Integration of AHP and ARAS Methods for Item Sorting based on the 'Spark Joy' Concept: A Decision Support System

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Abstract. This work combines the Analytical Hierarchy Process (AHP) with Assessment of Aggregate Rates (ARAS) approaches to develop a decision support system for item categorization, incorporating the 'Spark Joy' notion popularized by Marie Kondo. The notion of 'Spark Joy' advocates for the adoption of a habit wherein individuals maintain goods that inspire a sense of satisfaction, while simultaneously discarding those that do not. The objective of this technique is to create an atmosphere marked by cleanliness and an all-encompassing feeling of satisfaction.The research utilizes the AHP methodology to allocate weights to both criteria and alternatives, as well as to conduct pairwise comparisons of criteria. The ARAS approach is employed to assess the relative performance of various options by utilizing predetermined criteria. The decision-making process can be more efficiently carried out when these two strategies are combined.The findings of this combined method suggest that the prescribed order of objects for sale or donation comprises a 2-door wardrobe, a bookcase, a dining table and chairs, and a food cabinet. The employed methodologies in this study exhibit strong validity and dependability in informing the decision-making process grounded in the 'Spark Joy' idea.This study contributes to supporting the application of AHP and ARAS methods in item sorting based on the 'Spark Joy' concept. The combination of these methods can assist users in selecting items that truly bring happiness while minimizing unnecessary belongings, with the goal of creating a cleaner and happier environment.

Keywords: AHP, ARAS, Decision Support System, Spark Joy.

1. Introduction

"Spark Joy" is a concept created by Marie Kondo, an expert in organizing and reducing household items. This concept teaches that every item we possess should bring luck or joy to us. In practice, the Spark Joy concept can be applied by selecting and retaining only those items that bring happiness and discarding or donating items that do not [1]

Marie Kondo practices the Spark Joy concept and suggests that we pay attention to each item we own and ask ourselves whether the object brings us happiness or not. If an item brings happiness, we should systematically store it. However, if the item does not bring joy, it's better to dispose of or donate it.

The goal of the Spark Joy concept is to create an environment that is clean, organized, and filled with things that bring happiness. By having items that bring us joy, we can feel happier, calmer, and more productive in our daily lives[1]. The Spark Joy concept is closely related to environmental issues because eliminating unnecessary items can reduce waste and prolong the useful life of items that can still be used. In this context, Spark Joy also helps reduce

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overconsumption and excessive disposal of items that could potentially cause pollution[2]. Additionally, the Spark Joy concept can motivate us to seek environmentally friendly products when making new purchases[3]. By choosing quality and sustainable items, we can minimize repetitive purchases, reduce excessive consumption of natural resources, and cultivate a healthy and joyful lifestyle[4], [5]

This research proposes a decision support system for item sorting based on the Spark Joy concept to assist users who often struggle to decide which items to keep and which to dispose of. This difficulty can lead to the accumulation of unnecessary items in the home, disrupting balance and comfort.

In practice, many factors can influence the decision to keep or sell an item, such as emotional value, economic value, or utility. Therefore, sorting items can be challenging and time-consuming. With efficient Spark Joy-based item sorting, this system allows users to make more effective decisions in determining which items are still needed and which need to be discarded or given to others. This system can help users prioritize items to keep and streamline the decluttering process. Additionally, it minimizes the potential for errors in the decision-making process because decisions are based on objective data and analysis. Thus, this system can enhance the efficiency and effectiveness of item organization and create a cleaner, more organized, and comfortable environment.

The suggested system will utilize two methodologies, namely the Analytical Hierarchy Process (AHP) and the Additive Ratio Assessment (ARAS). The rationale behind the employment of these two strategies arises from the observation that their combination is not fully exploited in the context of addressing challenges inside decision support systems.

The advantages of the AHP method include providing a hierarchical structure to break down complex decisions, evaluating the relative importance between criteria and alternatives, measuring consistency, flexibility for various problem types, and ease of use with a clear reference framework. AHP helps decision-makers analyze and prioritize important factors in a structured manner, leading to better decision-making outcomes[6]–[8][9].

