see Fig 1). Firstly, identifying the definition of IT project success. Second, analysing the success dimension. Third, formulating the IT project success measurement framework. Finally, validating the proposed framework.

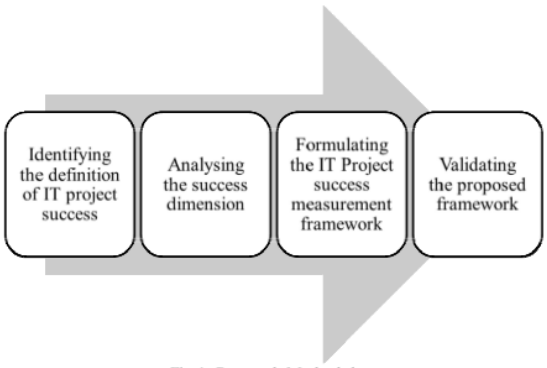

Fig 1. Research Methodology

Literature studies are conducted to get a definition of the success of IT projects. Books and papers that review the success of IT projects are studied in this step. The result is the definition of the success of the project.

The dimensions of success are analysed through a literature study of a paper that reviews the dimensions of success. Each paper will specify what dimensions are found. Furthermore, these dimensions are grouped based on similarity definitions.

The development of the framework is carried out through 3 activities, namely mapping the dimension, framework integration, and how to measure. Dimensional mapping begins with identifying the success framework of the information system that currently exists. Furthermore, mapping is based on the suitability of the focus and definition of each other. Every framework that has been successfully mapped with the dimensions of success needs to be reviewed whether the components in it are used all or not. This is adjusted to the size for each dimension. Merging the framework into a model includes defining dimension components, indicators, how to measure, and also defining levels. How to measure and define the level of success adjusts to the time frame of the IT project itself, which starts to be developed, submitted, used, and evaluated.

The proposed framework is validated by checking the completeness and accuracy of the components. Checking the completeness is done by mapping the proposed framework component to the initial definition of IT project success. While confirmation of the accuracy of components is done through the questionnaire method. This method aims to determine the respondent's approval of the proposed framework component. The questionnaire contains a statement of approval for each component with a likert scale.

III. Definition Of It Project Success

Success and failure are two things that are difficult to define and measure[12]. It is happen because everyone has a different view of success[13]. However, success is critical if you want to predict the future condition of the project[14].

Based on research conducted by Graeme, resulting that the success of IT project was not only seen on the achievement of output, but also takes the measurement of the outcome[12][3]. Measurement output is related to meet scope, time, and cost goal. Meanwhile the outcome of project consists of two components that are the customer satisfaction and business objective met[15].

IV. Dimension Of It Project Success

Related to the definition of the dimensions of success, there are 5 paper related. The first paper presented two dimensions of success, namely in terms of project management and stakeholder's acceptance[4]. Paper 2 concluded four dimensions, namely project management efficiency, the impact on customers, business success, and preparation for the future[5]. Paper 5 defined the success of projects in four dimensions, namely technical (project management success), the information system as a product, stakeholder acceptance, and the organizational benefit[6]. Paper 6 proposed two dimensions, namely project management and project product success[7]. Meanwhile, paper 7 concluded three dimensions of the success which includes output, stakeholder perspective, and organizational perspective[8].

Based on the details dimensions outlined of each paper, grouped by similarity of definition. The result of success dimension is presented in Fig 2. There are four dimensions used to define the success of IT projects. These dimensions include the project's technical, stakeholder acceptance, product quality, and organizational benefit.

Project technical dimension is the definition of success of IT projects in terms of project management (technical). The important thing that covered in this dimension is time, cost, and scope of the project. In this dimension, the fulfilment of three of the project boundary is defined as success. This means that the success of the project in terms of output only.

The second dimension is stakeholder acceptance that defines success of the project in terms of output acceptance by the project stakeholders. This means that when the output of the project was presented to the stakeholders, it's not been able to be fully a success. Admissibility of the output will be the next guide that IT projects can be a success.

After the product was accepted and used by all stakeholders, the definition of project success based on the quality of products produced by IT projects. This quality is

made up of three kinds, namely the system quality, information quality, and service quality.

The most fundamental dimension of success is organizational benefits. The success of the project are based on these dimensions can be seen from the improvement of the organization's business performance. These dimensions can be measured to see the achievement of the objectives of the project. As we know that a project was developed on the basis of specific objectives of an organization.

Project technical, stakeholder acceptance, product quality, and organizational benefit is an integral dimensions, so IT projects can be a success if it fulfils all of these dimensions. In addition, the measurement of each dimension is done at different times. Identification of these four dimensions indicate that an IT project cannot fully be a success if only the formation of the output with on time, on budget, and on scope. But the success of the project should be viewed from a multidimensional appropriate time.

