Integrated Multicriteria Decision Model for Software Project Selection at PT. Hexavara Tech

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***Abstract*—As a relatively young software company, PT. Hexavara Tech needs to select incoming projects since the number of requests exceeds the amount that the company can manage. Currently, there are no guidelines for selecting projects, so the project selection process is less structured and subjective. In fact, project selection is faced with several qualitative and quantitative criteria that tend to be conflictual in achieving objectives. So in this study, the integration of Analytical Hierarchy Process (AHP) and Goal Programming (GP) methods is used to select software projects that consider limitations and multi-objectivity. Based on the calculation of the level of importance of the criteria using AHP, the sequence of project selection criteria is obtained, namely profit for the company (0.287), potential development of the project scope (0.155), initial development capital (0.1), the opportunity to get relations from clients (0.097), conformity to team capabilities (0.093), risks contained (0.078), increasing the value of the company's portfolio (0.073), the opportunity to create a template for the next project (0.07), and the opportunity to learn new technology (0.047). After the optimization process using GP, the best final results are obtained, namely the e-wallet development project of savings and loan cooperatives, development of an android-based online motorcycle taxi application, development of e-commerce design works, development of overseas money transfer applications, and development of a website framework for cross border e-commerce.**

***Keywords*—Software Project, Project Selection, Goal Programming (GP), Analytical Hierarchy Process (AHP), Integrated Model.**

I. INTRODUCTION

THE Digital 2020 Report published by WeAreSocial and Hootsuite (2020) shows that the digital lifestyle has become an inseparable part of human daily life with the number of internet users reaching 175.4 million in Indonesia in January 2020 or 64% of the total population [1]. A large number of internet users in Indonesia has an impact on the high value of its digital economy. According to research conducted by Google, Temasek, and Bain & Company entitled e-conomy SEA Report 2019, the value of Indonesia's digital economy is the largest in Southeast Asia, amounting to USD40 billion (3.57% of Gross Domestic Product). This value is predicted to continue to increase and reach USD133 billion in 2025 (8.5% of GDP) [2].

The increasing number of internet users and its economic value makes the need for software also increase. On the website side, there has been an increase in the number of new websites registered in 2019 by 13.5 million websites worldwide [3] and 71,438 in Indonesia [4]. The increase also occurred in mobile application software where every day 3,755 new Android applications and 1,180 new iOS applications were registered [5]. The increase also occurred in corporate spending on enterprise software. According to Gartner (2019), global enterprise software expenditure increases by 10% on an annual basis and will reach a value of USD 503 billion by 2020 [6].

The increase in the number of websites, new mobile applications, and company spending on software shows the huge potential for software development for both the Indonesian and international markets. This is an opportunity as well as a challenge for PT. Hexavara Technology as a software development company. As a relatively new company, Hexavara has limited capital, workers, and expertise. The company needs to prioritize and select projects because the number of project requests exceeds the amount that the company can manage. Project selection aims to select projects that meet company objectives without exceeding existing resources [7].

In the project selection process, the company is faced with a decision situation with multiple conflicting objectives and criteria. So, it is necessary to have decision-making tools that accommodate multi-objective and multi-criteria conditions. Goal programming (GP) has been identified as a promising model as a tool in the project selection process [8]. The GP model is able to overcome multiple objective optimization problems, which have different units of achievement and criteria and make a trade-off of conflicts between objectives [9]. However, the GP method was unable to accommodate the qualitative parameters that were encountered in the project selection case in Hexavara. Therefore, it is necessary to use another methodology to measure the preference value of qualitative criteria. In this study, the Analytical Hierarchy Process (AHP) approach was used to quantify the qualitative preference values, then the results were used as priority weights in the GP model. AHP works by quantifying the qualitative aspects into quantitative aspects so that they can be taken into account in the Goal Programming model [9].

II. METHODOLOGY

A. Data Collection

The data used in this research are primary data obtained from PT. Hexavara Tech. Project-related data needs include project alternatives, project profiles (description, project clients), the cost of each project, the profit target of each project, the risks contained in each project, the total budget allocation, and the company's total profit target.

B. Identification of Software Project Selection Criteria

The next step is to identify the variables that are considered in the selection of a software project at PT. Hexavara. The process of identifying criteria is carried out through literature

Table 1.
Identification of Software Project Selection Criteria.