On the other hand, the ARAS method offers advantages such as a non-comparative approach, allowing decision-makers to provide absolute rankings of each alternative based on predetermined criteria. This method employs simple and understandable calculations, offering flexibility to adjust specific option settings. Thus, ARAS facilitates clear assessments and comprehensible decision outcomes for decision-makers[10]–[13].

2 Research Methods

The status of the commodities to be sorted is determined by combining ARAS and AHP approaches in this research.

2.1 AHP

The AHP or Analytical Hierarchy Process is a methodological approach utilized for decision-making purposes that involves analytical techniques. This methodology employs a hierarchical framework in order to deconstruct complex decisions into more manageable components. Within the realm of decision-making, decision-makers have the capacity to evaluate the consistency of weight assignments and distribute relative weights to both criteria and alternatives by employing the AHP [14], [15].

1. Decomposing the Problem
During the first stage, the identified problem is broken down into hierarchically structured pieces to facilitate decision-making. Figure 1 illustrates the organizational arrangement of the hierarchical structure. The diagram illustrates a hierarchical arrangement in which the initial tier consists of the expression of objectives, the subsequent tier contains the provision of standards, and the last tier involves the depiction of potential options. By utilizing this structured problem hierarchy, decisions are formulated by considering all relevant decision-makers.

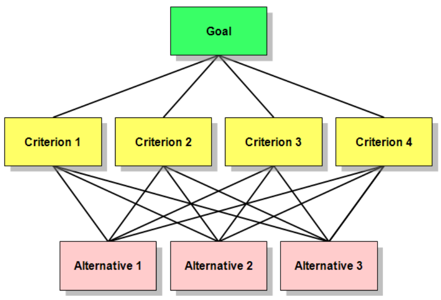

Fig.1. AHP Hierarchy

2. Comparative judgement
At this point, the determination of the relevance of the elements is accomplished through the implementation of paired assessments of items, employing pre-established criteria. The results of these assessments are presented in the form of a pairwise comparison matrix, which illustrates the relative rankings of various options for each criterion. The preference scale, as depicted in Table 1, spans from 1 to 9, where 1 signifies the minimal level of significance (representing equal importance), and 9 signifies the utmost level of importance (indicating significant importance).

Table 1. The Scale of Saaty Comparisons

Level of Significance	Description
1	Both elements hold equal significance.
3	One element holds a marginally greater significance compared to the other.
5	One element ingredient holds greater significance compared to the remaining elements.
7	One element exhibits a higher degree of significance compared to the remaining elements.
9	One element is significantly more crucial than the other elements.
2,4,6,8	The disparities in values observed between the two adjacent elements.

3. Synthesis
   The procedure executed in this phase entails the aggregation of the values within each column of the matrix. Following this, the normalization process involves dividing each value in a certain column by the entire sum of that column in order to derive the normalized matrix. Subsequently, the summation of values inside each row is computed and subsequently divided by the total number of elements in order to obtain the average value. The objective of this analysis is to determine a comprehensive ranking of factors by conducting pairwise comparisons.

4. Calculate Lambda Max (λmax).
   The assessment of consistency involves the multiplication of each value in the initial column by its corresponding relative priority, and this procedure is repeated for the values in the subsequent columns. The summation is subsequently calculated for every row. The summation of each row is partitioned according to the relative significance of the corresponding items. thereafter, the summation of these division outcomes is computed and thereafter divided by the overall quantity of elements.

5. To determine the Consistency Index (CI), the following formula is utilized:
   $$CI = (\lambda_{max} - n) / n \quad (1)$$
   where n is the cardinality of the set of elements

6. The calculation of the Consistency Ratio (CR) can be derived using the below formula:
   $$CR = CI / RC \quad (2)$$
   The Random Consistency Index (RC) is a metric used to evaluate the consistency of pairwise comparisons.

7. Verify the hierarchy's consistency
   At this step, it is imperative to rectify the evaluation of judgment data in the event that the consistency ratio value exceeds 10% (0.1). Failure to do so may lead to inconclusive outcomes generated by the AHP. Nevertheless, the accuracy of the computation results can be deemed acceptable when the value of the consistency ratio is less than or equal to 0.1. Further information regarding this criterion can be found in Table 2.

