RATIONALIZING THE INVESTMENT DECISION USING THE ANALYTIC HIERARCHICAL PROCESS (AHP)

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Abstract

The research aims by presenting one of the quantitative methods, which is the Analytical Hierarchical Process (AHP), and its impact on evaluating investment projects and comparing them, and developing an effective mechanism to rationalize investment decision-making, which is one of the most important and complex types of decisions and the most risky due to its future strategic dimensions and the length of its period, so it must be dealt with These decisions are more objective and not limited to only the financial aspect represented by calculating the cash inflows and outflows of the project, and the need to base these decisions on studied evaluation methods that are in line with the current conditions and contribute to the effective use of available resources, achieving the highest rates of economic growth and solving some economic and social problems. Where four investment projects will be evaluated, the company (subject of study) intends to compare them to choose the best project, with the identification of six criteria for comparison and evaluation, which are (quality, profits, costs, sustainability, geographical location, and delivery on time), and the study concluded that the hierarchical analysis process is a method Suitable for evaluating investment projects, as it takes into account the integration of financial and non-financial criteria side by side, calculating the relative importance of each criterion, and filling the gaps that the traditional approach cannot address due to its lack of flexibility and dependence primarily on financial criteria only, and not taking non-financial factors into account. The study recommended focusing It depends on many criteria when choosing between a group of investment projects, especially non-financial ones, and does not focus on financial criteria only such as costs and future cash flows of the project as a basis for the comparison process between the available alternatives.

Keywords: investment decisions, financial and non-financial criteria, hierarchical analysis process.

1. INTRODUCTION

In light of the fierce competition in the business environment, the process of evaluating investment projects has become an important criterion for decision-makers. As investment opportunities in the current business environment have become difficult for investors, especially in light of the ever-increasing technological progress, and to achieve the goal of the economic unit represented by maximizing the value of the enterprise and achieving profits for owners and shareholders, investment decision-making has become very necessary. Therefore, decision-makers and decision-makers must choose methods of evaluation for their projects in a thoughtful manner, taking into account non-financial and financial factors side by side, which have a significant impact on investment decision-making, and finding appropriate ways to measure these factors that have become necessary at present, such as project sustainability, geographical location, quality, and recent innovations. And how to deliver projects on time and achieve customer satisfaction and loyalty, and all of these factors have a significant impact on investment decision-making if they are taken into account, so all circumstances, factors, and variables surrounding the available alternatives must be taken into account in terms of risk, uncertainty and the quality of information that must be Provide it for alternatives, whether financial or non-financial. The rationalization of related investment decisions is considered one of the most difficult decisions in the field of business, and given that the decision-making process depends on predicting the future, which exposes the establishment to many risks, which requires the need to rely on a distinguished set of methods and methods in evaluating investment projects and the comparison between the available alternatives that are taken into consideration Financial and non-financial factors in evaluating their projects and not being satisfied with traditional methods that depend on financial factors only despite their objectivity and thus contribute to rationalizing capital budget decisions and making a sound decision that reduces the degree of risk and uncertainty. Therefore, the problem of the study can be asked according to the following question:

Does the hierarchical analysis process (AHP) contribute to the rationalization of investment decision-making by taking into consideration the descriptive (qualitative) factors along with the financial factors by determining the relative importance of each of the factors influencing decision-making?

The importance of the study lies in the issue of investment decision-making and the strategic and effective role it plays in economic development, maximizing the value of the economic unit and achieving its goals through the comparison between the available investment alternatives, and the need to rely on studied evaluation methods that are in line with the current conditions and the environment surrounding the investment project that is dominated by risk and lack of Certainty, which contributes to the proper use of available economic resources to achieve higher rates of growth, and not to be satisfied with traditional methods that take into account certain factors and ignore other factors. The importance of the research stems from its presentation of one of the scientific quantitative methods, which is the Analytical Hierarchical Process (AHP), and its impact on evaluating investment projects and comparing them, and developing an effective mechanism to rationalize investment decision-making, which is one of the most important types of decisions due to its strategic and future dimension and its impact on the economic arena and at the local and international levels. And the need to base these decisions on well-studied evaluation methods that are in line with the current conditions and contribute to the effective use of available resources, achieving the highest rates of economic growth and solving some economic and social problems.