No	Criteria	Source
1	Opportunity to learn new technology	Tech Department
2	Opportunity to create templates for the next project	Tech Department
3	Opportunities for client follow-up projects	Operational Department and CEO
4	Opportunity to get relations from a client	Operational Department
5	Increase the value of the company's portfolio	Snijders, G., & Meijer, C. (2018) and Marketing Dept
6	Conformity with team capabilities	Operational Department
7	The risks involved	Operational Department
8	Potential development from the scope of the project	CEO
9	Profit for the company	Operational Department and CEO
10	Aligned with company strategy	Snijders, G., & Meijer, C. (2018). Patanakul, P., Curtis, A., & Koppel, B. (2012)
11	Initial Development Capital	CEO

Table 2.
Final Software Selection Criteria.

Code	Criteria	Description
K1	Opportunity to learn new technology	The selected project is able to give the company the opportunity to learn new technology
K2	Opportunity to create templates for the next project	The selected project is able to give the company the opportunity to create a template for the next project
K3	Opportunity to get relations from a client	The selected project is able to give the company the opportunity to get relations from the clients
K4	Increase the value of the company's portfolio	The selected project is able to increase the value of the company's portfolio
K5	Conformity with team capabilities	The incoming project will be assessed based on the criteria of whether the team is able to do it or not
K6	The risks involved	The incoming projects are assessed for the risks they contain
K7	Potential development from the scope of the project	The incoming projects are assessed based on the potential development of the scope requested
K8	Initial Development Capital	The incoming projects are assessed based on the amount of initial capital needed by the company
K9	Profit for the company	Incoming projects are assessed based on the profit the company will get

Table 3.
Software Project Selection Assessment Parameters.

Code	Criteria	Parameters	Score
K1	Opportunity to learn new technology	a) Project provides the company the opportunity to learn new technologies	3
		b) Project moderately provides the company the opportunity to learn new technologies	2
		c) Project provides the company little opportunity to learn new technologies	1
		d) Project do not provide the company the opportunity to learn new technology	0
K2	Opportunity to create templates for the next project	a) Project provides the company the opportunity to create templates for their next project	3
		b) Project moderately provides the company the opportunity to create templates for their next project	2
		c) Project provides the company little opportunity to create templates for their next project	1
		d) Project do not provide the company the opportunity to create templates for their next project	0
K3	Opportunity to get relations from a client	a) Project provides the company the opportunity to get relations from a client	3
		b) Project moderately provides the company the opportunity to get relations from a client	2
		c) Project provides the company little opportunity to get relations from a client	1
		d) Project do not provide the company the opportunity to get relations from a client	0
K4	Increase the value of the company's portfolio	a) Project is able to increase the value of the company's portfolio	3
		b) Project is moderately able to increase the value of the company's portfolio	2
		c) Project can slightly increase the value of the company's portfolio	1
		d) Project is unable to increase the value of the company's portfolio	0
K5	Conformity with team capabilities	a) The team is able to work out the complexities contained in the project	3
		a) The team is moderately able to work out the complexities contained in the project	2
		c) The team is able to slightly work out the complexities contained in the project	1
		d) The team is incapable of working out the complexities inherent in the project	0
K6	The risks involved	a) The project contains a high risk	3
		b) The project contains a moderate risk	2
		c) The project contains a low risk	1
		d) The project does not contain risks	0
K7	Potential development from the scope of the project	a) The project has a high potential for scope development	3
		b) The project has a moderate potential for scope development	2
		c) The project has a low potential for scope development	1
		b) The project has no potential for scope development	0
K8	Initial Development Capital	The amount of initial capital for development	IDR
K9	Profit for the company	The amount of profit the company will receive	IDR

studies and interviews with the management of PT. Hexavara which can be seen in Table 1.

The list of criteria is then discussed with the company to obtain criteria that are under the project selection process that occurs in the company. From the discussion, it is known that criterion number ten was not included because it was less relevant to the conditions in the company. Furthermore, there is a similarity between criteria number three and eight so that they are merged into "potential development from the scope of the project".

Table 4.
Software Project Alternatives.

