Decision support system for neglected elderly social assistance recipients using the Weighted Product method

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Abstract. Among the people of Indonesia is an aging society, with an elderly population of around 20 million people, or 8% of the total population. The data is the governments concern to provide assistance proposals. In the process of proposing assistance, this is still done by checking one by one the documents of prospective beneficiaries and matching them with existing criteria. This method requires quite a long time and makes an error because of subjectivity. The purpose of this study was carried out to implement the Weighted Product (WP) method into a decision support system that can determine the priority proposals for recipients of neglected elderly social assistance. RUP (Rational Unified Process) used in the software development method. The final results of this study obtained a decision support system that can assist in the process of determining the ranking of recipients of abandoned social assistance proposals by using the WP method that gets an accuracy of 76.74%.

1. Introduction
Among the people of Indonesia is an ageing society, with an elderly population of around 20 million people or 8% of the total population [1]. But most of the elderly population has a very limited income level. It can even be projected that the elderly population over 60 years will reach 70 million people, or 21% of the population by 2050 [1], as well as the lack of economic protection for elderly citizens who need serious policy considerations. In Indonesia, there are only 11% of elderly people who receive pension funds. Most of them are retired Civil Servants and the military. In 2006, Indonesia created its first cash assistance program which only focused on elderly citizens, the Elderly Social Assistance (ASLUT). In 2013, ASLUT was run in all provinces in Indonesia and currently supports around 30,000 poor and disabled beneficiaries over the age of 65 with cash assistance of IDR. 200,000 per month [2]. In a person's life-changing ageing is a natural and certain thing, because every living thing, especially humans, of course, there are times where being children, adolescents, adults, and growing old is an absolute decision as a human being. Most people who have entered the elderly or elderly, sometimes they feel their life is no longer fully useful and physical and their organs some of them do not have a function anymore, but having an advanced age phase in life requires a sense comfort [3].

The social security program, which is a part of the social assistance program, is a form of responsibility held by the regional government for concern in communities that have poor and neglected conditions. A program is a form of implementation of the 1945 Constitution Article 34 paragraph (1)
which informs that the poor are maintained by the State [4]. Elderly according to the Decree of the Minister of Social Affairs R.I number HUK. 3-1-50 / 107 in 1971, a person is declared as an old person or elderly after the person reaches the age of 55 years, does not have the strength to provide for himself and meet their daily needs so that they only receive a living from others [5].

One of the causes of the uneven distribution of government assistance is due to inaccurate data due to data management that is still conventional (manual) [6]. So that in the process of determining the ASLUT recipient is still done in the subjective form and adjusted or matched one by one with the existing criteria so that there may be errors in determining it.

For this reason, it is necessary to design an automated application system that can assist government agencies in determining the decision support for the elderly. Computer-Based Information System (Computer Based Information System) where one of them is a Decision Support System (Decision Support Systems) is a computer-based information system that is well-connected (interaction) and can provide alternative solutions for decision-makers [7].

Decision Support System (DSS) expressed by Alter is the Decision Support System (DSS) is an interactive information system in providing information, modelling, and manipulating data. The system is certainly used as a form of assisting in deciding on a definite situation how decisions should be made [8]. The choice of Weighted Product (WP) method is also based on its ability to provide an optimal solution for a decision support system. The choice of these methods also based on computational complexity has a level of difficulty not too difficult so it requires time and obtains relatively short calculation [8]–[11].

Based on the explanation above, a decision support system is needed to determine the eligibility of the recipient Social Abused Elderly Assistance (ASLUT) by making criteria and weights based on age, income, previous help status, health condition, house condition, and status of residence. The purpose of this assistance is to ease the burden on the lives of the elderly. Then from the application system researchers can build a system that produces recommendations or alternative decision support systems that are right on target and transparency. then built a system that uses the Weighted Product method to obtain the expected final results. The system is entitled "Decision Support System for Displaced Elderly Social Assistance Recipients Using the Weighted Product Method".

2. Methods

In conducting this research, researchers used a scientific approach that is research-based on scientific and technological approaches where the data obtained were obtained from interviews, observations, study literature and documentation. Then the method used in software development, the researchers used the Relational Undefined Process (RUP) method. Relational Undefined Process is an iterative software approach to software, which focuses on architecture (architecture-centric), and is more directed based on use case driven. The Relational Undefined Process has four stages: Inception, Elaboration, Construction and Transition. The use of the Rational Unified Process method then collaborates with the use of the Weighted Product (WP) method, which is one of the multi-criteria decision-making methods. The Weighted Product method evaluates several alternatives to a set of attributes/criteria, where each attribute does not depend on one another. In the Weighted Product method, the use of multiplication as a form of linking attribute ratings, in the rating condition each attribute must be raised first with the corresponding attribute weights. This process can be said to be the same as normalization [7], [12]. The stages

2.1. Determine the criteria

These criteria will later be used as a benchmark in decision making, namely Ci and the nature of each criterion.

