Application of MCDM using PROMETHEE II Technique in the Case of Social Media Selection for Online Businesses.

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Abstract. Internet media has become one of the means of product promotion that has very good prospects today. The research aims to recommend the right social media for online businesses. The data collection method was conducted by interview and questionnaire to 300 respondents who conducted online business in Pematangsiantar city by random sampling. Based on the results of interviews and questionnaires obtained assessment criteria namely security (C1), application features (C2), community (C3), ease of access (C4) and response speed (C5). The alternatives used in this research are Facebook (A1), Instagram (A2), Line (A3) and WhatsApp (A4). The settlement method applied is a decision support system with the PROMETHEE II algorithm. The results of the algorithm show that the right alternative for doing online business is Facebook (A1) with a net flow of 0.25 and followed by WhatsApp (A4) with a net flow of ~0.1. The results of the study are expected to provide recommendations in conducting online business.

1. Introduction

The growing trend of the use of social media among the public and the development of internet technology, certainly brings quite encouraging opportunities for business people in general, this condition is supported by the advancement of mobile devices that are increasingly being used by the community. More creative among business people to take advantage of advances in cellular technology in running their business online. The development of the use of social media in Indonesia is growing rapidly. According to Nielsen's research, the growth rate of internet usage in Indonesia reached 26%. Indonesians spend 1.5 hours a day surfing the internet. According to ICT Watch, currently there are 180 million mobile phone users in Indonesia out of around 220 million Indonesians. Instagram users in Indonesia reached 22 million active users according to a press release received by CNN Indonesia [1]. Internet media has become one of the means of product promotion that has very good prospects at this time, where through the internet media sellers can reach consumers widely. Even now the internet has entered into various corners of the country, people who live far from cities can take advantage of this internet facility.
Based on Figure 1 that the data of internet users in previous years, there was a continued growth. In 2010 internet users in Indonesia were only 42 million users, compared to 2017 users, there was an increase of 3x within 7 years. This research was conducted in the city of Pematangsiantar which aims to recommend the right social media for online businesses, considering that Pematangsiantar City is one of the cities where consumers market their business products through social media. Besides the advantages gained in running an online business is the ease of finding information about products, prices, product selection or availability, pleasure, encouragement in the heart and customer service. Surely this has become positive for online businesses that have long been in the business. What if there are novice consumers who want to do business online but feel confused about choosing the right social media to use. Based on these hypotheses, researchers are interested in providing solutions to these problems. Many branches of computer science can solve complex problems both for predicting, estimating, ranking, classifying, associating and others. The branches of computer science are Artificial Intelligence such as datamining [2], [3], Decision Support Systems (SPK) [4]–[7], expert systems [8], Artificial Neural Networks (ANN) [9]–[11], fuzzy logic [12] and others.

Based on these problems, researchers used a decision support system with PROMETHEE II algorithm in solving these problems. Related research was carried out [1]. This study discusses the analysis of one social media on the formation of brand attachments. Research to be conducted is different from previous studies. The difference is in the settlement method used, the social media assessment criteria and the selection of more than one alternative for social media. It is expected that the results of the research can provide social media recommendations for online businesses, especially the pematangsiantar city community.

2. Methodology

2.1 Decision Support System

Decision Support System is a computer-based information system that approaches to produce various alternative decisions to help certain parties in dealing with problems [13], [14].

2.2 Social media

Social media is an online media, with its users can easily participate, share and create content including blogs, social networks, wikis, forums and the virtual world. Social media has the following characteristics:

a) The message delivered is not just for one person but can be many people for example messages via SMS or the internet;

b) The message is free, without having to go through a Gatekeeper;

c) The message conveyed tends to be faster than other media;

d) Recipient of the message that determines the interaction time [1].

2.3 PROMETHEE II (Preference Ranking Organization Methods for Enrichment Evaluation) Methods

PROMETHEE II is one of several methods for determining the order or priority in multicriteria analysis, which offers a flexible and simple way for users (decision makers) to analyze multi-criteria
problems. This method is able to accommodate the selection criteria that are quantitative and qualitative. The main problem is simplicity, clarity and stability [14].

2.4 Research Method
This study uses a Decision Support System (SPK) and Preference Ranking Organization Methods for Enrichment Evaluation (PROMETHEE II) conducted in Pematangsiantar City. The data collection process was carried out by interviewing and giving questionnaires to 300 respondents who conducted online business in the city of Pematangsiantar by random sampling. The assessment criteria used to choose the right social media for online business are security (C1), application features (C2), community (C3), ease of access (C4) and response speed (C5). Alternative social media used in the study are Facebook (A1), Instagram (A2), Line (A3) and WhatsApp (A4).