No	Project
1	E-wallet development of savings and loan cooperatives
2	Android based QC application
3	E-Commerce API development with Ruby on Rails
4	CMS for Smart-TV development
5	Property Listing Web
6	Android-bases online ojek application
7	E-Commerce for Design Works
8	Online Shop Application with React Native
9	iOS-based streaming application
10	Web and Android Apps for Community
11	Overseas Money Transfer Application
12	School Information System
13	Emergency Information System
14	website framework for cross border e-commerce

Table 5.
Assessment of Project Alternatives.

Criteria	Unit	Target	Project Alternatives						
			1	2	3	4	5	6	7
K1	Score	3	3	3	3	3	1	3	1
K2	Score	3	3	3	1	3	3	3	1
K3	Score	3	3	1	3	1	3	3	3
K4	Score	3	3	2	3	3	2	3	1
K5	Score	3	2	3	2	3	3	3	3
K6	Score	1	2	1	2	2	1	2	1
K7	Score	3	3	3	3	1	3	3	3
K8	IDR (million)	Rp150	31,54	6,59	8,77	12,02	9,54	25,52	28,01
K9	IDR (million)	Rp37,5	7,89	1,65	2,19	3,00	2,39	6,38	7,00
K1	Score	3	1	3	1	3	1	1	1
K2	Score	3	1	3	1	3	1	1	1
K3	Score	3	3	3	3	3	3	3	3
K4	Score	3	2	3	1	3	1	3	3
K5	Score	3	3	2	3	2	3	3	3
K6	Score	1	1	3	1	3	1	1	1
K7	Score	3	3	3	1	3	3	3	3
K8	IDR (million)	Rp150	9,50	8,43	13,25	21,95	9,18	6,88	23,72
K9	IDR (million)	Rp37,5	2,37	2,10	3,31	5,49	2,30	1,72	5,93

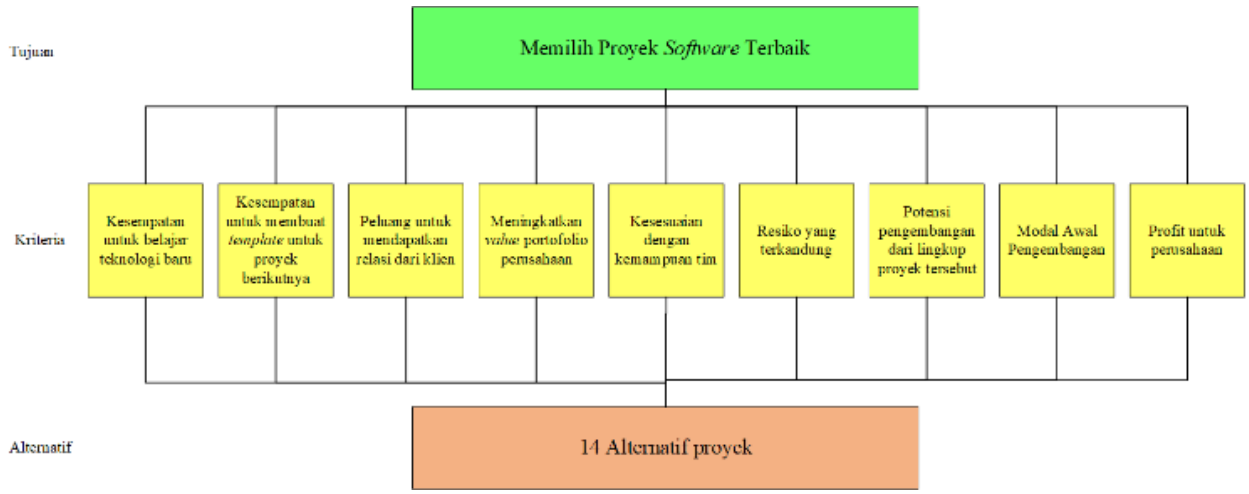

Figure 1. Software Project Selection Hierarchy Structure

Table 2 shows the criteria for selecting the software project. Based on the identified criteria, there are several project selection criteria in the form of qualitative data that needs to be converted into quantitative data by determining the assessment parameters and the score for each parameter. The assessment parameters for each criterion are shown in Table 3. Each alternative will then be assessed against the criteria using the parameters shown in the Table 3.

C. *Identification of Software Project Alternatives*

Table 4 shows the project alternatives that will be selected using the model.

Table 6.
Respondents' Profile.

