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Development of A Multi-Criteria Analysis Tool with a Focus on Classical, Robust Techniques and Weighting Values

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Abstract: At present, multi-criteria decision making is of great importance and essential in various fields of industry and education because it is one of the most active development areas in the field of decision science, it ranges from the resource management to decision making with multiple alternatives and criteria whose purpose is to guarantee an expected solution. However, to date there is still no user-friendly and free-to-use computing tool that facilitates the process of mathematical calculation of multi-criteria decision-making, a standardized and validated tool that can be used as support material both by academic and private institutions. The proposed tool presents the mathematical coding of various multi-criteria models, among which are: the weighted sum model (WSM), weighted product model (WPM), the weighted sum and product aggregate model (WASPAS), the Vikor method, the preference classification organization method for the enrichment evaluation (PROMETHEE) and the technique for the order of preference by similarity with the ideal solution (TOPSIS) both in its classical and fuzzy variants. Also including weighting calculation methods such as hierarchical decision analysis, the entropy method, among others. Consequently, among the contributions that stand out from this multi-criteria computing tool is its free use because it is a free license software, which is why it is expected to be used in public and private academic sectors. Furthermore, as it is a unique and support tool for the management and analysis of operations and resources, contributions are expected in the development of knowledge frontier methodologies whose purpose is to enrich the subject matter within the software.

Keywords: Computational Tool, Multi-Criteria Analysis, Classical Techniques

1. Introduction

Currently, multi-criteria decision-making is very important and essential, which is why it is one of the most active development areas in the field of decision science, and ranges from resource management to decision-making with multiple alternatives and criteria (Coccia, 2017). In addition, through its use it has been possible to enrich the solution to various problems and has allowed good decision-making management to guarantee an expected solution.

1.1 Problem Statement

Currently there is no multi-criteria analysis computing tool or at least free to use and with a user-friendly. Manual procedures such as formula assignment in existing computing tools are regularly used to address decision problems and, therefore, cause implementation errors that are not identified and lead to incorrect rankings.

In this way, at present there is no computer program that incorporates knowledge frontier methodologies that is free to use for people dedicated to research, as well as for postgraduate students (Zavadskas, Govindan, Antucheviciene & Turskis, 2016).

1.2 Objectives

Develop a computation tool that incorporates classical, fuzzy and weighting value techniques that is validated and tested, and that can be used to calculate the ranking of alternatives under various multi-criteria methods, avoiding manual calculations.

1.3 Justification

The development of a multi-criteria decision-making computing tool with a knowledge frontier methodology, which can be used by researchers, academics, students and professionals with the aim of solving practical decision models within their areas of knowledge. In addition, another of the purposes is to provide a tool that provides results with automatic calculation that reduce the calculation errors that can occur when using manual processes, thereby increasing the reliability of the results obtained.

Another contribution is that a computing tool was designed that does not yet exist. In this way, said tool will be free to use for universities and researchers. In this way, through its tools and selection of classic multi-criteria decision methods, decision alternatives will be evaluated in a context with different conflicting objectives and an uncertain environment; all this focused on a particular topic, be it a thesis project or research (Aznar, 2012).

2. Literature review

2.1 Multi-criteria decision making, alternatives and multi-criteria decision methods.

The development of multi-criteria techniques that aid decision making has its origins in operations research (IO), which dates back to the First World War, when Thomas Edison was tasked with investigating how the losses of shipments caused by enemy submarines, so the most feasible solution was to use a tactical board to find the solution, instead of risking the ships in real war contexts (Thierauf & Grosse, 1974).

From this point, according to Hillier and Lieberman (2010), some mathematical models, operations and symbols began to be used to solve those types of problems with a multi-criteria approach. In all decision-making processes, first the set of possible solutions or that could be feasible to the examined decision problem must be established; then an order of feasible solutions is established; Later, and with the support of multiple mathematical techniques, one proceeds to search among the feasible solutions for the one that has a higher degree of desirability, such an alternative represents an optimal solution (Szidarovszky, Gershon & Duckstein, 1986). The way in which any decision process is carried out depends on the organizational conditions of its environment (Pacheco & Contreras, 2008).

However, decision theories also depend on the number of criteria used simultaneously; and they are divided into unicriteria and multicriteria theories. Unicriteria theories are those elaborated by virtue of the development of a working method that contemplates the use of a single criterion (Triantaphyllou, 2013). On the other hand, multi-criteria theories help the decision maker when he wishes to decide by virtue of two or more criteria (Keeney & Raiffa, 1993).

