Determining the Best Location of Cash Recycle Machine using Simple Additive Weighting Method

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Abstract. CRM as a new technology in the present, is projected as a replacement for ATM in the future and is expected to increase efficiency by reducing charging operational costs and providing money for ATMs. Currently the spread of CRM is not as much as the location of ATMs because the price is more than three times the price of the ATM. This study aims to help decision makers in choosing the best CRM location from existing ATM locations. This study applies the Simple Weighting Additive (SAW) method using productive existing ATM data in Bandung, which is a productive ATM and located in offices. From the calculation by referring to the criteria for the average number of ATM transactions, the distance to the market or shops, the distance to the cash manager branch office, the number of Brilink agents around the location and the level of location security, the best locations to be placed for CRM are obtained through an effective calculation and right that can help facilitate decision makers.

1. Introduction

Banking is currently trying to develop a Cash Recycle Machine (CRM), an automated teller machine that can be used to save and withdraw cash at the same time. This CRM is designed to replace organic tellers while also replacing the Automatic Teller Machine (ATM) which is currently very much spread in various locations. The use of CRM is expected to increase efficiency by reducing charging operational costs and providing money for ATMs. However, the price of CRM machines is still expensive, which is about three times the current ATM price, an accurate strategy in its placement is needed so that it can satisfy the customer in conducting transactions and generate exceptional fee-based income for the company.

According to Fishburn and MacCrimon in Kusumadewi (2006: 74) [1] "the SAW method is often also known as the weighted sum method. The basic concept of the SAW method is to find a weighted sum of performance ratings on each alternative on all attributes ". The SAW method requires the process of normalizing the decision matrix (X) to an existing scale.

In the previous research, it is conducted on the selection of business location facilities using the Analytical Hierarchy Process (AHP) and Technique for order preference similarity to ideal solution
(TOPSIS) [2]. DSS is an interactive computer-based system that helps decision makers utilize data and models to solve a problem [3]. There are several methods in DSS, one of which is the Simple Additive Weighting (SAW) method.

Previous research has also been carried out using the SAW method but using different case, namely research conducted by Fajar Nugraha on asset management [4] and Raymond's research on ranking the choice of waste management in uncertain conditions [5] The purpose of this study is to apply the Simple Additive Weighting method in determining the best location for CRM

2. Method

2.1. Collecting Data Method

In conducting research to obtain data and information, the methods used in the data collection process are carried out as follows:

2.1.1. Observation

In this case is to find out and analyze the problems that exist in the Operational Section, Network and Services of Bandung BRI Regional Offices, which are closely related to the object under study, namely determining the location of the new CRM development.

2.1.2. Library Study Method

The method used is to find material that supports the problem definition through books, the internet, which is closely related to the object of the problem.

2.1.3. Interview Method

This method is done by interviewing employees and staff in the Operational, Network and Service Areas of BRI Regional Offices in Bandung.

2.2. Data Analysis Method

The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all available alternative ratings. This method is the most well-known and most widely used method in dealing with Multiple Attribute Decision Making (MADM) situations. MADM itself is a method used to find optimal alternatives from a number of alternatives with certain criteria.

This SAW method requires decision makers to determine the weight for each criterion. The total score for alternatives is obtained by summing all the multiplication results between the ratings (which can be compared across criteria) and the weight of each criterion. The rating of each criterion must be dimension free in the sense that it has passed the previous matrix normalization process.

The steps of the SAW Settlement are as follows:

1. Determine the criteria that will be used as a reference in making decisions, namely Ci.
2. Determine the suitability rating of each alternative on each criterion.

3. Make a decision matrix based on criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of criteria (profit criteria or cost criteria) so that the normalized R matrix is obtained.

4. The final result is obtained from the ranking process, namely the sum of the multiplications of normalized matrices R with the weight vector so that the largest value is chosen as the best alternative (Ai) as a solution.