No	Role	Work since (Years)	Job Description
1.	*CEO*	2018	Manage implementation of projects in general, manage project finance, and partnerships
2.	*COO, CTO*	2019	Estimating project complexity and cost, allocating resources, monitoring project implementation
3.	*CMO*	2018	Liaise with prospective clients in providing project offerings, maintaining client satisfaction levels

Table 7.
Level of Importance among Criteria.

Code	Criteria	Weight
K9	Profit for the company	0,287
K7	Potential development from the scope of the project	0,155
K8	Initial Development Capital	0,10
K3	Opportunity to get relations from a client	0,097
K5	Conformity with team capabilities	0,093
K6	The risks involved	0,078
K4	Increase the value of the company's portfolio	0,073
K2	Opportunity to create templates for the next project	0,07
K1	Opportunity to learn new technology	0,047

Table 8.
The Decision Variables

No	Project
X_1	E-wallet development of savings and loan cooperatives
X_2	Android based QC application
X_3	E-Commerce API development with Ruby on Rails
X_4	CMS for Smart-TV development
X_5	Property Listing Web
X_6	Android-bases online ojek application
X_7	E-Commerce for Design Works
X_8	Online Shop Application with React Native
X_9	iOS-based streaming application
X_{10}	Web and Android Apps for Community
X_{11}	Overseas Money Transfer Application
X_{12}	School Information System
X_{13}	Emergency Information System
X_{14}	website framework for cross border e-commerce

D. Assessment of Project Alternatives

Each alternative shown in Table 4 is then assessed based on the project selection criteria using the parameters shown in Tabe 3. The results are shown in Table 5.

E. Identification of The Level of Importance among Criteria

Level of importance identification among the decision criteria begins with structuring a hierarchy as shown in Figure 1. The next step is weighting the criteria using pairwise comparisons based on the AHP questionnaire that has been filled in by 3 respondents as shown in Table 6.

III. RESULTS

A. Level of Importance Among Criteria

The level of importance of the criteria is obtained by calculating the answers to the questionnaire using the AHP Calculator developed by Goepel, K.D. (2018). The result is shown in Table 7.

From this calculation, the value of the consistency ratio or CR is 2.9%. This shows that the calculation is consistent since the CR value is below 10%.

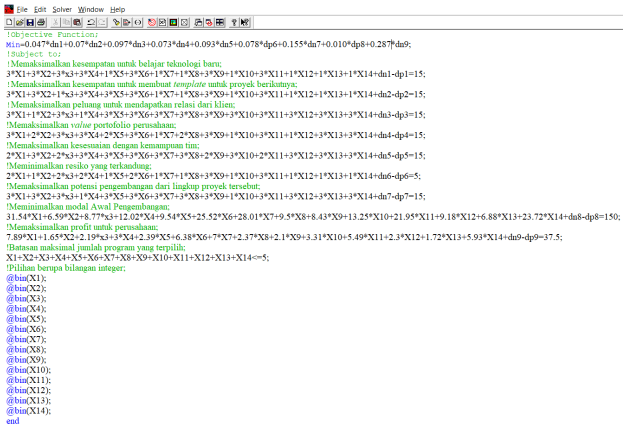

Figure 2. LINGO Model Formulation.

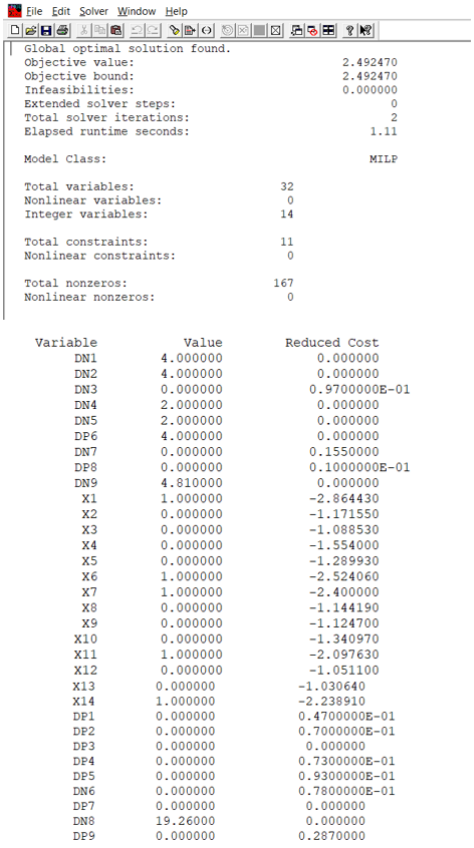

Figure 3. LINGO Run Results

B. Selection of Software Project

The goal programming method used is the non-preemptive method. This means that the objective that the company wants to achieve has the same priority level so that it considers the results of the parameter assessment and the weight of the criteria which are the objective functions in determining the best alternative.

