

Development of a Web-Based Scoring Model Application to Enhance Project Portfolio Selection

Muhammad Aziz Wibisono

Information Systems Department, School of Information Systems,
Bina Nusantara University,
Jakarta, Indonesia 11480
muhammad.wibisono001@binus.ac.id

Hedianto Samiaji Rachmadi

Management Program, Binus Business School Undergraduate Program,
Bina Nusantara University,
Jakarta, Indonesia 11480
hedianto.rachmadi@binus.ac.id

Mohammad Ichsan

Management Program, Binus Business School Undergraduate Program,
Bina Nusantara University,
Jakarta, Indonesia 11480
mohammad.ichsan@binus.edu

Ali Gunawan

Information Systems Department, School of Information Systems,
Bina Nusantara University,
Jakarta, Indonesia 11480
gunlee77@binus.ac.id

Abstract

Project Portfolio Selection is a process to determine which projects are aligned with organizational goals. In the last few decades, the development of technology has been growing rapidly, especially in the area of Project Management practices. Many applications on the market offer the feature to facilitate the implementation of Project Management. However, current applications on the market do not have the Project Portfolio Selection feature. Therefore, the author wants to create a Project Management application that focuses on the Project Selection Method using the multi-criteria scoring model so that the Project Management process can maximize project selection according to the needs and interests of the organization.

Keywords

Analytical Hierarchy Process (AHP), multi-criteria scoring model, Project Portfolio Selection

1. Introduction

Currently, the application of the use of technology is increasingly widespread and rapid. Today's technology can facilitate our activities, one of which is in doing our work. This can make a complex activity easier and shorten the time of the activity. One of these activities is Project Management.

Project management is defined not only as a set of knowledge and skills but also as a set of processes that are carried out to achieve a target and realize the desired goal. In this explanation, it can be concluded that Project Management functions as a technique to assist in managing a project that is being implemented (Salehah, 2018; Project Management

Institute, 2017). Project Management can be more helpful and easier in managing a project when combined with current technological developments, Software Project Management is created. Project Management Software is a tool for planning, organizing, staffing, monitoring, controlling, and leading a project. In project management there is a feature called Project Portfolio Selection, which is an iterative process where managers select projects from available proposals and current projects, to meet organizational goals. This process is critical to maintaining a competitive advantage, enabling organizations to focus on the most relevant and strategic projects. (Project Management Institute, 2017; Sajad et al., 2016; Flechas Chaparro et al., 2019; Baqeri et al., 2019)

1.1 Objectives

The objective of this study is to fill the gap in current web-based project management software by developing a simple project management tool to help the project stakeholders to perform project portfolio selection.

2. Literature Review

Recent project management tools are mostly used for planning individual projects purposes. There is lack of project management application that covers the area of project portfolio management, where projects are selected prior to execution. In this study, author compared some practical and common used PM tools with an intention to have a benchmark to some features (Almeida et al., 2017), or at different times which contains a comparison of features from the 5 applications being compared which include Monday.com, Trello, Asana, Primavera, Gantt Project.

Monday.com

- The advantage of this application is that they have features: Kanban Board, Dashboard, Timeline, Task Schedule, Gantt Chart, Status, Priority, Cost, Work Breakdown Structure.(Instagantt, 2021)
- From the above advantages, this application has disadvantages, namely: Reporting, and Project Selection(Instagantt, 2021)

Trello

- The advantage of this application is that they have features: Kanban Board, Dashboard, Timeline, Task Schedule, Status, Work Breakdown Structure.(Instagantt, 2021)
- From the above advantages, this application has disadvantages, namely: Gantt Chart, Reporting, Priority, Cost, and Project Selection.(Instagantt, 2021)

Asana

- The advantage of this application is that they have features: Kanban Board, Dashboard, Timeline, Task Schedule, Gantt Chart, Status, Priority, Work Breakdown Structure.(Instagantt, 2021)
- From the above advantages, this application has disadvantages, namely: Cost, Project Selection(Instagantt, 2021)

Primavera

- The advantage of these applications is that they have features: Dashboard, Timeline, Task Schedule, Gantt Chart, Reporting. Status, Priority, Work Breakdown Structure.(Sajad et al., 2016)
- From the above advantages, this application has disadvantages, namely: Kanban Board, Cost, Project Selection.(Sajad et al., 2016)

