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Developing the Methodology of the Financial Aspect in the Economic Feasibility Studies of Industrial Project

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Abstract

The aim of the present research was developing the methodology of the financial aspect in the economic feasibility studies of industrial project. Economic capital return rate index is one of the appropriate metrics that has been presented in recent years to determine the economic efficiency of investment projects. The mentioned index has simple solution steps, the ability to solve multi-rate problems and the absence of capital return rates; but this index has important flaws that have seriously limited its use. Based on this, this research introduces a new index named reliable economic capital return rate, which originates from the mentioned index; but it has completely fixed its disadvantages. Also, in some cases, it is difficult to estimate the amounts of financial processes in a definitive numerical way, which may lead to making a wrong decision in accepting or rejecting projects; For this purpose, by defining the values of the financial process in terms of fuzzy numbers, this research introduces a new solution to calculate the reliable economic capital return rate under the fuzzy environment, as well as the degree of economic feasibility of investment projects with high reliability and compatible with the present value method. to determine Finally, this article has used the Monte Carlo simulation method using @RISK software to analyse and validate the results.

INTRODUCTION

Pre-investment studies are not only one of the best tools for making decisions in the field of investment and project implementation, but also cause the selection of suitable plans for the optimal use and direction of human and material resources in the direction of the desired goal and not wasting these resources(Nagare & et al, 2019) . Detailed and all-round investigations regarding the implementation facilities and ensuring the practicality and implementation of the plan are called feasibility studies.(Prol & et al, 2020) In general, the purpose of the industrial evaluation of the plan is to ensure that the plan is based on correct and solid foundations in terms of economic, technical, financial and management. In practice, evaluating a new design based on the study of an operating design is easier than evaluating a design based on its test sample because the work records of an operating design and its technical and operational analyzes rely on Its facts, not speculation.(Gisin,2020).

The purpose of the design reviews from a technical point of view is to determine the technical specifications of the product and to provide equipment, machinery, materials, manpower, fuel, energy and other production factors in the right amount, quality and price for the production of the product. In fact, the stages of product manufacturing and the technical facilities of its manufacturing are studied. Also, one of the most important checks in the evaluation of industrial plans is to determine the place of implementation of the plan, and it is necessary to choose a place where the cost of production and distribution of the organization's products is as low as possible. From the economic point of view, the issues of marketing and supply and sale of manufactured products are examined, and from the financial point of view, what is the state of the plan in terms of production cost according to the market and competitors, and through the analysis of the costs and benefits acquired, It is determined to be affordable and profitable. To evaluate industrial plans and determine their priority and preference, there are financial methods, the most common of which are: the investment return period method, the capital interest method or the average return on capital, the internal rate of return method. In this Article to developing the methodology of the financial aspect in the economic feasibility studies of industrial project.

LITERATURE REVIEW

Economic evaluation means when entrepreneurs and senior investment and financial managers of companies always have different opportunities and projects in front of them for investment and profit.(Guerra,2022). These projects differ from each other in terms of profitability and various side costs, which have different advantages and attractiveness for different investors and companies to use investment opportunities. Some of them require initial investment and more expenses during the investment period, and others are longer in terms of time or their return periods are less than others. (Ali et al, 2019). Therefore, different projects should be fairly analyzed and evaluated financially and economically, and according to the conditions of the investors and their cost-effectiveness analysis, they should decide to choose between the

projects. In order to calculate the income and costs of plans and projects, it is necessary to use the concepts and techniques of economic and financial studies of projects (feasibility of projects). One of the main needs of the decision-making process for defining a project or operationalizing business ideas is to evaluate and analyze the justifiability of that project or idea. (Hazen ,2021, Jimenez,2021).

The increase in complexity as well as the dynamism of the conditions governing economic and financial activities and as a result the risk of decision-making in the field of investment or financing of economic projects, requires more advanced analytical methods that can provide more information than traditional evaluation methods. Provide economic plans. This is seen more and more in high-risk projects, including venture capital investments (Mohaisen et al, 2021).(Kussainov,2021) Based on this, in response to new needs, the real option analysis has expanded and found a lot of use and presents a new approach in relation to investment decisions and economic plan evaluation. About a plan; some of the calculations made the plan seem economical and others rejected it altogether. This issue caused the workers to think about standardizing definitions and calculations. But the main problem, i.e. the complexity of computational operations, still remained. (Khatami, 2012)

For solving this problem; there were two solutions: the first method was to use the same method for all projects and the second method was to formulate different methods according to the characteristics of each industry. Four important factors are studied in economic evaluation: 1. Basic concepts of facility investment evaluation 2. Economic evaluation methods 3. Effective factors in liquidity 4. Effects of different financing methods on the selection of projects (Kuchta, 2008, Magni, 2020, Magni, 2023).