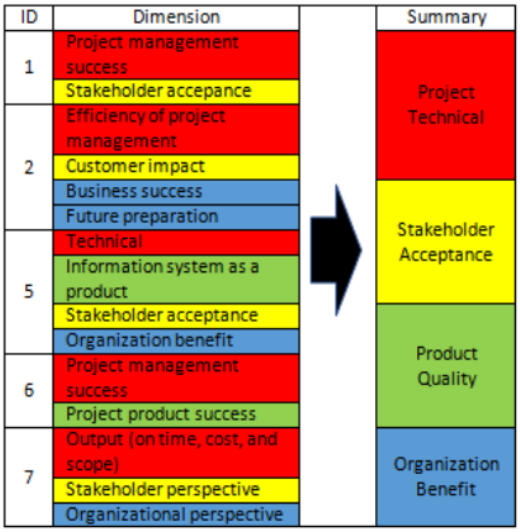

Fig 2. Dimension of Success

V. FORMULATING IT PROJECT SUCCESS MEASUREMENT PROJECT

In the model formulation stage, there were three main activities, namely mapping the dimension,

A. Mapping the Dimension with the framework that currently exists

Framework which will be compiled in this study is not purely a new framework, but rather the result of a merger of several frameworks that already exist with some adjustments. The next step after the success dimension was identified mapping the dimension with a framework that is presently existing as presented in Fig 3.

Technical dimensions define success in terms of project management (technical). The important thing covered in this dimension is time (time), cost (cost), and scope (scope) project[6]. This definition refers to the iron triangle framework that has been proposed by Oisen at 1971. This framework measures the success of the project from three things, namely the time, budget, and scope. This mapping is selected for suitability defines the dimensions with the composition of the framework.

The next dimension is the acceptance of stakeholders which define success of the project stakeholder's willingness to use the system. Intention to use something influenced by the perceive usefulness and ease of use[9]. As we know that the topic of information technology acceptance, the model most often used is the framework of the Technology Acceptance Model (TAM). Therefore, the framework corresponding to the dimensions of stakeholder acceptance is TAM. This model was chosen as the first step to see the achievement of the business objectives of the project development is the acceptance of the product. Intent of success in this dimension is an information system as a product is received and used by the project stakeholders, especially end-users.

Dimensions of the product quality with regard to the performance of the system as a product of IT project. Related to the evaluation, DeLone and McLean frameworks known as a model of success. The success of information systems as a product was seen from three things: systems, information, and services quality[10]. It is represents success in terms of information system performance.

Meanwhile for organizational benefit dimension refers to the framework of a balanced scorecard. As we know that an organization's business performance is not only financial but also refers to the non-financial[11]. This framework consisting of four perspectives to measure the overall performance of the organization's business. This is because the benefits of information technology for the organization would be more appropriate when seen from the perspective of a balanced.

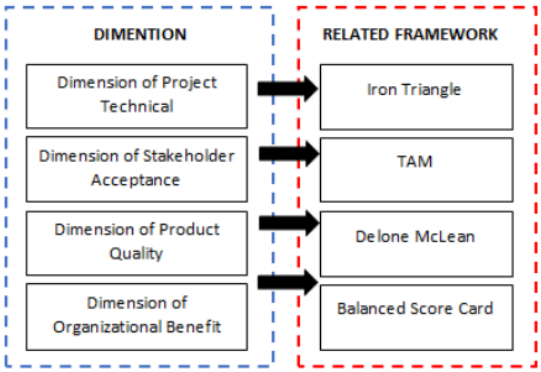

Fig 3. Mapping the Dimension with the framework that currently exists

B. Framework Combination

Results of adjustment and defining the framework components will be combined into a single new unified framework, namely IT project success measurement framework (presented in Fig 4). This framework consists of four elements, namely: project technical, stakeholder acceptance, product quality, and organizational benefit. Measurement was begun from the bottom element (iron triangle) that defines the success of the project from a technical dimension. Furthermore gradually ascends to the measurement of benefits for organizations using balance score card framework. Four dimensions of success cannot be measured in one time. The success of the technical

dimensions can be measured precisely when the project is completed. Meanwhile, a new stakeholder acceptance dimensions can be measured when the product has been submitted to the project owner and operates within the organization. A certain time interval product use by stakeholders, new product quality dimensions can be measured. The measurement was seen from the performance of the system. The most recent measurement of transactions are carried out are the dimensions of organizational benefits. This is because the impact to the organization will be felt after the success of system technically acceptable, and have a quality performance. Therefore, the value of the overall success of IT projects (outputs and outcomes) will be determined by the value of measurement.