Gantt Project

- The advantage of this application is that they have features: Timeline, Task Schedule, Gantt Chart, Status, Cost, Work Breakdown Structure.(Sajad et al., 2016)
- From the above advantages, this application has disadvantages, namely: Kanban Board, Dashboard, Reporting, Priority, Project Selection.(Sajad et al., 2016)

Table 1. Comparative Table of Application In The Market

| Application | Monday.com | Trello | Asana | Primavera | GanttProject |
|--------------------------|------------|--------|-------|-----------|--------------|
| Kanban Board | ✓ | ✓ | ✓ | x | x |
| Dash Board | ✓ | ✓ | ✓ | ✓ | x |
| Time Line | ✓ | ✓ | ✓ | ✓ | ✓ |
| Task Schedule | ✓ | ✓ | ✓ | ✓ | ✓ |
| GanttChart | ✓ | x | ✓ | ✓ | ✓ |
| Reporting | x | x | ✓ | ✓ | x |
| Status | ✓ | ✓ | ✓ | ✓ | ✓ |
| Priority | ✓ | x | ✓ | ✓ | x |
| Cost | ✓ | x | x | x | ✓ |
| Work Breakdown Structure | ✓ | ✓ | ✓ | ✓ | ✓ |
| Project Selection | x | x | x | x | x |

2.1 Portfolio Selection Method

Some scholars (Flechas Chaparro et al., 2019; Archer & Ghasemzadeh, 1999;Simplicio et al., 2017 defines a project portfolio selection (PPS) as a process where projects are selected from available proposals and current projects, to meet organizational goals. The PPS is a very useful method in selecting multiple strategic initiative projects in banking industries (Ichsan et al., 2018;Ichsan and Sadeli, 2020;Ichsan and Hamsal, 2019). This process strongly maintains a competitive advantage, enabling companies to focus on the most relevant and strategic projects. Nevertheless, some companies struggle to manage this process. The complexity of PPS depends on two main facts. First, the information needed to determine whether a project can be successful or not is very difficult. Second, because project and environmental conditions are too volatile, strategic objectives may change, leading to high levels of uncertainty.”(Flechas Chaparro et al., 2019)

2.2 Analytical Hierarchy Process (AHP)

Chen (2006) argued that, “The AHP approach, developed by Satyr, is one of the more widely used Multi Criteria Decision Making (MCDM) methods. AHP has been applied to a variety of human decision and appraisal processes. The approach is used to build the evaluation model and has weighted criteria. He integrates the different measures into one overall score for ranking decision alternatives. Applying them usually results in simplifying the problem of multiple criteria by breaking them down into a multilevel hierarchical structure.” (Chen, 2006)

The Analytical Hierarchy Process (AHP) was developed by Satyr (1987) to deal with technical and managerial issues that are often associated with decision-making through model assessment. An increasingly popular method for effective project selection, AHP is a four-step process. (Pinto, 2016)

The first stage in the Analytical Hierarchy Process (AHP) method is to create a structure from the criteria. For example, an organization wants to implement a project, this organization has determined 5 criteria, namely Revenue, Benefit-Cost Ratio, Budget, Resources, and Project Risk. These criteria can simplify and narrow the organizational requirements of the project. This gives managers a good reason to screen and prioritize the criteria. Since these criteria are aligned with the strategic objectives of the organization, it can also assist in the selection of projects according to the consistency with the business objectives. The first stage in the AHP aims to provide clear criteria for project selection.(Pinto, 2016)

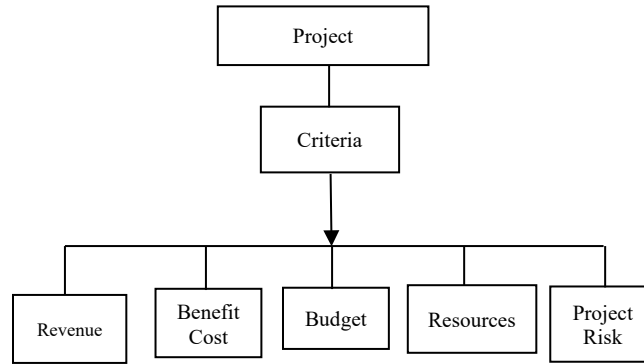


Fig. 1. Criteria Diagram

The second stage in the AHP method is to enter the burden on the criteria that have been made. The burden referred to here is the burden of the importance of the criteria. The following is an example of assigning a burden of interest to predetermined criteria.(Pinto, 2016).