3. Results and Discussion
3.1 Alternative Determination Stage
In determining social media alternatives, the author uses 4 alternatives as shown in the following table:

| Table 1. Alternatives |
|-----------------------|
| Social Media | Information |
| Facebook | A1 |
| Instagram | A2 |
| Line | A3 |
| WhatsApp | A4 |

3.2 Criteria Determination Stage
The criteria used in the selection of the best social media for online businesses as shown in the following table:

| Table 2. Social Media Selection Criteria |
|-----------------------------------------|
| Criteria | Information | Alias |
| Criteria 1 | Security | C1 |
| Criteria 2 | Application Features | C2 |
| Criteria 3 | Community | C3 |
| Criteria 4 | Ease of Access | C4 |
| Criteria 5 | Response Speed | C5 |

3.3 Application of the PROMETHEE Method II
The following research data are used to carry out calculations using the PROMETHEE II method. Previously the data had been recapitulated using Microsoft Excel software. The following research data will be processed using PROMETHEE II:

| Table 3. Match Ratings of Each Alternative on Each Criteria |
|----------------------------------------------------------|
| Alias | Min/Max | Criteria | A1 | A2 | A3 | A4 |
|-------|---------|----------|----|----|----|----|
| C1    | Max     |          | 0.9| 0.7| 0.5| 0.9|
| C2    | Max     |          | 0.9| 0.9| 0.2| 0.7|
| C3    | Max     |          | 0.7| 0.7| 0.9| 0.7|
| C4    | Max     |          | 0.9| 0.7| 0.7| 0.9|
| C5    | Max     |          | 0.7| 0.9| 0.5| 0.7|

After determining the match rating for each alternative on each criterion, calculate the preference value. The following are the completion steps
### a. Step I: Calculate the Preference Value

The existing criteria will then be calculated as a value and preference index as follows:

#### Usual Criteria

1. **Security Criteria Value (C1)**

   
   \[
   \begin{array}{ll}
   C1(A1,A2) : & d = C1(A1) - C1(A2) \\
   & d = 0.9 - 0.7 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A2,A1) : & d = C1(A2) - C1(A1) \\
   & d = 0.7 - 0.9 \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C1(A1,A3) : & d = C1(A1) - C1(A3) \\
   & d = 0.9 - 0.5 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A3,A1) : & d = C1(A3) - C1(A1) \\
   & d = 0.5 - 0.9 \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C1(A1,A4) : & d = C1(A1) - C1(A4) \\
   & d = 0.9 - 0.9 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A4,A1) : & d = C1(A4) - C1(A1) \\
   & d = 0.9 - 0.9 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A2,A3) : & d = C1(A2) - C1(A3) \\
   & d = 0.7 - 0.2 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A3,A2) : & d = C1(A3) - C1(A2) \\
   & d = 0.5 - 0.7 \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C1(A2,A4) : & d = C1(A2) - C1(A4) \\
   & d = 0.7 - 0.9 \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C1(A4,A2) : & d = C1(A4) - C1(A2) \\
   & d = 0.9 - 0.7 \\
   & d > 0 \text{ then } H|d| = 1 \\
   
   C1(A3,A4) : & d = C1(A3) - C1(A4) \\
   & d = 0.5 - 0.9 \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C1(A4,A3) : & d = C1(A4) - C1(A3) \\
   & d = 0.9 - 0.5 \\
   & d > 0 \text{ then } H|d| = 1
   \end{array}
   \]

2. **Application Features Criteria Value (C2)**

   
   \[
   \begin{array}{ll}
   C2(A1,A2) : & d = C2(A1) - C2(A2) \\
   & d = 0.9 - 0.9 \\
   & d = 0 \\
   
   C2(A2,A1) : & d = C2(A2) - C2(A1) \\
   & d = 0.2 - 0.9 \\
   & d = -0.7 \\
   
   C2(A1,A3) : & d = C2(A1) - C2(A3) \\
   & d = 0.9 - 0.2 \\
   & d = 0.7 \\
   
   C2(A3,A1) : & d = C2(A3) - C2(A1) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A1,A4) : & d = C2(A1) - C2(A4) \\
   & d = 0.9 - 0.7 \\
   & d = 0.2 \\
   
   C2(A4,A1) : & d = C2(A4) - C2(A1) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A2,A3) : & d = C2(A2) - C2(A3) \\
   & d = 0.9 - 0.2 \\
   & d = 0.7 \\
   
   C2(A3,A2) : & d = C2(A3) - C2(A2) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A2,A4) : & d = C2(A2) - C2(A4) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A4,A2) : & d = C2(A4) - C2(A2) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A3,A4) : & d = C2(A3) - C2(A4) \\
   & d < 0 \text{ then } H|d| = 0 \\
   
