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IT Investment Evaluation Using Multi Objective Multi Criteria: Case Study on an Expedition Company

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***Abstract*—Information Technology (IT) is an essential part of a company. IT can enhance the company's strategic position by helping them to take the next step in productivity and profitability. However, in many cases, there are failures in IT investment. IT investment only increases costs and does not provide any benefit for the company. IT investment must be aligned with the company's strategy. Business needs for IT also has to be prioritized. Projects should be initiated and scheduled based on priorities and availability of IT resources. This paper describes a model based on Multi Objective Multi Criteria (MOMC) to help determining priorities in IT investment. The MOMC approach can reflect both tangible and intangible benefits, associate the investment to company strategies, and suggest important features on application portfolio selection. In addition, a case study of an expedition company is presented in which the model has been applied. This company determined the priority in selecting IT applications to be invested using MOMC model.**

Keywords*— *Information technology investment, MOMC, application portfolio

I. INTRODUCTION

One way to maximize IT investment is by considering how an IT project is initiated today. First, the need for the project is identified by a business unit or department. Then these business needs for IT supports are prioritized. Projects are initiated and scheduled based on priorities and availability of IT resources. This approach is focused on allocating IT resources, the resources which are insufficient to meet IT's backlog of project work.

During the previous research (Fig. 1), a process of a strategic planning information system has been conducted for an expedition company. The process consisted of Porter Value System Analysis, SWOT Analysis, TOWS Analysis, which generated a strategy for this company. This research conducted a selection both for the most needed application as well as most aligned to the strategy of the company using multi objective multi criteria (MOMC) methods. This method consisted of Balanced Scorecard (BSC) from four different viewpoints, Critical Success Factors (CSF), and Analytical Hierarchy Process (AHP).

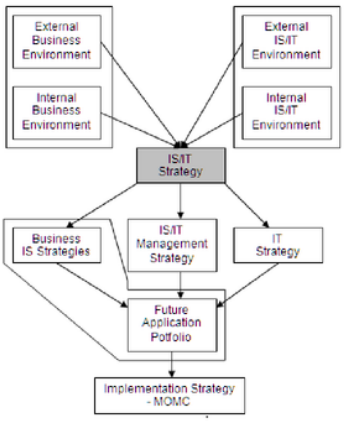

Fig. 1. IS/IT Strategic Model [10]

II. THEORY

A. *Multi Objective Multi Criteria (MOMC)*

Corresponding with its name, this method finds the most optimal solution for a problem having multiple objectives [3]. This is the best decision making method by considering various objectives, costs and benefits in a company. Besides, this method allows a selection process for optimization to be conducted [7]. This MOMC method covers several research methodologies such as Balance Scorecard (BSC), Critical Success Factors (CSF), Delphi Method and Analytical Hierarchy Process (AHP).

MOMC is a pretty much used variant of Cost Benefit Analysis [5][2]. This method is developed due to the reality that a company is holding a number of stakeholders having different views on the costs and benefits of many information technology aspects or elements [8] Every information technology project definitely has objectives to be met. It often has more than one objective as each stakeholder, as a decision maker, has different viewpoints towards that objective. Therefore each party has the right to give weight to the objective, for instance viewed from the priority side or the significant impact of the investment. Then the value that has been synchronized with the costs and benefits is multiplied by each weight to obtain the end result.

B. *Balanced Scored Card (BSC)*

This is a method which changes the concept and working steps of a company to be objective and measurable. If the company is going to do some improvement in something intangible, the result of the intangible measurement has to be integrated into the management system of the company [4]. In this case, the ones categorized as intangible are the concept and working steps of a company. To be integrated into the management system of the company, the concept and working steps have to be analyzed using BSC method. The analysis using BSC method involves 4 perspectives:

- Financial Perspective
- Customer Perspective
- Learning and Growth Perspective
- Internal Business Perspective

By analyzing the 4 perspectives, the Company Strategic Planning will be generated [7].

C. *Critical Success Factor (CSF)*

This method is a series of requirements, if owned by a company, will ensure the success of the company. CSF of the company can be obtained by comparing the company strategy with the result of the Balanced Scorecard analysis from various viewpoints. Then the CSF of the company for each view point will be obtained [7].

D. *Analytical Hierarchy Process (AHP)*

This method helps decision makers to select the best solution out of a number of choices and selection criteria [1]. In assigning weights, some errors might happen, due to the lack of consideration or some contradiction in assigning weights. Using AHP method, the weight assignment to the criteria, can be conducted with various consideration and calculation that can minimize errors [7]. AHP is one of the current main mathematical models, used to give supports in decision making theory [9]. The first stage in using AHP is to determine clear criteria for the selection [6].

III. ANALYSIS USING BSC & CSF

The strategy resulted from the previous analysis was analyzed again using the BSC method. Each strategy was grouped into four BSC viewpoints, such as Financial Perspective, Internal Business Perspective, Innovation Perspective, and Customer Perspective.