The main element of multi-criteria tools is the decision maker ", since he is the one who poses the problem and has the duty to solve it. However, collective decisions can be made, whose group of persons, natural or legal, must propose the alternatives, evaluate them and decide on them (Garcia, Martinez, Del Campo & Lopez 2013). On the other hand, multi-criteria evaluation techniques allow dealing with quite complex decision problems, even when there are heterogeneous characteristics in a certain phenomenon (Hwang & Yoon, 1981).

Now, decision-making problems can be classified into two categories: the first is called discrete decision problems ", which consists of the involvement of a set of decision alternatives, where each of them are described through a series of attributes that have a meaning of evaluation criteria (Zarghami & Szidarovszky, 2011). On the other hand, the second category belongs to the continuous decision problems ", where the region where the decision alternatives are found is identified, same which is known as a feasible or specific alternative region (Doumpos & Zopounidis, 2004).

Alternatives are the main basis of decision making. The task of the decision maker is to make a description of these, using an appropriate language of the actions and their consequences (Yager, 1988). For its part, the ranking consists of ranking the alternatives from best to worst, with the possibility of equivalences and incompatibilities (Aravossis, Anagnostopoulos, Koungolos & Vliamos, 2003).

It should be noted that, within the classification problem, the result depends on the absolute evaluation of the alternatives that has to be carried out previously using multi-criteria decision methods (Orozco, 2010).

In this way, multi-criteria decision making, or commonly called MCDM (Multiple-criteria decision analysis), is frequently used to help people make decisions based on their preferences according to their circumstances, logically when there are more than a criterion (Ho, 2008).

In addition, it is a process that mixes the performance and execution of decision alternatives that passes through various criteria that can be contradicted, these can also be qualitative and / or quantitative. In the same way, existing methods are applicable and usually provide solutions to real-life problems that may be located in different fields, such as industrial activities "as the authors Kabak & Dagdeviren (2014) point out.

The methods used in the field of multi-criteria analysis decision (MCDM) are the weighted sum (WSM), weighted product (WPM), technique for the order of preference by similarity with the ideal solution (TOPSIS), and the method organization of preference ranking for the evaluation of the enrichment meeting (PROMETHEE), among other techniques used. It should be noted that these aforementioned methods have provided solutions in applications with problems related to sustainability and energy (Kabak & Dagdeviren, 2014).

As additional data, the MCDM was introduced by Saaty and the main purpose was to assess priorities (Saaty, 1996). Therefore, it is quite useful for the creation and formulation of policies, assessment of new technologies, since this system has the ability to include technical attributes such as economic factors in the decision-making process (Kabak & Dagdeviren, 2014).

2.2 Classic multi-criteria techniques: Weighted sum model (WSM)

The weighted sum model is a classic multi-criteria method in which there are multiple alternatives, for which it must be determined which is the best alternative to choose based on various criteria (Budihario & Muhammad, 2017).

In addition, this model has had various applications today such as robotics, data processing, among others. The steps of the weighted sum model (WSM) are as follows:

1. Determine the type of criterion (if it is direct or inverse).
2. The decision maker must assign the corresponding weights (Wj).
3. Application of the algorithm to direct criteria if it applies:

$$\bar{x}_{ij} = \frac{x_{ij}}{x_j^{Max}} \tag{1}$$

4. Application of the algorithm to inverse criterion if it applies:

$$\bar{x}_{ij} = \frac{x_j^{Min}}{x_{ij}} \tag{2}$$

5. Finally, the following formula is applied to generate the normalized decision matrix:

$$A_i^{WPM} = \prod_{j=1}^{n} x_{ij}^{w_j} \tag{3}$$

Once the last step is applied, final results are produced and the one with the highest value (selection of the highest hierarchy) will be selected because it will be the best option for the decision maker. An example of the application of this method is found in one-dimensional problems as addressed by Rao and Venkatasubbaiah (2016) in the computational analysis of multiple responses in the experimentation of industrial machinery. Another application is in the evaluation of the competence of the workforce in the industry because this methodology supports the choice of the best operator among several alternatives and criteria (Chourabi, Z. et al. 2018).

