Design of Multicriteria Decision Making Tools for IT Project Selection: A Case from Software House

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Abstract. Information Technology as an enabler helps organization to improve business by gaining more competitive advantage, it plays a significant role for organization to compete. Many organizations sense the pressure to leverage their investment towards information system. Selecting the optimal portfolio of IT projects is becoming increasingly important as the dependency on IT for organizational performance increases. The purpose of this research is to design tools for IT project selection tools in the software house. Combination of Delphi, AHP, and Factor rating method is used to gain the prioritize of the projects. Agile method is used to develop the application. The application is built in web platform to help the organization decision. Future research can be done to consider more variables for choosing the right project for the organization.

Keywords: Agile Method, AHP, Factor Rating, Project Selection, Software House

1. Introduction
The growth of Information Technology (IT) leads the significance of using IT as an enabler to help improve business process from organization. The development of IT has brought changes into the business environment in the organization, in example it can enhance the customer service, reduce distribution cost, etc [1]. Nowadays the utilization of information technology for the organization becomes a requirement to support the business [2]. Information Technology (IT) plays a significant role in an organization’s ability to compete in the marketplace. Due to many advantages can be obtained through the implementation of IT, many organizations senses the pressure to leverage their investment towards information system [3]. Selecting the optimal portfolio of IT projects is becoming increasingly important as the dependency on IT for organizational performance increases [4]. The process of project selection is not easy, because there is a lot of criteria that must be taken into consideration, besides there are many issues such as too many projects, aligning business strategy and projects and poor coordination between projects and the resistant from the organization. In a software company, usually there is two type of project that is occurred during the business, which is the internal project that can help the company to gain advantage and the external project which is the main activity of the software company. The research is needed to support start-up company to guide them in taking a decision and avoid a choice that could lead to business failure. Most of the IT project-based companies are dependent on the project revenues as the source of income, therefore the optimal project selection is needed to increase the profitability of the organization. The need and authorization for projects, regardless of the selection methods, can come from one or more sources: marketplace opportunity, business need, customers, advances in technology, legal, and social [5].
The purpose of this research is to design the tools to pick and choose the suitable IT project for software company both internally and externally using multicriteria decision making (MCDM). MCDM methods are commonly used to rank multiple alternatives according to multiple and often conflicting criteria, therefore it is suitable to use in the IT project selection [6]. The object of this study is a start-up company, especially software house. According to Archibald, Thomas, Betts, and Johnston[7], start-up companies are considered to be an important element in a successful economy. In addition to the IT project selection, the Delphi method is also often used as a reference in qualitative determinations. The most important requirements for the use of Delphi are the need for experts' judgment, group consensus to achieve the results, anonymity in data collection, a complex, multidimensional, and interdisciplinary problem, lack of consensus and imperfect knowledge, experienced and capable experts, dispersion of experts, no time limitation, and lack of cost-effective method [8]. The Delphi method is beneficial when the problem at hand can benefit from collective, subjective judgments or decisions and when group dynamics do not allow for effective communication (e.g., time differences, distance, and personality conflicts) [9]. In this research, Analytical Hierarchy Process (AHP) is used. The Analytic Hierarchy Process (AHP) is a theory of measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales. It is these scales that measure intangibles in relative terms. The correlations are made utilizing a size of total decisions that speaks to, the amount increasingly, one component overwhelms another regarding a given property. The decisions might be conflicting, and how to gauge irregularity and improve the decisions, when conceivable to acquire better consistency is a worry of the AHP [9]. Factor rating method is used to determine the highest score of each possible project, the method multiply the value with the weight of each indicators [10]. The advantage of this method it is most widely used in analytical technique and most popular technique because a wide variety of factor can be included in the analysis [11]. In factor rating method, Most Important Factors must be identified in evaluating alternative sites for the new facility. Then a weight between 0 and 100 should be assigned to each of these factors. Agile method is used to develop the application because the methods can break down the projects into small chunk and support the dynamic change in the requirement from the stakeholder [12], the dynamic change can embrace the flexibility and the agility in the development process which something that the traditional approach can’t be supported [13].

2. Methods
The purpose of this research is to design the tools to pick and choose the suitable IT project for software company both internally and externally using multicriteria decision making (MCDM). The object of the study is one software house company in Bandung, Indonesia. To choose the suitable project, it is needed to create the criteria based on the stakeholder perspective. The criteria are gathered from previous research and validate with the stakeholder. The stakeholder in this research is the CEO, CTO, COO of the company. Delphi method is used to collect the suitable criteria from the stakeholder, according to Grime [9], Delphi is suitable for facing the collective judgments such as group decision where effective communication is limited. After the criteria is defined, the next step is to develop the selection method, Analytical Hierarchy Process (AHP) is used to select the best portfolio by determine the weight of each criteria. AHP is suitable for multicriteria decision because it measured through pairwise comparisons and relies on the judgements of experts to derive priority scales [14]. To determine the weight of each criteria it is needed to check the consistency of the data. To gain which project that is need to be selected, factor rating is used to calculate the weight and the value given by the stakeholder.