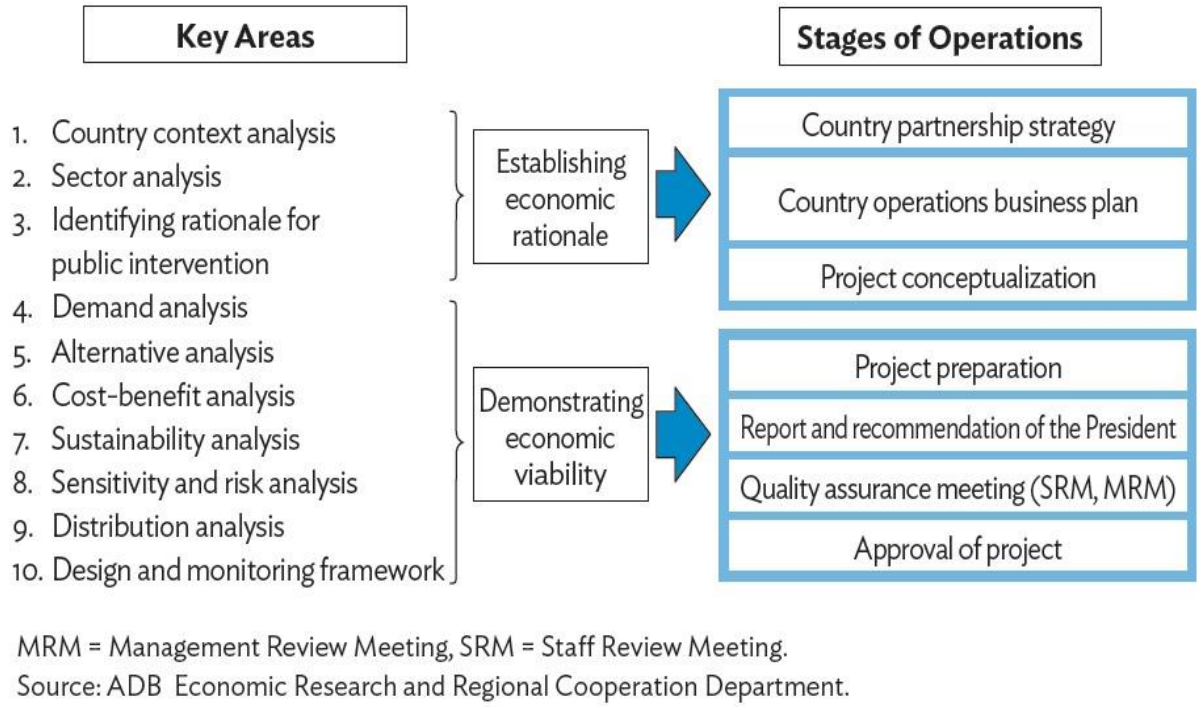

Figure 1- Economic analysis of industrial projects

Economic evaluation methods

Economic evaluation methods are numerous and the mistake in selecting them in different situations can lead to significant losses. The most important methods of economic evaluation that are widely used in different fields are:

Cost analysis

Cost analysis (CA) is a systematic method of economic evaluation in which all the costs of a program are collected, organized and analyzed separately and in full detail in terms of currency(Babaie & et al,2015).

Cost-effectiveness analysis

CEA analysis effectiveness-Cost Effectiveness is a measure to measure the degree of success of a system in reaching its goals and responding to the expectations of that system, and cost-effectiveness analysis is a measure to measure the ability of that system to achieve its goals, from The point of view is the costs incurred. In fact, this method examines the achievement of a specific production or service with the lowest possible cost (Barry, 2014).

Cost benefit analysis

Cost utility analysis CUA is a way to measure the success rate of a system in reaching the maximum goals considered and the most desirable services defined by the organization (Danielson,2018).

Cost benefit analysis

In this method, all costs and results of a plan or program, including benefits and losses, are compared based on currency.

Among the above methods, the cost analysis method as a partial evaluation method Partial evaluation is known because no comparison is made in it and it only considers the costs caused by a specific intervention or decision. But the other three methods are called full evaluation because they have a comparative framework for considering the cost and effectiveness of two or more interventions. (Dobis,2023).

For accurate economic evaluation of any project or system, it is necessary to pay attention to both cost and benefit elements. Until now, the main focus of libraries in the matter of evaluation has been on costs, but in recent years, this attention has been directed towards the benefit of library services for users and their evaluation. Among the above methods, the cost-benefit analysis method has a special position on costs and benefits and compares both in an integrated manner and with a single scale. (Ghaffari,2019).

Among quantitative approaches to decision-making, what has become popular in recent years is cost-benefit analysis, which is used as an efficient tool to narrow down the range of choices by developing useful information about the favorable and unfavorable effects of projects. Many economists consider cost-benefit analysis to be the most accepted method of economic evaluation due to its roots in welfare economics. (Marchioni, 2018).

In fact, preliminary studies include three main parts of opportunity studies, preliminary feasibility studies and feasibility studies. If there is an employer, they will be checked and then in the second step of preliminary feasibility studies with the aim of checking the options obtained from opportunity studies, we will review and select the project and finally or in the

last step, feasibility studies with the aim of final approval A project is carried out for the implementation and investment phase.(Mellicamp, 2017).

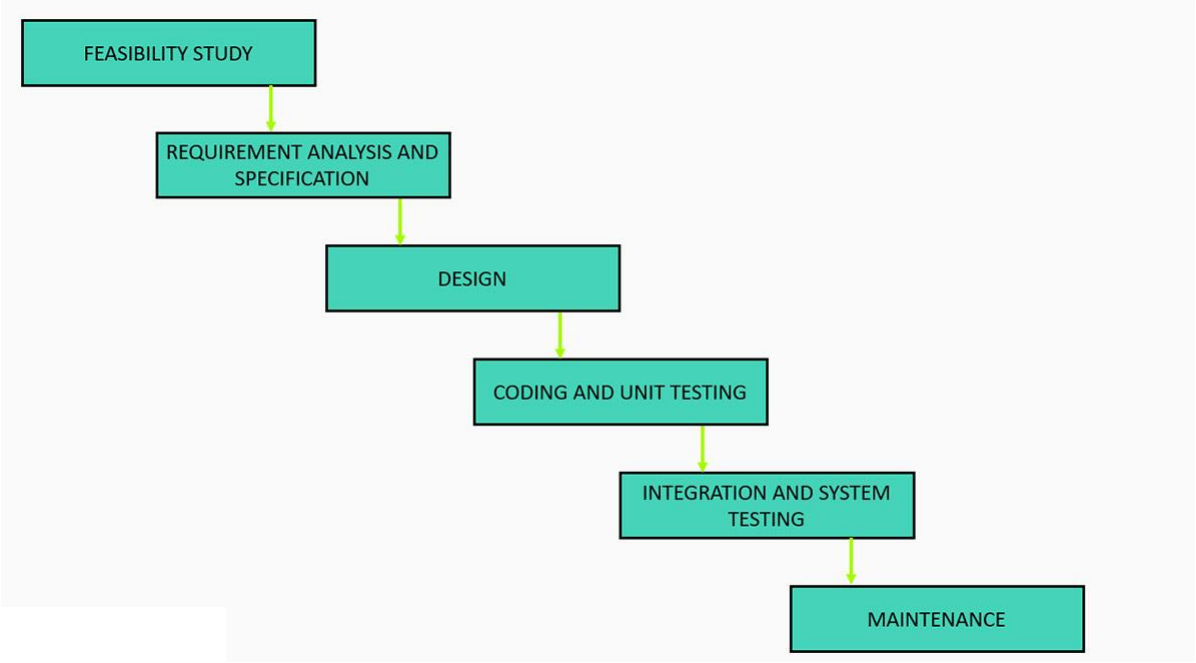

Figure 2- Feasibility study process

METHODOLOGY

According to the mentioned research gaps, in this research, the RERR index is used, which definitely leads to results greater than -1, and then, by defining the values of the financial process in terms of fuzzy numbers, a method for calculating the rate of return of reliable fuzzy economic capital (FRERR) is presented and a new solution with high reliability and compatible with the current value method is introduced to determine the economic level of the projects; Therefore, the innovations of this research compared to previous efforts are as follows:

The calculated capital return rate, according to the RERR index, is a unique rate and must be greater than -1.