2.3 Weighted Product Model (WPM)

This method is very similar to the weighted sum model except that instead of the mathematical formula incorporating addition, it incorporates multiplication. The steps to follow to apply this model are shown below:

1. The type of criterion is determined.
2. The corresponding weights are assigned.
3. Application of the formula or algorithm to direct criteria if it applies:

$$\bar{x}_{ij} = \frac{x_{ij}}{x_j^{Max}} \tag{4}$$

4. The formula or algorithm is applied to inverse criteria:

$$\bar{x}_{ij} = \frac{x_j^{Min}}{x_{ij}} \tag{5}$$

5. Finally, the formula for the generation of the normalized decision matrix is applied:

$$A_i^{WSM} = \sum_{j=1}^{n} w_j x_{ij} \tag{6}$$

In this way, the highest figure (highest hierarchy) that will be the best decision of the decision maker will be selected. This method is commonly used for decision problems where a selection of a product must be made where there are multiple variations of this, an example is the selection of mobile devices such as electronic tablets where a simulation process is modeled for its selection using domains of the weighting criteria (Atmojo, Cahyani & Lie, 2014). Another application is in the food sector, whose approach to the problem is to find the solution to the lack of food. The choice of food can be based on diversification that aims to find the best option of food alternatives; therefore, the use of this method helps and provides the best decision in the choice of food (Adriyendi, 2015).

2.4 WASPAS (Weighted Aggregated Sum Product Assessment)

This method or model starts from the results of the hierarchies of the WSM and WPM methods. Consequently, the decision maker assigns a value of λ that is between 0 and 1.

The value of λ assigned is used in the formula of the generalized criterion of the WASPAS set, for which the algorithm is as follows:

$$A_i^{WASPAS} = \lambda\, A_i^{WSM} + (1-\lambda)\, A_i^{WPM} \tag{7}$$

Similarly, the highest-ranking figure is selected. The applicability of this methodology is generally made in multiple problems related to manufacturing, for example Chakraborty, Antucheviciene & Gediminas (2015) apply it using five problems related to real-time manufacturing when selecting a flexible manufacturing system, a machine in a flexible manufacturing cell, an automated guided vehicle, an automated inspection and an industrial robot where it is finally observed that for all these five problems, the WASPAS method provides quite acceptable results.

On the other hand, this methodology has application in the study and solution of problems concerning the energy demands of fossil fuels, which is the world's main energy resource, for which it has been used to evaluate potential wave power stations on the coast. Vietnamese. Furthermore, all criteria and sub-criteria affecting the wave power plant location selection process have been identified through literature review and expert interviews (Wang, Chen & Tung, 2021).

2.5 PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation)

This model is also called a preference ranking organization method for enrichment evaluation. The first step is to normalize the evaluation matrix, that is, the decision matrix. Subsequently, it is necessary to classify the attributes in criteria of benefit and cost or commonly called direct and inverse criteria.

Direct or benefit criteria:

$$R_{ij} = \frac{[x_{ij} - Min(x_{ij})]}{[Max(x_{ij}) - Min(x_{ij})]} \tag{8}$$

Inverse or cost criterion:

$$R_{ij} = \frac{[Max(x_{ij}) - x_{ij}]}{[Max(x_{ij}) - Min(x_{ij})]} \tag{9}$$

After showing the minimum and maximum values, the formula is applied according to the type of criterion (direct or inverse).

Now, the next step consists of evaluating the evaluative differences of the i-th alternative with respect to other alternatives and the preference function is calculated by means of the following mathematical formulas:

$$P_j(a,b) = \begin{cases} 0 & if\ R_{aj} \le R_{bj} \\ (R_{aj} - R_{bj}) & if\ R_{aj} > R_{bj} \end{cases} \tag{10}$$

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The interpretation of the first formula is that, if the difference is equal to or less than 0, the result is 0. The second formula means that, if the difference is greater than 0, the result is the result of the difference. In this way, the aggregated preference is calculated using the following formula:

$$\pi(a,b) = \left[\sum_{j=1}^{n} w_j P_j(a,b)\right] / \sum_{j=1}^{n} w_j \tag{11}$$

After applying the formula and relating columns, the upper flows of the input and output range of the alternatives are determined, these are classified into positive and negative flow:

$$\varphi^{+} = \frac{1}{m-1} \sum_{b=1}^{m} \pi(a,b) \tag{12}$$

$$\varphi^{-} = \frac{1}{m-1} \sum_{b=1}^{m} \pi(b,a) \tag{13}$$

Next, the net top-ranking flow is calculated for each alternative:

$$\varphi(a) = \varphi^{+}(a) - \varphi^{-}(a) \tag{14}$$

Given the results of the previous formula, the ranking or hierarchy of all the alternatives considered is determined based on the values of the result.