2.2. Normalizing Weights

At this stage, the weighting is done early, so that the total weight $\sum W = 1$. By:
\[ W_j = \frac{W_j}{\sum W_j} \]

Where: \( W_j \): Attribute Weight
\( \sum W \): Addition of Weight of Attributes

2.3. Determining the Vector Value of S

At this stage, there is a way to multiply all parameters or criteria for each alternative with the weight as a positive rank for the benefit criteria and the weight functions as a negative rank in the criteria. Has the following formula:

\[ S_i = \prod_{j=1}^{n} X_{ij} W_i \]

Where:
- \( S \): Express alternative preferences described as vector \( S \)
- \( X \): criteria value
- \( W \): Weights criteria
- \( i \): alternative
- \( A \): Criteria
- \( n \): Number of criteria

2.4. Determining Vector V Values

It is determined by determining the vector value to be used to calculate Preferences (\( V_i \)) for grading. Has the following formula:

\[ V_i = \frac{\prod_{j=1}^{n} X_{ij} W_j}{\prod_{j=1}^{n} (X_j \ast \ast) W_i} \]

Where:
- \( V \): describes alternative preferences described as vector \( V \)
- \( X \): criteria value
- \( W \): Weight of criteria
- \( i \): alternative
- \( j \): Criteria
- \( n \): Many criteria

In the context of this study, the Weighted Product method is used to analyze elderly people who are entitled to receive social assistance for displaced elderly based on criteria and weights (table 1).

| Initials | Criteria                  | Weight |
|----------|---------------------------|--------|
| C1       | Age                       | 5      |
| C2       | Income                    | 4      |
| C3       | Previous Help Status      | 1      |
| C4       | Health condition          | 3      |
| C5       | House Conditions          | 2      |
| C6       | Status of Residence       | 2      |
3. Results and discussion

3.1. Data analysis and weighted product calculations

The data used in this study are abandoned elderly citizens in Bandung. The source of data in this thesis research from the Social Service City of Bandung. Ranking of prospective beneficiaries using the WP method that has been adapted to the required criteria. The following is the data of prospective recipients of abandoned social assistance:

| No | Name          | Address                           |
|----|---------------|-----------------------------------|
| 1  | Djunasih      | Jl. Rajawali timur gg. sastra Rt 07 Rw 07 |
| 2  | Holis         | Jl. Andir gg. sastra No. 233 78   |
| 3  | Ukay Rochaeni | Jl. Andir gg cioroyom v No. 260 26 |
| 4  | Ilek Sumarna  | Jl. Andir No. 181 78              |
| 5  | Sulaeman      | Jl. Andir gg sastra No. 58 78     |

Table 2. Prospective recipient data.

The criteria and weights used (table 1) in this decision support system are obtained from interviews with DINS Officers. From the interview results obtained 6 criteria with overall weight. Based on the predetermined criteria, the level of importance of the criteria is made with the weight already determined. Criteria and weights can be seen in table 3:

| No | Criteria                | Preference Weight | Requirements                      | Score |
|----|-------------------------|-------------------|-----------------------------------|-------|
| 1  | Age                     | 5                 | <=65 Age                          | 3     |
|    |                          |                   | 66 – 75 Age                       | 2     |
|    |                          |                   | > 75 Age                          | 1     |
|    |                          |                   | > IDR. 800.000                   | 4     |
|    |                          |                   | IDR. 400.001 – IDR. 800.000     | 3     |
|    |                          |                   | IDR. 200.001 – IDR. 400.000     | 2     |
|    |                          |                   | <= 200.000 IDR                   | 1     |
| 2  | Income                  | 4                 | Ever                              | 2     |
|    |                          |                   | Never                             | 1     |
|    |                          |                   | Healthy                           | 4     |
| 3  | Previous Help Status    | 1                 | Mild pain                         | 3     |
|    |                          |                   | Badly sick                        | 2     |
|    |                          |                   | Paralyzed                         | 1     |
|    |                          |                   | Worthy                            | 3     |
| 4  | Health condition        | 3                 | Inadequate                        | 2     |
|    |                          |                   | Not feasible                      | 1     |
|    |                          |                   | Private property                  | 3     |
| 5  | House Conditions        | 2                 | Rent / Contract                   | 2     |
|    | Status of Residence     |                   |                                  |       |

Table 3. Weight and value criteria.