The RERR index has simple solution steps and is not irrationally sensitive to the change of the market rate component, which confirms the appropriate applicability of that method.

The value of the RERR index increases with the increase in the market rate; Therefore, there is no need to use the vertex method in calculating the fuzzy capital return rate, which greatly reduces the solution steps.

This research introduces a new method that is more accurate than other methods in determining the economic value of investment projects under a fuzzy environment.

The current research is a quantitative-applied research and its purpose is to determine the economic level of investment projects under the fuzzy environment. The basic method of the research is the rate of return on economic

capital. In this research, in addition to eliminating the shortcomings of the mentioned method, a new index called the rate of return on reliable economic capital is introduced. Then, to investigate the issue under the fuzzy environment, the flow values of the financial process are defined in terms of fuzzy numbers, and using the concept of cutting fuzzy numbers, a method for calculating the return rate of fuzzy economic capital is explained.

Next, to determine the economic level of investment projects, this article introduces a new method that is more accurate than other methods used in the theoretical foundations of the subject, and the Monte Carlo simulation method is used to validate the results.

Consider the flow of the financial process of investment X with the number of n periods. The amount of net present value (NPV) of the financial process X under the market rate r is calculated as follows:

$$NPV(X|r) = \sum R_k \,.\, (1+ R1+1)^{-k} = R_0 + R_1/(1+r)^1 + R_2/(1+r)^2 + \ldots.. + R_n/(1=r)^n$$

Obviously, project X is economic if the corresponding NPV value is greater than zero. Also, in the theoretical foundations of the subject, the NPV method is considered a basic method; in such a way that the accuracy of the results from other methods is determined by the degree of compatibility with the results from the NPV method.

Also, the IRR index has been one of the most attractive methods for various reasons such as being comprehensible and concrete for the general researchers and the possibility of comparing the said rate with the market rate, inflation rate, minimum absorbing rate, etc. The IRR index is equal to the rate at which the project's revenues and costs break even and the project's NPV becomes zero. Based on the IRR index, the investment financial process will be economic if and only if the IRR index is greater than the market rate; But the IRR index has disadvantages such as the lack of rate of return and the existence of several rates of return on domestic capital, on the basis of which, various researchers tried to solve the problems of the IRR index, among which the ERR index, introduced by Bari and Robison (2014), as an index suitable can be mentioned.

To calculate the ERR index; consider the market value of the financial process in different periods (V_t) as follows:

$$V_t = \sum R_k.(1=r)^{-k(1-t)}$$

Therefore, the market value of project X in period zero is calculated as follows:

$$V_0 = \sum R_k \,.\, (1+ R1+1)^{-k} = R_0 + R_1/(1+r)^1 + R_2/(1+r)^2 + \ldots.. + R_n/(1=r)^n = NPV\,(X|r) - R_0$$

According to the aforementioned definitions, Bari and Robison (2014) defined the interest rate of the first period (I_1) as follows:

$$I_1 = R_1 - (V_0 - V_1)/V_0$$

Where is $\alpha=C_0/V_0$ and C0 is the amount of investment in period zero and is equal to the ratio of the amount of financial process in period zero (-R0), they introduced the following relationship to calculate the rate of return on economic capital (ERR):

$$ERR = [(1+i_1).(1+r)^{n-1}]^{1-n}$$

Finally, if the ERR index is greater than the market rate r, then the financial process of investment X will be economic.

Also, due to the uncertainty in calculating the values of the financial process of some projects, a number of researchers investigated the issue under the fuzzy environment, and finally, to determine the degree of economic feasibility of the projects, they used the methods available in the topic of ranking fuzzy numbers.

Jimenez (1996) also introduced a relationship that can be used to calculate the possibility of the fuzzy number being larger than the fuzzy number ($\mu_m(\tilde{A},\tilde{B})$) as follows:

$$\mu_m= (\tilde{A},\tilde{B})=E_2^A-E_1^B/ E_2^A-E_1^B-(E_2^A-E_1^B)$$

Where $E_2^A-E_1^A$ and $E_2^B-E_1^B$ represent the expected intervals of fuzzy numbers $\tilde{A}$ and $\tilde{B}$ respectively. Also, if $\tilde{A}$ the fuzzy number is equal to the triangular fuzzy number (a_1, a_2, a_3), then $\tilde{A}$ the expected distance is calculated as follows:

$$EI(\tilde{A}) = [E_1^A , E_2^A] =[1/2(a_1+a_2), 1/2(a_2+a_3)]$$

Also, DuBois and Prad (2012), proposed the method of "pure possibility of becoming larger" to calculate the degree of possibility $\tilde{B} = (b_1,b_2,b_3)$ of the fuzzy number being larger than the $\tilde{A} = (a_1,a_2,a_3)$fuzzy number as follows:

$$Poss (\tilde{B} > \tilde{A})= b_3+a_2/(b_3-b_2)+(a_3-a_{2)}$$

RESEARCH RESULT

In this section, the effectiveness of the proposed method of the article is evaluated based on a real project. Accordingly, the project (-2/25, -1/5, -0/75, 0, 0/75, 1/5, 2/2, 3, 4) = P, which is called "Mineral Materials Industrial Project" It was mentioned, it has been checked. To define the values of the financial process of the mentioned project in terms of fuzzy numbers, consider the mentioned values as possible values and the minimum and maximum values of the related triangular fuzzy numbers with a range of about 50% changes as follows:

Table 1-Projet Data

Terms	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Min	-3/38	-2/25	-1/13	0	0/37	0/75	1/12	1/5	-6
feasible	-2/25	-1/5	-0/75	0	0/75	1/5	2/25	3	-4
Max	-1/12	-0/75	-0/37	0	1/13	2/25	3/38	4/5	-2

