THE APPLICATION OF PROMETHEE AND BORDA METHODS FOR SELECTING BUSINESS LOCATION

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ABSTRACT

The development of a franchise business requires the opening of new branches to be able to expand the wider market in the community. The selection of a franchise's new location is a very decisive factor in the success of the franchise in the future. With the new location allows to increase the range, market and number of consumers. The object of research in this case is a retail franchise. The PROMETHEE method is used to manage individual decisions of each decision maker, while the Borda method is used to manage group decisions on the results of the PROMETHEE method ranking. The use of these two methods is one solution to produce more objective group decisions. Alternative ranking of this location is in accordance with the rules and policies and procedures for opening a new branch of a retail franchise. The variables in this study are facilities and infrastructure, crime, per capita income, economic growth, population and the number of retail franchises around the alternative location for opening the retail franchise branch. The results obtained from this study are location E or Endrosono area as the best alternative location.

Keywords: Decision support system; Selection of franchise locations; PROMETHEE, Borda

1. INTRODUCTION

In the world of franchising businesses are often faced with the problem of site selection for opening new branches. Site selection is an initial stage in the development and relocation of a company's business (Rikalovic, 2014). Choosing the right location can determine the success of the retail franchise in the future. Therefore, a decision-making process is needed in choosing alternatives that are available or provided (Boufounou, 1995). Taking decisions is one part of human activities that can be done in everyday life. In the decision-making process opening this new branch was carried out by several people who played an important role in the franchise. This is done to get the right location for opening a new branch of a retail franchise.

Determining the location of the new retail franchise branch requires an analysis of the criteria that will be used by decision makers. This is due to the process of selecting a location for opening a new retail franchise branch that has several criteria (multi criteria) for the location to be selected. The criteria for these criteria are related to the factors that support the smoothness and progress of the retail franchise. The location criteria commonly used in decision support systems for opening new retail franchise branches are generally industrial estate areas that have a higher economic level by looking at regional per capita income, crime rates, facilities and infrastructure, the number of retail franchises available, the number of residents, as well as the socio-economic life of the

surrounding population which will serve as the location for opening a new retail franchise branch (Boufounou, 1995).

Decision support system is a system used to assist in problem solving and decision support. In this study the PROMETHEE and Borda methods were used. Method of Preference Ranking Organizational Method for Enrichment Evaluation (PROMETHEE) is a method of determining sequence or priority in multicriteria analysis that offers a flexible and simple way for (decision makers) to analyze multicriteria problems (Doumpos, 2010). In the application of daily life the PROMETHEE method is often used in several aspects, including the fields of education, agriculture, government, and sports (Behzadiana, 2010). In the case of location selection for opening a new branch of the franchise the PROMETHEE method is used to make individual decision making. Individual decision making is done by each decision maker by providing input in the form of value or weighting on the criteria used. The PROMETHEE method is used in this study because this method is quite good in calculating the characteristics of the data and provides many functions that can accommodate various characteristics of the data (Akafpour, 2013). The Borda method uses preferential calculations to rank the inputs given by decision makers who have more than one alternative (Klamler, 2004). The Borda method in this study is used to accommodate the decisions of each decision maker resulting from the calculation of the PROMETHEE method. Calculations using bordering methods use weights on each ranking of each decision maker. The alternative choice with the top ranking position produced by each decision maker is given a higher value than the ranking below. By using this method, the

decisions made are wiser depending on the original ranking (Wu, 2011).

In this study using several criteria regarding the location to be chosen by several parties involved as an alternative location choice for opening a new retail franchise branch. Therefore, a group decision support system is needed to determine the location of opening a new retail franchise branch so that the resulting decision is the right and wise decision. Based on the explanation above, a group decision support system will be developed using the PROMETHEE and Borda methods for selecting locations for opening new retail franchise branches.

In the writing of this journal is also used a lot of literature as a reference to support the research conducted, such as including the following: Sistem pendukung keputusan seleksi calon Karyawan dengan metode promethee studi Kasus pamella group yogyakarta (Nurul Azizah, 2014), Sistem Pendukung Keputusan Kelompok Penentuan Dosen Berprestasi Di Universitas Muhammadiyah Purwokerto (Muhammad Hamka, 2014), Implementasi Metode Promethee Dalam Penentuan Penerima Kredit Usaha Rakyat (KUR) (Hanifah, 2015), Penerapan Metode Promethee Dalam Seleksi Beasiswa Mahasiswa Berprestasi (Eka Larasati Amalia, 2017), Sistem Pendukung Keputusan Pemilihan Dosen Terbaik Menggunakan Metode Promethee (Studi Kasus: Teknik Informatika Universitas Tanjungpura) (Sofhian, 2016), Group Decision Support System Untuk Pembelian Rumah Dengan Menggunakan Analytical Hierarchy Process (AHP) Dan Borda (Oei, 2013), A Group Decision Support System for Cooperative Multiple Criteria Group Decision Making (Bui, 1987), Decision Support Systems and Intelligent Systems 7th Ed.

