Optimization of Weighted Product Methods for Choosing Internet Providers

Niken Dwi Nirma, Linda Perdana Wanti[a] and Riyadi Purwanto[b]
Department of Informatics, Politeknik Negeri Cilacap, Jl. Dr. Soetomo No.1, Cilacap, Central Java, Indonesia

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Abstract: The Internet is very much needed and important for most people in the digital era now. The problem that arises is that there is competition among internet providers to give the best service in fulfilling the user needs of internet access. This study optimizes Weighted Product (WP) decision-making method to choose the internet provider with the best service so that users can determine the provider to be used as needed. The criteria used to optimize the WP method are access speed, price, latency, validity period, provider credibility, and the amount of quota in each package. Extreme Programming (XP) is the system development used to build this decision support system. This study issues recommendations of internet provider that is produced by optimizing the WP method with various criteria used that has the highest preference value, thus it becomes a reference for the user to choose that provider to meet the needs of internet access.

1 INTRODUCTION

Every year internet card providers are competing to improve their quality. It can be improving the speed of access and latency or competing to attract the consumers attention by providing low prices and more internet quota (Marwa Sulehu, 2015). However, the Kubangkangkung area is a village that has slow internet access in all providers, thus requiring alternative criteria and ranking calculations to get the appropriate provider. The choice of internet providers in Kubangkangkung area, which is a highland region, encountered several problems, including the affordability of the signal, the speed of access, and competitive price. By considering several criteria that will be used to solve problems regarding the selection of internet providers in the Kubangkangkung area, a decision support system is created by optimizing the decision support method used, the WP method. The WP method was chosen to find solutions for the selection of internet providers because the method can display alternatives with the highest preferences weighted produced by multiplying the criteria attribute rating weights for each alternative involved that has been normalized in advance (Chourabi et al., 2019). Another reason is because the calculation time is more quickly completed, there are Cost and Benefit variables, which are useful for determining the weighting value for each criterion followed by an alternative ranking of internet provider cards in order to produce the best internet provider card. However, there are the criteria that must be included in the benefit group and ones that are included in the cost group. The criteria used are the speed of access for each existing client, the quota price for each internet provider, the amount of quota per each internet provider, signal strength or latency, the internet validity period and finally by K1 to K6. While the alternatives for those involved in this decision support system are 5 alternatives representing internet providers, namely Telkomsel, Smartfren, Indosat, XL, and Tri symbolized by R1 through R5.

The decision support system for choosing an internet provider has been carried out by several researchers. Previous research was make a decision support system for the selection of internet providers in STMIK AKBA. The method used to find solutions is the weighted product method. The problem faced by internet users at STMIK AKBA is to replace the internet provider that is now used by paying attention to several things such as connection type, maintenance, connection stability, access speed, price

[a] https://orcid.org/0000-0002-6679-2560
[b] https://orcid.org/0000-0001-7066-2905

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and etc. The results obtained are the chosen internet provider that will be used on the STMIK AKBA campus, namely icon + which gets a preference weight of 0.2650, among the three other internet providers namely Indihome with 0.2354, Indosat with a weight gained 0.2448 and Lintasarta with 0.2546 (Marwa Sulehu, 2015). Previous research was implemented the analytical method hierarchy process (AHP) to select internet providers using the criteria of cost, speed, package, needs and quota. Decision support system are made based on web with alternatives involved in weighting of six namely Indosat, Smartfren, Axis, XL, Tri, and Telkomsel. This study produces an internet provider recommendation that has been analysed using the AHP method with rank 1 to 6 in sequence, namely Telkomsel, Indosat, Tri, Smartfren, XL, Axis (Prasetyo et al., 2013). Previous research was analysed the selection of internet providers at PT. Pool Cargo Services that requires internet access in each of the company's operational activities. PT. Pool Cargo services require a decision support system that provides recommendations for an internet provider to support operational activities using several criteria used. The criteria used include internet provider credibility, customer satisfaction, security from internet providers and fees for each internet provider. The alternatives selected in this study were three namely speedy Telkom, First media, and CBN.net. The decision-making method used in research is AHP. The results obtained from the research conducted is a decision support system that produces recommendations from internet providers chosen by PT. Pool Services that is a speedy Telkom with a weight of 45.3% higher than the other two alternatives, each of which is First Media at 35.4% and CBN.Net at 19.3% (Amin, 2015).