3. Methods

The first stage in the Analytical Hierarchy Process (AHP) method is to create a structure from the criteria. For example, an organization wants to implement a project, this organization has determined 5 criteria, namely Revenue, Benefit-Cost Ratio, Budget, Resources, and Project Risk. These criteria can simplify and narrow the organizational requirements of the project. This gives managers a good reason to screen and prioritize the criteria. Since these criteria are aligned with the strategic objectives of the organization, it can also assist in the selection of projects according to the consistency with the business objectives. The first stage in the AHP aims to provide clear criteria for project selection.(Pinto, 2016). can be seen in the Figure 1 below

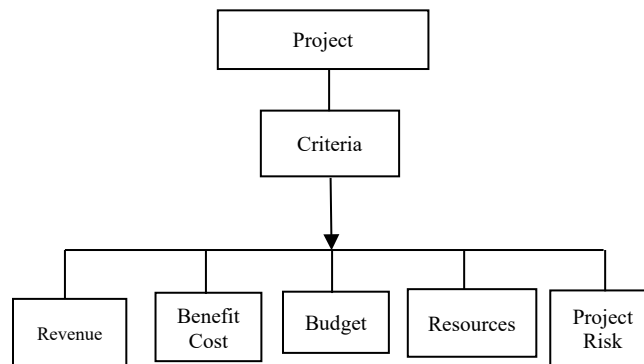


Fig. 2. Criteria Diagram

The second stage in the AHP method is to enter the burden on the criteria that have been made. The burden referred to here is the burden of the importance of the criteria. The following is an example of assigning a burden of interest to predetermined criteria.(Pinto, 2016). can be seen in the Table 2 below

Table 2. Example of Load Allocation to Defined Criteria

| No. | Criteria | Weight (%) |
|-----|--------------------|------------|
| 1 | Revenue | 51% |
| 2 | Benefit Cost Ratio | 25% |
| 3 | Budget | 11% |
| 4 | Resources | 8% |
| 5 | Project Risk | 5% |
| | | |
| | Total Weight | 100% |

In stage 3 of the AHP, we can provide an assessment of these criteria using numbers. This number will give a scale according to the given number. For example, 1 = Very bad, 2 = Poor, 3 = Fair, 4 = Very Fair, 5 = Perfect. This can also be referred to as Rating. This is related to the second stage of the AHP, namely the assignment of a burden of importance to the criteria. The following is an example of applying the rating to the criteria set by the organization.(Pinto, 2016), can be seen in the Table 3 below

Table 3. Example of Rating on Predefined Criteria

| No. | Criteria | Rating | Weight (%) |
|-----|--------------------|--------|------------|
| 1 | Revenue | 5 | 51% |
| 2 | Benefit Cost Ratio | 3 | 25% |
| 3 | Budget | 2 | 11% |
| 4 | Resources | 3 | 8% |
| 5 | Project Risk | 4 | 5% |

The fourth stage of the AHP method is the last stage. In this stage we multiply the rating with the load that has been given and give results for each of the criteria that have been given. The following is an example of how to multiply the criteria with a given load.(Pinto, 2016), can be seen in the Table 4 below

Table 4. Example of Score Results Using the AHP Method

| No. | Criteria | Rating | Weight (%) | Score |
|-----|--------------------|--------|------------|-------|
| 1 | Revenue | 5 | 51% | 2.55 |
| 2 | Benefit Cost Ratio | 3 | 25% | 0.75 |
| 3 | Budget | 2 | 11% | 0.22 |
| 4 | Resources | 3 | 8% | 0.24 |
| 5 | Project Risk | 4 | 5% | 0.02 |
| | | | | |
| | Total Score | | | 3.78 |

In the table above, the score for each criterion has been multiplied by the burden of the level of importance that has been given. The following is a detailed explanation of the score calculation.