This method has been used in the field of prediction models (DPM) in financial decisions, so this methodology provides a multi-criteria evaluation of competing DPMs, whether companies or institutions (Mousavi & Lin, 2020). In contrast, the use of PROMETHEE has spread in the field of robotics, applying the methodology in search and exploration algorithms, making a better decision based on search criteria (Taillandier & Stinckwich, 2011).

2.6 TOPSIS (Techinque for Order Preference by Similarity to Ideal Solution)

The TOPSIS (Techinque for Order Preference by Similarity to Ideal Solution) method is based on the concept that the best alternative must have the shortest distance or Euclidean distance from the ideal solution and from the complete TOPSIS form. This technique is used for preference ordered by similarity to the ideal solution.

First, the normalization of the vector must be done using the following mathematical formula:

$$\bar{x}_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^{2}}} \tag{15}$$

In this way, the calculation is made and a final result is obtained for each criterion. Therefore, to obtain the normalized matrix, each value or figure of the criteria must be divided by the totals or results of the application of the previous formula. Therefore, the weights of each criterion are multiplied with the normalized performance value of each cell or values and thus a weighted normalized decision matrix is obtained.

Consequently, the best and worst ideal value is calculated for non-beneficial criteria, such as the lowest and highest value of each criterion. For this, the following indices are used:

$v_j^{+} = Indicates\ the\ ideal\ (best) value$

$v_j^{-} = indicates\ the\ ideal\ (worst) value$

Given the above we need the formula to calculate the Euclidean distance from the best idle and the idle. Here is the formula to calculate the Euclidean distance from idle rest or also called as Euclidean distance from ideal best:

$$s_i^{+} = [\sum_{j=1}^{m} (v_{ij} - v_j^{+})\text{^}2\ ]\ \text{^}\ 0.5 \tag{16}$$

Similarly, the Euclidean distance from the worst ideal is calculated using the formula:

$$s_i^{-} = [\sum_{j=1}^{m} (v_{ij} - v_j^{-})\text{^}2\ ]\ \text{^}\ 0.5 \tag{17}$$

Taking the Euclidean distance, the performance score is calculated, the formula is as follows:

$$P_i = \frac{S_i^-}{S_i^+ + S_i^-} \tag{18}$$

In this way, based on the results of each criterion with its alternative, the hierarchy is made to make the best decision. A very common application of this methodology is in the selection of personnel, since the selection of qualified human resources is a key success factor for an organization and the incorporation of this method is coupled with factors that determine decision makers (Kelemenis & Askounis, 2010).

On the other hand, this methodology has also supported the analysis of decisions of various criteria for interval data in research on the level of development of the information society based on countries such as the European Union (Łatuszyńska, 2014).

2.7 Fuzzy TOPSIS

The first difference between this method and the previous one is that the qualitative values are fuzzy, since they are made up of three numbers for each criterion according to its alternative. Second, the number of decision makers can be more than one.

To combine the decision matrices of each decision maker, two fundamental formulas must be considered. The first groups the numbers of the first position and is expressed as:

$$\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}) \tag{19}$$

Subsequently, the following formula is applied in order to generate the combined decision matrix where k is equal to the number of decision makers:

$$a_{ij} = \min_k\{a_{ij}^k\}, b_{ij} = \frac{1}{k}\sum_{k=1}^{k} b_{ij}^k,\ c_{ij} = \max_k\{c_{ij}^k\} \tag{20}$$

After applying the previous formula, you need to calculate the weighted combination using the formula:

$$\tilde{w}_{ij} = (w_{j1}, w_{j2}, w_{j3}), w_{j1} = \min_k\{w_{j1}^k\}, w_{j2} = \frac{1}{K}\sum_{k=1}^{K} w_{j2}^k, w_{j3} = \max_k\{w_{j3}^k\} \tag{21}$$

Therefore, it is necessary to calculate the fuzzy normalized decision matrix and previously identify the type of criterion.