The difference between this research and previous research is that alternatives involved in the decision of the best internet provider can later be used in the Kubangkangkung area. In addition to alternatives, the criteria used to obtain the best decision are six criteria. Optimization of the decision-making method that is the weighted product method is also a renewal of research conducted with previous studies. A selected alternative can be used as a recommendation for decision on previous calculations. By maximizing the function of the decision support system itself, the user can obtain a decision on a problem through calculations using the WP method.

2 DECISION SUPPORT SYSTEM

A computer-based system that are used to provide a recommended solution to the problem is called a decision support system. Decision support systems are also used with a variety of methods used to recommend a solution(L. et al Wanti, 2020)(Mamat et al., 2019). Solving previous problem decisions uses conventional methods without taking into account the decision-making criteria (L. P. Wanti et al., 2019) (Dweiri et al., 2017). After the existence of a decision support system, solutions are made with assistance of a computer device containing a decision support system while still taking into account the criteria and utilizing the decision making method to obtain a decision with the highest value or weight calculation (L. P. Wanti et al., 2020)(Zasada et al., 2017). Decision support system can be implemented in various ways such as the selection of internet providers.

2.1 Conceptual Model Decision Support System

The conceptual model of a decision support system consists of several main components including data management used for processing decision support systems that are taken and stored from a decision support system database (Abd Rahman et al., 2020). Then there is the management model that is used to develop a decision support system (Alyaev et al., 2019). Knowledge management to support the system created is like additional knowledge issued by the system when displaying the output of the developed decision support system (Putra et al., 2018). And lastly, there is a management interface that is used for interaction between end-users and the decision support system made (Irvanizam, 2017).

Figure.1 explains the conceptual model of decision support systems with databases, users and other computer-based systems. The figure also describes a flexible decision support system when connected to other computer-based systems that pay attention to output for the user through the design of the user interface and with the database which used both data from the system environment and data from outside the system (Alshibly, 2015) (Alyaev et al., 2019). The data used is then put into the data management section to be associated with the knowledge management and model management that can be used to obtain solutions (Chandra et al., 2019) (Putra et al., 2018).

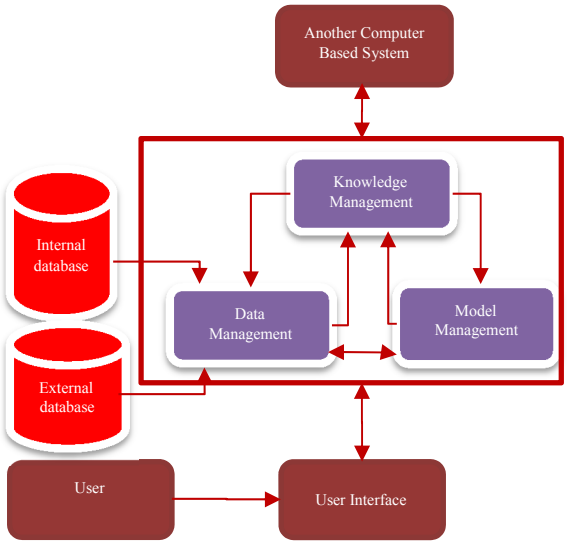

Figure 1: DSS Conceptual.

2.2 Weighted Product Method

The decision support system method used in the selection of internet providers is weighted product. The method is optimized to obtain the best internet provider decision results with six criteria used to determine the weight of each alternative involved(Ahsan, 2019)(Taufik, 2019). The WP method is easily adapted because of the simple step of multiplying each attribute rating and linking the attribute rating for each criterion used (Chourabi et al., 2019). It is done by first ranking each attributes by weighting the attribute criteria used and the alternatives involved (Khairina et al., 2016). The stages of the WP method are as follows:

- Specify alternative (Ri) i= 1,2,3..,n is object namely provider.
- Specify criteria (Kj) j= 1,2,3,…,n is criteria to choose provider.
- Calculate the criterion weight value (Wj) for selecting provider. Weight value in the selection of provider criteria values from the people in Kubangkangkung.

$$\sum_{j=1}^{n} Wj = 1 \quad (1)$$

- Calculate the value of Pi, Pi is the preference value for alternatives (Ri).

$$Pi = \prod_{j=1}^{n} Yij^{wj} \quad (2)$$

with i=1,2,3,…n

- Qi that is the vector value used to determine Ri ranking.

$$Qi = \frac{\prod_{j=1}^{n} Yij^{wj}}{\prod_{j=1}^{n} Yj^{wj}} \quad (3)$$

with i=1,2,3,…n

3 RESEARCH METHOD

The research method used to develop optimizing of WP methods for choosing internet providers is an extreme programming method. The extreme programming method is used because it is felt to be the most appropriate situation and conditions at the time of the development of this decision support system. System development must be quickly done by taking into account the needs of the system being analyzed in a short time, with a minimum risk that must be carried by the developer and equipped with flexibility which means the system can later be adapted and easy to implement (Roky & Meriouh, 2015) (Tolfo & Wazlawick, 2008). The object oriented approach when developing an internet provider selection decision support system is also one of the reasons for choosing extreme programming methods (Fojtik, 2011) (Pertiwi, 2018).

Figure.2 below is explains the stages of the XP method. System development starts with selecting all user needs to be implemented in the decision support system. After all user definitions are detailed, they break down and sort out each user's needs in plans for the tasks to be carried out and completed. At the planning stage of this task, the design modules of the internet provider selection decision support system are made and be integrated with the database used and the user interface in accordance with user needs at the beginning of the XP method process (Azdy & Rini, 2018) (Schneider & Johnston, 2005). After the system is finished, the resulting product is tested to determine deficiencies and improvements that must be done and adjusted for feedback from the test results recommended by testers or users who test this decision support system (Rahmi et al., 2016) (L. P. Wanti et al., 2021). After repairs are made, the product is in the final stage before being released and evaluated in case there is an error in the future when the product is implemented or when it is used (Supriyatna, 2018) (Gumelar et al., 2017).

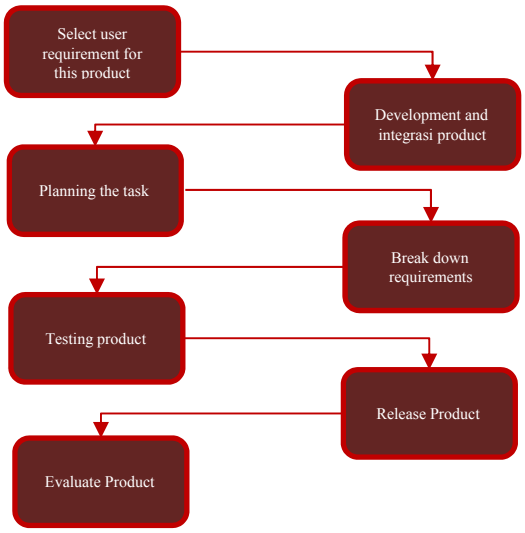

Figure 2: Extreme Programming.

4 RESULTS AND ANALYSIS

4.1 Alternative

The following is a list of alternatives that have been defined in this system which will later be used as alternative options to consider problem solving:

Table 1: Alternative.

Code alternative	Name alternative
R1	Telkomsel
R2	Smartfren
R3	Indosat
R4	Xl
R5	Tri

4.2 Criteria

There are six criteria in the provider selection decision support system, symbolized by K1, K2, K3, K4, K5, and K6. This criterion generate a weight value to measure how important the value of each criterion .The six criteria have the following values:

Table 2: Criteria.