Table 2. Index Ratio

N	RI
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45

10	1.49

2.2 ARAS

The ARAS approach is a decision-making process that does not involve direct comparison between options. Rather of engaging in a direct comparison between alternatives, the decision-maker in this approach provides a definitive evaluation of each alternative, taking into consideration predetermined criteria. The ARAS technique employs basic computational operations, such as addition and comparison, to facilitate decision-making by evaluating and analyzing correlations among many alternatives. The primary advantages of the ARAS method are its clear and systematic approach, as well as its capacity to adjust parameters based on selected options. The ARAS technique facilitates decision-makers in enhancing the precision of their evaluations and expediting the comprehension of findings[11], [15].

The ARAS approach incorporates the following phases in doing ranking:

1. Decision-Making Matrix Formation (X)

   The decision matrix (X) is structured such that rows represent alternatives and columns indicate criteria. The matrix displays the performance of each choice based on different factors.

$$X = \begin{bmatrix} x_{01} & \cdots & x_{0j} & \cdots & x_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{m2} & \cdots & x_{mn} \end{bmatrix} (i = 0,1,2,\ldots,m, j = 1,2,\ldots,n) \quad (3)$$

   where :

   The evaluation of the i-th option in the j-th criterion is indicated by the variable x_{ij} , where m represents the total number of alternatives and n represents the total number of criteria [16].

   X_{0j} denotes the optimal performance value of criterion j. In cases where the value of X_{0j} is not specified, it is conventionally presumed to represent the highest value for benefit criteria or the lowest value for non-benefit criteria.

$$x_{0j} = max_i x_{ij} \ \ if\ max_i x_{ij}\ \ is\ the\ highest\ value$$
$$x_{0j} = min_i x^*_{ij} \ \ if\ min_i x^*_{ij}\ \ is\ the\ highest\ value \quad (4)$$

2. Formation of Normalized Matrix (R)

   Criteria with a benefit type will be normalized using the following linear normalization procedure:

$$r_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}}; j = 1,2,\ldots,n \quad (5)$$

   Where the value of r_{ij} is the normalized value.

Two processes will be used to normalize criteria that have a cost type. The inverse of each criterion against all possibilities is taken in the first stage as follows:

$$x_{ij}^{*} = \frac{1}{x_{ij}}; i = 1,2,\ldots,n \quad (6)$$

The normalized values are calculated as follows in the second step:

$$r_{ij} = \frac{x_{ij}^{*}}{\sum_{i=0}^{m} x_{ij}^{*}}; j = 1,2,\ldots,n \quad (7)$$

3. Creating Weighted Normalized Matrix (D)

$$D = [d_{ij}] m \times n = rij\ \dot{w}j; i = 0,1,2,\ldots,m; j = 1,2,\ldots,n \quad (8)$$

where $\dot{w}j$ is the weight of the j-th criterion.

4. Determining the Value of the Optimum Function (S)

$$S_i = \sum_{j=1}^{n} d_{ij}; i = 0,1,2,\ldots,m, j = 1,2,\ldots,n \quad (9)$$

The variable S_i represents the optimal function value for the i-th choice. In this particular context, the greatest value is considered to be the most favorable, whereas the lowest number is considered to be the least favorable. The ultimate results in this procedure are impacted by the proportional correlation between the values and weights of the examined criteria. The optimal function of the ideal option is represented by the symbol S_o

5. Determining Utility Rankings (K)
The next step is to determine the utility level K_i for each alternative i as follows:

$$K_i = \frac{S_i}{S_0}; i = 0,1,2,\ldots,m; \quad (10)$$

The values of the optimization criteria are denoted by Si and So. The utility value Ki falls between [0, 1], with 1 denoting the highest priority. The best alternatives are those that have the highest Ki utility values. Then, these options can be ordered in order to create a rangking.