   C2(A4,A3) : & d = C2(A4) - C2(A3) \\
   & d < 0 \text{ then } H|d| = 0
   \end{array}
   \]
3. Community Criteria Value (C3)

\[ C3(A1,A2) : \]  
\[ d = C3(A1) - C3(A2) \]  
\[ d = 0.7 - 0.7 \]  
\[ d = 0 \]  
\[ d = 0 \]  
\[ d = 0 \]  
\[ d = C3(A1,A2) \]  
\[ d = 0.2 \]  
\[ d = 0 \]  
\[ d = C4(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  
\[ d = C3(A1,A2) : \]  
\[ d = C3(A1) - C3(A2) \]  
\[ d = 0.7 - 0.7 \]  
\[ d = 0 \]  
\[ d = 0 \]  
\[ d = C3(A1,A2) \]  
\[ d = 0.2 \]  
\[ d = C3(A2) - C3(A1) \]  
\[ d = 0 \]  
\[ d = 0 \]  
\[ d = C4(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  
\[ d = C3(A2) - C3(A1) \]  
\[ d = 0.7 - 0.7 \]  
\[ d = 0 \]  
\[ d = 0 \]  
\[ d = C4(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  

4. Ease of Access Criteria Value (C4)

\[ C4(A1,A2) : \]  
\[ d = C4(A1) - C4(A2) \]  
\[ d = 0.9 - 0.7 \]  
\[ d = 0.2 \]  
\[ d = C4(A1,A2) \]  
\[ d = 0.2 \]  
\[ d = C4(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  
\[ d = C5(A1,A2) : \]  
\[ d = C4(A1) - C4(A2) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  
\[ d = C5(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  

5. Response Speed Criteria Value (C5)

\[ C5(A1,A2) : \]  
\[ d = C4(A1) - C4(A2) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]  
\[ d = C5(A2,A1) : \]  
\[ d = C4(A2) - C4(A1) \]  
\[ d = 0.7 - 0.9 \]  
\[ d = -0.2 \]  
\[ d = 0 \]
b. Step II: Calculate the Preferences Index

Alternative partner (A1,A2)
(A1,A2) = (1 + 0 + 0 + 1 + 0) = 2/5 = 0.4

Alternative partner (A2,A1)
(A2,A1) = (0 + 0 + 0 + 0 + 0) = 1/5 = 0.2

Alternative partner (A1,A3)
(A1,A3) = (1 + 1 + 0 + 1 + 1) = 4/5 = 0.8

Alternative partner (A3,A1)
(A3,A1) = (0 + 0 + 1 + 0 + 0) = 1/5 = 0.2

Alternative partner (A1,A4)
(A1,A4) = (0 + 1 + 0 + 0 + 0) = 1/5 = 0.2

Alternative partner (A4,A1)
(A4,A1) = (0 + 0 + 0 + 0 + 0) = 0/5 = 0

Alternative partner (A2,A3)
(A2,A3) = (1 + 1 + 0 + 0 + 1) = 2/5 = 0.4

Alternative partner (A3,A2)
(A3,A2) = (0 + 0 + 1 + 0 + 0) = 1/5 = 0.2

Alternative partner (A2,A4)
(A2,A4) = (0 + 1 + 0 + 0 + 1) = 2/5 = 0.4

Alternative partner (A4,A2)
(A4,A2) = (1 + 0 + 0 + 1 + 0) = 2/5 = 0.4

Alternative partner (A3,A4)
(A3,A4) = (0 + 0 + 1 + 0 + 0) = 1/5 = 0.2

Alternative partner (A4,A3)
(A4,A3) = (1 + 1 + 0 + 1 + 1) = 4/5 = 0.8

Following are the complete results of the Preference Index Value as shown in the following table:
c. Step III: Calculate PROMETHEE II

1. Calculate Leaving Flow

Then obtained:
A1 = 1 / (5-1) (0.4 + 0.8 + 0.2) = 0.35
A2 = 1 / (5-1) (0.2 + 0.4 + 0.4) = 0.25
A3 = 1 / (5-1) (0.2 + 0.2 + 0.2) = 0.15
A4 = 1 / (5-1) (0 + 0.4 + 0.8) = 0.3

2. Calculate Entering Flow

Then obtained:
A1 = 1 / (5-1) (0 + 0.2 + 0.2) = 0.1
A2 = 1 / (5-1) (0.4 + 0.2 + 0.4) = 0.25
A3 = 1 / (5-1) (0.8 + 0.4 + 0.8) = 0.5
A4 = 1 / (5-1) (0.2 + 0.4 + 0.2) = 0.2

Following are the complete results of Leaving Flow and Entering Flow calculations as shown in the following table:

| Social Media | Leaving Flow | Entering Flow |
|--------------|--------------|---------------|
| Facebook     | 0.35         | 0.1           |
| Instagram    | 0.25         | 0.25          |
| Line         | 0.15         | 0.5           |
| Whatsapp     | 0.3          | 0.2           |

Based on net flow from table 5 above, then you can get a ranking of each social media alternative for online business. The alternative with the largest net flow is the alternative with the top ranking. If the alternative is minus, it means the value of entering flow is greater than leaving flow, this means that the comparison of some of the criteria is not better. As for the social media alternative for Facebook's highest online business (A1) with a net flow of 0.25.
4. Conclusion

Based on these results it can be concluded that the PROMETHEE II method can be applied in selecting the right social media for online businesses with the highest ranking results Facebook (A1) with net flow 0.25 and followed by whatsapp (A4) with net flow = 0.1.

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