2. RATIONALIZATION OF INVESTMENT DECISION

2.1. THE CONCEPT OF RATIONAL INVESTMENT DECISION

An investment decision in companies can be described as a financial commitment that lasts for many years and has long-term effects such as returns, risks, uncertainty, and the time value of money. The money associated with these investments is usually very large, with a relatively long time scale. Examples of investment decisions are numerous, including new projects, asset substitution, investment for expansion, product improvement, and cost reduction. It is influenced by the full nature of the economic institution and its direction in a way Basic to the decision of corporate investment. Therefore, inappropriate investment decisions can have a serious impact on companies. The economic objective of the company is to maximize the wealth of owners and shareholders by investing in projects with positive net present value as these investments will increase the value of the company's real assets (Adeniji, 2021:37). The process of making investment decisions is one of the important things when starting any activity, to have a clear impact of those decisions on the course of economic units, where decision-makers seek to identify alternatives and trade-offs between them to make the appropriate decision. In the sense that the decision is based on the principle of rationality in the disposition, and rational decision-making represents the process through which that decision is made using the information and evidence collected and analytical thinking before making the decision, and decision-making in the absence of any information related to it is irrational behavior and leads to negative results reflected on the future of the economic unit (retribution, 2014:84). The term rationality in decision-making was defined by Albrecht & Bos, 2020:19) as the degree to which decision-makers try to reach the best possible decision given the specific situation, and this process includes collecting all possible data to evaluate different scenarios and ultimately make a sound decision. The rational decision is the behavior that requires the process of collecting opinions, facts, and basic standards after setting goals, and then supported by a methodology and scientific method that doubles the value of the expected results of the decisions that will be taken.

2.2. BASIC COMPONENTS OF A RATIONAL INVESTMENT DECISION

3. administrative, financial, and environmental obligations to improve investment from any negative complications.

3- Taking into account the relationship between return and risk: The investor must balance the degree of risk and the expected return. He must be convinced that investment activities are risky, so the investor must make a good choice of the project so that he can bear his risks.

3.2 Stages of rational investment decision-making

For the success of the investment project, a scientific approach must be followed in making the investment :decision and going through several stages to reach the best decision, and these stages include the following (Mansour & Ibrahim,2022:90)

-1 Identify the investment problem: It is one of the most important stages, because the next stages stop on it, and it is intended to determine the subject to be decided on accurately so that the other stages do not come and cause a waste of money and time without solving the basic problem.

2- Collecting data and information for decision-making: where the data intended for the goal to be achieved is collected according to specialists.

3- Identifying possible alternatives: It is the investigation and search for possible investment alternatives, provided that these alternatives can achieve the goal within the available capabilities and resources and be evaluable.

4- Evaluation of future returns of investment alternatives: It is based on the results that are expected for each alternative, which do not appear until the future, and the evaluation is done through a trade-off between the strengths and weaknesses of each of the available alternatives, depending on the experience and accuracy of the available information.

5- Choosing the investment opportunity or the appropriate alternative for the specified objectives: After collecting data and evaluating the expected future returns for each alternative, and the percentage of risks that the investor can bear, a comparison is made between the available alternatives and a decision is made to choose the most appropriate alternatives, and who obtains the best digital result through the evaluation process.

4.2 TYPES OF INVESTMENT DECISIONS

Companies are constantly looking for new investment opportunities and are working to evaluate some of them and monitor what is being implemented from these projects, and therefore a set of types of these decisions can be included concerning the nature of the risks associated with them: (Gheno, 2019:17-19)

1. Substitution: The replacement of fixed assets (especially intangible assets) may become necessary either because they are eroded by their use or because they have become obsolete due to the novelty of new technologies in the market. This category of decisions generally involves lower levels of risk.

2- Expansion: This type of decision aims to expand the company's current product or market due to increased demand, the risks associated with this type of decision are in a very low state because companies still have experience in costs, cash flows, and demand trends.

3- Diversification: In such decisions, companies decide to operate in several markets instead of one market to reduce their overall risks, so entering into such capital investments becomes necessary. This decision is more dangerous than replacement and expansion projects because the company does not have sufficient management experience or maybe non-existent regarding the new product or market.

4- Research and development: Large sums of money are spent on research and development, especially in industries where technology is changing very quickly. This type of investment, as in the previous case, involves a high level of risk.

5- Miscellaneous: Companies may have to invest their money in projects that do not achieve profit-oriented goals directly, meaning they do not usually generate revenue, these expenses may be driven by legal requirements (investments in safety) or come in a voluntary form (investments for the benefit of the local community). The degree of risk associated with this type of project depends on its importance and size.

4. HIERARCHICAL ANALYSIS PROCESS (AHP)

4.1. THE CONCEPT OF THE HIERARCHICAL ANALYSIS PROCESS (AHP)

Custom (Satyr) Analytical Hierarchy (AHP) decision-making process is a theory of relative measurement based on binary comparisons used to derive standard absolute scales of numbers whose elements are then used as priorities, double-pair comparison matrices are formed either by providing judgments for estimating dominance using absolute numbers from the base scale 1 to 9 of AHP, or by direct construction of marital dominance ratios using actual measurements. AHP can be applied to both tangible and intangible standards based on informed and expert judgments (Saaty, 2007:860). The hierarchical analysis process has also attracted the attention of many researchers, mainly due to the beautiful mathematical characteristics of this process and the fact that the data to be entered is easy to obtain (Awad et al., 2019: 157), the AHP method provides a comprehensive and logical framework for structuring the problem, representing and quantifying its elements, linking those elements to general objectives, and evaluating alternative solutions, as it is used Around the world in a wide range of decision-making situations in government, business, healthcare, industry, and education (Obaidi, 2018:67). The **researchers believe that the hierarchy process (AHP) is defined as a** method of arranging the available alternatives for decision-making and choosing the appropriate alternative when the decision-maker or decision-maker has multiple goals and criteria on which that decision is based and is considered one of the most used methods and techniques. Among the multiple methods of decision-making that analyze and disassemble the complex problem into a hierarchical structure consisting of goals, sub-criteria, and alternatives.