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right) and\ c_j^* = \max_i(c_{ij})\ for\ benefit\ criteria \tag{22}$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right) and\ a_j^- = \min_i(a_{ij})\ for\ cost\ criteria \tag{23}$$

As a next step, the weighted normalized fuzzy decision matrix is calculated using the following mathematical formula:

$$\tilde{v}_{ij} = \tilde{r}_{ij} * w_j \tag{24}$$

When the weighted normalized fuzzy decision matrix has been generated, it is necessary to calculate the FPIS (Fuzzy Positive Ideal Solution) and the FNIS (Fuzzy Negative Ideal Solution), for this these two formulas are used:

$$A^* = (\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*), where\ \tilde{v}_j^* = \max_i(v_{ij3}) \tag{25}$$

$$A^- = (\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-), where\ \tilde{v}_j^- = \min_i(v_{ij1}) \tag{26}$$

Where in A^* the selection of the largest number for each criterion is made and in A^- the smallest numbers of each criterion are selected.

Therefore, the distance of each alternative to the FPIS and the FNIS is calculated:

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$$d\,(x,y) = \sqrt{\frac{1}{3}\left[(a1-a2)^2+(b1-b2)^2+(c1-c2)^2\right]} \tag{27}$$

Once the results have been obtained, the distance to each alternative to the FPIS and the FNIS is calculated using the following formulas:

Fuzzy positive ideal solution:

$$d_i^* = \sum_{j=1}^{n} d\left(v_{ij}, v_j^*\right) \tag{28}$$

Fuzzy negative ideal solution:

$$d_i^- = \sum_{j=1}^{n} d\left(v_{ij}, v_j^-\right) \tag{29}$$

Finally, the proximity coefficient CCi is calculated for each alternative:

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*} \tag{30}$$

In this way, once the final results are obtained, the hierarchy or rank is identified. In this way, its application is of vital importance when administrative members of an organization are not sure to determine and define the decision-making criteria, fuzzy theory provides an adequate tool to face such uncertainties. However, if decision makers cannot agree on the method of defining linguistic variables based on fuzzy sets, fuzzy set theory with interval values can provide a more accurate model (Ashtiani, B. et al., 2009).

Another example of the application of this method is in failure modes and effects analysis (FMEA). It is an engineering technique widely used to design, identify and eliminate faults, problems, potential errors of the system, design, process and / or service before they reach the customer, so by applying the fuzzy method it allows experts to use linguistic variables that allow them to reach a solution (Kutlu & Ekmekçioğlu, 2012).

2.8 Entropy method for decision making

It is a parameter that describes how different the alternative is to another with respect to a criterion. First, the decision matrix must be normalized according to the data given by the mathematical formula:

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{31}$$

Therefore, the entropy is calculated with the following formula:

$$e_j = -h \sum_{i=1}^{m} r_{ij} \ln r_{ij}\,, \;\; j = 1, 2, \ldots, n. \tag{32}$$

It should be noted that to know the value of "h", the number of alternatives must be considered (m), and the formula applied:

$$h = \frac{1}{\ln(m)} \tag{33}$$

Therefore, the value of each summation is multiplied by the negative value of h. After this, the weighted vector is calculated, and its mathematical formula is applied:

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)}\,, j = 1, 2, \ldots, n. \tag{34}$$

Applying the previous formula, the final results and their hierarchy or rank must be displayed. This methodology is generally used when choosing the best option among the different alternatives, such is the case of selecting a computer from a set of them from the same range, so the entropy method is used to evaluate the weight of the attributes of the characteristics (Singh, Sohani & Singh, 2014). On the other hand, the entropy method is used when there is a fuzzy environment and with unknown attribute weights, in this way this method handles the impression of the data and allows adding preferences in decision-making, such as in the selection of a house (Nikunj, 2015).

2.9 AHP (Analytic Hierarchy Process) Method

This method usually calculates criteria weights and is based on 3 fundamental steps. The first step is to develop a hierarchical structure with an objective at the highest or highest level, then the attributes / criteria are positioned at the second level and the alternatives at the third level.

The second step is to determine the relative importance of different attributes or criteria with respect to the objective, this is done using a pairwise comparison matrix. This pairwise comparison is created with the help of the relative importance scale. Subsequently, the comparison matrix is created, which is equivalent to the number of criteria.

Then, to generate the normalized pair matrix, all the elements of the matrix must be divided by their sum. Subsequently, the weight of each alternative is calculated by means of the average of all the elements of the row or the alternative and in this way the normalized matrix is generated.