Code criteria	Name criteria	Value	Type
K1	Internet access speed	5	Benefit
K2	Internet Package Prices	5	Cost
K3	Large Quota	4	Benefit
K4	Latency	4	Cost
K5	Internet Term	4	Benefit
K6	Credibility of the Provider	4	Benefit
∑ W		26	

4.3 The Criteria Weight Value

Calculate the normalized weight (Wj).

$$Wj=\frac{wj}{\sum wj} \quad (1)$$

$$W1=\frac{5}{\frac{5}{5+5+4+4+4+4}}=0.192 \quad (2)$$

$$W2=\frac{5}{\frac{5}{5+5+4+4+4+4}}=0.192 \quad (3)$$

$$W3=\frac{4}{\frac{4}{5+5+4+4+4+4}}=0.154 \quad (4)$$

$$W4=\frac{4}{\frac{4}{5+5+4+4+4+4}}=0.154 \quad (5)$$

$$W6=\frac{4}{\frac{4}{5+5+4+4+4+4}}=0.154 \quad (6)$$

The result of the of calculating the normalized weight values from the criteria table above by entering the weight value into the formula such as the calculations that have been done above, a result table is obtained below:

Table 3: Normalized Weight Of Criteria.

Code criteria	Criteria value	Normalized weight (Wj)
K1	0.192	0.192
K2	0.192	-0.192
K3	0.154	0.154
K4	0.154	-0.154
K5	0.154	0.154
K6	0.154	0.154

4.4 List of Alternative Values based on Criteria (Y_{ij})

Alternative involved in the decision process of choosing internet provider are 5 alternatives symbolized by R1, R2, R3, R4, and R5. R1 to R5 represents the providers that will be selected, namely Telkomsel, Smartfren, Indosat, XL, and Tri. The values for each alternative of each criterion can be seen in the following table:

Table 4: Weight of Each Alternative for Each Criteria.

Alternatife	Criteria					
	K1	K2	K3	K4	K5	K6
R1	7.615	65000	10	98	30	31.7
R2	1.710	80000	28	61	28	21.7
R3	5.485	85000	27	75	30	20
R4	5.635	67000	15	47	30	25
R5	5.125	60000	51	76	30	1.6

4.5 The Value Vector (P*i*)

$$Pi = \prod_{j=1}^{n} Yij^{Wj}, i = 1,2,3,\dots n \quad (1)$$

$$P1=(7.615^{0.192})(65000^{-0.192})(10^{0.154})(98^{-0.154})(30^{0.154})(31.7^{0.154})= 0.355 \quad (2)$$

$$P2=(1.71^{0.192})(80000^{-0.192})(28^{0.154})(61^{-0.154})(28^{0.154})(21.7^{0.154})=0.301 \quad (3)$$

$$P3=(5.485^{0.192})(85000^{-0.192})(27^{00.154})(75^{-0.154})(30^{0.154})(20^{0.154})= 0.358 \quad (4)$$

$$P4=(5.635^{0.192})(67000^{-0.192})(15^{0.154})(47^{-0.154})(30^{0.154})(25^{0.154})= 0.382 \quad (5)$$

$$P5=(5.125^{0.192})(60000^{-0.192})(51^{0.154})(76^{-0.154})(30^{0.154})(1.6^{0.154})= 0.282 \quad (6)$$

$$\sum Pi = 1.677 \quad (7)$$

The preference value Pi for alternative R1 based on Table 5 is 0.355, alternative R2 is 0.301, alternative R3 is 0.358, alternative R4 is 0.382, and alternative R5 is 0.284. The highest P1 value is obtained by alternative R4 which represents internet provider from XL with a preference weight of 0.358. The second rank is R3 which represents Indosat with a preference weight of 0.358, then Telkomsel which is R3 with a weight of 0.355 fourth is R2 with a preference weight of 0.301 which represents the internet provider Smartfren, and lastly, there is a provider from Tri which is an R5 with a weight of 0.282. Limitation of the criteria and the place taken may be a reference for readers or developers to develop this system by taking data in different places in the future.

Table 5: Value of Pi.