2.3 ADVANTAGES AND DISADVANTAGES OF THE HIERARCHICAL ANALYSIS PROCESS (AHP)

2.3.1 ADVANTAGES OF THE HIERARCHICAL ANALYSIS PROCESS (AHP)

The advantages of the AHP process are summarized in the following points: (Ennaceur, 2015:23)

1- It is the only MCDM model that can measure consistency in the judgments of the decision-maker.

2. It can also help decision-makers arrange critical aspects of the problem in the form of a hierarchical structure, making it easier to deal with the decision-making process.

3. Decision makers often prefer pair comparisons in AHP, allowing them to derive standard weights and dozens of alternatives from comparison matrices instead of directly determining weights/scores.

4. AHP can be combined with many operations research techniques to deal with more complex problems.

5. AHP is easier to understand and can effectively handle all data, whether qualitative or quantitative.

2.3.2 DISADVANTAGES OF THE HIERARCHICAL ANALYSIS PROCESS (AHP)

Despite the features that have been referred to Extinguished However, some disadvantages may affect the hierarchical analysis process (AHP) They are as follows:

1- The inability to deal with uncertainties, and the inability to use them in the event of a large number of alternatives, but these criticisms can be overcome by integrating the hierarchical analysis process (AHP) with other methods and techniques to determine the best alternative, and thus the possibility of giving greater flexibility in decision-making and evaluations. (Aqisa, 2017:211)

2. Whether the hierarchical structure of the decision-making process is poorly designed or does not take into account the factors important for the investigation, the weights of the criteria can be distorted, causing errors in the results reached. (Anchelía Carhuaricra & Mori Sáenz,2020:27)

3. The significant disadvantage of AHP is the independence of sub-standards, which are considered unrelated to each other.

-4 Another important limit is its static naturewhichdoes not make it suitable for medium/long-term decisions ,in dynamic environments, as a result of its static natureAHP providesthe ideal result at a given moment for a .stable situation

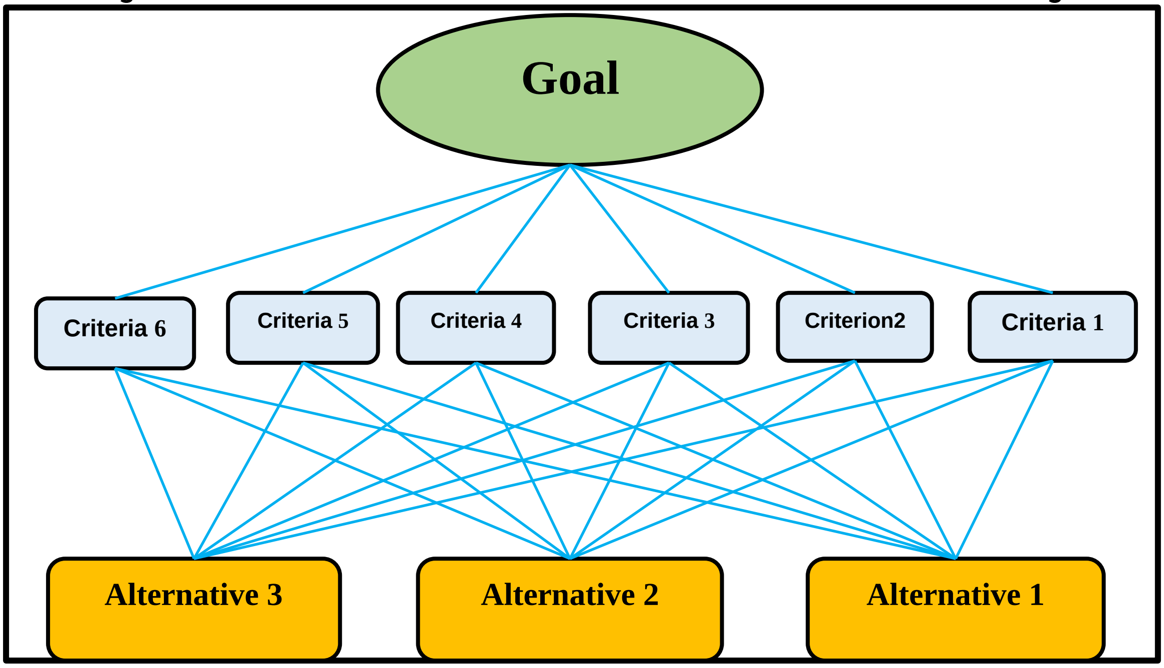
-5 When a dynamic situation is handled, the priorities obtained at a specific time can shift in time. This problem can be addressed using the dynamic judgments method, time-changing judgments are represented as temporal functions. The adaptation program is called AHP Hard with a name environment that changes over time Dynamic AHP (Improta et. al,2019:1534).

