

"Multi-Criteria Methods in Selecting Investment Projects Application of the PROMETHEE Method in the Project Site Selection ProcessCase Study of Naftal Company in Maghnia, Tlemcen"

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Abstract: This research aims to recognize the use of the PROMETHEE method as a scientific model and approach based on multiple criteria methods in selecting investment projects. To achieve the study's objectives, the main criteria for selecting the best location for establishing points of sale were identified through seven alternatives, drawing on data provided by Naftal and using the Visual PROMETHEE (2013 version) specially designed for multi-standard methods. The study found that the climate standard was selected as the best criterion in terms of importance, and the Ndroma site as the best location for point-of-sale construction.

Keywords: project selection, Multi-standard analysis, Decision-making, PROMETHEE method.

Jel Classification Codes : C40, D70

1. INTRODUCTION

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Enterprises face a lot of situations that need help to be decided on, whether it be assistance based on methods such as past experiences and others, or by developing models and procedures based on quantitative methods such as process research, multi-standard decision-making assistance used in many areas especially inventory management, selection of marketing mix, selection of investments. Decision-making problems often aim to look for examples of an economic function based on mathematical methods and various multi-standard methods, with presentation of the PROMETHEE method. With several different criteria, for evaluating and selecting investment projects, a multi-criteria analysis methodology was proposed that would help decision makers to take Note the different aspects of the project, such as clarifying the priority of the criteria in terms of importance, their order, and the degree of coherence among them., and the structuring of preferences, so it would have been more appropriate to resort to methods that encompassed several aspects and several constraints, namely, multi-criteria. These include both quantitative criteria and how, and often not as important in decision-making .

In order to complete this research, the following problem must be answered:
How far can multi-standard analysis be used using the PROMETHEE method to select an investment project?

In order to learn about the multiple aspects of this problem, we should have addressed the sub-questions that we will try to answer through this research:

- *What does project management mean?
- *What are the QTY methods to solve the site selection problem?
- *How do we solve the problem of choosing a project site using the PROMETHEE method?

1-1-Hypotheses:

Where to address this topic the following hypotheses have been formed:

- Given the multiplicity of goals that decision makers want to achieve from a location, quantitative methods, especially PROMETHEE, must be used.
- PROMETHEE is the best way and a comprehensive and integrated framework to rationalize decision makers to trade between sites.

1-2-The rationale for choosing a search:

What invited us to choose this research lies in:

- We recognize the importance of the subject, especially with the development of Algerian institutions.
- The weak study of the project, particularly from the technical aspect related to the choice of the project's location, often leads to project failure.

1-3- Study Objectives:

This study aims to achieve the following objectives:

- * To identify the quantitative methods for selecting the project site.

* To determine the criteria (factors) that influence the decision of selecting the project site.

* "Resolve the project site selection problem using the PROMETHEE method."

1-4-Study Limits:

This study is limited to Natal Company which provides products (petroleum materials) to citizens and deals with customers. The study will not include other public institutions that distribute and sell non-petroleum products. The study will be applied to Naftal Company and in particular to areas in need of the Company's products.

1-5- Research curriculum and tools used:

The approach to this research is the quantitative analytical approach that fits the problem at hand. We worked on identifying the quantitative methods that help to choose the project location and applied the PROMETHEE method to choose the best location.

In order to learn about the multiple aspects of this problem, we should have addressed the sub-questions to which we will try to answer through the following axes:

- **Previous studies.**
- **Decision-making and project management methods.**
- **Study method methodology.**
- **Applied study.**

2. Previous studies

2-1-Study: Salima tbaibia and saida Burdema (2010), Entitled "Multi-standard analysis and its role in decision-making".

This study aims at how to apply a multi-standard analysis methodology to test investments with limited financial resources and many proposed projects in which the two researchers in this study ,the PROMETHEEIN method was relied upon for selecting and ranking investment projects. The distinction methods are considered among the most widely used, which determines the available options between PROMETHEE and ELECTRE1, in addition to the fact that the latter option actually fits the study's data and its problem, but gives the nucleus of preferred incidents without the overall ranking of incidents, and because the decision-maker is interested in arranging all incidents (investments).

This study concluded that the PROMETHEE method gives the decision maker the order of all incidents without exception, and takes into account quantitative and qualitative criteria.