The third and final step to follow is to calculate consistency. It consists of checking if the calculated values are correct, and for this the comparison matrix is taken by pairs that is not normalized and each value is multiplied with the weights.

Thus, the relationship between the value of the weighted sum and the weight of the criteria must be calculated, in order to calculate lambda max, which is the average of those results. Therefore, the consistency index is calculated:

$$Consistency\ Index\ (C.I) = \frac{\lambda \max - n}{n-1} \quad (35)$$

In this way, the consistency relationship is calculated, which is obtained using the following mathematical formula:

$$Consistency\ Ratio = \frac{Consistency\ Index(C.I)}{Random\ Index} \quad (36)$$

The random index is the consistency index of a randomly generated paired matrix. Now, to conclude that the metrics are reasonably consistent, the value of consistency ratio must be less than 0.10, which is the standard of measurement.

Finally, the weights of the criteria are defined according to the previous results since the condition of the standard makes it proceed. It is important to highlight the applications that are given to this methodology today, because, over the years, several solutions and methods have emerged to address the problem of supplier selection in the industry, but the effective application of This method for selecting suppliers helps organizations to optimize cost and quality functions (De Felice, F. et al. 2015). Another application of this methodology is in public sectors, such as in supporting the performance evaluation of public security financial expenditure where, based on the analytical hierarchy process (AHP), it establishes a system of performance evaluation indices that It is adapted to the financial expenditure of public security organs with the comprehensive evaluation of the performance of public financial expenditure as addressed by Zhao, Zhang, & Jin (2014).

2.10 Vikor (multicriteria optimization and compromise solution)

This multi-criteria method is based on the calculation of the S_i value of the criteria values, the formula is as follows:

$$S_i = \sum_{j=1}^{m} \left(w_j \frac{x_i^+ - x_{ij}}{x_i^+ - x_i^-} \right) \quad (37)$$

Consequently, the R_i value is calculated and the mathematical formula is as follows:

$$R_i = \max_{j} \left(w_j \frac{x_i^+ - x_{ij}}{x_i^+ - x_i^-} \right) \quad (38)$$

Subsequently, the following formula is applied to determine the hierarchies:

$$Q_i = v \left(\frac{S_i - S^*}{S^- - S^*} \right) + (1 - v) \left(\frac{R_i - R^*}{R^- - R^*} \right) \quad (39)$$

Where $S^* = \min_i (S_i)$, $R^* = \min_i (R_i)$, $S^- = \max_i (S_i)$, $R^- = \max_i (R)$ and the decision maker assigns a value of v. In this way, the hierarchy and the best option of the alternatives are known. This methodology is suitable for any academic organization when the selection of academic personnel is required since many factors influence, such as professional capacity, communication skills, work experience, etc., and this becomes a decision-making problem. of multiple criteria where the Vikor method plays an important role (Sajja, 2013).

On the other hand, the Vikor method is usually used in the support and improvement of information security where it allows the decision maker to understand gaps in projects and aspects, classifying them to improve these large gaps in the control elements to reach the desired level (Ou Yang, et al., 2009).

3. Methodology

Based on the software development methodology called "Scrum", the specific objectives are listed as follows:

1. Research (theoretical) of multi-criteria decision-making tools (MCDM) to be implemented within the computing tool.
2. Viewing tasks or to-do list (within code).
3. Tasks or activities in development: in this phase the activity or task is placed once it is complete, if it is incomplete or something is missing, it is removed to the previous phase (visualization of tasks or list of tasks to be done).
4. Tests: tests are carried out in the software to check if the activities were carried out successfully. If everything works correctly, it goes to the next phase, otherwise such activities would return to the phase of tasks in development.
5. Deployment: once the code is validated, the activities that successfully analyzed the test phase are added in this phase (deployment), for the purpose of being uploaded to production in the system (such activities are approved and given green light for that purpose).
6. Completed - In this phase, tasks that are fully completed are simply added and documented.