Measurements of success using this framework include definition of level. The point is the level of success of a project can be different from one another. It depends on the time measurement. The first level look the success of the project in terms of the project's technical dimension which is measured when the project is completed. This means that the project managed to provide precise output on time, corresponding costs, and meet the specifications of the scope. The second level means of success is measured when the project was recently handed over to stakeholders. This means that the outcome of the project has been received and the stakeholders are willing to use. The third level is achieved by the project are already used in organization in some years. That is, the product is used with the performance of the product (systems, information, and services quality). The combined success of level 2 and 3 indicate that the system is already satisfying stakeholders. While the success of fourth level is measured to see the project's role in the organization. This means that the product has achieved the main objectives of procurement projects and provides benefits to business performance improvement organization.

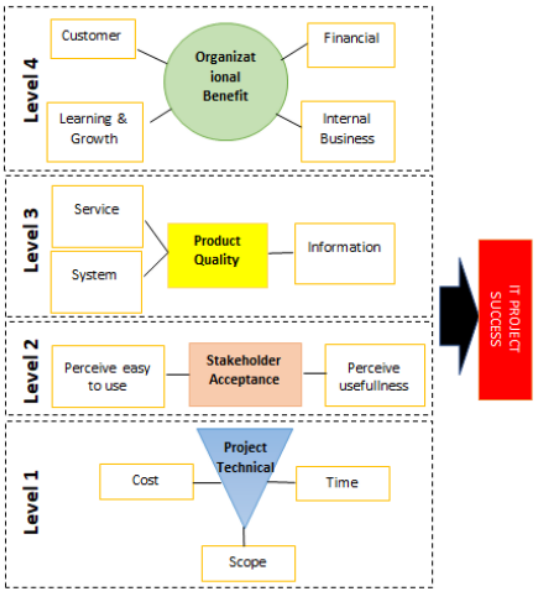

Fig 4. The Proposed Framework

C. How to Measure the Dimention

As if mentioned earliner, that the organization which can managed to determine the measurement and measure the success of the project can develop the project outcome and can optimize resource utilization[12]. Therefore, the proposed framework does not only define the measure of success, but equipped with a way to measure it. Research is conducted by Marija [16]concluded that the success analysis framework consists of four elements, namely the definition of CSF, defining KPIs, measurement of project success based on KPIs is determined, and document measurement results. These results reinforce previous statements that the measurement of the success of IT projects includes determining the measurement, the process of measuring, and documenting the results.

Project technical dimension is a measure of the success of the project in terms of project management. Therefore, success at this level was measured during and at the end of the project. Monitoring is carried out during the project and will be evaluated at the end of the period. How to measure this dimension is done by comparing the realization of the project management to project planning made earlier. Source is needed is a planning document of cost, time, and scope of the project, as well as the document of project realization.

Cost is a criteria to measure the success of the suitability of the use of the cost for the project from the initial budget. The measurement used to look at the suitability of the cost is the CPI, EV, AC. Hopefully, the CPI value > = 1, which means the maximum project cost is equal to or smaller budgets. Meanwhile, if the CPI value is < 1 means that there are problems with the project because the cost is over budget[15].

Time is a criteria to measure the timeliness project. The measurement used is SPI (which is the ratio between the EV and PV). SPI with a value of 1 means the project is completed on time (according to baseline). While the SPI value is not equal to 1 means that there are problems (SPI <1), otherwise the project is completed more quickly (SPI> 1)[15].

Quality as project success criteria relating to the fulfillment of the scope (on scope). Testing the system using a test case is used as a measure of compliance with the specifications of system functions. Test cases are based on a list of requirements of a software. Artifacts seen two things, namely completeness and accuracy of the fulfillment of requirements based on test results[15].

Measurements of success in this dimension can be done with quantitative methods using questionnaires. A series of statements is a translation of the previously defined indicator. Based on the results of the questionnaire processing will know the level of stakeholder acceptance of the new technologies resulting from the project[9].

Similar to the previous dimensions, product quality can be measured by quantitative methods using questionnaires. The questionnaire is based on several indicators that proposed by DeLone McLean. In addition based on the results of the questionnaire, some of the items on the quality of products that require technical verification will be tested immediately. That is, it will be checked the system with some testing scenario. The results will give an explanation, either support or other arguments from the questionnaire.

Measurement of organizational performance can be seen from the annual report was generated. A series of financial information can be measured by looking at the balance sheet

related organizations; both profit, revenue, or return on investment. The number of customers or customer satisfaction survey results is also presented in the annual report. In addition to actual data usage within the company, some points such as employee satisfaction can be obtained based on the survey questionnaire. So is the case with customer satisfaction can also be equipped with primary data results of the questionnaire.