2-2- Study: Teibi Boumediene (2010) titled 'Multi-Criteria Analysis as a Decision Support Tool: Application of the PROMETHEE Method - Case Study: Seror Company'.", The researcher of this study used multi-standard analysis where he applied PROMETHEE as a decision-making aid, as demonstrated by the method used,

the two-method arrangement, the partial arrangement PROMETHEE I and the overall arrangement PROMETHEE II, to demonstrate the effectiveness of this method and its assistance in multiple decision-making:

"How does the PROMETHEE method help in multi-standard decision making?

To answer this problem, the researcher divided the study into three chapters decision-making ", addressing in chapter I the issue of decision-making and its relationship to the information system, In chapter II, he addressed the presentation of a multi-standard analysis with mention The paragraph discusses the advantages and disadvantages of the method, and in the third chapter, the fundamental principles of the PROMETHEE method are explained, along with the application of the PROMETHEE I and PROMETHEE II methods SEROR, where the institution had to choose between six (6) alternatives (S.N.V.I, Renault, Fiat, Mercedes, Volvo, Toyota), based on five (5) criteria (Machine technical characteristics, machine cost, security level of proposed machine, after-sales service quality, estimated maintenance costs during machine life cycle) In order to maximize criterion I, III and IV, and to reduce criterion II and V, the research findings are as follows:

I chose Renault as the best option, as it recorded a net flow of 0.12, followed by S.N.V.I in second place with a net flow of 0.06. Volvo came in third with a net flow of -0.01, then Toyota with a net flow of -0.04, followed by Mercedes with a net flow of -0.05, and finally Fiat with a net flow of -0.07.

2-3-- Study: Abdelkader Boumaza and others (2013), Entitled: "Application of the hierarchical analysis method To determine the location of the Salat production factory."

In this study, the researcher reviewed the use of the hierarchical analysis method., which is one of the multi-standard methods in which it addressed the problem of choosing a site for the production of psalm in an Algerian institution for the preparation and paving of STAAR roads, where the researcher provided a theoretical explanation of the method used, in addition to reviewing the various ways to apply it.. In the latter, he addressed the problem of trade-offs between available locations consisting of four (4) alternatives, To choose the best alternative based on five (5) main criteria of site space Land Ownership, Proximity to Main Road, Population Dimension, Sales Volume matrix ", based on the pairwise comparison matrix between the main criteria and the pairwise comparison matrix between the alternatives for the main criteria, the following results were obtained:

- I chose Mashreya as the best site with 37% compared to the other sites, taking into account the aforementioned criteria..

-Pyramid Analysis and Problem Solving Method fits as demonstrated by its success in all studies because of its flexibility and ease of application.

2-4-Study: Suhaila Shaniya:(2014) ,Title: The application of the PROMETHEE multi-criteria analysis method in the employee selection process at the institution - Reducing the situation of the National Center for Scientific and Technical Research in Arid Areas (CRSTRA) -

The researcher in this study highlighted the methods of multi-standard analysis, especially the PROMETHEE method, as well as its application in the field of human resource selection and assisting the enterprise in the selection of staff, and tried to answer the following problems:

"How can the PROMETHEE multi-standard analysis method be applied to the selection process of employees in the organization?

On this basis, it addressed two hypotheses.

*The result of recruitment contests varies when using the PROMETHEE method rather than the normal methods of selection within the organization.

*PROMETHEE method takes several criteria into account the quantity and how when used in selection during the enterprise-level recruitment process. The study was divided into three chapters:

Chapter I is devoted to decision-making, human resources management and chapter II is devoted to basic concepts about the multi-standard method PROMETHEE and the use of my software: Academic Edition PROMETHEE Visual 1.4 and provides an illustrative example. Chapter III was devoted to the application of the PROMETHEE method in the Scientific and Technical Research Centre for Dry Areas, The method was applied to the rank associated with the research specialization in zoology and the rank of government engineer. The results were summarized as follows:

* Three candidates were selected from four alternatives in the first specialization, based on criteria that include specialization compatibility, study path, certificate date, and interview result.

* for the second specialization, two positions were selected from 6 available alternatives and relied on 8 criteria, including complementary composition, works, studies and the professional experience resulting from the interview..

* The PROMETHEE method is considered fairer compared to the old method., compared to the 2014 competition where when using the PROMETHEE method, the institution added a secondary standard in both disciplines, which made the difference between the third and fourth candidates because they were married.