Below is part of the methodology developed: the main screen of the software:

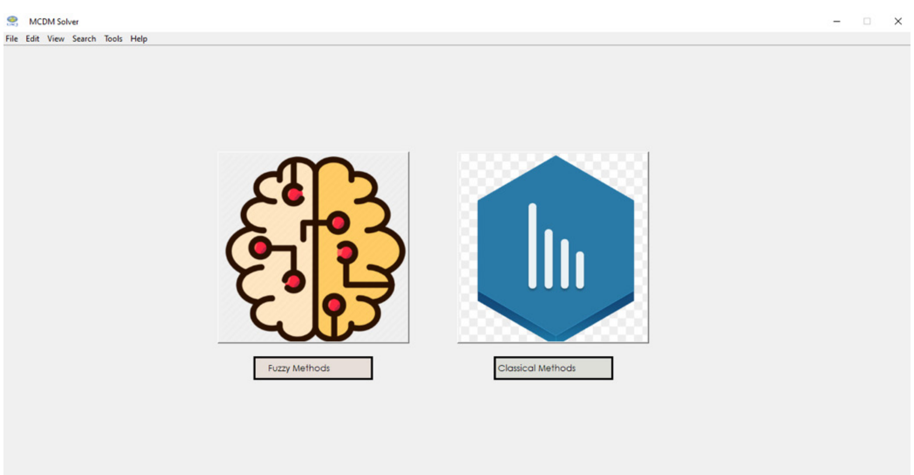


Figure 1. Software initial screen.

Figure 2. User interface for classic methods.

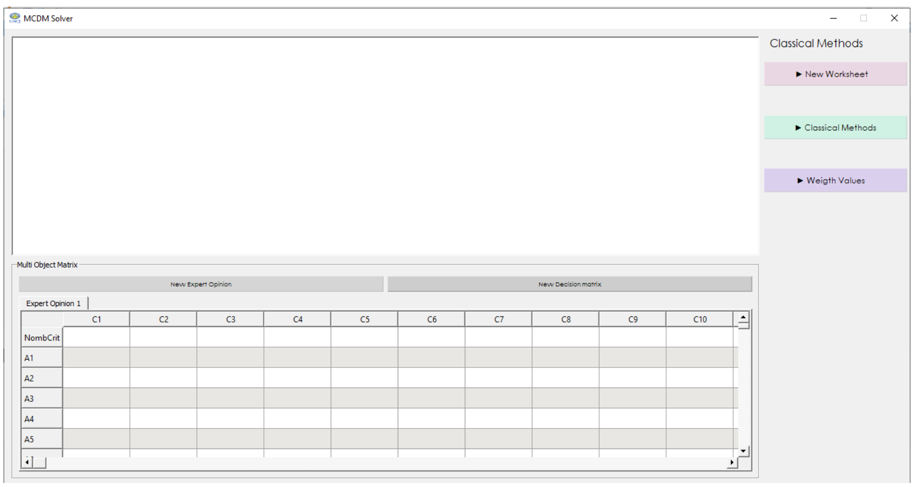
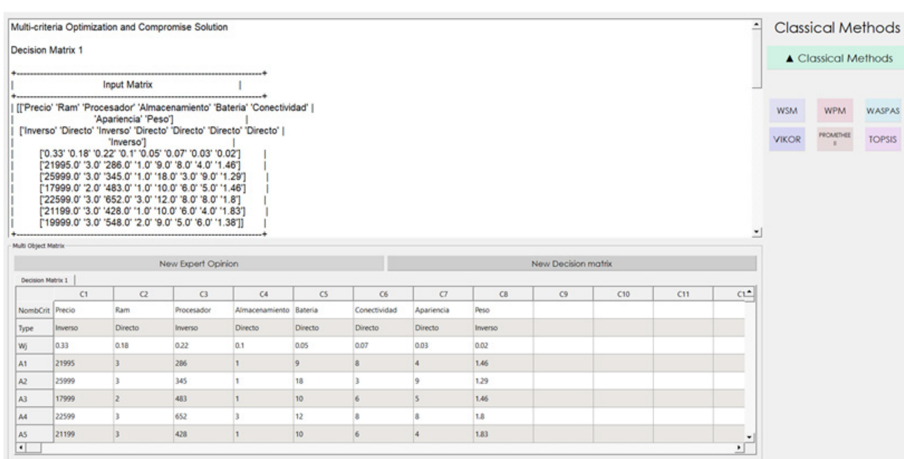


Figure 3. Data interface entry.