Considering the market rate equal to the triangular fuzzy number (20%, 15%, 10%), the FRERR of the mentioned project is obtained according to Figure 3:

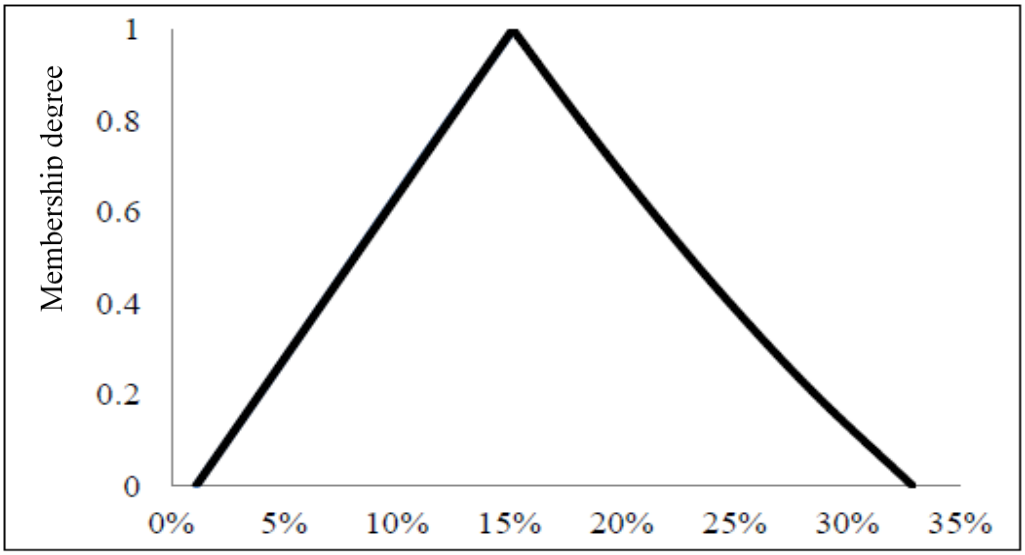

Figure 3- RERR chart for mineral extraction projec

The pessimistic, optimistic and possible states of the financial process are as described in table number 2:

Table 2- The amount of RERR for different states of the financial process

State	Basic financial process				New financial process				mr	RERR
	0	1	2	3	0	1	2	3		
pessimistically	-120	600	-1200	550	-1320	600	-1200	15/1939	%0/5	%52/0
pessimistically	-80	650	-1000	650	-1080	650	-1000	88/2170	%0/15	%30/20
Likely	-100	620	-1100	600	-1200	620	-1100	10/2064	%0/10	%16/10

The value of RERR in the pessimistic state (0.52%) is not greater than the maximum value of the market rate (15%) and the value of the mentioned index in the optimistic state (20.30%) is not smaller than the minimum value of the market rate (5%); Therefore, the said financial process is not 100% economic or non-economic.

Then, the value of RERR in the probable state (10.16%) is greater than the probable value of the market rate (10%); Therefore, the project in this case is economic; So the degree of its economic feasibility should be determined. The

calculations related to the fourth step are a suggested solution related to the α = 0 cut as described in tables No. 3 and 4:

Table 3- The amount of difference between pessimistic and optimistic states of the financial process

α = 0	0	1	2	3
pessimistically	-1320	600	-1200	15/1939
pessimistically	-1080	650	-1000	88/2170
difference	240	50	200	72/231

In the following, according to the amount of difference obtained, we calculate the pessimistic financial process flow values by one percent to the optimistic flow values and the related RERR under the market rate = 10%. We repeat this process until the RERR results from a larger amount and, in fact, the financial process becomes an economic result.

Table 4- Values of components and financial process for α = 0

Present	0	1	2	3	RERR
0%	-0/1320	600	-1200	15/1939	%63/0
1%	-6/1317	5/600	-1198	47/1941	%82/0
2%	-2/1315	601	-1196	78/1943	%01/1
...	...	...	...	...	...
49%	-4/1202	5/624	-1102	70/2052	%90/9
50%	-0/1200	625	-1100	01/2055	%09/10

According to the mentioned information, if we approach at least 50% (I_0) of the pessimistic financial process to the optimistic one, then the RERR value of the mentioned financial process (10.09%) will be greater than the value (10%) and as a result, the value of the component number is 50. 0 is obtained. We do the same calculations for other cuts. The summary of the results is as described in Table No. 5:

Table 5- Values of components and financial process

α		
α = 0.0	50/0	50/0
α = 0.2	50/0	50/0
α = 0.4	49/0	51/0
α = 0.6	48/0	52/0
α = 0.8	46/0	54/0
α = 1.0	0	1

The related diagram is according to figure number 4:

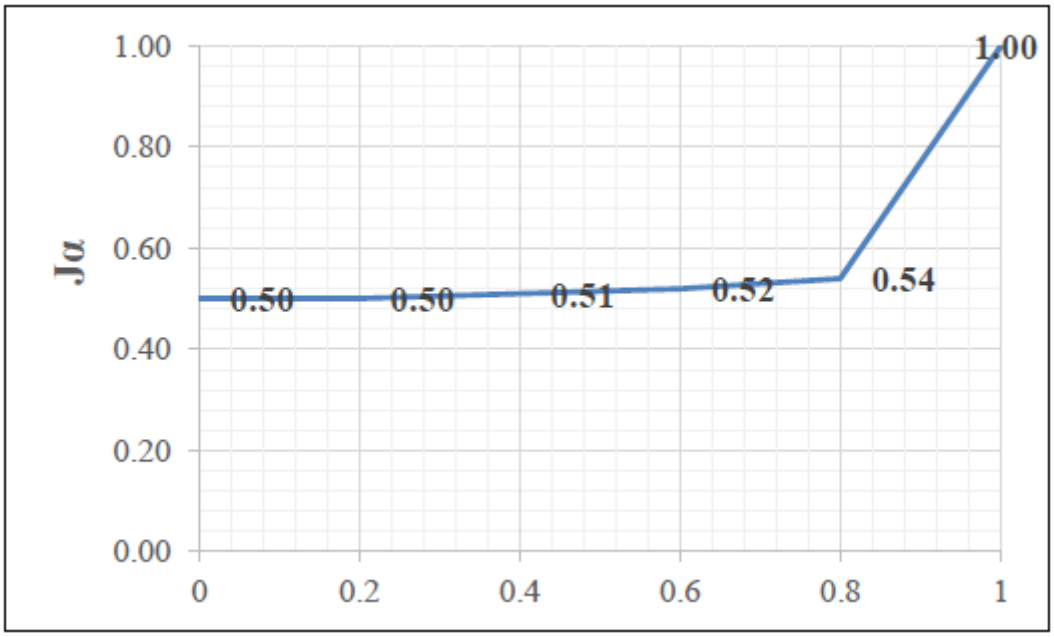

Figure 4- Diagram of the fuzzy financial process for 6 slices α

The area under the mentioned diagram is equal to 0.564; therefore, according to the proposed solution of the article, the fuzzy financial process is economic with a degree of possibility of 56.4%.

The functions of the left and right wings of the mentioned graph are almost linear; Therefore, FRERR is almost equal to the triangular fuzzy number (32.89%, 15.17%, 1.10%). @RISK software was also used to validate the result, and the corresponding RERR diagram was obtained after one million repetitions of the simulation in the form of Figure 5:

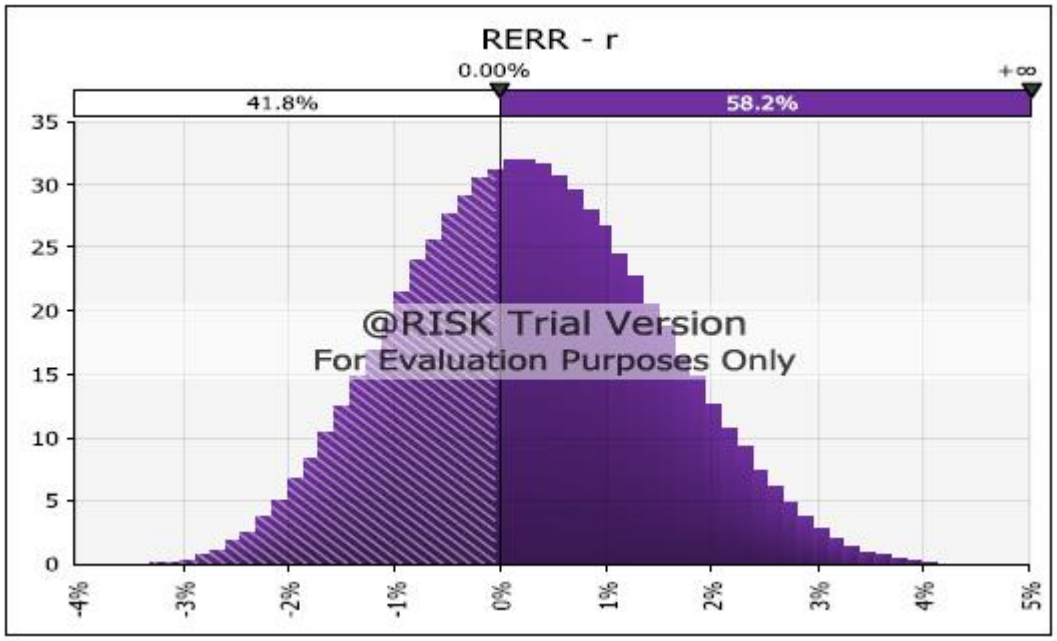

Figure 5. RERR chart for mineral extraction project

The summary of the results is as follows:

Table 6. Solution results

	Min	**Mean**	**Max**
RERR according to @RISK software	59/4%	21/15%	25/27%
FRERR according to the proposed solution of the article	10/1%	08/16%	89/32%

As can be seen, the results, according to the proposed solution, are close to the results obtained from the simulation, which confirms the correctness of the method proposed in the article in calculating FRERR. Also, the value of RERR in the minimum state (1.10%) is not greater than the maximum value of the market rate (20%) and the value of the mentioned index in the maximum state (32.89%) is not smaller than the minimum value of the market rate (10%); Therefore, the mentioned mineral extraction project is not 100% economic or non-economic; Then, the value of RERR in the probable state (15.17%) is greater than the probable value of the market rate (15%); Therefore, the said project in this case is economic; Therefore, the degree of its economic feasibility should be determined. After performing the calculations, the diagram of the Jα component was obtained according to Figure 5:

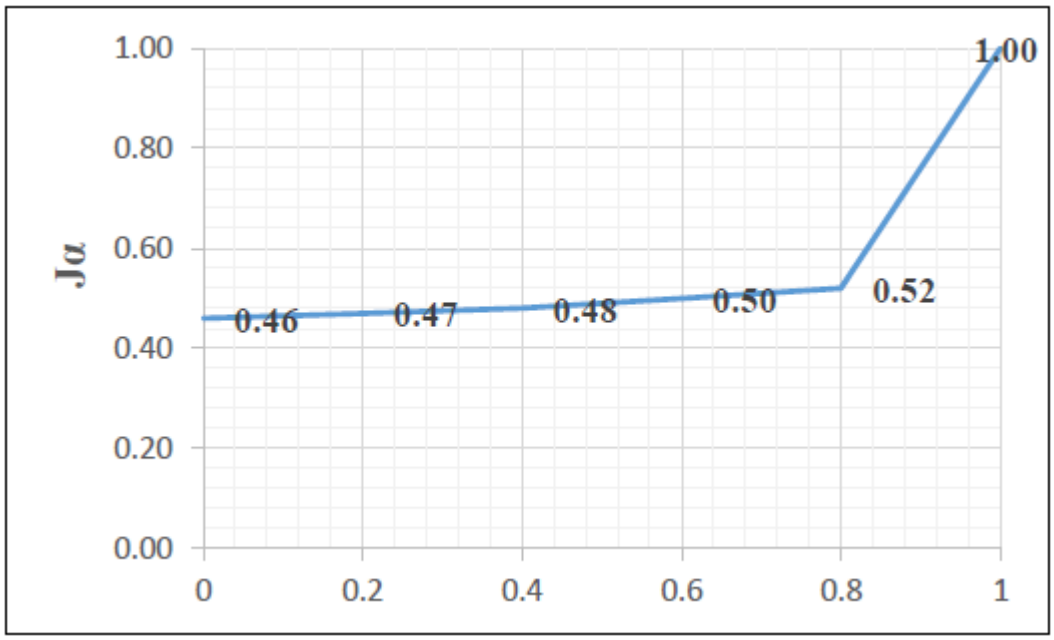

Figure 6 - Chart for the mineral extraction project for 6 cuts α

The area under the mentioned diagram is equal to 0.54; Therefore, according to the proposed solution of the article, the mineral extraction project is economic with a degree of feasibility of 54%; Then, @RISK software has been used to validate the results. The NPV diagram for the mineral extraction project was obtained after one million repetitions of the simulation in the form of Figure 7:

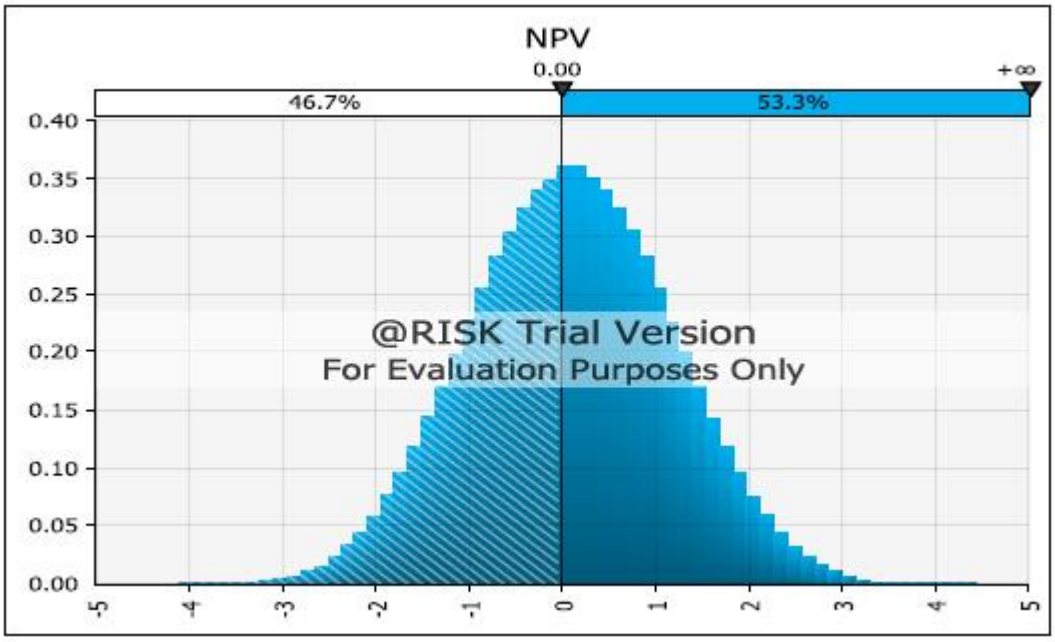

Figure 7- NPV chart for mineral extraction project with @RISK software

As can be seen, according to the Monte Carlo simulation method, the value of the NPV index is positive in 53.3% of the simulation iterations, and in fact, the mineral extraction project is economic with a probability of 53.3%; Therefore,

according to the mentioned information, the degree of economic feasibility of the mentioned project is according to the proposed solution of the article (54%) and very close to the simulation output (53.3%), which shows the appropriate accuracy of the proposed method of the article.

Also, to validate the RERR index, the difference between the RERR index and the market rate (RERR-r) was obtained after a million repetitions of the simulation, as shown in Figure 8:

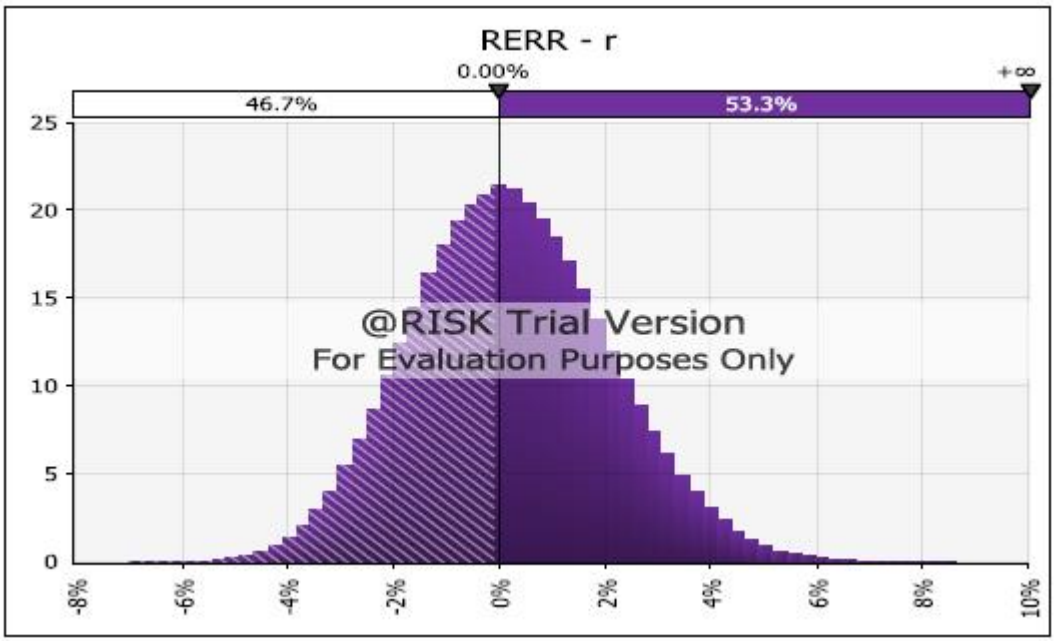

Figure 8- Difference diagram of RERR index and market rate for mineral extraction project

In this research, @RISK software was used to validate the results. The NPV diagram of the fuzzy financial process after one million repetitions of the simulation was obtained as Figure 9:

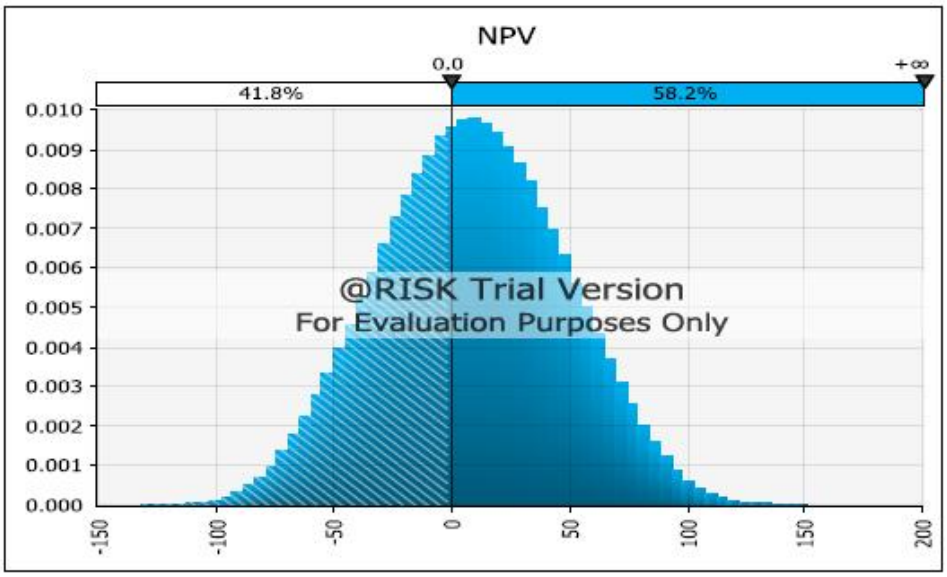

Figure 9- NPV chart for fuzzy financial process with @RISK software

As can be seen, according to the Monte Carlo simulation, the value of the NPV index is positive in 58.2% of the simulation repetitions, and in fact, the fuzzy financial process is economic with a probability of 58.2%. The summary of the results is as described in table number 6:

Table 6- Comparison of the economic level of the fuzzy financial process according to different methods

Method	Economic rate
Expected distance comparison method	9/51%
The method of the possibility of getting bigger	1/68%
The proposed solution of the article	4/56%
Monte Carlo simulation – @RISK software	2/58%

According to the mentioned information, the result of the proposed solution is closer to the result obtained from the simulation than other methods, which confirms the appropriate accuracy of the solution; Of course, the degree of economies of the mentioned financial process is more accurate according to the "comparison of expected intervals" method than the "possibility of pure larger" method.

In fact, using the simulation technique and RERR index, the mentioned financial process is economic with a probability of 58.2%, which confirms the compatibility and correctness of the results obtained from the RERR method with the NPV method.

DISCUSSION

In fact, using the simulation technique and RERR index, the mentioned project is economical with a probability of 53.3%, which confirms the compatibility of the results obtained from the RERR method with the NPV method.

This article showed that the SAIRR, EAIRR and ERR indices about some financial processes may calculate the rate of return on capital less than -1 and have great sensitivity to the change in the market rate. The ERR index has simpler calculations than other methods, and at the same time, it has the ability to cover multi-rate problems and the lack of capital return rate; Therefore, in this research, it was tried to modify the ERR index in such a way that the mentioned problems are solved. The reason for the aforementioned disadvantages is that the value of the ERR index is based on the value of the interest rate of the first period and the value of the said component is dependent on the amount of investment in the zero period; Therefore, the initial amount of the financial process should properly reflect the amount of overall investment made in the project; For this reason, this article considers the initial value of the investment project to be equal to the sum of the negative values of the financial process, which properly represents the total investment amount of the project, and also modifies the final value of the financial process in such a way that the NPV of the financial process does not change. ; Then, it proves that

by doing this, the value of the resulting capital return rate (RERR) is definitely greater than -1 and a suitable rate is obtained as the capital return rate.

Next, to calculate the RERR index under the fuzzy environment, in this article, the fuzzy number cutting method is used, and the value of the RERR index will definitely increase with the increase in the market rate; Therefore, there is no need to calculate the mentioned index for pessimistic and optimistic financial processes under different values of the market rate, and in fact, this feature of the RERR index causes a large reduction in the mentioned calculations compared to the methods presented based on the Vertex method such as Khatami (2012), Babaei, Ghafari and It is based on Haddad (2015) and Ghaffari and Jussi (2019). Also, the mentioned researches have used indices based on the AIRR method to calculate the FIRR, which makes it possible to estimate the rate of return on capital with a value of less than -1 with the mentioned indices, and in practice, the application and accuracy of the mentioned methods have been placed in a halo of uncertainty.

After calculating the FRERR index, the economic level of the investment projects should be determined. Based on this, the simplest possible method is to convert the fuzzy capital return rate and the fuzzy market rate into a definite number, and finally, by comparing the obtained numbers, it is determined whether the projects are economic or uneconomic; While according to this method, very little information is provided to the decision maker. In this connection, Khatami (2012) and Ghaffari and Jussi (2019) respectively, used the methods of "average comparison of expected distances" and "pure possibility of being larger" and calculated the degree of economic feasibility of the projects. The mentioned methods provide more information to the decision maker; But in this article, it was found that the mentioned methods are not reliable for all projects and may lead to inaccurate results; Therefore, this article proposes a new solution according to which the pessimistic and optimistic financial processes are analyzed under each cut in order to determine to what extent we should approach the pessimistic financial process to the optimistic one so that the financial process becomes economic. Finally, by summing up the results obtained from each cut, the degree of economic feasibility of the investment project is calculated more reliably.

CONCLUSION

The IRR method is one of the most common methods used by researchers and decision makers to determine the economics of financial processes; But the mentioned method has serious disadvantages that have faced important limitations in its application; For this purpose, various researchers tried to solve the mentioned problems, each of the presented methods had its own advantages and disadvantages. In the meantime, Bari and Robison (2014) introduced a new index called economic capital return rate (ERR), which is one of the appropriate indicators in the theoretical foundations of the subject; But this index has important shortcomings as follows:

(1For some financial processes, the ERR index calculates the rate of capital return smaller than -1, which is obviously an incorrect rate and has no economic meaning.