TABLE I BSC – FINANCIAL PERSPECTIVE

▪ Reduction of losses due to cost compensation on the damaged and lost property of the customers ▪ Minimizing the operational cost by improving the use of carriages sharing system at the company ▪ Improving the company competitiveness by surpassing the cost as minimal as possible

TABLE 2 BSC – INTERNAL BUSINESS PERSPECTIVE

▪ Improving the speed of delivery process closer to the delivery process using airfreight. ▪ Addition of the numbers of railway carriages, car and truck of the company. ▪ Improving the organization structure of the company ▪ Developing a wider marketing scale of the company ▪ Improving the communication and information exchange systems among divisions in the company ▪ Improving the company competitiveness by providing more services compared to those of other companies ▪ Improving the security, management, and inventory systems of the property at the company warehouse

TABLE 3 BSC - INNOVATION PERSPECTIVE

▪ Applying the checking system of the shipment content and the calculation of the shipment value to be able to determine the treatment for the shipment to minimize the company loss ▪ Improving the efficiency process in the business activities of the company using the support of technology ▪ Developing the form of the business into a new one. as a delivery boarding out service provider for other companies that have no carriages ▪ Developing the delivery form of the company not only using railway but using airfreight as the fast delivery service of the company ▪ Applying the route management system based on priorities, target address, numbers and sizes of the shipment. ▪ Appling the forecasting system towards the everyday number of customers who would like their property to be shipped.

TABLE 4 BSC - CUSTOMER PERSPECTIVE

▪ Applying CRM using the support of technology

After grouping the strategy into four BSC perspectives had been conducted, CSF analysis of the company of each strategy was conducted. With regard to the company strategy and company CSF, an IS analysis could be developed. This analysis was needed to support the company strategy. The following Table 5 is an example of CSF analysis on the financial perspective.

TABLE 5 CSF

Financial			
Objective	Measure(s)	Action (CSF)	IS Need
▪ Reduction of losses due to cost compensation on the damaged and lost property of the customers	▪ Number of damaged property ▪ Number of lost	▪ Systematic, orderly and secure shipment management	▪ An inventory control using RFID to simplify the shipment inventory and security process. ▪ Position management for placing the shipment

			at the warehouse and railway carriages supported by Mixed Reality System (MREAL) in the form of Warehouse Planning ▪ A Warehouse security system using CCTV

IV. APPLICATION PORTFOLIO

IS and IT resulted from the CSF analysis were categorized into 4 parts at the application portfolio such as strategic, key operational, high potential, and support. The categorization depended on their contribution towards the success of the company business. The Application Portfolio resulted can be viewed at Table 6.

V. MULTI OBJECTIVE MULTI CRITERIA

The next process was using Delphi method to determine the criteria and sub-criteria. This method generated some criteria and sub-criteria as shown on Figure 2. The criteria and sub-criteria were further analysed using AHP to determine the priority of the company IT implementation process.

AHP analysis was conducted using Expert Choice Program. The analysis process was started by determining the goal. In this case the goal of the AHP was to determine the Implementation Project Portfolio Priority. The next step was to determine the alternatives. In this case the entire IT application portfolio was used as the alternatives. This process was followed by the weighting process. Figure 2 is the result of the weighting process of the criteria and sub-criteria.

The results of the weighting process shown in Figure 2, showed that the most important criteria for the company was Minimizing risks which had a point of 0.4. The least important criteria was improving the financial advantage which had a point of 0.107.

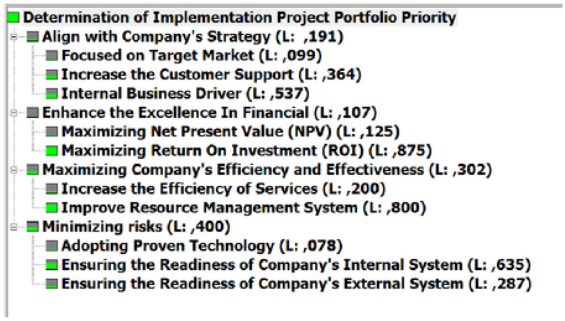

Fig 2. Determining IT Priority

The results of the IT implementation priority determination at the company can be viewed at Figure 3.