	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
NombCrit	Precio	Ram	Procesador	Almacenamiento	Bateria	Conectividad	Apariencia	Peso			
Type	Inverso	Directo	Inverso	Directo	Directo	Directo	Directo	Inverso			
Wj	0.33	0.18	0.22	0.1	0.05	0.07	0.03	0.02			
A1	21995	3	286	1	9	8	4	1.46			
A2	25999	3	345	1	18	3	9	1.29			
A3	17999	2	483	1	10	6	5	1.46			
A4	22599	3	652	3	12	8	8	1.8			
A5	21199	3	428	1	10	6	4	1.83			

Figure 4. Data interface output.

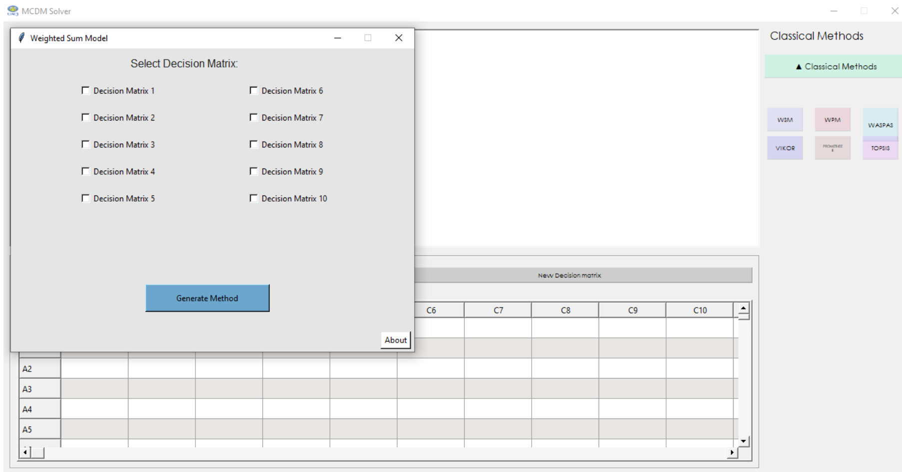


Figure 5. Selection of method and decision maker.

The number of lines of code amounts to 7000 (written in Python language).

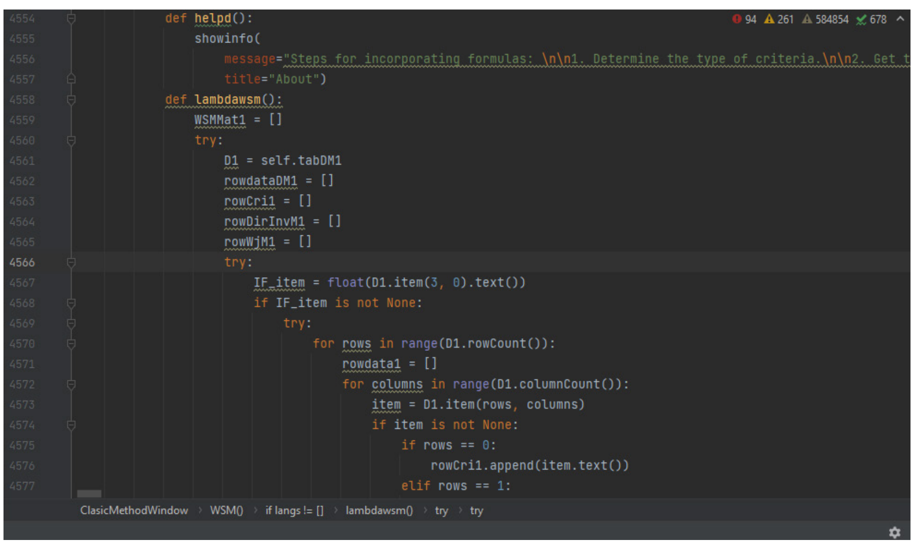


Figure 6. Source code.

4. Conclusion

The development of multi-criteria techniques within a computer program provides great support as a decision-making tool, due to its need in multiple areas such as industry and academia, so its field ranges from resource management even making important decisions at the administrative level.

However, the development of this computational tool is a contribution that currently does not exist in any field, and the purpose of its development has an impact on the research sector, so it will be free to use for said sector.

It should be noted that the interface generated by this computation tool will generate accurate results faster through its standardized formulas compared to the process of entering formulas from other computational tools due to the classical, fuzzy and weighting techniques incorporated. within the software they are more useful and applicable because of their easy interpretation of data and their wide variety of expert opinions.

In this way, it is important for organizations to have reliable decision-making systems that seek to solve complex problems, which requires a high degree of reliability of the computer programs to be used.

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