- Decision Variables

Xi : Software project alternatives
= 1, If a project alternative is selected
= 0, If a project alternative is not selected

Table 9.
The Objectives and Its Function.

1. No	2. Objectives	3. Function	4. F(X)	5. w
6. 1	7. Maximizing the opportunity to learn new technology	8. $3X_1 + 3X_2 + 3X_3 + 3X_4 + X_5 + 3X_6 + X_7 + X_8 + 3X_9 + X_{10} + 3X_{11} + X_{12} + X_{13} + X_{14} + n1 - p1 = 15$	9. Min n1	10. 0,047
11. 2	12. Maximizing the opportunity to create templates for the next project	13. $3X_1 + 3X_2 + X_3 + 3X_4 + 3X_5 + 3X_6 + X_7 + X_8 + 3X_9 + X_{10} + 3X_{11} + X_{12} + X_{13} + X_{14} + n2 - p2 = 15$	14. Min n2	15. 0,07
16. 3	17. Maximizing the opportunity to get relations from a client	18. $3X_1 + X_2 + 3X3 + X_4 + 3X_5 + 3X_6 + 3X_7 + 3X_8 + 3X_9 + 3X_{10} + 3X_{11} + 3X_{12} + 3X_{13} + 3X_{14} + n3 - p3 = 15$	19. Min n3	20. 0,097
21. 4	22. Maximizing the value of the company's portfolio	23. $3X_1 + 2X_2 + 3X_3 + 3X_4 + 2X_5 + 3X_6 + X_7 + 2X_8 + 3X_9 + X_{10} + 3X_{11} + X_{12} + 3X_{13} + 3X_{14} + n4 - p4 = 15$	24. Min n4	25. 0,073
26. 5	27. Maximizing the conformity with team capabilities	28. $2X_1 + 3X_2 + 2X3 + 3X_4 + 3X_5 + 3X_6 + 3X_7 + 3X_8 + 2X_9 + 3X_{10} + 2X_{11} + 3X_{12} + 3X_{13} + 3X_{14} + n5 - p5 = 15$	29. Min n5	30. 0,093
31. 6	32. Minimizing the risks involved	33. $2X_1 + X_2 + 2X_3 + 2X_4 + X_5 + 2X_6 + X_7 + X_8 + 3X_9 + X_{10} + 3X_{11} + X_{12} + X_{13} + X_{14} + n6 - p6 = 5$	34. Min p6	35. 0,078
36. 7	37. Maximizing the potential development from the current scope	38. $3X_1 + 3X_2 + 3X3 + X_4 + 3X_5 + 3X_6 + 3X_7 + 3X_8 + 3X_9 + X_{10} + 3X_{11} + 3X_{12} + 3X_{13} + 3X_{14} + n7 - p7 = 15$	39. Min n7	40. 0,155
41. 8	42. Minimazing the Initial Development Capital	43. $31{,}54X_1 + 6{,}59X_2 + 8{,}77X3 + 12{,}02X_4 + 9{,}54X_5 + 25{,}52X_6 + 28{,}01X_7 + 9{,}50X_8 + 8{,}43X_9 + 13{,}25X_{10} + 21{,}95X_{11} + 9{,}18X_{12} + 6{,}88X_{13} + 23{,}72X_{14} + n8 - p8 = 150$	44. Min p8	45. 0,10
46. 9	47. Maximizing the profit for the company	48. $7{,}89X_1 + 1{,}65X_2 + 2{,}19X3 + 3{,}00X_4 + 2{,}39X_5 + 6{,}38X_6 + 7X_7 + 2{,}37X_8 + 2{,}10X_9 + 3{,}31X_{10} + 5{,}49X_{11} + 2{,}3X_{12} + 1{,}72X_{13} + 5{,}93X_{14} + n9 - p9 = 37{,}5$	49. Min n9	50. 0,287

Table 10.
The Hard Constraints.