*PROMETHEE method is one of the multi-standard methods that takes into account all criteria of whatever kind (quantity) such as experience or year of certification as well as (quantity) conforming to a specialty, for example.

3-Decision-making and project management methods

3-1-Project management concept:

Project management concept is conceived as science and art. Some definitions of project management can be given that reflect the organizational (functional)

perspective and supervisory nature, and the substantive aspect thereof. These definitions include:

*It is a permanent and independent management body located at the highest administrative level in the organization, often reporting to the Chairman of the Board, and consists of a group of specialists with competencies and specialized skills. (Amar & Sabrina , 2017)

*Project management involves planning, organization, control and control of the aspects of the project, as well as motivating both project interventions, to achieve the objectives firmly and in the specific cost, duration and efficiency criteria". (Morly, 2006)

3-2-Quantitative methods for choosing the project location:

There are several ways to choose a project site, depending on the nature of the project, time, and cost, as well as estimates and personal opinions, is considered insufficient to reach the final decision.

The methods used to select the project's location can be divided into : (Roy & bouyssou, 1985)

* Methods that take into account financial factors only .

Methods that take into account all factors (financial and non-financial).

There are also linear programming methods where we find the goal-written programming method defined by both M.Tamz and C.Romero 1998: "as a mathematical method that tends to be realistic flexibility in resolving complex decision-making issues and which takes into account several objectives, many variables and constraints" (Tamz & Romero, 1998).

The first formulation of the goal programming model was carried out by both American scientists "Charnes et Coofer" 1961 as follows : (Mareschal , 2000)

Minimiser $|f_i(x) - g_i|$

$$cx \leq c$$

Under restrictions: $w_j \geq 0 (j = 1, \dots, n)$

so that:

$f_i(x) = \sum_{j=1}^n a_{ij}x_j$
 $f_i(x)$: Represents goals with $i=1, 2, \dots, p$
 g_i : The goal to be reached for goal number i $i=1, 2, \dots, p$
 x_j : The decision variable represents the number $j=1, 2, \dots, n$
 a_{ij} : Technical Transactions.
 c_i : Learn about the transactions related to model constraints
 c : Ray of available resources

can be written in its well-known linear form.

$$\text{Min}Z = \sum_{i=1}^p (\delta_i^+ + \delta_i^-)$$

$$\sum_{j=1}^n a_{ij}w_j - \delta_i^+ + \delta_i^- = g_i (i=1,...;p)$$

Under restrictions:

$$cx \leq c$$

$$x_j \geq 0 (j=1,...;n)$$

$$\delta_i^+ . \delta_i^- \geq 0 (i=1,...;p)$$

Where the product of positive and negative deviations is zero. because $(\delta_i^+ \times \delta_i^- = 0)$
 $\delta_i^+ + \delta_i^- \geq 0 (i=1,...;p)$ That is, it cannot be achieved together for the goal.

That is, if it is achieved δ_i^+ It is supposed to be $\delta_i^- = 0$

Since we cannot simultaneously reach a value smaller than the target g_i and a value greater than g_i .

4- Study method methodology

4-1- The concept of multi-criteria analysis:

It can be defined as those methods that help The decision-maker, when making a multi-criteria decision, expresses the achievement of a certain solution to problems or to achieve a specific goal by taking into account a set of criteria that are often complex (quantitative and qualitative variables), and are for maximization or minimization or both, and from here it was necessary to resort to methods that include several aspects and several restrictions, which are multi-criteria methods. There are also three main stages to reach a decision according to this methodology.: (Zemmori & Otmane, 2000)

- Defining the decision situation and setting objectives;
- Defining incidents and establishing criteria;
- Choosing the appropriate solution or solutions.

4-2- The PROMETHEE method:

4-2-1- PROMETHEE I ORDER

PROMETHEE I method forms a partial ordering on A considering the outflows and inflows of event a as follows (Mareschal, 2000.p56):

a Preferred if $\Phi^+(a)$ big and $\Phi^-(a)$ small.