(Turban, 2005), Pencarian Suatu Alternatif yang terbaik dengan metode Nilai Borda (Ratna, 2000).

This research is organized as follows, chapter 1 introduction, chapter 2 shows material and methodology, chapter 3 shows the results of data and discussion, chapter 4 conclusion.

2. MATERIAL/METHODOLOGY

2.1. Group Desicion Support System (GDSS) or commonly known as a group decision support system developed to provide assistance in group decision making (Brans J. V., 1986). The components of the GDSS consist of people (assessors / decision makers), and procedures. The procedure for GDSS is divided into three stages, namely:
Determination of alternatives and criteria
a. Evaluation by each decision maker
b. Group evaluation

2.2. PROMETHEE

PROMETHEE Method (Preference Ranking Organization Method for Enrichment Evaluation) is a method of determining sequence or priority in multicriteria analysis that offers a flexible and simple way for users (decision makers) to analyze multicriteria problems (Little, 1970).

The aim of PROMETHEE is to facilitate the decision-making process by grouping the types of decisions into six function criteria (preferences). The criteria for the criteria are:
a. General preference criteria
b. Quasi preference criteria
c. Linear preference criteria
d. Level preference criteria
e. Linear preference criteria and areas that are not different
f. Gaussian Criteria

Of the 6 types of preferences used in this study is the third preference type, namely linear preference type. **Figure 2.1** is a picture of a linear preference type.
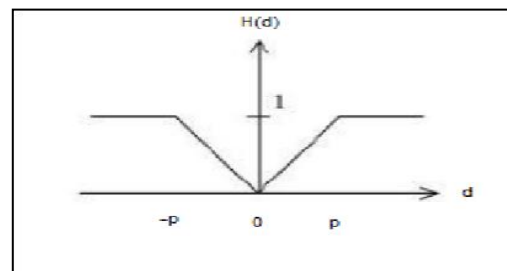
Figure 2.1 : Linier Preference Type

As long as the difference in value is lower than x, then the preference of the decision maker increases linearly with the value of m If the value of x is greater than the value of m, then absolute preference occurs.

$$p(x) = \begin{cases} x/m \text{ jika } x \leq m \\ 1 \text{ jika } x > m \end{cases} \quad (2.1)$$

Where,
x = difference in criteria value
$$(x = f(a) - f(b))$$

The calculation steps with the PROMETHEE method are as follows:
a. Determine several alternatives.
b. Determine several criteria.
c. Determine the criteria weight.
d. Determine the rules of assessment, where the rules of assessment have two types, namely: minimum or maximum.
e. Determine the type of preference for each criterion based on the data and

consideration of the decision maker. These types of preferences are Usual, Quasi, Linear, Linear Quasi, and Gaussian.

Calculate preference index

$$\pi(a, b) = \frac{1}{k} \sum_{h=1}^{k} P_h(a, b) \quad (2.2)$$

f. Leaving Flow, Entering Flow and Net Flow calculations

$$\phi^+(a = \sum_{x \in K} \pi\ a, x \quad (2.3)$$
$$\phi^-(a) = \sum_{x \in K} \pi(x, a) \quad (2.4)$$
$$\phi(a) = \phi^+(a) - \phi^-(a) \quad (2.5)$$

g. Ordering results from ranking (Brans J. a., 1985).

2.3. Borda

The Borda method was discovered by Jean-Charles de Borda in the 18th century. The Borda method is a method used to assign rankings to decision making preferentially. Borda method is used in group decision making to rank candidates who are based on the choices of each decision maker (Zarghami, 2011).

Borda method is one that can be used to accommodate the results of decision makers. Calculations on borders use weights at each ranking position produced by each decision maker. The alternative choice with the top ranking position is rated higher with the candidate in the next ranking position in a paired comparison. Calculation of the borda method as a group decision-making method to determine the best location for opening a new branch of the franchise based on the preferences of the decision-making group. The output of the calculation process uses the PROMETHEE method in the form of an alternative location to become the input of the Borda process.