3.3 STEPS OF THE HIERARCHICAL ANALYSIS PROCESS (AHP)

STEP 1: BUILDING THE HIERARCHICAL STRUCTURE OF THE PROBLEM OF RESOLUTION 1-3-3

In general, the hierarchical structure is created at three levels: goal, criteria, and alternatives. The goal is placed at the top, the criteria are in the middle, and the alternatives are at the bottom (Almeida et. al,2018:5). It can be said that the best way to build a hierarchical structure is to discuss the subject broadly and accurately in the presence of a group of stakeholders, experience, and competence, after that a list of all the elements and alternatives that have been put forward related to the problem is determined, then all elements and alternatives are collected and arranged hierarchically. (Burqa, 2018: 28).

Figure 1: The Hierarchical Structure of the Decision Problem of the AHP Program



Source: Prepared by the authors based on the source (Serdar, 2017:14)

The researchers see through Figure (1) above that the hierarchical structure in this scheme reflects the relationship between the various factors of the system, where the effectiveness and impact of the factors of the lower hierarchical level in the factors within the upper hierarchical level, by calculating the relative importance of each factor in the hierarchical structure.

STEP 2: BILATERAL COMPARISONS AND CONSTRUCTION OF THE GOVERNANCE MATRIX 2-3-3

Once the hierarchical structure of the problem is structured, the next step is to build the even comparison matrix as proposed by the watchmaker, where the input data for the problem consists of even comparison matrices for single-level elements that contribute to achieving the goals of the next higher level. In other words, elements of a given level are compared concerning a particular element in the immediate upper level. Once the matrix is created, the elements are compared on a pair basis to determine their relative importance in terms of each building criterion(s). On the scale given by Saaty (1 to 9) as in Table (1), using this scale, the verbal judgments of each pair of wise elements are converted into numerical quantities, usually, the item with a higher rating or rank is considered superior (or more influential) compared to another element that receives a lower rating. (Abay et. al,2019:18)

Table No. (1) Hourly Scale of Relative Importance Levels

Clarification	Definition	Importance
.Both activities contribute equally important	Equal importance	1
Preference for one activity over another to an average degree	Medium importance	3
Experience and strong judgment favor one activity over another	Basic and strong importance	5
Strongly prefers activity, its dominance appears in practice	Very strong importance	7
The directory that prefers one activity over another is the highest ranking	Utmost importance	9
When a compromise is needed	Intermediate values between two adjacent judgments	2,4,6,8

Source: Prepared by the authors based on the source (Sales et.al, 2020:5)

STEP 3: DERIVATION OF RELATIVE WEIGHTS 3-3-3

It is a step that requires estimating the relative weights of each of the basic and sub-criteria of the decision sequence, researchers have developed many methods to estimate the relative weights of the comparison matrix, although the eigenvector method is widely used to derive the relative weights proposed by the watchmaker as a pioneer in the field of AHP technology. Waris et. al,2019:6), and to apply this step, we follow the following sub-steps :(Taher and Mohammed, 2017: 8)

1- Calculate the column sums of the matrix A, where:

$$\sum_{i=1}^{n} \text{aij} \; ; \quad \text{Aj} = 1,2,\ldots\ldots..,\text{n}$$

-2 We convert the matrix A into a standard matrix (natural) by dividing each element in the original matrix ($A\ norm$A) by the total sum of the column to which that element belongs, that is,

$$\boldsymbol{aij}_{(norm)} = \frac{aij}{\sum_{i=1}^{n} aij}$$

Thus we get the natural matrix as follows: $A\ norm$

$$(\boldsymbol{aij})_{(norm)} = \left(\frac{aij}{\sum_{i=1}^{n} aij}\right) \quad Ai,j = 1,2,\ldots\ldots,n\ldots$$

-3 Calculate the vector of weights W*, where these weights represent the vector of priorities or preference between the criteria, by calculating the sum of each row in the normal matrix, so we will get a vector that represents the total number of rows: $A\ norm$

$$\boldsymbol{Zi} = \left(\sum_{i=1}^{n} aij\right) norm \quad Ai = 1,2,\ldots\ldots,n\ldots$$

After that, we divide each element in the vector by the degree (n) to be able to obtain the average for each of these rows, and thus we will get the priority vector or the priority vector as follows:

$$\text{W}^* = \frac{a1}{n}\ \frac{a2}{n} \ldots\ \frac{an}{n} \ldots.$$

$$\sum_{i=1}^{n} Wi = 1$$

STEP 4: CHECK CONSISTENCY 4-3-3

The quality of the final decisions can be judged by the stability of the judgments of the decision makers during the bilateral comparisons, and because it is difficult to achieve this stability in all bilateral comparisons, the hierarchical analysis process (AHP) can measure the degree of stability of the provisions of decision makers, if the result of the degree of stability is acceptable then the decision-making process continues, but if the degree of stability is unacceptable, the bilateral comparisons are repeated and adjusted to continue the analysis process. The limit Acceptable for the stability rate (0.10) for the level of bilateral comparisons, but if the value of this rate exceeds (0.10), this indicates the instability of the judgments of decision makers when conducting bilateral comparisons, and this also indicates that the order of alternatives is incorrect or unacceptable, which requires reconsidering the conduct of bilateral comparisons. (good and Mahdi,2019: 75)