The arrangement in this way is given as follows:

$$\left. \begin{array}{l} \Phi^-(a) \leq \Phi^-(b) \quad \text{and} \quad \Phi^+(a) > \Phi^+(b) \\ \text{or} \\ \Phi^-(a) < \Phi^-(b) \quad \text{and} \quad \Phi^+(a) = \Phi^+(b) \\ \text{or} \\ \Phi^-(a) = \Phi^-(b) \quad \text{and} \quad \Phi^+(a) > \Phi^+(b) \end{array} \right\} \text{whether } a P b$$

$$a I b \quad \text{if } \Phi^-(a) = \Phi^-(b) \quad \text{and} \quad \Phi^+(a) = \Phi^+(b)$$

$R(b, a) = 1$ if a is not preferred to b ; And at the same time unbiased- b

4-2-2-PROMETHEE II Arrangement:

This method is a total arrangement for all accidents, using net flows, and is used in some applications that need to know the order of each incident, and is as follows :
(Taibi , 2002)

$a \succ b$ if $\Phi(a) > \Phi(b)$

$a \sim b$ if $\Phi(a) = \Phi(b)$.

5- Applied study

5-1- Asking the problem

Among the areas that should be compared to choose the best location for establishing additional points of sale in the Maghnia region, we find: 1) Tounane, 2) Boughrara, 3) Nedroma, 4) Ghazaouet, 5) Bab El Assa, 6) Beni Bousaid, 7) Marsa Ben Mehidi.

The factors or criteria on the basis of which Naftal selects sites are:

Four, as follows:

**road quality

**the climate

**number of families that consume natural gas.

**number of families that consume butane gas.

Based on the information obtained from the company (the decision maker) and the theoretical conclusions drawn about the PROMETHEE method, the best location can be selected using the visual PROMETHEE software.

5-2- Solving the problem using PROMETHEE method

5-2-1- Evaluates criteria and preference formula

After consulting with the decision-maker (the company owner), we determined the values of the four criteria for each of the seven sites by assigning a weight, value, or points to each site according to each criterion. This was done based on the importance of each criterion to the decision-maker, as well as relying on the values of the pairwise comparisons that he established. (Thomas.L.Saaty,2004), For example, a score of 9 can be given in the case of absolute or very strong preference, while in the case of weak or very weak preference, a score of 1 out of 9 can be given. Average values were also used in the evaluation and formulation of preferences. Based on the company's information, the values of the four criteria for each alternative were determined, and the formulation of preferences was as follows:

First Standard C1: Road Quality

The evaluation of this criterion is based on the decision maker's experience, as well as on criteria considered secondary in the previous method, where a point of 9 was given at each type of site or project.

Road quality assessments were as follows:

Standard: Road Quality	
Point/9	alternatives
8	Location 1
5	Location 2
9	Location 3
6	Location 4
6	Location 5
8	Location 6
5	Location 7

Source: Prepared by researchers based on the company owner's information

10	Standard Weight
Type V	Generalized Standard Type
/	Threshold Both
1	Detailed threshold
MaximizeMax	directional

In the next table we will determine preferences on the basis of the Road Quality Standard (Single Standard Assessment), where we give the P code in case of preference (Préférence), and give the I code in case of reverse (Indifférence).

Location 7	Location6	Location 5	Location 4	Location 3	Location 2	Location 1	alternatives
	I			P			Location 1
I	P	P	P	P		P	Location 2
							Location3
	P	I		P		P	Location4
	P		I	P		P	Location5
				P		I	Location 6

	P	P	P	P	I	P	Location7
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Collecting the number of preferences in the table."

Dominé Par	I	P	alternatives
4	1	1	Location1
0	1	5	Location2
6	0	0	Location3
2	1	3	Location4
2	1	3	Location5
4	1	1	Location6
0	1	5	

The ranking of the sites based on the preferences of the road quality criteria is as follows:

The site of Ndromah is ranked first.

- Tonan and Beni Basseed are second.
- The location of the conquests and the doorstep is third.
- Bogarar and Ben Mehidi marina are last ranked.

At the same stages, based on the company's outputs, we repeat the trade-off between alternatives. (Locations) This is based on the decision-maker's (owner's) preferences for each criterion, as in some cases we note that alternatives cannot be traded (Sites), thus placing them in the same position and thus ensuring that this stage is preliminary to a solution that achieves the highest percentage of satisfaction for the decision-maker by relying on a multi-standard analysis method after the preparation of the so-called decision matrix.