51. No	52. Constraints	53. Function
54. 1	55. Maximum limit of the number of projects selected	56. $X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{13} + X_{14} \leq 5$
57. 2	58. The project choice is an integer. The project is selected if it is 1, otherwise it is 0	59. $Xi \in (0,1)$

Table 11.
Selected Software Projects.

Alternatives	Decision Variable	Value
E-wallet development of savings and loan cooperatives	X_1	1,000
Android based QC application	X_2	0,000
E-Commerce API development with Ruby on Rails	X_3	0,000
CMS for Smart-TV development	X_4	0,000
Property Listing Web	X_5	0,000
Android-bases online ojek application	X_6	1,000
E-Commerce for Design Works	X_7	1,000
Online Shop Application with React Native	X_8	0,000
iOS-based streaming application	X_9	0,000
Web and Android Apps for Community	X_{10}	0,000
Overseas Money Transfer Application	X_{11}	1,000
School Information System	X_{12}	0,000
Emergency Information System	X_{13}	0,000
website framework for cross border e-commerce	X_{14}	1,000

With respect to:
i : software project which i=1,2,3….14
nk : Negative (*under achievement*)
pk : Positive variabel (*over achievement*)

Table 8 shown the decision variable used in this model.

- Objectives and Constraints

Table 9 shows each objective and its function for software project selection.
Table 10 shows the hard constraints of the model.

- Objective function

The most optimal solution from the goal programming method is to minimize the deviation value of the achievement vectors.

Minimize Z = 0,047 n1 + 0,07 n2 + 0,097 n3 + 0,073 n4 + 0,093 n5 + 0,078 p6 + 0,155 n7+ 0,010 p8 + 0,287 n9

The next step is to calculate the mathematical model using the LINGO software. Figure 2. below is the LINGO model used in accordance with the data above. Table 11 shows the alternatives result based on Figure 3.

Based on Table 11, the highlighted rows are five software project alternatives to be implemented that has considered the criteria and objectives above. Table 12 is the achievement of each objective based on the LINGO run result.Based on Table 12, is it known that there are three goals that are achieved and six goals that are not.

C. Sensitivity Analysis

The sensitivity test aims to review the stability of the results of selecting a software project if changes are made to the Right Hand Side (RHS) value of an objective function or

Table 12.
Goals Achievement Result.

Goal	Variable	Value	Conclusion
Maximizing the opportunity to learn new technology	n1	4	*Goal* isn't achieved
Maximizing the opportunity to create templates for the next project	n2	4	*Goal* isn't achieved
Maximizing the opportunity to get relations from a client	n3	0	*Goal* is achieved
Maximizing the value of the company's portfolio	n4	2	*Goal* isn't achieved
Maximizing the conformity with team capabilities	n5	2	*Goal* isn't achieved
Minimizing the risks involved	p6	4	*Goal* isn't achieved
Maximizing the potential development from the current scope	n7	0	*Goal* is achieved
Minimazing the Initial Development Capital	p8	0	*Goal* is achieved
Maximizing the profit for the company	n9	4.810	*Goal* isn't achieved