To test consistency mathematically, we follow these steps:

1. CALCULATION OF THE CONSISTENCY INDEX (CI)

When a judgment matrix has complete consistency, its maximum eigenvalue is represented as λmax = n, the final judgment matrix that is proposed is often completely inaccurate and the maximum eigenvalue value is n. Therefore, it is necessary to test the differences between the judgment matrix and complete consistency. CI is mathematically formulated as follows: (Yu et.al, 2020:4)

$$\boldsymbol{CI} = \frac{\boldsymbol{\lambda max - n}}{\boldsymbol{n - 1}}$$

Whereas:

$(\lambda max)$is the maximum value of the governance matrix.

(n)Represents the elements that will be compared to i.e. it (the size of the matrix)

2. CALCULATION OF CONSISTENCY (CR)

CR is calculated mathematically according to the following equation:

$$\boldsymbol{CR} = \frac{\textbf{CI}}{\boldsymbol{RI}}$$

Whereas:

CR consistency ratio.

CI is the consistency index that was extracted in the previous step.
RI is a random consistency index, the principle of the reference value, and can be extracted from Table 2, so when a = 0, the CI is consistent; the larger the CI, the more serious the inconsistency of A. When CR is <0.1, A's inconsistency is within the permissible range, and eigenvector A can be used as a weight vector. (Yuan&Li,2021:166)

Table 2) Random consistency indexRI)

10	9	8	7	6	5	4	3	2	1	N
1.49	1.45	1.41	1.32	1.24	1.12	0.90	0.58	0	0	Random indicatorRI

Source: Prepared by the authors based on the source (Liu,2016:18)

STEP 5: SENSITIVITY ANALYSIS 5-3-3

The sensitivity analysis process is the fifth step in the methodology of the hierarchical analysis process (AHP), where sensitivity analysis allows us to understand the strength of our decision made and what were the motives i.e. the criteria that influenced the original results. It is an important part of the process as a final decision can only be made after an allergy analysis. Mu & Pereyra-Rojas, 2017:20) Sudaryanto described sensitivity analysis as a method aimed at reaching an unbiased decision by excluding alternatives in the decision-making process. Decision-making needs to be able to investigate its sensitivity to the choices made. Sensitivity analysis is necessary to ensure that changes in the evaluation of available alternatives and criteria do not pose a risk that may alter the test results. Sensitivity analysis is also used to determine the sensitivity of the criteria in determining the final results of the test, meaning if it is said that one of the criteria is sensitive, then the evaluation must be carried out carefully, and the sensitivity analysis is processed using the "Expert Choice" program (Sudaryanto,2017:32,94).

STEP 6: DECISION MAKING 6-3-3

In this step, the alternatives are arranged according to the percentages obtained, and the alternative that represents the highest priority percentage among the competing alternatives is selected. (Attia et al., 2020:210)

3.4 THE USE OF HIERARCHICAL ANALYSIS (AHP) IN RATIONALIZING INVESTMENT DECISIONS

The adoption of investment project decisions on financial criteria or factors only, without taking into account non-financial factors, may lead to inappropriate decisions. The non-financial approach taken by many strategic analyses may be an attempt to overcome short horizons and arbitrariness in the financial analysis process, which is often misapplied. Non-financial valuation techniques provide numerous information about less realistic factors and are expected to be able to identify competitive advantages in investment projects that do not. Financial technologies can capture them, as the selection of an investment project involves an assessment of multiple quantitative and qualitative attributes or criteria. The non-monetary aspects of the project need more accurate understanding and analysis so that they can be managed and that failure to take these aspects into account or neglect leads to the failure of the investment projecteven thoughthe financial components or elements are favorable and effective. Many researchers have also confirmed that non-financial standards play a role. Investment analysis and decision-making should cover a broad process of financial and non-financial aspects including quality, flexibility, potential future growth, strategy, and market direction, as well as ethical, .social, political, environmental, and legal considerations) Batra&Verma,2017:31-37)