The formula for normalizing is:

\[
R_{ij} = \begin{cases} 
\frac{X_{ij}}{\text{Max } X_{ij}} & \text{if } j \text{ is benefit attribute} \\
\frac{X_{ij}}{\text{Min } X_{ij}} & \text{if } j \text{ is cost attribute}
\end{cases}
\]

Where:
- \(R_{ij}\) = matrix R of the normalized performance rating
- \(\text{Max } X_{ij}\) = the maximum value of each row and column of the X matrix
- \(\text{Min } X_{ij}\) = the minimum value of each row and column of the X matrix
- \(X_{ij}\) = row and column of matrix X

With \(R_{ij}\), the performance rating is normalized from the alternative Ai in the Cj criteria with i = 1, 2, ..., m and j = 1, 2, ..., n.

The preference value for each alternative (Vi) is given as:

\[
V_i = j R_{ij}
\]

Where:
- \(V_i\) = Final value of alternative; with i = 1, 2, ..., etc.
Wj = predetermined weight
Rij = matrix of normalized performance rating
A larger Vi value indicates that the alternative Ai is more chosen.

3. Results and Discussions

To make a decision, there are several objects to be discussed including goals, criteria, and alternatives. The alternative in this study is 30 (thirty) exit ATM locations which will later be replaced with CRM. Following are some of the criteria needed for measure and assess the best ATM locations, including (see Figures 1 – 3):

The preference weight is given as follows:
1. W1 = ATM Transaction (20%) = 0.20
2. W2 = Distance to market (30%) = 0.30
3. W3 = Distance with the office of cash management branch (15%) = 0.15
4. W4 = The closest number of Brilink agents (20%) = 0.20
5. W5 = Empathy (15%) = 0.15