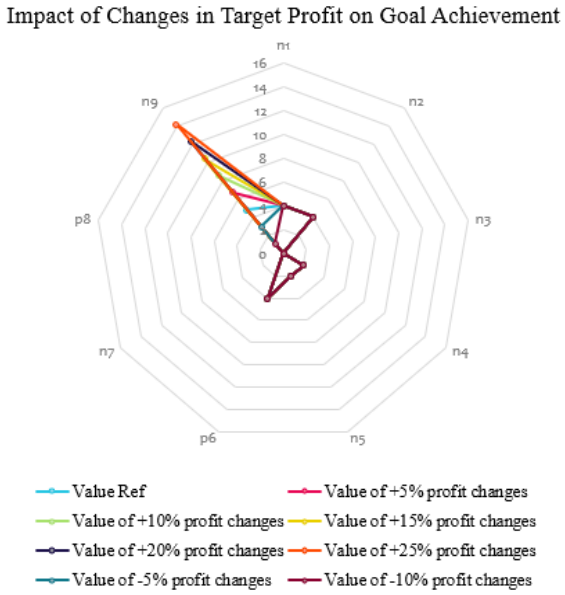

Figure 4. Impact of Changes in Target Profit on Goal Achievement

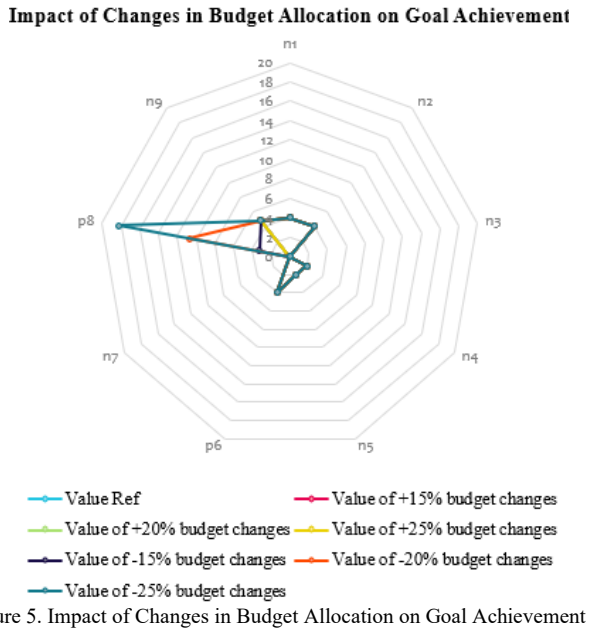

Figure 5. Impact of Changes in Budget Allocation on Goal Achievement

constraint. In this study, a changes conducted in profit target, budget limit, and in the weight of objective priorities.

- Changes in profit target

Table 13 shows the variances of the profit target and its effect to the solution.

As shown in Table 13, there is a change in solution when the target profit is changed by -25% while other changes do not affect the solution. These changes affect the achievement of goals as shown in Figure 4.

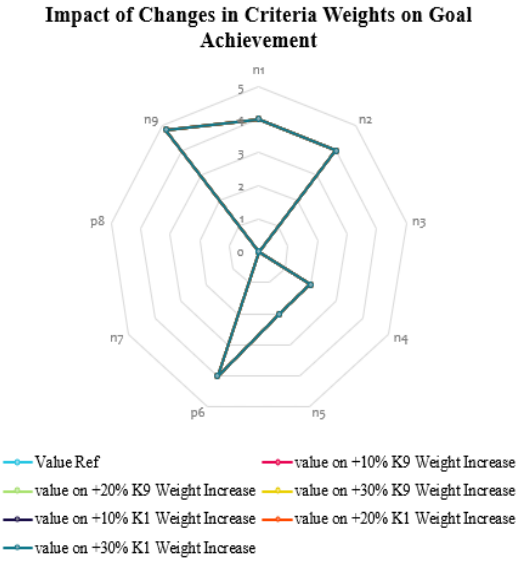

Figure 6. Impact of K1 and K9 Weight Changes on Goal Achievements.

As shown in Figure 4, changes in profit target only affect the achievement of objective 9 (variable n9) and do not provide any changes to the achievement of other goals.

- Changes in budget allocation

Table 13 shows the variances of the budget allocation and its effect to the solution.

As shown in Table 13, there is no change in solution when the target profit is changed by -25% to 25%. It implies that the solution relatively stable to the budget allocation changes by -25% to 25%. These changes affect the achievement of goals as shown in Figure 5.

The selected project solution is the same as before for changes in profit criterion (K9) weight of 10%, 20%, and 30%. It implies that the solution is relatively stable to the target profit criterion changes.

- Changes in the Weights of Opportunity to Learn New Technologies criterion (K1)

K1 is the lowest weight in this model. This study wants to know whether changes in its weight will affect the solution or not. Table 16 below shows the variance of the proft target weight.

The selected project solution is the same as before for changes in the K1 criterion weight of 10%, 20%, and 30%. It implies that the solution is relatively stable to the target profit criterion changes.

Figure 6 shows the impact of K1 and K9 weight changes on goal achievements.

As shown in Figure 6, there is only one line indicating that changes in K1 and K9 weight do not affect the goal achievements. The value remains the same as before, so the

Table 13.
Changes in Profit Target.