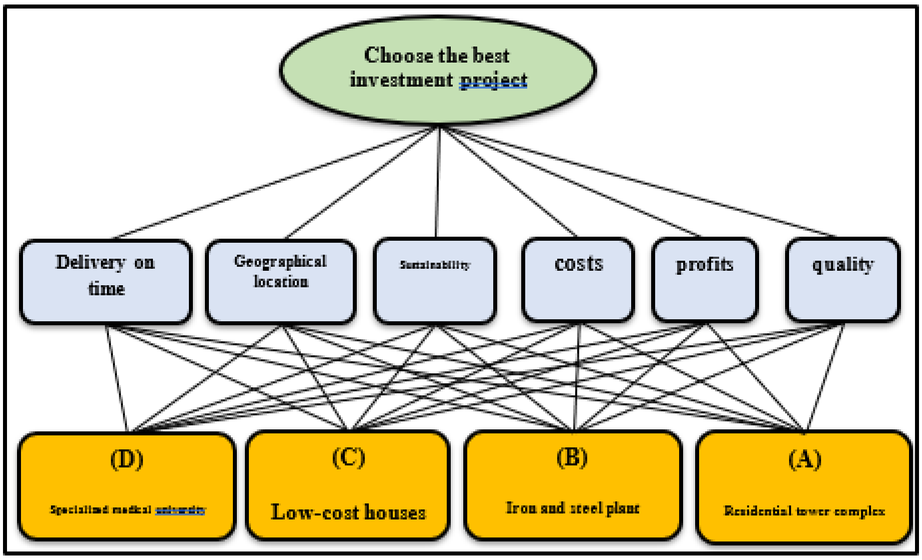
(Hilton& Platt,2020:588) pointed out that although many financial measures are used in evaluating the sectoral performance of companies, specifically investment centers, such as the profitability of the sector, return on investment, residual income, and value-added, and their widespread use in evaluating performance, non-financial measures are no less important than financial measures or factors in evaluating sectoral performance, so the appropriate evaluation of the company and its segments requires the use of multiple performance measures to introduce financial and non-financial measures in evaluating performance. Anton, 2019:46 criticized this issue, noting that investment decisions are usually made based on the results of net present value (NPA), which are based on accounting figures. However, a range of behavioral, qualitative, and financial information, in general, that is no less important than other financial considerations in the evaluation of investment projects is ignored.

5. RESULTS

In this section, the hierarchical analysis process (AHP) will be applied to future investment projects, which aim (Karbala International Group Company for Real Estate Investments, Contracting, and General Trading) to compare among themselves and choose the project that achieves the highest profitability to start its implementation by integrating financial and non-financial criteria (descriptive), or arranging alternatives according to preference, where the process of comparison and evaluation will take place between (4) competing investment projects, namely; Project (A)) Residential towers complex, project (B) iron and steel factory, project (C) low-cost role, project (D) specialized medical university. (6) criteria will be used in the evaluation process, including financial and non-financial criteria: quality, profits, costs, sustainability, geographical location, and on-time delivery.

The first step: building the hierarchical structure of the decision problem

Figure 2: Hierarchical Structure of the Decision Problem of AHP



STEP TWO: BINARY COMPARISON AND GOVERNANCE MATRIX BUILDING

Once the hierarchical structure of the problem is structured, the researcher distributed the bilateral comparison form for standards and alternatives to some department managers and those with experience in the field of investment projects, and after obtaining the values of bilateral comparisons according to the scale (Saaty) shown in Table (1). The arithmetic mean of each of the binary comparisons was calculated by adding up the values of the four degrees of importance of the experts and (After finding the sum of the values, we find the arithmetic mean by dividing the sum of the values by their number, where the binary comparison matrix for alternatives (investment projects) (the primary matrix) was created according to each criterion, as well as the binary comparison matrix (the initial matrix) of the criteria according to the overall goal and the result was as in tables (3, 4, 5, 6, 7, 8 and 9).

Table (3) Matrix of Bilateral Comparisons of Projects (Primary Matrix) of the Quality Standard

D	C	B	A	Projects Investment
4	4	1	1	A
5	5	1	1	B
2	1	1/5	1/4	C
1	1/2	1/5	1/4	D
12.000	10.500	2.400	2.500	Total

Table (4) Matrix of Bilateral Comparisons of Projects (Primary Matrix) for Profit Criterion

D	C	B	A	Projects Investment
2	4	1	1	A
5	3	1	1	B
2	1	1/3	1/4	C
1	1/2	1/5	1/2	D
10.000	8.500	2.533	2.750	Total

Table 5 Project Binary Comparison Matrix (Primary Matrix) for Cost Standard

D	C	B	A	Projects Investment
3	2	1	1	A
4	4	1	1	B
2	1	1/4	1/2	C
1	1/2	1/4	1/3	D
10.000	7.500	2.500	2.833	Total

Table 6 Two-way Project Comparisons Matrix (Primary Matrix) for Sustainability Standard

D	C	B	A	Projects Investment
2	1	1	1	A
2	3	1	1	B
3	1	1/3	1	C
1	1/3	1/2	1/2	D
8.000	5.333	2.833	3.500	Total

Table 7 Bilateral Comparisons Matrix for Projects (Initial Matrix) for Geographical Location Criterion

D	C	B	A	Projects Investment
1	2	1	1	A
4	2	1	1	B
2	1	1/2	1/2	C
1	1/2	1/4	1	D
8.000	5.500	2.750	3.500	Total

Table 8 Project Two-Dimensional Comparisons Matrix (Initial Matrix) for Delivery Standard