2.3 Requirements Analysis

System needs analysis is necessary to understand the requirements of the system to be developed. System needs analysis consists of functional and non-functional requirements[17]. Functional requirements are the needs that encompass the processes performed by the system. The system's functional requirements encompass the following aspects:

1. The system must be able to make decisions using the AHP and ARAS methods.
2. The system must be able to compare items that will be discarded, sold, or donated.
3. The system must be able to manage alternative data, criteria, assessments, and user access.

2.4 Sources of Data

The storage of data in a data warehouse for the purpose of supporting decision-making is facilitated by a database server. Depending on the data sources, a decision support system application may leverage different databases. The decision support system utilizes a range of internal and external data sources, which encompass personal information pertaining to one or multiple users, in order to extract the necessary data.

2.5 Modeling

When selecting an object, it is important to consider many aspects such as the condition, value, needs of others, length of usage, storage space, and financial requirements. These indicators or factors play a crucial role in the decision-making process. When making a decision on whether to dispose of, sell, or donate a certain object, individuals should take into account the following factors. Item alternatives and criteria can be generated within the system. Subsequently, based on pre-established criteria, each potentiality is evaluated. Subsequently, employing the ARAS approach, a systematic evaluation process is conducted to assign ratings to each potential option. The AHP is utilized to determine the weights necessary for the Application of Ratio Analysis to Assess Sustainability (ARAS) approach in order to do computations. The framework of the decision-making model is depicted in Figure 2.

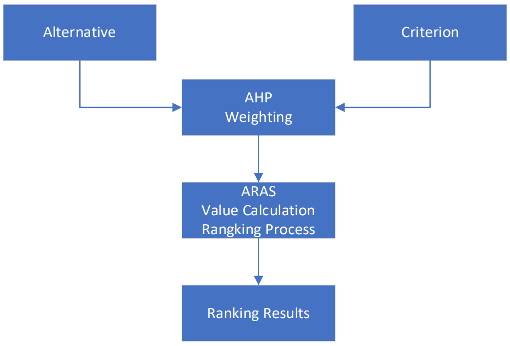

Fig.2. Modelling

3 Result and Discussion

The following data presents the outcomes of the manual decision-making calculations performed for several alternative items. Table 3 presents a collection of five things that are subject to ranking, with further determinations to be made regarding their disposition, namely whether to sell, give, or dispose of them. The table presented also illustrates the evaluations conducted for each individual item.

Table 3. Item value for each criteria

Items	A1	A2	A3	A4	A5	A6
Wardrobe	6	10	10	2	6	10
Refrigetaror	6	10	6	3	6	10
Dining Table	6	6	6	10	10	6
Bookshelf	10	10	3	6	3	3
Cupboard	6	6	10	10	6	3

In table 4 below, the criteria used in assessing these items are written and a description of the criteria in question.

Table 4. Criteria Description

No	Criteria	Description
A1	Item Condition	Evaluation of the physical and functional condition of the goods.
A2	Item Value	Valuation is based on the value of the item in its current condition.
A3	Needs of Others	Consideration of whether items are needed by others.
A4	Usage Time	How often the item is used or how long it is used.
A5	Storage Room	Availability of storage space for goods.
A6	Financial Needs	Can selling goods provide financial benefits.

3.1 AHP Calculation Procedure

The AHP is utilised in order to determine weight values. By using the above-discussed technique, each criterion is assigned a weight after being evaluated in relation to the others. Pairwise comparison matrices are created for each criterion in order to establish criterion precedence, which is the first step in the AHP computation process. Table 5 below shows the pairwise comparison matrices for each criterion.

Table 5. The pairwise matrix of criteria

	A1	A2	A3	A4	A5	A6
A1	1	2	2	2	4	2
A2	0,5	1	3	3	3	3
A3	0,5	0,5	1	3	2	2
A4	0,5	0,33	0,33	1	2	3
A5	0,25	0,33	0,5	0,5	1	2
A6	0,5	0,33	0,5	0,33	0,25	1
Total	**2,75**	**4,167**	**6,833**	**9,5**	**12**	**12**

Subsequently, the amalgamation of the criterion matrices is executed. The amalgamation of the criterion matrices is visually presented in the subsequent table.