Table 1. Compatibility of Criteria in Alternatives

| Alternative / Criteria | ATM Transaction | Distance to the Market | Distance to Branches Office | Amount of Brilink agent surround | Level of security |
|------------------------|-----------------|------------------------|----------------------------|---------------------------------|------------------|
| KODIKTAT               | 188.04          | 1                      | 1                          | 1                               | 4                |
| KUPPUS DIRKUAD         | 209.32          | 2                      | 2                          | 1                               | 4                |
| POLDA JABAR            | 222.82          | 1                      | 1                          | 1                               | 4                |
| BHAYANGKARA SARTIKA    | 226.75          | 2                      | 2                          | 1                               | 4                |
| KANTOR BPKP            | 234.39          | 2                      | 2                          | 3                               | 2                |
| GEDUNG MULIA MITRA    | 240.07          | 2                      | 2                          | 5                               | 3                |
| PT. INTI               | 241.32          | 1                      | 1                          | 7                               | 2                |
| PT. KAI (DAOP 2)       | 290.07          | 1                      | 1                          | 2                               | 3                |
| GEDUNG WARME           | 299.07          | 2                      | 2                          | 3                               | 3                |
| PT. INTI (PERSERO)     | 312.21          | 1                      | 1                          | 7                               | 2                |
| Alternative / Criteria | ATM Transaction | Distance to the Market | Distance to Branches Office | Amount of Brilink agent surround | Level of security |
|------------------------|-----------------|------------------------|---------------------------|---------------------------------|-------------------|
| LANUD SULAIMAN BDG     | 343.36          | 1                      | 1                         | 2                               | 4                 |
| LANUD SULAIMAN 2       | 346.36          | 1                      | 1                         | 2                               | 4                 |
| NUSANTARA TURBIN P     | 351.68          | 5                      | 5                         | 1                               | 4                 |
| DITAJENAD              | 384.54          | 2                      | 2                         | 2                               | 4                 |
| PINDAD                 | 392.57          | 1                      | 1                         | 9                               | 3                 |
| SESKOAD                | 405.11          | 1                      | 1                         | 2                               | 4                 |
| AA. MULYA MITRA        | 182.89          | 2                      | 2                         | 5                               | 3                 |
| PENGADILAN TINGGI      | 254.79          | 1                      | 1                         | 1                               | 4                 |
| PUSDIKU                | 211.54          | 2                      | 2                         | 1                               | 4                 |
| BALAI DIKLAT KEAGAMAAN | 181.00          | 3                      | 3                         | 3                               | 2                 |
| BPJS KESEHATAN         | 272.32          | 2                      | 2                         | 3                               | 2                 |
| PUSAT PENDIDIKAN BAKTI ASIH | 283.86    | 2                      | 2                         | 1                               | 2                 |
| PUSDIKMIN POLRI        | 288.82          | 2                      | 2                         | 5                               | 4                 |
| YON ZIPUR              | 289.86          | 1                      | 1                         | 4                               | 4                 |
| BULOG KW JABAR         | 333.25          | 3                      | 3                         | 1                               | 3                 |
| SESKOAD                | 341.18          | 1                      | 1                         | 1                               | 4                 |
| PUSENIF                | 575.50          | 1                      | 1                         | 8                               | 4                 |
| KEMENAG KOTA BANDUNG   | 228.68          | 2                      | 2                         | 3                               | 3                 |
| KANTOR BBPP LEMBANG    | 268.54          | 3                      | 3                         | 1                               | 2                 |
| KOMPLEK SECAPA AD      | 297.50          | 2                      | 2                         | 1                               | 4                 |
| Alternative / Criteria | ATM Transaction | Distance to the Market | Distance to Branches Office | Amount of Brilink agent surround | Level of security |
|------------------------|----------------|------------------------|-----------------------------|----------------------------------|------------------|
| KODIKTAT               | 0.33           | 1.00                   | 1.00                        | 0.11                             | 1.00             |
| KUPPUS DIRKUAD         | 0.36           | 0.50                   | 0.50                        | 0.11                             | 1.00             |
| POLDA JABAR            | 0.39           | 0.50                   | 0.50                        | 0.11                             | 1.00             |
| BHAYANGKARA SARTIKA    | 0.39           | 0.50                   | 0.50                        | 0.11                             | 1.00             |
| KANTOR BPKP            | 0.41           | 0.50                   | 0.50                        | 0.33                             | 0.50             |
| GEDUNG MULIA MITRA     | 0.42           | 0.50                   | 0.50                        | 0.56                             | 0.75             |
| PT. INTI               | 0.42           | 1.00                   | 1.00                        | 0.78                             | 0.50             |
| PT. KAI (DAOP 2)       | 0.50           | 1.00                   | 1.00                        | 0.22                             | 0.75             |
| GEDUNG WARME           | 0.52           | 0.50                   | 0.50                        | 0.33                             | 0.75             |
| PT. INTI (PERSERO)     | 0.54           | 1.00                   | 1.00                        | 0.78                             | 0.50             |
| LANUD SULAIMAN BDG     | 0.60           | 1.00                   | 1.00                        | 0.22                             | 1.00             |
| LANUD SULAIMAN 2       | 0.60           | 1.00                   | 1.00                        | 0.22                             | 1.00             |
| NUSANTARA TURBIN P     | 0.61           | 0.20                   | 0.20                        | 0.11                             | 1.00             |
| DITAJENAD              | 0.67           | 0.50                   | 0.50                        | 0.22                             | 1.00             |
| PINDAD                 | 0.68           | 1.00                   | 1.00                        | 1.00                             | 0.75             |
| SESKOAD                | 0.70           | 1.00                   | 1.00                        | 0.22                             | 1.00             |
| AA. MULYA MITRA        | 0.32           | 0.50                   | 0.50                        | 0.56                             | 0.75             |
| PENGADILAN TINGGI      | 0.44           | 1.00                   | 1.00                        | 0.11                             | 1.00             |
| PUSDIKU                | 0.37           | 0.50                   | 0.50                        | 0.11                             | 1.00             |
| BALAI DIKLAT KEAGAMAAN | 0.31           | 0.33                   | 0.33                        | 0.33                             | 0.50             |
| BPJS KESEHATAN         | 0.47           | 0.50                   | 0.50                        | 0.33                             | 0.50             |
| PUSAT PENDIDIKAN BAKTI ASIH | 0.49 | 0.50               | 0.50                        | 0.11                             | 0.50             |
| PUSDIKMIN POLRI        | 0.50           | 0.50                   | 0.50                        | 0.56                             | 1.00             |
| Alternative / Criteria | ATM Transaction | Distance to the Market | Distance to Branches Office | Amount of Brilink agent surround | Level of security |
|------------------------|-----------------|------------------------|-----------------------------|---------------------------------|------------------|
| YON ZIPUR              | 0.50            | 1.00                   | 1.00                        | 0.44                            | 1.00             |
| BULOG KW JABAR         | 0.58            | 0.33                   | 0.33                        | 0.11                            | 0.75             |
| SESKOAD                | 0.59            | 1.00                   | 0.33                        | 0.11                            | 1.00             |
| PUSENIF                | 1.00            | 1.00                   | 1.00                        | 0.89                            | 1.00             |
| KEMENAG KOTA BANDUNG   | 0.40            | 0.50                   | 0.50                        | 0.33                            | 0.75             |
| KANTOR BBPP LEMBANG    | 0.47            | 0.33                   | 0.33                        | 0.11                            | 0.50             |
| KOMPLEK SECAPA AD      | 0.52            | 0.50                   | 0.50                        | 0.11                            | 1.00             |