Note:

When ranking sites on the basis of decision-maker preferences for each criterion in some cases it is not possible to trade when the values of the standard are equal and this

makes them the same rank, so we use a multi-standard analysis method to achieve the greatest level of satisfaction for the decision-maker for all criteria at once (Pattyn & Wouters , 2002)

5-2-2- Preparation of decision matrix:

This matrix includes the values of each criterion for each alternative (location) and the weights of the criteria according to the preferences of the decision-maker, as well as the type of preference function for each criterion, as shown in the following table:

Table (01): Multi-standard decision matrix

Critère	C1	C2	C3	C4
Unité	Points	Points	Points	Points
Poids	10	45	25	20
Type	Type v	Linéaire	Usuel	Type V
Action				
The site 1	8	8	6	5
The site 2	5	7	5	2
The site 3	9	9	9	4
The site 4	6	9	8	5
The site 5	6	6	5	2
The site 6	8	6	6	5
The site 7	5	4	6	3

Source: Prepared by researchers based on the company owner's information

5-3- Applying the PROMETHEE method and analyzing the results:

Regarding the weights of the criteria, there is no precise way to evaluate them; rather, it depends on the experience and impartiality of the decision-maker. Through the resolution matrix, we note that the criteria are initially defined by giving different weights, varying according to the degree of importance of each criterion in decision-making, where these weights are not fixed and accurate and even vary between them by ocean, or decision-maker. For example, the road quality standard is 10% because the owner is not afraid of this aspect to consider the road quality as the first and most prominent conditions in each alternative or available projects The climate criterion, which accounts for 45%, is the most important, as the amount of consumption depends on the climate degree., Also, the standard for families consuming natural gas is 25% based on the number of families consuming natural gas The standard for families consuming Bhutan gas is 20%, with the number of families consuming Bhutan gas being the primary weight of this standard.

We insert resolution matrix values in visual PROMETHEE (Version 2013) which helps to analyze results with accurate and sophisticated tools, and resolution matrix shown in the following figure:

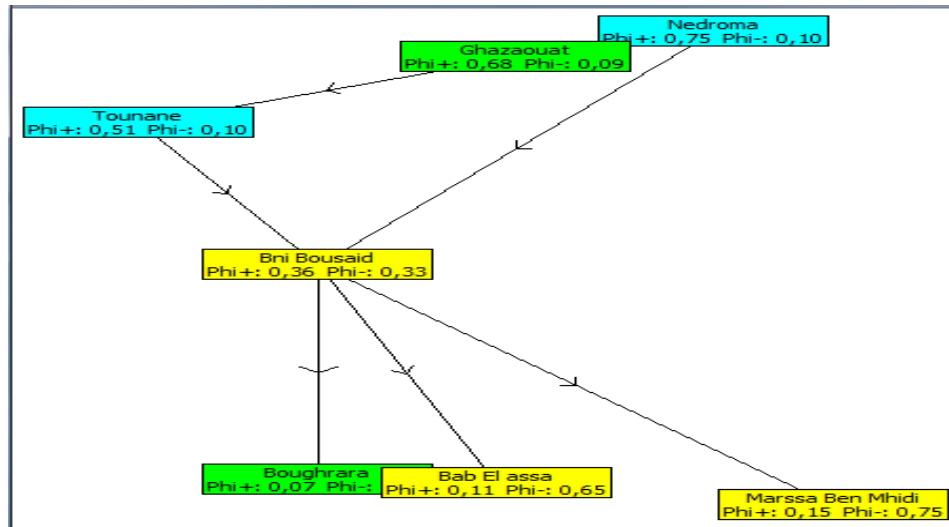
Figure (01): Resolution matrix

Bertrand		توزيع الطريق	المناخ	الغابات الم...	الغابات الم...
Unité		points	points	points	points
Cluster/Groupe					
Préférences					
Min/Max		max	max	max	max
Poids		10,00	45,00	25,00	20,00
Fn. de préférence		Forme en V	Linéaire	Usuel	Forme en V
Seuils		absolu	absolu	absolu	absolu
- Q: Indifférence		n/d	1	n/d	n/d
- P: Préférence		1	2	n/d	1
- S: Gaussien		n/d	n/d	n/d	n/d
Statistiques					
Minimum		5	4	5	2
Maximum		9	9	9	5
Moyenne		7	7	6	4
Ecart-type		1	2	1	1
Evaluations					
بلدية تونان		8	8	6	5
بلدية بوعقارة		5	7	5	2
بلدية بوعقارة		9	9	9	4
بلدية عزوات		6	9	8	5

Source: Visual PROMETHEE (2013)

5-4- Results obtained using PROMETHEE method

Figure (02): Format showing position order by preference



Source: Visual PROMETHEE(2013)

The locations are ranked according to preference as follows:

- *The Ndroma website is ranked first
- *Second-ranked invasion site
- *Tunan site is third.
- *Pence's site is in fourth place.
- *boughrara site is ranked 5th.
- *The threshold of the door is in sixth place.
- * The location of Mers ben mehidi is in last place.