Table 6. Synthesis of criteria matrix

	A1	A2	A3	A4	A5	A6	Total	Priority
A1	0,36	0,48	0,29	0,21	0,33	0,17	1,85	**0,37**
A2	0,18	0,24	0,44	0,32	0,25	0,25	1,68	**0,34**
A3	0,18	0,12	0,15	0,32	0,17	0,17	1,1	**0,22**

A4	0,18	0,08	0,05	0,11	0,17	0,25	0,83	**0,17**
A5	0,09	0,08	0,07	0,05	0,08	0,17	0,55	**0,11**
A6	0,18	0,08	0,07	0,04	0,02	0,08	0,47	**0,09**

Subsequently, the aforementioned priority values are employed as coefficients in the ARAS computation.Subsequently, it is necessary to generate the summation matrix for every individual row.

Table 7. Summation matrix

	A1	A2	A3	A4	A5	A6	Total
A1	0,37	0,67	0,44	0,33	0,44	0,22	2,25
A2	0,18	0,34	0,66	0,5	0,33	0,33	2,01
A3	0,18	0,17	0,22	0,5	0,22	0,22	1,29
A4	0,18	0,11	0,07	0,17	0,22	0,33	0,75
A5	0,09	0,11	0,11	0,08	0,11	0,22	0,51
A6	0,18	0,12	0,18	0,12	0,09	0,37	0,71

Next, determine the consistency ratio shown by the table provided.

Table 8. Consistency ratio

	Total/Row	Priority	Results
A1	2,25	0,37	2,62
A2	2,01	0,34	2,34
A3	1,29	0,22	1,51
A4	0,75	0,17	0,92
A5	0,51	0,11	0,62
A6	0,71	0,09	0,8

When considering a sample size of n=6 with a maximum eigenvalue of $\lambda max = 1.6031$, it is evident that the confidence interval (CI) is -0.6797 and the consistency ratio (CR) is -0.6069. The calculated CR value falls below the threshold of 0.1, suggesting that the CR is considered satisfactory.

3.2 ARAS Calculation Procedure

3.1.1.1 Formation of a decision matrix

The initial phase involves constructing a decision matrix (X) based on the available initial data. Based on the data presented in Table 3, it is possible to construct a decision matrix in the following manner.

$$x = \begin{matrix} 6 & 10 & 10 & 2 & 6 & 10 \\ 6 & 10 & 6 & 3 & 6 & 10 \\ 6 & 6 & 6 & 10 & 10 & 6 \\ 10 & 10 & 3 & 6 & 6 & 3 \\ 6 & 6 & 10 & 10 & 6 & 3 \end{matrix}$$

The data in the i-th row of the decision matrix (X) represents the data from the i-th alternative, while the data in the j-th column represents the data from the j-th criterion. For instance, data x3.2 displays information for the 3rdalternative, Dining Table, which has a value of 6 for criterion 1 (Item value).

The maximum score for each criterion that is of the benefit type and the lowest score for each criterion that is of the cost type can be calculated from the decision matrix (X) acquired. So that the following results in the best option (x_o):

$$x_o = 10 \quad 10 \quad 10 \quad 3 \quad 3 \quad 10$$

3.1.1.2 Formation of the normalized matrix R

Once the decision matrix has been constructed, the subsequent phase involves the creation of a normalized decision matrix R. The primary objective of this stage is to restrict the range of data in order to facilitate the computation of the ARAS method.
In accordance with the equations (5), (6) and (7) the normalized values can be calculated to produce a matrix as shown below

$$R = \begin{matrix} 0{,}1765 & 0{,}2381 & 0{,}2857 & 0{,}0645 & 0{,}1935 & 0{,}3125 \\ 0{,}1765 & 0{,}2381 & 0{,}1714 & 0{,}0968 & 0{,}1935 & 0{,}3125 \\ 0{,}1765 & 0{,}1429 & 0{,}1714 & 0{,}3226 & 0{,}3226 & 0{,}1875 \\ 0{,}2941 & 0{,}2381 & 0{,}0857 & 0{,}1935 & 0{,}0968 & 0{,}0968 \\ 0{,}1765 & 0{,}1429 & 0{,}2857 & 0{,}3226 & 0{,}1935 & 0{,}0968 \end{matrix}$$

The value of the best normalized data (R_0) can be calculated from the normalized R data matrix as follows:

$$R_0 = 0{,}1765 \quad 0{,}2381 \quad 0{,}2857 \quad 0{,}3226 \quad 0{,}1935 \quad 0{,}3125$$

The biggest number for each criterion is used to get the optimal value.