After determining the criteria and the weight of the next step is determining an alternative compatibility rating for each criterion. Matching ratings for each alternative can be seen in table 4:
Table 4. Criteria value for each alternative.

| No | Name       | C1 | C2 | C3 | C4 | C5 | C6 |
|----|------------|----|----|----|----|----|----|
| 1  | Djunasih   | 1  | 2  | 2  | 1  | 2  | 1  |
| 2  | Holis      | 3  | 1  | 1  | 3  | 1  | 2  |
| 3  | Ukay       | 1  | 3  | 1  | 2  | 1  | 3  |
| 4  | Rochaeni   | 1  | 1  | 1  | 3  | 3  | 1  |
| 5  | Sulaeman   | 3  | 2  | 1  | 1  | 1  | 2  |

The weight improvement process is carried out using the following equation:

\[ W_j = \frac{W_j}{\sum W_j} \]

From the previous weighting \( W = (5, 4, 1, 3, 2, 2) \), then for the calculation of \( W_1 \) weights the order of criteria 1 and so on are:

\[ W_1 = \frac{5}{5 + 4 + 1 + 3 + 2 + 2} = 0.2941 \]
\[ W_2 = \frac{4}{5 + 4 + 1 + 3 + 2 + 2} = 0.2352 \]
\[ W_3 = \frac{1}{5 + 4 + 1 + 3 + 2 + 2} = 0.0588 \]
\[ W_4 = \frac{3}{5 + 4 + 1 + 3 + 2 + 2} = 0.1764 \]
\[ W_5 = \frac{2}{5 + 4 + 1 + 3 + 2 + 2} = 0.1176 \]
\[ W_6 = \frac{2}{5 + 4 + 1 + 3 + 2 + 2} = 0.1176 \]

After normalizing the calculation weights above, then determining the \( S \) vector value, which can be calculated using the following formula:

\[ S_i = \prod_{j=1}^{n} x_{ij}^{W_i} \]

Furthermore, each prospective beneficiary has the value of each criterion, the value is raised and multiplied by the results of the weight calculation which has previously been calculated:

Note S1 - 1st participant.

\[ S_1 = (1^{0.2941})(2^{0.2352})(2^{0.0588})(1^{0.1764})(2^{0.1176})(1^{0.1176}) = 1.3303 \]
\[ S_2 = (3^{0.2941})(1^{0.2352})(1^{0.0588})(3^{0.1764})(1^{0.1176})(2^{0.1176}) = 1.8194 \]
\[ S_3 = (1^{0.2941})(3^{0.2352})(1^{0.0588})(2^{0.1764})(1^{0.1176})(3^{0.1176}) = 1.6654 \]
\[ S_4 = (1^{0.2941})(1^{0.2352})(1^{0.0588})(3^{0.1764})(3^{0.1176})(1^{0.1176}) = 1.3814 \]
\[ S_5 = (3^{0.2941})(2^{0.2352})(1^{0.0588})(1^{0.1764})(1^{0.1176})(2^{0.1176}) = 1.7643 \]

After doing the vector \( S \) calculation and get the results. The next stage is to determine the ranking of the results above, by determining the value of vector \( V \), using the following formula

\[ V = \frac{\prod_{j=1}^{n} x_{ij}^{W_j}}{\sum_{j=1}^{n} (x_{ij}^{W_j})} \] or simply put \( V_1 = \frac{s_1}{s_1 + s_2 + s_3} \)

\[ V_1 = \frac{1,3303}{1,3303 + 1,8194 + 1,6654 + 1,3814 + 1,7643} = 0,167105 \]
\[ V_2 = \frac{1,3303 + 1,8194 + 1,6654 + 1,3814 + 1,7643}{1,8194} = 0,228549 \]
After obtaining the final results of the V vector calculation, then ranking based on the smallest and largest results or scores to rank which alternatives are prioritized in accepting social assistance for neglected elderly.

**Table 5. Ranking results.**

| Ranking | Alternative | Name          | Score     |
|---------|-------------|---------------|-----------|
| 1       | V1          | Djunasih      | 0.167105  |
| 2       | V4          | Ilek Sumarna  | 0.173527  |
| 3       | V3          | Ukay Rochaeni | 0.209197  |
| 4       | V5          | Sulaeman      | 0.221622  |
| 5       | V2          | Holis         | 0.228549  |

Explain the priority ranking results of stranded elderly social assistance recipients where the highest candidate is V1 namely Djunasih with a value of 0.167105 second V4 namely Ilek Sumana with a value of 0.173527, third V3 is Ukay Rochaeni with a value of 0.209197, the fourth V5 is Sulaeman with a value of 0.221622 and V2 namely Holis with a value of 0.228549

4. Conclusions

The research that has been carried out and applied the WP method to determine the priority of proposals for displaced elderly social assistance can be concluded that implementation of application of the WP method in this decision support system starts from determining the criteria and weight. Then do the weight normalization first, then calculate the vector s and finally calculate the vector v results to rank the results of the calculation. The accuracy value obtained in this decision support system is 76.74% of the 43 data contained in ASLUT. From the 43 data obtained the same results with the system of 33 people and 10 different people.

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