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Keywords: *Multi-criteria decision making, Exploration projects, Ranking, Electre III, Sonatrach company, TOPSIS, SMART, SAW*

1 Introduction

Hydrocarbons occupy a prominent place in modern life. They are commonly used for heating, transport and manufacture of a multitude of products. Thus, the exploitation of oil and gas as a source of energy is one of the pillars of the contemporary industrial economy. Due to the very high capital intensity of the oil and gas industry, investment has to take into account all factors affecting the environment, and not only the average of its returns but also the associated financial cost. The usual techniques of project ranking often use the sorting of these projects in descending order according to their *Net Present Value (NPV)*, while the actual environment uses many more criteria. The evaluation of the project by a single criterion expressed in economic terms does not fit with the complex nature of the project, whose dimensions are not reducible to economic criteria.

Algeria is an oil and gas producing country whose economy relies heavily on hydrocarbon revenues; it intensifies its exploration efforts to meet the energy needs of the internal and external market, but also to consolidate its position as an oil and gas producer, a reliable player in the oil and gas sector. Therefore, an increase in research and development of deposits is carried out as a strategy to make more discoveries in order to renew its reserves. Our study is performed by Sonatrach, an Algerian company and a major international player in the hydrocarbon industry. It consists in classifying the projects in order of priority by considering a set of criteria. Hydrocarbon exploration projects are a long, complicated and investment-intensive process involving teams of multidisciplinary specialists (geologists, geophysicists, engineers, technicians, economists, etc.). To this end, the proposed projects are evaluated, ranked and submitted to decision-makers establishing priorities according to several objectives.

Today, the decision-maker prefers solutions that reach sufficient levels for a set of pre-established objectives, rather than solutions that achieve optimal performance on one objective and poor level on others. The majority of real-life problems cannot be reduced to the simple optimization of a mono-objective problem. As a result, there is an abundant literature and much research using multicriteria decision making paradigms such as: Renewable Energies, Environment, Oil Projects, Information Systems, etc.

In our study, we propose a multicriteria approach for project portfolio management taking into account seven criteria. The model used in this work precisely reflects the problem of

Sonatrach. Since it requires a new ranking policy, we have opted for the Ranking-oriented (P_γ) Problematic and the use of ELECTRE III [2], SAW [5], SMART [6] and TOPSIS [1] methods which are compared on the basis of experimental results using real data.

Our approch is articulated around four main steps:

- Identification of all actions to be classified.
- Establishment of a coherent list of priority criteria.
- Evaluation of the performance of each action according to the different criteria used.
- Application of an aggregation procedure to classify actions based on their aggregate performance.

2 Problem formulation

In order to answer the problem posed by the company, we introduce a multicriteria decision support tool for project portfolio management according to different criteria that we define in this section.

2.1 The set of actions

The decision-maker has the choice of 18 projects among 35 in order to establish an investment policy which is as efficient possible. Hence we define the set of actions as follows:

- p_i: denotes the i^{th} project, for $i = \{1, 2, \ldots, 35\}$.

2.2 The set of criteria

After several meetings with the decision-maker of the company, we identify three families of criteria:

2.2.1 Economic criteria

1. z_1 = Net Present Value (NPV): this is the sum of each cash flow associated with the project. The criterion of discounted income is the fundamental criterion of economic calculations.
2. z_2 = Internal Rate of Return (IRR): this is the maximum rate at which the capital used to finance the project can be paid without the operation becoming a deficit.
3. z_3 = Recovery Time (POT): the present value of the recovery period, i.e., the period of operation after which the project funds were used to reimburse the amount of the initial investment and to remunerate the capital corresponding to a rate equal to the discount rate.
4. z_4 = Profitability Index (PI): this is the ratio between the NPV of the project and the total of discounted investments. It measures the average return on investment over the life of the project.

2.2.2 Strategic Criteria

5. z_5 = Fiscal Zone (FZ): the Fiscal Zone (FZ) of a project is a factor to be taken into account when there is a preference in relation to the place where the project takes is conducted. The company may prefer to settle in certain areas for administrative taxation or because the taxes generated in certain areas are less important than in in some others.
6. z_6 = Reserve in Place (RP): this is an approximation of the actual quantity of hydrocarbons available for each project.

2.2.3 Risk criterion

7. z_7 = Probability of Success (POS): this probability encompasses risks: geological, safety, technical. It represents the probability of success of a project. This criterion is crucial because of the nature of the discoveries and the cost of prospecting.