After the selection method is developed the next step is to create the tools for calculate the result. Agile method is used to develop the application. Agile have the ability to rapidly adapt to volatile requirements which the plan-driven approach can’t accommodate [15], the unique characteristic of agile method is the modularity on development process level, the iterative phase with short cycles enabling fast verifications and corrections [16]. Figure 1 shows the agile method phase. The first phase is the planning, in this phase the project backlog is created. After the product backlog is created, the next step is the sprint process, each sprint consists of iterative method from requirement, develop, and testing phase. The sprint process usually takes one weeks to develop and is done by selecting the most possible
product backlog to be developed [12]. In each sprint, daily meeting is essential, after each sprint is finished the next step is the retrospective meeting with the product owner, the product owner in this research is the CEO of the company.

![Agile Method SCRUM](image)

**Figure 1.** Agile Method SCRUM

### 3. Result and Discussions

#### 3.1. Criteria Development

In criteria development, literature study is conducted to gather the suitable criteria for IT Project selection. Table 1 shows the criteria gathered for this research.

| No. | Criteria                     | Author |
|-----|------------------------------|--------|
| 1   | Politics                     | [4]    |
| 2   | Value / Opportunity          | [4]; [5] |
| 3   | Execution                    | [4]; [6] |
| 4   | Time-Pressure                | [4]; [6]; [17] |
| 5   | Relevant Methods             | [4]    |
| 6   | Resource                     | [4]; [17]; [18] |
| 7   | Risk                         | [4]; [6] |
| 8   | Management Commitment        | [4]    |
| 9   | Strategy Alignment           | [4]; [5]; [6] [18] |
| 10  | Social                       | [5]; [19] |
| 11  | Legal                        | [5]    |
| 12  | Cost                         | [17]; [18];[19] |
| 13  | Profitability                | [18]; [19] |

After develop the base of criteria the next step is to validate the criteria to the stakeholder. Data gathering is conducted to the CEO, CTO, and COO of the company. All the chief officer is asked to prioritize which criteria is the most important for the company. Delphi method is used in the form of a questionnaire. The consensus of each stage is set to 60%.

The consensus is obtained after 3 iterations, the result of the prioritized information system is shown in Table 2. From the result, it is known that only 10 criteria that is selected by the chief officer. The “Execution” criteria is changed into difficulty because all three stakeholders agree that the execution of the project is depend on the difficulty of the IT Projects.

#### 3.2. Weight Calculation

After the criteria is developed. The next step is calculating the weight of each criteria. The calculation of the weight of the criteria was done by using analytical hierarchy process (AHP). The result of the weight calculation can be seen in Table 2. In order to ensure that the respond from respondents was
consistent, the calculation of consistency ratio was performed. The value of consistency ratio obtained from the calculation is 0.097. Since the value of consistency ratio is less than 0.1, the respond from respondents is considered consistent and valid. After the weight of each criteria was determined, the next step was to determine the scale of each criteria. Table 3 shows the scale of each criteria.

| Criteria# | Criteria                  | Weight |
|-----------|---------------------------|--------|
| C1        | Value / Opportunity       | 5%     |
| C2        | Difficulty                | 2.9%   |
| C3        | Time-Pressure             | 25.6%  |
| C4        | Resource                  | 9.4%   |
| C5        | Risk                      | 13.6%  |
| C6        | Management Commitment     | 3.3%   |
| C7        | Strategy Alignment        | 2.2%   |
| C8        | Social                    | 1.5%   |
| C9        | Cost                      | 18.8%  |
| C10       | Profitability             | 17.7%  |

Factor rating method was used to calculate the score for each IT project. The score generated from factor rating will be used as based for stakeholder to make decision related IT project that will be selected. The step of factor rating is [11]:
1. Identify the criteria
2. Determine the weight for each factor that is reflecting as the relative importance of each criteria
3. Determine the scale for each criterion
4. Determine the score for each criterion for each alternative based on scale, then normalized the score
5. Multiply the score and the weight for each alternative
6. Make recommendation based on highest score

Therefore, the model to calculate the score for each project is as follow:

\[ S_{A_{Si}} = 0.005(NC_{1_i}) + 0.029(NC_{2_i}) + 0.256(NC_{3_i}) + 0.094(NC_{4_i}) + 0.136(NC_{5_i}) + 0.033(NC_{6_i}) + 0.022(NC_{7_i}) + 0.015(NC_{8_i}) + 0.188(NC_{9_i}) + 0.177(NC_{10_i}) \]  