(2Regarding some financial processes, the value of the ERR index may change a lot for a small change in the market rate; In other words, for some projects, the mentioned index is very sensitive to changes in the market rate.
Based on this, this article introduces a new index called reliable economic capital rate of return (RERR), which is derived from the ERR index; But it definitely leads to a value greater than -1, and in cases where the ERR index is irrationally sensitive to changes in the market rate, the RERR index does not have the aforementioned defect. In this regard, this article proves that if we make the initial amount of investment projects equal to the sum of the negative values of the relevant financial process, then the resulting capital return rate (RERR) will definitely be greater than negative -1. In this connection, this article proposes a solution that without changing the intermediate values of the financial process, only the initial and final values of the investment financial process are modified in such a way that the current value of the new financial process does not change.

Also, sometimes due to various reasons, it is not possible to definitively estimate the amounts of financial processes; Therefore, many efforts have been made to calculate the capital return rate under the fuzzy environment; For this purpose, in this article, the method of cutting fuzzy numbers and RERR index was used, which definitely calculates the capital return rate greater than -1 and has much less calculations than other methods; Then, by examining the distances obtained from cutting the fuzzy values of the financial process and by presenting a new and reliable solution, a method was introduced that correctly calculates the economic level of the projects according to the relevant degree of possibility and provides more comprehensive and accurate information to the decision maker than other methods. to give

Finally, in this article, the @RISK software was used to validate the results, and according to the results, it was found that the estimate of the fuzzy capital return rate using the RERR index and the fuzzy number cutting method is very close to the result of the simulation, which confirms the appropriate accuracy of the introduced solution. Is. Also, the results obtained from the @RISK software in determining the economic level of the projects showed that the solution proposed in this article is more accurate than the methods of "average comparison of expected distances" and "possibility of sheer greaterness" and is fully compatible with the present value method .

Investigating the issue of ranking competitive projects under fuzzy environment, investigating the issue under other uncertainty environments and using robust optimization approach in this field are among the suggestions for future researches.

REFERENCES

Ali, K.S., Mohaisen, H.A., Hameed, A.A. (2019). "Joint audit and the financial reporting quality: Empirical study on Iraqi voluntary joint audits". International Journal of Innovation, Creativity and Change, 7(8), pp. 343–359.

Babaie, B., Ghaffari, H.A., and Aslhadad, A. (2015). "A New Method to Calculate Fuzzy Internal Rate of Return Using the Economic Average IRR Index and Vertex Method". 11th International Industrial Engineering Conference.

Barry, P.J., and Robison, L.J. (2014). "Technical Note: Economic Rates of Return and Investment Analysis". The engineering economist, 59(3), 231-236.

Danielson, M.G. (2018). "Double vision: Insights about the origin and interpretation of multiple IRRs". The engineering economist, 63(3), 217-235.

Dubois, D.,. (2023). Possibility theory: an approach to computerized processing of uncertainty. New York: Springer Science and Business Media.

Ghaffari, H.A. (2019). "A fuzzy modeling for determining feasibility of cash flows using an efficient and novel IRR metric". Economic Computation and Economic Cybernetics Studies and Research, 53(1): 231-246.

Gisin, V.B. (2020). "Net present value and internal rate of cash flows with fuzzy payments". Мягкие измерения и вычисления, 28(3): 33-54.

Guerra, M.L., Magni, C.A., and Stefanini, L. (2022). "Interval and fuzzy average internal rate of return for investment appraisal". Fuzzy Sets and Systems, 257: 217-241.

Guerra, M.L., Sorini, L., and Stefanini, L. (2018). "Fuzzy Investment Decision Making". Proceedings of IPMU 08 Torremolinos (Malaga). June 22-27. 2008. 848-854.

Hazen, G., and Magni, C.A. (2021). "Average internal rate of return for risky projects". The Engineering Economist, 66(2): 1-31.

Jiménez, M. (2021). "Ranking fuzzy numbers through the comparison of its expected intervals". International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems, 4(04): 379-388.

Khatami, H. (2012). Internal rate of return under fuzzy environment. Master of science thesis in industrial engineering, K.N. Toosi University of Technology, Not published.

Kuchta, D. (2008). Fuzzy rate of return analysis and applications. In Fuzzy Engineering Economics with Applications (pp 97-104): Berlin, Heidelberg: Springer.

Kussainov, C., and Alliyarov, A. (2021). "Classification of investment risks with fuzzy financial indicators". Scientific Collection «InterConf», 50: 631-637.

Magni, C.A. (2020). "Average internal rate of return and investment decisions: a new perspective". The engineering economist, 55(2): 150-180.

Magni, C.A. (2023). "The internal rate of return approach and the AIRR paradigm: a refutation and a corroboration". The engineering economist, 58(2): 73-111.

Marchioni, A., and Magni, C.A. (2018). "Investment decisions and sensitivity analysis: NPV-consistency of rates of return". European Journal of Operational Research, 268(1): 361-372.

Mellichamp, D.A. (2017). Internal rate of return: "Good and bad features, and a new way of interpreting the historic measure". Computers and Chemical Engineering, 106: 396-406.

Mohaisen, H.A., Al-Abedi, T.K., Saeed, H.S. (2021), "The Impact of Accounting Disclosure According to Integrated Business Reports on the Value of the Company and the Cost of Capital: An Empirical Study in Iraq Stock Exchange". Webology, 18(Special Issue), pp. 328–351.

Nagares, N., Sison, A., and Medina, R. (2019). "An Optimized Newton-Raphson Algorithm for Approximating Internal Rate of Return". International Journal of Advanced Trends in Computer Science and Engineering, 8(6): 3265-3268.

Nakhaeinejad, M., and MomenShad, N. (2020). "Project portfolio selection by considering triple-wise interaction among projects". Journal of Production and Operations Management, 11(20): 1-22.

Olfat, L., Ghazinoori, S., and Ghasemi, M. (2019). "The relationship between manufacturing strategic decisions, competitive priorities and firm performance in the automotive supply industry of Iran". Journal of Production and Operations Management, 10(2): 17-35.

Pierru, A. (2010). "The simple meaning of complex rates of return". The engineering economist, 55(2): 105-117.

Prol, J.L., and Steininger, K.W. (2020). "Photovoltaic self-consumption is now profitable in Spain: Effects of the new regulation on prosumers' internal rate of return". Energy Policy, 146, 111793.