-Analysis of results based on inflows and outflows:

Figure (03): Format showing analysis by flow

Rang	Car		Phi	Phi+	Phi-
1	Nedroma		0,6500	0,7500	0,1000
2	Ghazaouat		0,5833	0,6750	0,0917
3	Tounane		0,4083	0,5083	0,1000
4	Bni Bousaid		0,0333	0,3583	0,3250
5	Bouhrara		-0,5333	0,0750	0,6083
6	Bab El assa		-0,5417	0,1083	0,6500
7	Marssa Ben Mhidi		-0,6000	0,1500	0,7500

Source: Visual PROMETHEE(2013)

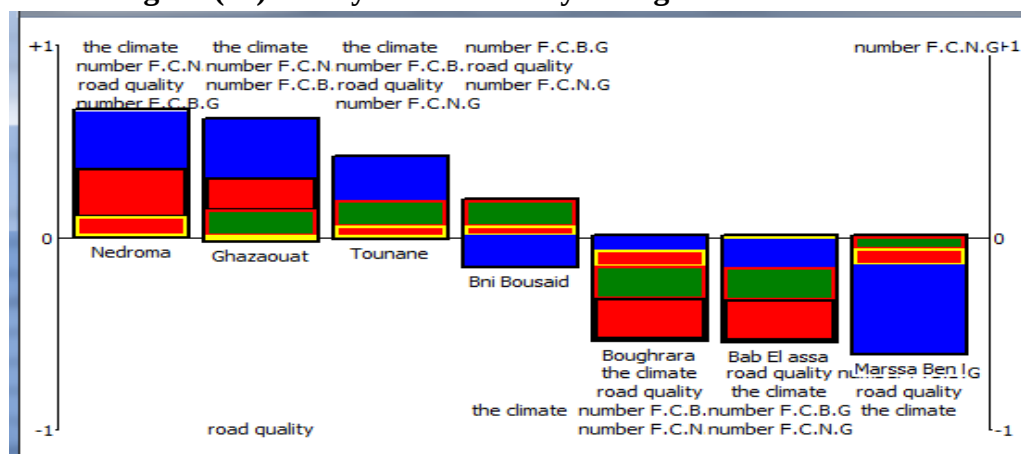
Net flow of Ndroma = 0.75 greater than net flow of invasion = 0.675.

-Net flow of the invasion site = 0.675 greater than the net flow of the Tunan site = 0.5083.

*If as a result it can be said: the site of Ndroma is better and better in terms of importance for the entrepreneur, the site of invasions is the second best site and so on.

5-5- Results analysis through Arc-en-ciel PROMETHEE:

Figure (04): Analysis of results by strengths and weaknesses

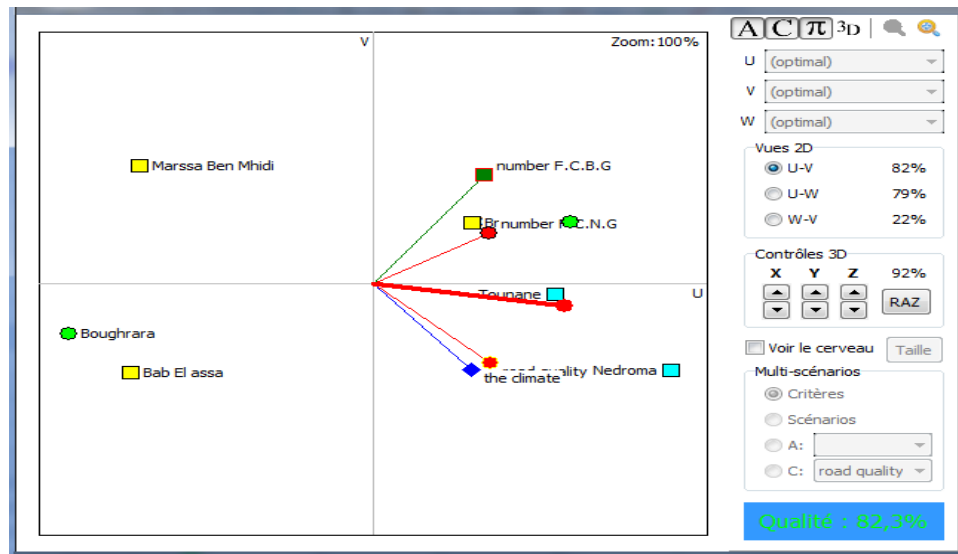


Source: Visual PROMETHEE(2013)