Alternative locations are given N-1 points for each ranking level. The biggest point is obtained by alternative locations with the highest ranking most from decision-making groups (Wu, 2011).

2.4. Location Criteria

The criteria used in the decision support system for opening new retail franchise branches are: crime rates, facilities and infrastructure, per capita income, economic growth, population and number of retail franchises in the alternative locations for opening new retail franchise branches. The alternative locations used in this study are: A = Wonosari, B = Almost all, C = Wonokusumo, D = Edge, E = Endrosono.

2.5. Research Methodology

To solve problems in the observed research, steps are needed and determined to describe the approach and model of the problem. The steps taken are:
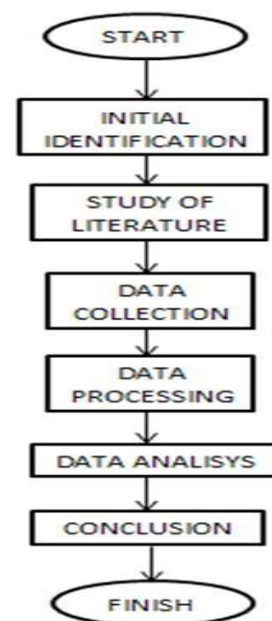
Fig. 2.2. Research Methodology Flowchart.

Target: the aim of this research is to produce a decision support system to determine the best new location in the development of a retail franchise. The stages can be explained as follows:

a. Defining the problem

Before a decision support system is built, problems in research must be precisely defined so that the results obtained are in accordance with the problems at hand.

b. Data collection.

Data collection was obtained by conducting a literature study of the PROMETHEE and Borda methods used in the study, as well as the variables and determining criteria for opening a new branch of a retail franchise from several literatures such as journals, books and other scientific sources related to and relevant to research.

c. Identification and processing of data

At this stage identification and processing of data that has been obtained will be carried out.

d. System Analysis and Design Perform analysis and system design according to the problems that have been identified. The Promethee method is used to generate individual location ranking by decision makers and the Borda method for group selection of the best retail franchise branches.

e. System Implementation

At this stage, the system will be implemented in accordance with the concepts that have been prepared in the previous stage.

f. System Testing

After the implementation of the process is complete then testing of the system that has been made. System testing is done to find out whether the system is made in accordance with the expected results or not. Tests are carried out in two stages, namely testing the system performance and testing the analysis calculation process. The system performance validation process is done by looking at the facts of the field or history with the output of the system. Final result obtained from the process of perankingan that is the summation of the matrix multiplication ternormalisasi, The last step provides suggestions for improvement and conclusion.

3. RESULT AND DISCUSSION

3.1. **Research result**. Applications created can be used by users using a browser. From the application it can be seen that there are differences in access rights, the assessor is the decision maker whose job is to provide an assessment of the criteria of each alternative location. Furthermore, the assessment is processed using the PROMETHEE method, so as to produce individual decisions. The manager is in charge of managing the results of individual decisions into group decisions using the Borda method. The results of ranking each decision maker then become input for the calculation process using the Borda method. While the admin serves as the manager of the system that performs the process of adding, changing and also storing. The criteria used in this study include: crime, facilities and infrastructure, per capita income, economic growth, population and number of banks available at each alternative location for opening a new retail

franchise branch. In Table 1 can be seen the results of the assessment given by the first decision maker (first Appraiser).

Table 1. The first table of evaluator's Criteria values

No	Criteria	A1	A2	A3	A4	A5
1.	Crime	45	70	50	75	90
2.	Infrastructure	20	40	23	20	60
3.	Per capita income	60	77	65	60	80
4.	Economic growth	15	40	20	45	60
5.	Total population	65	40	60	40	70
6.	Number of retail franchises	35	25	20	30	40

Table 2. is an assessment given by the second decision maker (second Appraiser).

Table 2. Table of values of the second assessment criteria.

No	Criteria	A1	A2	A3	A4	A5
1.	Crime	30	53	50	51	80
2.	Infrastructure	23	45	25	23	70
3.	Per capita income	70	80	70	65	85
4.	Economic growth	20	45	23	48	70
5.	Total population	70	45	65	40	73
6.	Number of retail franchises	35	41	20	42	40

Table 3 is an assessment given by the third decision maker (Third Appraiser).