$$\text{Rating} \times \text{Weighting} = \text{Score}$$

Total Score = The sum of each score in the criteria

$$\text{Revenue: } 5 \times 51\% = 2.55$$

$$\text{Benefit Cost Ratio: } 3 \times 25\% = 0.75$$

$$\text{Budget: } 2 \times 11\% = 0.22$$

$$\text{Resources: } 3 \times 8\% = 0.24$$

$$\text{Project Risk: } 4 \times 5\% = 0.02$$

$$\text{Total Score: } 2.55 + 0.75 + 0.22 + 0.24 + 0.02 = 3.78$$

Of the many existing Project Portfolio Selection methods, the author uses the Analytical Hierarchy Process (AHP) method as an example. This AHP is one method of the multi-criteria scoring model to solve problems in multi-criteria decision making. The use of this method is considered superior by the authors because this method has a scoring system based on the criteria and priorities determined. The use of the AHP method by comparing criteria that have different but interconnected priority loads.

4. Results and Discussion

In this study, the author designs a project management selection application which focuses on project selection based on the scores obtained from the project portfolio selection method, namely the multi-criteria scoring model using the python programming language and the Laravel framework.

4.1 Program Menu

In this menu, the user must fill in the program form containing the Program Name, Program Funder, Program Owner. in this menu the user can add, modify the program as needed. can be seen in the Figure 2 below

| # | Program Name | Program Funder | Program Owner | Status | Action |
|---|--------------|-------------------|---------------|---------|-------------|
| 1 | Program A | Asian Dev Bank | Kemenhub | PENDING | Delete Edit |
| 2 | Program B | World Bank | KemenPUPR | PENDING | Delete Edit |
| 3 | Program C | China Const. Bank | KemenESDM | PENDING | Delete Edit |

Fig 2. Program Menu

4.2 Project Criteria

In this menu, the user must fill in a form containing revenue, benefit cost ratio, budget, resources, project risk to get results for scoring calculations. users can also change criteria percentage. can be seen in the Figure 3 below

| # | Revenue (%) | Benefit Cost Ratio (%) | Budget (%) | Resources (%) | Project (%) | Action |
|---|-------------|------------------------|------------|---------------|-------------|--------|
| 1 | 10.00 | 20.00 | 30.00 | 15.00 | 25.00 | Edit |

Fig 3. Project Criteria

4.3 Project Menu

In this menu, the user must fill in the 13 columns available on the form containing Project Name, Project description, Program, Project Manager, Estimated Budget, Man-days, Rating Revenue, Rating Benefit Cost Ratio, Rating Budget, Rating Resources, Rating Project Risk to get scoring calculation results. Users can also change data that has been submitted or is already available on the Project home page. can be seen in the Figure 4 below

Fig 4. Project Menu

4.3.1 Detail Scoring

To be able to see the results of the scoring calculation, the user can open the project menu and select the scoring detail to display the results of the calculation of the Project Criteria and rating, which is the result of the Detail Scoring by multiplying the Weighting criteria and ratings that have been given are then added together so that they can produce a score. This score acts as a tool to determine the ranking value of a project. can be seen in the Figure 5 below

| Detail Scoring | | | | | | |
|----------------------|---------------------------------|---------------------|------------------------|----------------------|---------|------|
| Revenue (%) x Rating | Benefit Cost Ratio (%) x Rating | Budget (%) x Rating | Resources (%) x Rating | Project (%) x Rating | Scoring | |
| 10.00% x 5 | 20.00% x 4 | 30.00% x 2 | 15.00% x 1 | 25.00% x 3 | 2.80 | |
| 0.5 | + | 0.8 | + | 0.6 | + | 0.15 |
| | | | | | + | 0.75 |