TABLE 6 APPLICATION PORTFOLIO

STRATEGIC	HIGH POTENTIAL
▪ CCTV. ▪ The company official website as an online marketing media. ▪ RFID for inventory control. ▪ Forecasting software. ▪ CRM software ▪ X-Ray Machine for inspecting the shipment's content. ▪ Features on shipment route management based on the priority of the shipment delivery location, and the size of the shipment at the Company operational software ▪ GPS for location tracking towards delivery unit ▪ GPS for determining the best delivery route ▪ Shipment value column at the shipment table at the company operational software	▪ MREAL for warehouse planning. ▪ Features on online order, location delivery checking and the shipment status checking at the company official website
▪ Features on the data maintenance of shipment, customers, and suppliers as well as receipts, loading lists, travel documents and invoices writings at the Company operational software	▪ Features on the data maintenance of the partnering companies at the Company operational software ▪ Feature on data maintenance of customers at the Company operational software ▪ The facility of crypto payment for the online order feature at the company official website
KEY OPERATIONAL	SUPPORT

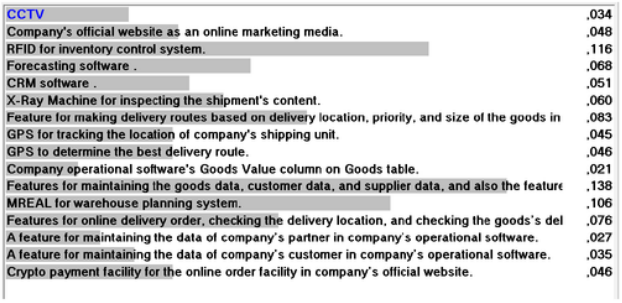

Fig 3. The results of IT Implementation Priority Determination

TABLE 7 THE IT IMPLEMENTATION WEIGHTING ORDER

IT	Criteria				Total weights
	Aligning with the Company Strategy	Increasing the Financial Excellence	Maximizing the Company Efficiency and Effectiveness	Minimizing Risks	
CCTV	0,043	0,040	0,028	0,034	0,034
The company official website as an online marketing media	0,043	0,073	0,059	0,036	0,048
RFID for inventory control	0,080	0,075	0,139	0,128	0,116
Forecasting Software	0,062	0,093	0,082	0,054	0,068
CRM Software	0,073	0,066	0,047	0,039	0,051
CX-Ray Machine for inspecting the shipment's content	0,027	0,021	0,023	0,111	0,060
features on shipment route management based on the priority of the shipment delivery location and the size of the shipment at the company operational software	0,094	0,117	0,091	0,062	0,083
GPS for location tracking towards delivery unit	0,044	0,029	0,037	0,057	0,045
GPS for determining the best delivery route	0,043	0,040	0,042	0,052	0,046
Shipment value column at the shipment table at the company operational software	0,026	0,022	0,020	0,018	0,021
Features on the data maintenance of shipment, customer, and supplier as well as receipts, loading lists, travel documents and invoices writings at the company operational software	0,122	0,141	0,155	0,133	0,138
MREAL for warehouse planning	0,069	0,075	0,105	0,130	0,106
Features on Online order, location delivery checking and the shipment status checking at the company official website	0,098	0,111	0,080	0,054	0,076
Feature on partnering companies data maintenance at the operational company software	0,034	0,029	0,028	0,022	0,027
Feature on customer data maintenance at the company operational software	0,060	0,037	0,033	0,024	0,035
the facility of crypto payment for the online order feature at the company official website	0,082	0,033	0,032	0,044	0,046

The results of the weighting process at Figure 3 and Table 7, showed that:

- The 1st order is "Features on the data maintenance of shipment, customers, and suppliers as well as receipts, loading lists, travel documents and invoices writings at the integrated company operational software which can be accessed online", as many as 0,138
- The 2nd order is "RFID for Inventory control", as many as 0,116
- The 3rd order is "MREAL for warehouse planning", as many as 0,106
- The 4th order is "features on shipment route management based on the priority of the shipment delivery location and the size of the shipment at the company operational software", as many as 0,083
- The 5th order is" Features on Online order, location delivery checking and the shipment status checking at the official company website". as many as 0,076
- The 6th order is "Software forecasting", as many as 0,068
- The 7th order is "X-Ray Machine for checking the shipment's content" ,as many as 0,060
- The 8th order is "CRM Software", as many as 0,051
- The 9th order is "The company official website as an online marketing media", as many as 0,048
- The 10th order is "GPS for determining the best delivery route and the facility of crypto payment for the online order feature at the company official website", as many as 0.046
- The 11th order is "The GPS for location tracking towards delivery unit", as many as 0,045
- The 12th order is "Feature on customer data maintenance at the company operational software", as many as 0,035
- The 13rd order is "CCTV", as many as 0,034
- The 14th is "Feature on partnering companies data maintenance at the operational company software", as many as 0,027
- The last order is the "Shipment value column at the shipment table at the company operational software", as many as 0.027

VI. CONCLUSION

- The Critical Success Factors owned by PT. X shows that PT. X is a company applying a modern system, structured, orderly and using the support of integrated modern technology. Thus the company is able to run the business process efficiently, orderly and secure
- Currently the company most needed IT application, which is also the key operational of the company, is the development of "Features on the data maintenance of shipment, customers, and suppliers as well as receipts, loading lists, travel documents and invoices writings at the integrated company operational software which can be accessed online".

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