3.1.1.3 Form a weighted normalized matrix D

The previous process's normalized matrix data (R) is then transformed into a weighted normalized data matrix (D). The calculation outcomes for all data are determined using equation (8) computations.

$$D = \begin{matrix} 0{,}0543 & 0{,}0665 & 0{,}0523 & 0{,}0448 & 0{,}0176 & 0{,}0247 \\ 0{,}0543 & 0{,}0665 & 0{,}0523 & 0{,}0090 & 0{,}0176 & 0{,}0247 \\ 0{,}0543 & 0{,}0665 & 0{,}0314 & 0{,}0134 & 0{,}0176 & 0{,}0247 \\ 0{,}0543 & 0{,}0399 & 0{,}0314 & 0{,}0448 & 0{,}0294 & 0{,}0148 \\ 0{,}0905 & 0{,}0665 & 0{,}0157 & 0{,}0269 & 0{,}0088 & 0{,}0074 \\ 0{,}0543 & 0{,}0399 & 0{,}0523 & 0{,}0448 & 0{,}0176 & 0{,}0074 \end{matrix}$$

3.1.1.4 Calculate the value of the optimal function.

The optimal function value S is determined for each choice using equation (9).The ideal value of the function for each scenario is determined, as presented in Table 9.

3.1.1.5 Determines the utility rankings

The final step is to rank the utility value (K) by first determining the utility value of each alternative using equation (10)

Table 9. Optimum Value, Utility and Rank

Alternative	Optimum Value	Utility	Rank
Wardrobe	0,2244	0,8624	1
Refrigetaror	0,208	0,7993	5
Dining Table	0,2146	0,8246	4
Bookshelf	0,2158	0,8295	3
Cupboard	0,2163	0,8313	2

According to the table 9, the items to be sold or given to others are as follows: Wardrobe, Cupboard, Bookshelf, Dining table, and Refrigerator.

4 Conclusion

In this study, the AHP and the ARAS were combined to create a thorough and efficient technique. The AHP technique makes it easy to compare criteria and alternatives in pairs, and it assigns weights to criteria based on how important or preferred they are. While the ARAS approach is employed to assess how well alternatives compare to one other in terms of meeting preset criteria. This study attempts to propose a more thorough and effective solution for the article classification process based on "Spark Joy" by integrating the two methods.

The consistency index and consistency ratio were used to validate the outcomes of pairwise comparisons of the criteria and alternative AHP methods. The reliability and validity of the Arranged elements based on "Spark Joy" are tested using real case data or simulation studies to validate the outcomes of the combination of AHP and ARAS methodologies. In presenting data to people, this study underlines the value of simplicity and result visualization. Users will find it simple to comprehend and use the results of the computation in their regular work as a result. It is also possible to convey and explain information to consumers more effectively by using simple computations and visualizing the results in the form of graphs or diagrams.

In conclusion, the study "Combination of AHP and ARAS methods for commodity classification based on 'Spark Joy'" has the potential to have significant theoretical and practical benefits. This research makes a significant contribution by facilitating the process of categorizing goods according to individual preferences and needs, which increases user satisfaction with the goods they own and contributes to efforts to reduce the accumulation of unnecessary goods around us. This is done by utilizing the "Spark Joy" principle and combining two potent methods, AHP and ARAS.

This research has the potential to be developed into a more sophisticated and integrated system that combines the AHP and ARAS methods. Apart from sorting goods, the DSS concept involving AHP and ARAS can be applied in areas such as risk management, employee selection, investment selection, and selection of the best products in online stores. The system can also be expanded with a more intuitive and interactive user interface, allowing users to set preferences and parameters more easily.

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