2.3 The consistency of the criteria family

To verify the coherence of the adopted family of criteria, we checked that they satisfy each of the exhaustiveness, cohesion and nonredundancy requirements defined in [3].

2.4 The relative significance coefficients of the criteria

The preferences between each criterion formulated by the decision-maker are defined in Table 1. After determining a coherent family of criteria, we will evaluate the relative importance of

	z_1	z_2	z_3	z_4	z_5	z_6	z_7
z_1	1	3	3	5	5	7	9
z_2	1/3	1	3	5	5	7	7
z_3	1/3	1/3	1	3	3	5	7
z_4	1/5	1/3	1/3	1	3	5	7
z_5	1/5	1/5	1/3	1/3	1	3	5
z_6	1/7	1/7	1/5	1/5	1/3	1	3
z_7	1/9	1/9	1/7	1/7	1/5	1/3	1

TAB. 1: The matrix for comparison of criteria by pair.

each of the above criteria. This evaluation will be carried out by calculating the weight of the different criteria. The assignment of these coefficients (or weights) to the criteria was performed according to the AHP method [4]; We obtained the following weights:

criteria	z_1	z_2	z_3	z_4	z_5	z_6	z_7
weight	0.363	0.243	0.156	0.113	0.068	0.035	0.023

TAB. 2: The weights of the criteria.

3 Resolution and computational results

We used four methods of problem-solving for multicriteria decision support, which are Electre III (E_3), Topsis (T), Smart (Sm), Saw (Sa). Table 3 summarizes the obtained results.

4 Conclusion

The present work consists of modeling, designing and implementing an interactive multicriteria decision support system to deal with a problem of project portfolio management. Our study is conducted to determine the projects, the criteria and their weights to be able to find a family of coherent criteria, and we can say that the original objective has been achieved. The obtained results show that multicriteria decision support is a very appropriate tool to allow a company such as Sonatrach to evolve in a multi-criterion environment in which several requirements are in conflict. We have also shown that the application of a rigorous decision-making methodology makes it possible to obtain satisfactory answers for the decision-maker and to best meet his requirements.

Rank	E_3	Sa	Sm	T	Rank	E_3	Sa	Sm	T	Rank	E_3	Sa	Sm	T
1	p_{25}	p_{25}	p_{25}	p_{25}	13	p_{23}	p_5	p_5	p_6	25	p_{34}	p_{34}	p_{34}	p_{16}
2	p_{19}	p_8	p_{19}	p_{19}	14	p_{32}	p_{17}	p_{29}	p_5	26	p_{18}	p_{11}	p_{18}	p_{34}
3	p_{26}	p_{19}	p_8	p_{27}	15	p_{10}	p_{29}	p_{17}	p_{23}	27	p_{11}	p_{18}	p_{11}	p_{18}
4	p_{27}	p_{27}	p_{27}	p_{26}	16	p_{14}	p_{32}	p_{23}	p_{31}	28	p_{20}	p_{35}	p_{20}	p_{21}
5	p_8	p_{26}	p_{26}	p_8	17	p_{30}	p_{23}	p_{32}	p_{17}	29	p_{35}	p_{20}	p_{21}	p_{35}
6	p_1	p_2	p_2	p_3	18	p_{15}	p_{10}	p_{10}	p_{14}	30	p_{21}	p_{21}	p_{35}	p_{20}
7	p_2	p_1	p_1	p_1	19	p_6	p_{14}	p_{14}	p_9	31	p_{33}	p_{33}	p_{33}	p_{33}
8	p_3	p_3	p_3	p_2	20	p_9	p_9	p_{15}	p_{15}	32	p_{24}	p_{24}	p_{24}	p_{24}
9	p_{28}	p_{12}	p_{31}	p_{28}	21	p_{16}	p_{15}	p_9	p_{11}	33	p_{22}	p_{22}	p_{22}	p_{22}
10	p_{29}	p_6	p_{12}	p_{29}	22	p_5	p_7	p_{30}	p_{10}	34	p_{13}	p_{13}	p_{13}	p_{13}
11	p_{31}	p_{31}	p_{28}	p_{12}	23	p_7	p_{30}	p_{16}	p_7	35	p_4	p_4	p_4	p_4
12	p_{12}	p_{28}	p_6	p_{32}	24	p_{17}	p_{16}	p_7	p_{30}					

TAB. 3: The results obtained for the Sonatrach problem

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