**Table 3. Normalization of Matrices**

| Rank | Result | Percentage | Location             |
|------|--------|------------|----------------------|
| 1    | 0.98   | 97.78%     | PUSENIF              |
| 2    | 0.90   | 89.89%     | PINPAD               |
| 3    | 0.79   | 78.96%     | YON ZIPUR            |
| 4    | 0.79   | 78.91%     | PT. INTI (PERSERO)   |
| 5    | 0.79   | 78.52%     | SESKOAD              |
| 6    | 0.76   | 76.48%     | LANUD SULAIMAN 2     |
| 7    | 0.76   | 76.44%     | PT. INTI             |
| 8    | 0.76   | 76.38%     | LANUD SULAIMAN BDG   |
| 9    | 0.74   | 74.08%     | SESKOAD              |
| 10   | 0.71   | 71.08%     | PENGADILAN TINGGI    |
| 11   | 0.71   | 70.78%     | PT. KAI (DAOP 2)     |
| 12   | 0.70   | 69.97%     | POLDA JABAR          |
| 13   | 0.69   | 68.76%     | KODIKTAT             |
| 14   | 0.59   | 58.65%     | PUSDIKMIN POLRI      |
| 15   | 0.55   | 55.31%     | DITAJENAD            |
| Rank | Result | Percentage | Location                  |
|------|--------|------------|----------------------------|
| 16   | 0.53   | 53.20%     | GEDUNG MULIA MITRA         |
| 17   | 0.51   | 51.22%     | AA. MULYA MITRA            |
| 18   | 0.51   | 50.81%     | GEDUNG WARME               |
| 19   | 0.50   | 50.06%     | KOMPLEK SECAPA AD          |
| 20   | 0.48   | 48.36%     | KEMENAG KOTA BANDUNG       |
| 21   | 0.48   | 47.60%     | BHAYANGKARA SARTIKA        |
| 22   | 0.47   | 47.07%     | PUSDIKU                    |
| 23   | 0.47   | 47.00%     | KUPPUS DIRKUAD             |
| 24   | 0.46   | 46.13%     | BPJS KESEHATAN             |
| 25   | 0.45   | 44.81%     | KANTOR BPKP                |
| 26   | 0.42   | 42.09%     | PUSAT PENDIDIKAN BAKTI ASIH|
| 27   | 0.40   | 40.05%     | BULOG KW JABAR             |
| 28   | 0.38   | 38.44%     | NUSANTARA TURBIN P         |
| 29   | 0.35   | 35.46%     | BALAI DIKLAT KEAGAMAAN     |
| 30   | 0.34   | 34.05%     | KANTOR BBPP LEMBANG        |

4. Conclusion

The results of this study aim that the Simple Additive Weighting method can help in determining the best location for offsite CRM more easily, quickly and precisely from several prospective CRM locations that were previously ATM locations.

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