This analysis highlights the strengths and weaknesses of each alternative. For example, the strength of the Nedroma site lies in its climate, the number of households using natural gas, and the ease of access compared to other locations. However, we also observe a weakness in the number of households using butane gas.

5-6- Results analysis using the GAIA scheme:

Figure (05): Analysis of results by GAIA chart



Source: Visual PROMETHEE(2013)

- The quality of GAIA plans = 82.3% indicating that the scheme is fully acceptable.
- Accidents (locations) spread well in the same direction as their strengths.
- - The criteria are approaching being the focal point of decision π .
- • By analyzing the GAIA diagram, monitoring the spread of incidents (alternatives), and the distribution of criteria on the graph, we observe that the strengths of each supplier are oriented in the same direction as their presence, while the weaknesses are oriented in the opposite direction.
- • The climate criterion and the road quality criterion tend to be located in the same position as Ndroma (the best alternative).
- We note that the site of the Marsa Ben Mehidi, Bougharara and Bab al-Assa are in the opposite direction and therefore we say that these alternatives are weak in all criteria.

Finally, it can be said that the Ndroma site is located in the same axis of the resolution π indicating ,This alternative ranks first, while the other option is chosen by the decision-maker as the best location for conducting oil sales."

6-. Conclusion:

in order to provide a better alternative than the approach taken in Algeria's economic and financial institutions, and to seek a method or method on which these institutions rely to trade and arrange between projects, based on several criteria (Main and secondary), we have tried to apply the PROMETHEE method of the company in question, which includes accurate data, whether quantitative or how, and this is what was discussed in this paper, where a decision matrix was built that includes seven (7) projects (alternatives) and four main criteria, where the matrimonial comparison between the criteria, as well as the matrimonial comparisons between these The alternatives for the criteria, based on their importance, are derived from the visual version of the PROMETHEE method (2013). Due to the difficulty of selecting projects in Algerian institutions, and for several reasons, the most notable of which is the ineffectiveness of the information system, as well as the traditional methods used that rely on financial and informational analysis, this makes it necessary for Algerian institutions to adopt a quantitative approach to making a rational and sound decision to prefer between projects and choose between available alternatives and the best for the success of any project.

Conclusions and recommendations:

Our goal in this research was to attempt to answer the fundamental question regarding the extent to which multi-criteria methods are used in decision-making within Algerian institutions., as well as how to arrange projects, thereby maximizing objectives, reducing risks and discovering ways of preventing and treating them both before and when they occur.

In the light of what we have mentioned, and in order to elaborate on the objective of the study, we have used multi-standard methods in the ranking of several projects, using the PROMETHEE method as a decision-making aid. Through this study, both theoretical and applied, we have reached several results, the most important of which are:

- To assess and mitigate these risks during the project selection process, which relies on choosing the best available projects based on comparisons according to their level of importance. On the other hand, leveraging past experiences,gained and shared or the principle of consultation, it is a multi-standard decision that can be addressed only through multi-standard methods.
- Through this scientific research we have come to give an assessment and the degree of importance to each criterion and this is Pairwise comparisons between the criteria related to the objective, resulting in the determination of the weights of these criteria. which will help future decision makers in making decisions as quickly, more accurately, and less expensive.

- Through this study, multi-standard methods have demonstrated their effectiveness by giving them healthier and more accurate results, using the PROMETHEE method at a quality rate of 82.3%, which expresses the validity and non-conflict of comparisons.
- To respond to global transformations and developments in the economy and finance, modern methods and methods have to be introduced and used, based on precise and sophisticated scientific principles in the field of sports and scientific programming, primarily multi-standard methods, The most important method is the PROMETHEE method using the Visual PROMETHEE software, in addition to other methods and techniques such as the AHP (Analytic Hierarchy Process). Therefore, it is essential to inform the stakeholders about the advantages of the PROMETHEE method and provide them with the necessary information to make decisions regarding the selling points that can be offered to this company.

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