No	Profit Taget	% of Target Profit	Selected Alternatives
1	Rp28,125,000	-25%	1. E-wallet development of savings and loan cooperatives (X_1) 2. Property listing website (X_5) 3. Android-based online ojek application (X_6) 4. Overseas Money Transfer Application (X_{11}) 5. Website framework for cross border e-commerce (X_{14})
2	Rp30,000,000	-20%	1. E-wallet development of savings and loan cooperatives (X_1) 2. Android-based online ojek application (X_6) 3. E-Commerce for Design Works (X_7) 4. Overseas Money Transfer Application (X_{11}) 5. Website framework for cross border e-commerce (X_{14})
3	Rp31,875,000	-15%	
4	Rp33,750,000	-10%	
5	Rp35,625,000	-5%	
6	Rp37,500,000	0%	
7	Rp39,375,000	5%	
8	Rp41,250,000	10%	
9	Rp43,125,000	15%	
10	Rp45,000,000	20%	
11	Rp46,875,000	25%	

Table 14.
Changes in Budget Allocation.

No	Budget Allocation	% of Target Profit	Selected Alternatives
1	Rp112,500,000	-25%	1. E-wallet development of savings and loan cooperatives (X_1) 2. Android-based online ojek application (X_6) 3. E-Commerce for Design Works (X_7) 4. Overseas Money Transfer Application (X_{11}) 5. Website framework for cross border e-commerce (X_{14})
2	Rp120,000,000	-20%	
3	Rp127,500,000	-15%	
4	Rp135,000,000	-10%	
5	Rp142,500,000	-5%	
6	Rp150,000,000	0%	
7	Rp157,500,000	5%	
8	Rp165,000,000	10%	
9	Rp172,500,000	15%	
10	Rp180,000,000	20%	
11	Rp187,500,000	25%	

Table 15.
Changes in K9's Weight.

Criteria	Weight	Increased priority on criteria			Weight Changes
		10%	20%	30%	
Opportunity to learn new technology	4.70%	3.51%	2.31%	1.12%	-1.19%
Opportunity to create templates for the next project	7%	6%	5%	4%	-1.02%
Opportunity to get relations from a client	9.70%	8.27%	6.85%	5.42%	-1.43%
Increase the value of the company's portfolio	7.30%	5.35%	3.39%	1.44%	-1.95%
Conformity with team capabilities	9.30%	9.29%	9.27%	9.26%	-0.01%
The risks involved	7.80%	5.28%	2.77%	0.25%	-2.52%
Potential development from the scope of the project	15.50%	15.05%	14.60%	14.14%	-0.45%
Initial Development Capital	10%	9%	7%	6%	-0.01427
Profit for the company	28.70%	38.70%	48.70%	58.70%	10%

Table 16.
Changes in K1's weight

Criteria	Weight	Increased priority on criteria			Weight Changes
		10%	20%	30%	
Opportunity to learn new technology	4.70%	3.51%	2.31%	1.12%	-1.19%
Opportunity to create templates for the next project	7%	6%	5%	4%	-1.02%
Opportunity to get relations from a client	9.70%	8.27%	6.85%	5.42%	-1.43%
Increase the value of the company's portfolio	7.30%	17.30%	27.30%	37.30%	10.00%
Conformity with team capabilities	9.30%	9.29%	9.27%	9.26%	-0.01%
The risks involved	7.80%	5.28%	2.77%	0.25%	-2.52%
Potential development from the scope of the project	15.50%	15.05%	14.60%	14.14%	-0.45%
Initial Development Capital	10%	9%	7%	6%	-0.01427
Profit for the company	28.70%	26.75%	24.79%	22.84%	-1.95%

lines overlap on top of each other. Hexavara can use this model in any planning horizon. Hexavara only needs to replace the project alternatives with new alternatives and then reassess the criteria based on the assessment parameters in the model. Furthermore, the objective function in the model is adjusted to the results of the previous parameter assessment.

IV. CONCLUSION

Nine criteria and 14 project alternatives are considered in selecting software projects using the GP-AHP integration model. The five selected projects are e-wallet development of savings and loan cooperatives, android-based online ojek application, e-commerce for design works, overseas money transfer application, and website framework for cross border e-commerce. The decision model is not much influenced by changes in constraints and objective weights. The results of the sensitivity test show that the solution is relatively stable to changes of 10%, 20%, and 30% in the objective function with the largest weight (K9) and the smallest weight (K1). This also applies to changes in the value of the profit target (the most important criterion) and the allocation of initial development capital (another quantitative target besides the profit target). This research can be refined by considering the use of fuzzy number to represent a relatively subjective scale, conducting a sensitivity test for changes in the weight of each criterion, and adding trade-offs between objectives to further enrich the model.

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