Fig 5. Detail Scoring

4.3.2 Project Ranking Calculations

In this menu, users can sort projects based on the scores obtained which are sorted by the results of the largest to the lowest scores where if the project has the highest score, then the project that best meets the needs and goals of the organization, the project is also profitable for the organization. can be seen in the Figure 6 below

| Ranking | Project Name | Project Description | Program | Project Manager | Estimated Budget (\$) | Start Date | Finish Date | Mandays | Score | Action |
|---------|-------------------|---------------------|-----------|-----------------|-----------------------|------------|-------------|---------|-------|--------------------------------------|
| 1 | Project Hambegsen | Perbankan | Program B | Budi | 1,250,000 | 2020-01-15 | 2020-09-10 | 1500.00 | 3.25 | SDM Edit Delete Detail Scoring |
| 2 | Project Melat | Perbankan | Program C | Bambang | 650,000 | 2020-02-10 | 2020-10-17 | 750.00 | 3.05 | SDM Edit Delete Detail Scoring |
| 3 | Project Anggrak | Perbankan | Program A | Bambang | 1,500,000 | 2020-01-10 | 2020-05-14 | 750.00 | 2.95 | SDM Edit Delete Detail Scoring |
| 4 | Project Mawar | Perbankan | Program B | Bambang | 625,000 | 2020-02-05 | 2020-09-07 | 1250.00 | 2.95 | SDM Edit Delete Detail Scoring |

Fig 6. Project Ranking Calculations

4.3.3 Bubble Chart

In this menu, users can see a bubble chart to compare each project based on a predefined category, namely: X for man days, Y for duration (Months), Z for Estimated Budget, where the larger the estimated budget of a project, the larger the diameter of the circle. can be seen in the Figure 7 below

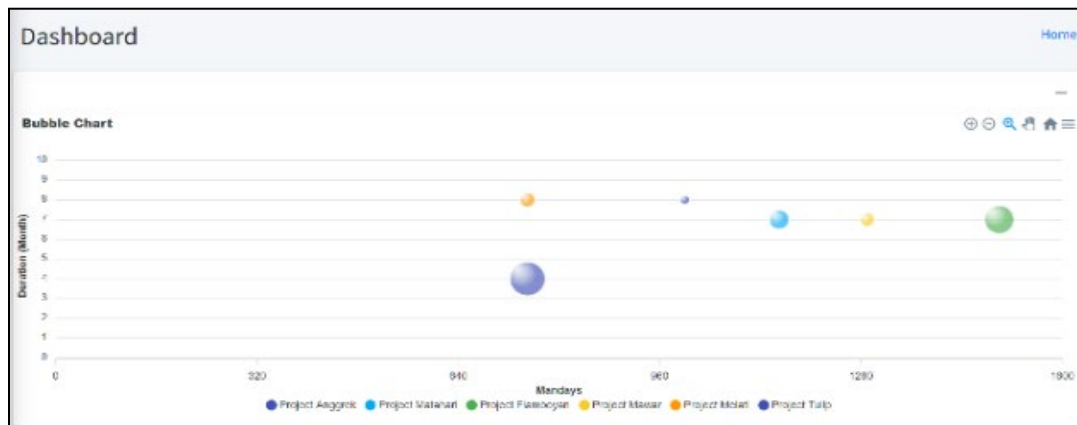


Fig 7. Bubble Chart

5. Conclusion

Based on the results of the study, the applications on the market today do not have Project Selection, Criteria and Scoring features in Project Selection. This application emphasizes the Project Portfolio Selection system using a multi-criterion scoring model to facilitate project selection that is in line with organizational goals. Based on the conclusions that have been discussed above, the author hopes that future developments can fill the limitations that exist in applications that have been designed by the author. The author provides suggestions so that application users who have designed by the author so as not to be careless and required to be careful of filling the Weighting and Rating on criteria and projects predetermined.

References

Almeida, F., Superior, I., Gaya, P., Queirós, A., & Faria, D. *Strengths and Limitations of Qualitative and Quantitative Research Methods Innovation and Entrepreneurship View project Observatory of Portuguese Academic Spin-offs View project European Journal of Education Studies* STRENGTHS AND LIMITATIONS OF QUALITATIV.