Alternatife	Criteria						Pi
	K1	K2	K3	K4	K5	K6	
R1	1.478	0.119	1.425	0.494	1.688	1.702	0.355
R2	1.109	0.114	1.670	0.531	1.670	1.605	0.301
R3	1.387	0.113	1.660	0.515	1.688	1.585	0.358
R4	1.394	0.118	1.517	0.553	1.688	1.641	0.382
R5	1.369	0.121	1.831	0.514	1.688	1.075	0.282
∑ Pi							1.677

Figure 3 below is the result of vector Pi calculations. Pi value is obtained by multiplying all the criteria weights for each alternative with positive rank weights for the criteria included in the benefit criteria group and negative rank weights for the criteria included in the cost criteria group by using two equation.

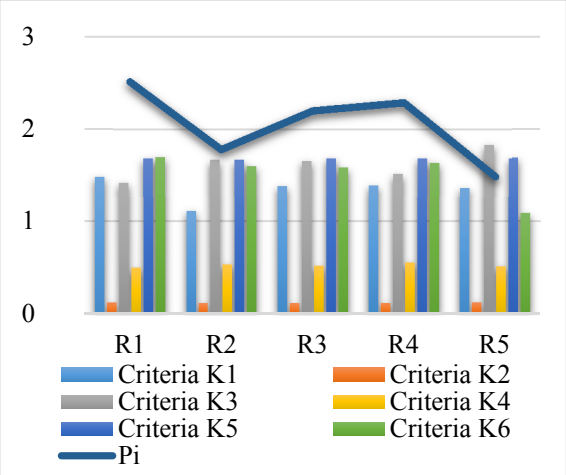

Figure 3: Preference Value of Each Alternative.

4.6 Ranking (Q*i*)

The final stage in the weighted product method is to calculate the value of Qi vector after previously having obtained the Pi vector in figure 3 divided by the number of Pi vectors which are then sorted by the highest value (Chourabi et al., 2019).

$$Qi = \frac{Pi}{\sum Pi} \quad (1)$$

$$Q1 = \frac{0.355}{1.677} = 0.211 \quad (2)$$

$$Q2 = \frac{0.301}{1.677} = 0.179 \quad (3)$$

$$Q3 = \frac{0.358}{1.677} = 0.213 \quad (4)$$

$$Q4 = \frac{0.382}{1.677} = 0.228 \quad (5)$$

$$Q5 = \frac{0.284}{1.677} = 0.168 \quad (6)$$

Table 6 shows the results of the calculation of the Qi vector value for each alternative R1 to R5 provider which is involved in the internet provider selection process against the criteria K1 to K6.

Table 6: Vector Qi.

Code alternative	Qi	Ranking
R1	0.211	3
R2	0.179	4
R3	0.213	2
R4	0.228	1
R5	0.168	5

The following is the final graph of determining the best alternative:

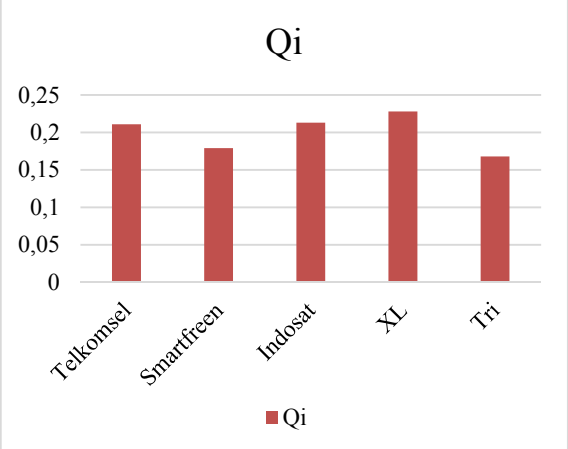

Figure 4: Grafik Value Vector Qi

5 CONCLUSIONS

Optimization of the weighted product method has resulted in a solution to the problem of selecting internet provider recommended for use in the Kubangkangkung area with a preference value vector Qi of 0.228. XL was chosen by using predetermined criteria and adjusted to the geographical situation and condition of the Kubangkangkung area. Among the second to fifth consecutive are Indosat with a preference value vector Qi of 0.213,Telkomsel with a preference value vector Qi of 0.211, Smartfren with a preference value vector Qi of 0.179 and in the distended position there is Tri provider with a preference value vector Qi of 0.168. This research has produced a decision support system for the selection of internet providers with the highest results of Telkomsel.

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