VI. Model Validation

The verification of the resulting framework is carried out by checking the completeness of the elements of the framework for the initial definition of measuring the success (output and outcome) of information technology projects[15]. The visualization of the verification process is presented in Fig 5.

Based on Fig 5 it can be seen that the framework elements made can be mapped to the success definition of an IT project. The iron triangle framework used to measure the technical dimensions of the project has met the definition of project success from the output side (met scope, time, and cost goals). Meanwhile the TAM framework for stakeholder acceptance dimensions and DeLone McLean for product quality dimensions meets the definition of project success in terms of outcomes (satisfied the customer / sponsor). This is seen from the measure of the willingness of stakeholders to accept and use products and the quality of product performance. While the balanced scorecard framework for organizational benefit dimensions has met the definition of project success from an outcome point of view (met its main objective) seen from organizational performance. This means that the resulting framework meets specifications (the definition of IT project success).

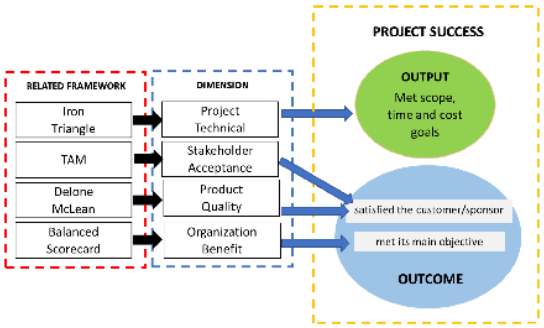

Fig 5. Verification of Proposed Framework

The questionnaire was used as the framework validation method produced. This questionnaire aims to find out the respondent's agreement with the components of the framework measuring the success of an IT project. The framework element (success criteria) is formed in the statement in the questionnaire. Details of the contents of the questionnaire are presented in Appendix 1.

Respondents from the validation questionnaire of this framework are IT project actors consisting of project managers, programmers, analysts, and other project members. The number of respondents who filled out the questionnaire was 36 people. Details of respondents based on their roles in the project are 6 Project Managers, 5 programmers, 3 analysts, 2 programmers and analysts, 2 stakeholders, 1 surveyor and 17 other project members. Among the respondents, most (18 people) of respondents participated in the IT project 2 to 5 times, as many as 15 people have participated in more than 5 IT projects and 3 people have only participated once. The duration of the project undertaken by respondents was partly for 3 to 6 months.

In the projects carried out by respondents, 20 respondents said that they had measured the success of the project while 16 other respondents did not measure success. Among the respondents who measured the success of IT projects, almost all of them only measured the success of IT projects in terms of output. There is 1 respondent who also measures from the user's side other than the output side. This proves that IT project actors do not yet have an awareness of the importance of measuring project success not only in terms of output but also need to be measured in terms of IT project outcomes.

Based on this validation it is known that 50% of respondents agree with the use of the iron triangle, 64% of respondents agree with the use of TAM, 61% of respondents agree with the use of Delone McLean, and 67% of respondents agree with the use of BSC. This indicates that the elements of each proposed framework are approved by the respondent. Meanwhile related to the proposed framework, there are 69 % of respondents stated their agreement to the combined framework produced.

The results of the model validation show that the proposed model is comprehensive, including the output and outcome levels. This result is an novelty, considering that previous measures commonly used are only limited to the output level (project management dimension). In addition, limitations related to certain focus and time frames are also addressed by the proposed model. An illustration of the updated results of the research is presented in TABLE I.

TABLE I. The Comparison Of Prior And Proposed Model

Focus	Prior Model	Proposed Model
Dimension	Project technical	1. project technical, 2. stakeholder acceptance, 3. product quality, and 4. organizational benefit
Scope	Output	Output dan outcome

VII. Conclusion

Project success is seen from 4 dimensions, namely project technical, stakeholder acceptance, product quality, and organizational benefits. Product technical dimensions, including scope, time, and cost. Stakeholder acceptance dimensions are perceived usefulness and perceived ease of use. Dimensions of product quality, including system, information, and service quality. The organizational benefit dimension is seen from 4 perspectives, namely: financial, customer, internal business, and learning and growth. There are 4 levels of success in measuring the success of an IT project depending on the fulfilment of the measure of each dimension. Based on model validation, there are 69% of respondents stated their agreement with the combined

framework proposed. All of framework elements also can be mapped to the success definition of an IT project.

VIII. Discussion And Further Research

Based on the proposed framework, the next research that can be conducted is the evaluation of framework implementation at several type of IT project. This is important to know the compatibility this framework with type of IT Project.

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