\[ NC_{1_i} = \frac{SC_{1_i}}{4} \times 10 \]  
\[ NC_{2_i} = \frac{Min(SC_{2_i})}{SC_{2_i}} \times 10 \]  
\[ NC_{3_i} = \frac{Min(SC_{3_i})}{SC_{3_i}} \times 10 \]  
\[ NC_{4_i} = \frac{Min(SC_{4_i})}{SC_{4_i}} \times 10 \]  
\[ NC_{5_i} = \frac{Min(SC_{5_i})}{SC_{5_i}} \times 10 \]  
\[ NC_{6_i} = \frac{SC_{6_i}}{Max(SC_{6_i})} \times 10 \]  
\[ NC_{7_i} = \frac{SC_{7_i}}{Max(SC_{7_i})} \times 10 \]  
\[ NC_{8_i} = \frac{SC_{8_i}}{Max(SC_{8_i})} \times 10 \]  
\[ NC_{9_i} = \frac{Min(SC_{9_i})}{SC_{9_i}} \times 10 \]
\[ NC_{i}^{10} = \frac{SC_{i}^{10}}{\text{Max}(SC_{i}^{10})} \times 10 \]  \hspace{1cm} (11)

Where,
- \( SAS_{i} \): Factor rating score for project-\( i \)
- \( NC_{ij} \): Normalized score for project-\( i \) in criteria-\( j \)
- \( SC_{ij} \): Score for project-\( i \) in criteria-\( j \)
- \( \text{Min} \{SC_{nj}\} \): Minimum score of criteria-\( j \) from all project
- \( \text{Max} \{SC_{nj}\} \): Maximum score of criteria-\( j \) from all project

Table 3. Scale of Each Criteria

| Criteria# | Scale | Priority                      |
|-----------|-------|------------------------------|
| C1        | 1-10  | Higher C1, higher priority   |
| C2        | 1-10  | Lower C2, higher priority    |
| C3        | 1-10  | Lower C3, higher priority    |
| C4        | 1-10  | Lower C4, higher priority    |
| C5        | 1-10  | Lower C5, higher priority    |
| C6        | 1-10  | Higher C6, higher priority   |
| C7        | 1-10  | Higher C7, higher priority   |
| C8        | 1-10  | Higher C8, higher priority   |
| C9        | 1-10  | Lower C9, higher priority    |
| C10       | 1-10  | Higher C10, higher priority  |

3.3. Development

The development phase starts with the product backlog. Product backlog is a list that contains all information needed for developing the product [20]. Product backlog is a master list of all projects [21]. In the first phase of product development, the product backlog contains the known requirements from the customer. The product backlog result can be seen in Table 4.

Table 4. Product Backlog

| No. | Description                                | Estimation (Hours) |
|-----|--------------------------------------------|--------------------|
| 1   | Initial Analysis                           | 4                  |
| 2   | Model Development                          | 8                  |
| 3   | IT Project Selection Support System        | 12                 |

From the product backlog, it is known there are 3 product backlogs and in the actual development process, there are 3 sprint backlogs that are equal to the product backlog. In each sprint, the development phase is done by defining the menu map for the application. Figure 2 shows the menu map of the application.

![Figure 2. Menu Map](image-url)
After the menu mapping is done, the next step is creating the Entity Relationship Diagram (ERD) for the design of the database and the Activity Diagram to map the business process into technical view. Figure 3 shows the activity diagram for creating the indicator.

![Activity Diagram Example](image)

**Figure 3. Activity Diagram Example**

The application is developed based on the activity performed by the stakeholder in selecting the right IT project portfolio. The initial activity is the stakeholder login into the system and choose the criteria menu, in this menu all criteria and the weight are defined. The system will respond by displaying the current criteria that is set by default. After the criteria and weight is defined then the stakeholder can input the current project with the respective value of each indicator. When user choose the calculation menu, the result of the application will be shown. The model form previous step is used to calculate the result. After the design phase is done, the next step is to develop the application, in this research the application platform is web based and using PHP as a programming language.

![Project Menu](image)

**Figure 4. Project Menu**

Figure 4 shows the project menu, in this menu the project that will be chosen by the stakeholder is shown. In the project menu, when the add project button is clicked, it will prompt the user to input the value of each criteria from 1 to 10 scale.
Figure 5 shows the criteria menu, this menu shows the current criteria set by the stakeholder. When the add criteria is clicked, it will prompt the user to enter the criteria name and the weight of each criteria. In this research, the weight of each criteria is gained from the AHP calculation in the previous phase by giving the AHP questionnaire to the stakeholder.

Figure 6 shows the calculation result menu, in this menu each project is scored by the value given by the stakeholder multiply with the weight of each indicator. The highest score will be shown with the green colour in the project name.

4. Conclusions
This research tends to guide a start-up IT company in taking better decision by designing the tools to pick and choose the suitable IT project. From the result, we can conclude that in IT Project selection, there are 10 criteria that used to prioritized in IT Project; namely Value/Opportunity, Difficulty, Time-pressure, resource, risk, management commitment, strategy alignment, social, cost, and profitability. From thus 10 criteria, 5 are in higher criteria - higher priority; Value/Opportunity, management commitment, strategy alignment, social, and profitability. And the other 5 have lower criteria - higher priority; Difficulty, Time-pressure, resource, risk, and cost. Future research can be done to test the instrument and add more specific criteria.
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