Table 3. Table of values for the third assessment criteria

No	Criteria	A1	A2	A3	A4	A5
1.	Crime	50	60	40	50	70
2.	Infrastructure	25	50	30	25	75
3.	Per capita income	75	85	73	65	90
4.	Economic growth	25	50	25	50	90
5.	Total population	75	50	70	45	75
6.	Number of retail franchises	45	50	25	45	50

In this study the PROMETHEE method was used in determining the priority of the location of opening a new retail franchise branch. Each criterion that is owned by an alternative location will be compared with the criteria from other alternative locations. The preference type used is a linear preference type. Following is a case study for the first assessor to determine the location of opening a new retail franchise branch using the PROMETHEE method.

Table 4. Data on PROMETHEE calculations

Cri	W	Rule	A	B	C	D	E	T		P1	P2
k1	1	max	45	70	50	75	90	3	m	50	
k2	1	max	20	40	23	20	60	3	m	50	
k3	1	max	60	77	65	60	80	3	m	50	
k4	1	max	15	40	20	45	60	3	m	50	
k5	1	max	65	40	60	40	70	3	m	50	
k6	1	max	35	25	20	30	40	3	m	50	

Based on these data, the calculation is then performed using the PROMETHEE method. The calculation produces a preference index value. In Table 5 you can see the results of the first appraisal preference index value from each location alternative.

Table 5. Preference index values

Value Table $\pi(a_i, a_j)$				
	A	B	C	D	E
A	0	0,1167	0,0667	0,1000	0
B	0,2900	0	0,2467	0,1233	0
C	0,0600	0,0667	0	0,0933	0
D	0,2000	0,0500	0,2000	0	0

E	0,5333	0,3600	0,5400	0,4333	0

From the preference index value above, leavingflow, enteringflow, and netflow values can be obtained. This value can be seen in Table 6.

Table 6. Leavingflow, enteringflow, and netflow values

Preorder data Φ^+ & Φ^-						
Alternative Code	$\Phi+$	$\Phi-$	Φ	**Leaving Ranking**	**Entering Ranking**	**NetFlow Ranking**
A	0,2833	1,0833	-0,8000	4	1	4
B	0,6600	0,5933	0,0667	2	4	2
C	0,2200	1,0533	-0,8333	5	2	5
D	0,4500	0,7500	-0,3000	3	3	3
E	1,8667	0	1,8667	1	5	1

The ranking process for determining the alternative location for opening a new retail franchise branch is sorted by the largest to smallest netflow value. From Table 6 above it can be seen that location E is the most potential location for opening a new branch of the bank then after that B, D, A, and the last C. In the same way the data for the second appraiser after processing the PROMETHEE calculation produces location E is the most motivated location then B, D, C, and last A. Whereas for the third assessor produces the location E ranking as the most potential location, then next location B, A, D, and C.

From the results of individual decisions produced by each decision maker, then processing is done using the borda method. Borda calculations are used to manage group decisions from the rankings produced by each assessor so that the resulting decisions are more objective. The ranking results of each assessor can be seen in Table 7.

Table 7. Ranking of Individual Appraisers

Alternative	**PROMETHEE Ranking**		
	App 1	**App 2**	**App 3**
A1	4	5	3
A2	2	2	2
A3	5	4	5
A4	3	3	4
A5	1	1	1

From the above ranking, the Borda method is then calculated. Borda calculation is done by giving weight where the first rank gets the value of n-1, where n is the number of alternatives. Table 8 is the result of the Borda calculation produced.

Table 8. Borda ranking values

Alternative	**Borda**	
	Value	**Ranking**
A	3	4
B	9	2
C	1	5
D	5	3
E	12	1

From these results it can be seen that ranking group decisions using the borda method produces location E as the top priority, then B, D, A and C.

4. CONCLUSION

In this study a decision support system was established for the selection of the location for opening a new retail franchise branch using the PROMETHEE and Borda methods. The system created produces the same output with manual calculations and the reality of data in the field.

Each decision maker produces a ranking sequence using a different PROMETHEE method, which is then processed using the Borda method so that the final ranking results obtained are the result of group decisions. However, the decision to open the location remains entirely in the hands of the manager. The output shows that the alternative location that gets the highest ranking is at Location E, but in that area the retail franchise location was opened last year. This research only proves that the output of the system created produces the appropriate ranking for the recommendation of the location of opening a new retail franchise branch. Therefore the application in this study can be used to determine the recommendation for the location of opening the next branch.

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