- September. <https://doi.org/10.5281/zenodo.887089> (2017).
- Archer, N. P., & Ghasemzadeh, F. An integrated framework for project portfolio selection. *International Journal of Project Management*, 17(4), 207–216. (1999). [https://doi.org/10.1016/S0263-7863\(98\)00032-5](https://doi.org/10.1016/S0263-7863(98)00032-5)
- Baqeri, K., Mohammadi, E., & Mofrad Gilani, M. Multi objective project portfolio selection. *Journal of Project Management*, 4, 249–256. (2019). <https://doi.org/10.5267/j.jpm.2019.6.003>
- Chen, C. F. Applying the analytical hierarchy process (AHP) approach to convention site selection. *Journal of Travel Research*, 45(2), 167–174. (2006). <https://doi.org/10.1177/0047287506291593>
- Flechas Chaparro, X. A., de Vasconcelos Gomes, L. A., & Tromboni de Souza Nascimento, P. The evolution of project portfolio selection methods: from incremental to radical innovation. *Revista de Gestão*, 26(3), 212–236. (2019). <https://doi.org/10.1108/rege-10-2018-0096>
- Ichsan, M., Abbas, B. S., Hamsal, M., & Sadeli, J. Responding Business Uncertainties with Effective Strategic Initiative Implementation: An Empirical Study in Indonesian Banks. *International Journal of Pure and Applied Mathematics*, 119(16), 2359–2364. (2018). <https://doi.org/http://www.acadpubl.eu/hub/>
- Ichsan, M., & Hamsal, M. The Importance of PMO Practices in Strategic Initiative Implementation : An Empirical Study of Indonesian Banks. *Pertanika Journal Social Sciences & Humanities*, 27(S2), 49–61. (2019).
- Ichsan, M., & Sadeli, J. Fostering project delivery capabilities in indonesian commercial banks. *Pertanika Journal of Social Sciences and Humanities*, 28(2), 827–846. (2020).
- Instagantt. *Top 10 Free Project Management Software in 2020*. (2021).
- Pinto, J. K. *Project Management: Achieving Competitive Advantage* (4th ed.). Pearson Education Inc. (2016).
- Project Management Institute. *A Guide to Project Management Body of Knowledge* (6th ed.). Project Management Institute, Inc. (2017).
- Saaty, R. W. The analytic hierarchy process-what it is and how it is used. *Mathematical Modelling*, 9(3–5), 161–176. (1987). [https://doi.org/10.1016/0270-0255\(87\)90473-8](https://doi.org/10.1016/0270-0255(87)90473-8)
- Sajad, M., Sadiq, M., Naveed, K., & Iqbal, M. S. Software Project Management : Tools assessment , Comparison and suggestions for future development . *International Journal of Computer Science and Network Security*, 16(1), . (2016).
- Salehah, A. *Manajemen Kearsipan Dalam Ketatausahaan Di Min 3 Pringsewu*. 1–114. (2018).
- Simplicio, R., Gomes, J., & Romão, M. Projects Selection and Prioritization: A Portuguese Navy pilot model. *Procedia Computer Science*, 121, 72–79. (2017). <https://doi.org/10.1016/j.procs.2017.11.011>

Biographies

Muhammad Aziz Wibisono is a former student at Information System Department, School of Information Systems, Bina Nusantara University, Indonesia. He has pursued his Bachelor of Information System from Bina Nusantara University. He is also interested in project management, project management office (PMO), and business development.

Hedianto Samiaji Rachmadi is a former student at Binus Business School of Bina Nusantara University in Jakarta, Indonesia. He also has pursued his Bachelor of Economy in Management, minoring in Business Development Management, from Bina Nusantara University.

Mohammad Ichsan is an Assistant Professor in Binus Business School of Bina Nusantara University. He has pursued his Diplom Ingenieur in Electrical Engineering from Hochschule Darmstadt, Germany prior to get his master's degree in project management from the University of Indonesia. Dr. Ichsan has continued his study and received his doctoral degree in Strategic Management. His teaching area is project management and operations management, meanwhile his research domain is project portfolio management, project management office practices and project risk management.

Ali Gunawan is a Lecturer from Bina Nusantara University from the Department of Information Systems where he started teaching from 2000 until now. Ali Gunawan is a Binus Alumni who graduated in 1998 majoring in Information Systems and continued his master's degree at Esa Unggul University majoring in Master of Management. His specialization started as a System Analyst and Project Manager then from 2007 - 2015 focused on Data Warehouse, but since 2016 he started to focus on Knowledge Management and also many papers and research on Knowledge Management.