D	C	B	A	Projects Investment
3	2	1	1	A

5	5	1	1	B
1	1	1/5	1/2	C
1	1	1/5	1/3	D
10.000	9.000	2.400	2.833	Total

Table 9 Binary Comparisons Matrix (Primary Matrix) of Standards According to the Overall Objective

deliverable	Site	Sustainability	Costs	Earnings	Quality	Standards
3	4	3	1	1	1	Quality
3	3	4	2	1	1	Earnings
2	2	1	1	1/2	1	Costs
2	5	1	1	1/4	1/3	Sustainability
1	1	1/5	1/2	1/3	1/4	Site
1	1	1/2	1/2	1/3	1/3	deliverable
12.000	16.000	9.700	6.000	3.417	3.917	Total

Step Three: Deriving Relative Weights

-1 Set up the settlement matrix (Normalized Matrix)

The settlement matrix is prepared by dividing each element by the sum of the column that contains that element, for example, and by referring to Table (3) and to obtain the first column of the adjustment matrix for the quality standard shown in Table (10), we divide the first element in the first column by the sum of that column 2.500/1 so that the result is **0.400 and this represents the first element in the first column of the adjustment matrix for** a standard Quality.

-2 Shred the initial preference vector

The initial preference vector is obtained by finding the arithmetic mean for each row of the matrix (settlement matrix) Table (10) so the initial preference vector of the alternative (A) according to the quality criterion: 4 = 0.383 / 0.400 + 0.417 + **0.381 + 0.333**

Table (10) Settlement matrix for investment projects according to the quality standard

First Preference Vector	D	C	B	A	Projects Investment
0.383	0.333	0.381	0.417	0.400	A
0.428	0.417	0.476	0.417	0.400	B
0.111	0.167	0.095	0.083	0.100	C
0.078	0.083	0.048	0.083	0.100	D
1	1	1	1	1	Total

In the same previous procedure, the settlement matrix is found and the first preference vector for the rest of the investment project matrices is found for each criterion, in addition to the settlement matrix for the criteria according to the overall objective, as shown in Table (11 and 12) below:

Table (11) First Preference Vector for All Criteria

The first preference vector for the investment project matrices for each criterion						Investment Projects
deliverable	Site	Sustainability	Costs	Profits	Quality	
0.323	0.285	0.270	0.330	0.357	0.383	A
0.456	0.379	0.363	0.422	0.403	0.428	B
0.118	0.188	0.242	0.152	0.135	0.111	C
0.103	0.148	0.126	0.096	0.105	0.078	D

Table 12 Adjustment matrix for standards according to the overall objective

First Preference Vector	deliverable	Site	Sustainability	Costs	Earnings	Quality	Standards
0.254	0.250	0.250	0.309	0.167	0.293	0.255	Quality
0.288	0.250	0.187	0.412	0.333	0.293	0.255	Earnings
0.161	0.167	0.125	0.103	0.167	0.146	0.255	Costs
0.151	0.167	0.312	0.103	0.167	0.074	0.085	Sustainability
0.069	0.083	0.063	0.021	0.083	0.097	0.065	Site
0.077	0.083	0.063	0.052	0.083	0.097	0.085	deliverable
1	1	1	1	1	1	1	Total

3. Preparation of the matrix of weights (matrix W) for alternatives and criteria **(primary preference vectors)**

The weights matrix (W) is prepared from the initial preference vectors of each matrix, provided that the preference vector column in the settlement matrix is a row in the weights matrix (W), except for the preference vector column of the settlement matrix for the criteria for selecting investment projects, which will represent the criteria vector column.

Table (13) Matrix of Weights (W) (Primary Priority Vectors)

Criteria vectors	D	C	B	A	Investment Projects
					Standards
0.254	0.078	0.111	0.428	0.383	Quality
0.288	0.105	0.135	0.403	0.357	Earnings
0.161	0.096	0.152	0.422	0.330	Costs
0.151	0.126	0.242	0.363	0.270	Sustainability
0.069	0.148	0.188	0.379	0.285	Site
0.077	0.103	0.118	0.456	0.323	deliverable

Step Four: Check Consistency

-1 Calculation of the second preference vector

The secondary preference vector is calculated by multiplying the initial matrix (The Initial Matrix) by the primary preference vector of each matrix, and to obtain the secondary preference vector of the quality standard matrix, for example, we multiply each row of the primary matrix of the quality standard by the column of the primary preference vector of the quality criterion extracted from calculating the arithmetic :mean for each row of the quality standard leveling matrix, as shown below

4	4	1	1		0.383
5	5	1	1		0.428
2	1	1/5	1/4		0.111
1	1/2	1/5	1/4		0.078

B11= 0.383 (1) +0.428 (1) +0.111 (4) +0.078 (4) = 1.567

B12= 0.383 (1) +0.428 (1) +0.111 (5) +0.078 (5) = 1.756

B13= 0.383 (1/4) +0.428 (1/5) +0.111 (1) +0.078 (2) = 0.448

B14= 0.383 (1/4) +0.428 (1/5) +0.111 (1/2) +0.078 (1) = 0.315

In the same way above, the secondary preference vector is extracted for the rest of the criteria, and the secondary preference vector of the criteria matrix is also extracted according to the total goal in the same way as shown below:

Matrix of all criteria according to the overall objective

3	4	3	1	1	1		0.254
3	3	4	2	1	1		0.288
2	2	1	1	1/2	1		0.161
2	5	1	1	1/4	1/3		0.151
1	1	1/5	1/2	1/3	1/4		0.069
1	1	1/2	1/2	1/3	1/3		0.077

B71 = 0.254 (1) + 0.288 (1) + 0.161 (1) + 0.151 (3) + 0.069 (4) + 0.077 (3) = 1.663

B72 = 0.254 (1) + 0.288 (1) + 0.161 (2) + 0.151 (4) + 0.069 (3) + 0.077 (3) = 1.906

B73 = 0.254 (1) + 0.288 (1/2) + 0.161 (1) + 0.151 (1) + 0.069 (2) + 0.077 (2) = 1.002

B74 = 0.254 (1/3) + 0.288 (1/4) + 0.161 (1) + 0.151 (1) + 0.069 (5) + 0.077 (2) = 0.968

B75 =0.254 (1/4) +0.288 (1/3) + 0.161 (1/2) + 0.151 (1/5) + 0.069 (1) +0.077 (1) = 0.416

B76 = 0.254 (1/3) +0.288 (1/3)+ 0.161 (1/2) +0.151 (1/2) +0.069 (1) + 0.077 (1) = 0.483

From the previous results, we will prepare the (secondary preference vector matrix) matrix B so that the value of B11 corresponds to the value of the secondary preference vector of the quality criterion of project A and the value of B12 corresponds to the value of the secondary preference vector of the quality criterion of project B, and so on, as shown in Table (14)

Table (14) Matrix B (Secondary Preference Vector Matrix)

All Criteria	D	C	B	A	Investment Projects Standards
1.663	0.315	0.448	1.756	1.567	Quality

1.906	0.432	0.569	1.690	1.510	Earnings
1.002	0.388	0.615	1.744	1.344	Costs
0.968	0.523	1.011	1.611	1.127	Sustainability
0.416	0.622	0.816	1.632	1.188	Geographical location
0.483	0.420	0.474	1.884	1.324	Delivery time

-2 Calculation of the third preference vector
We can find the third preference vector by dividing each of the values of the secondary preference vector by the corresponding values of the primary preference vector (i.e. dividing the matrix B by the W matrix), for example, we will find the third preference vector for the project matrix for the quality criterion as shown below and in the same way for the rest of the criteria matrices:

Matrix of projects for quality standard

	0.315	0.448	1.756	1.567	B
	0.078	0.111	0.428	0.383	In
Arithmetic mean	project D	project C	project B	project A	Projects
4.067	4.038	4.036	4.102	4.091	Quality

Matrix of all criteria according to the overall objective

1.663		0.254		6.547
1.906		0.288		6.618
1.002		0.161		6.224
0.968	÷	0.151	=	6.411
0.416		0.069		6.029
0.483		0.077		6.273
B		In	Arithmetic mean	6.350

-3 Calculate the eigenvalue (Eigenvalue) Top (mix)
After obtaining the third preference vector, the higher eigenvalue (λmax) can be calculated by calculating the arithmetic mean of the third preference vector for each matrix.
The value of (λmax) for each of the matrices of alternatives and criteria will be as follows:

Table (15) Value (λmax) for the matrix of alternatives and criteria

(λmax) قيمة	Matrix
4.067	Matrix of projects for quality standard
4.188	Project matrix for earnings criterion
4.074	Project matrix for cost criterion
4.235	Project Matrix for Sustainability Standard
4.254	Project matrix for geolocation criterion
4.082	Project matrix for standard delivery on time
6.350	Matrix of all criteria according to the overall objective

-4 Stability index (Consistency Index)
After we have evaluated λmax, we can calculate the stability index by the equation:

$$C.I = \frac{\lambda max - n}{n - 1}$$

Below calculate the stability index for the project matrix for the quality standard, and so on for the rest of the project matrices for all standards, as well as the stability index for all standards matrix according to the final goal as in Table (16)

$$C.I = \frac{4.067 - 4}{4 - 1} = 0.022$$

Table (16) Value of the stability index for project matrices and all criteria

stability index (C.I)	Matrix
0.022	Matrix of projects for quality standard
0.063	Project matrix for earnings criterion
0.025	Project matrix for cost criterion
0.078	Project Matrix for Sustainability Standard
0.085	Project matrix for geolocation criterion
0.027	Project matrix for standard delivery on time
0.070	Matrix of all criteria according to the overall objective

-5 احتساب نسبة الثبات (Consistency Ratio)

We calculate the stability ratio for each matrix and the value of the random indicator R. I is determined. Based on the table of the random stability index table (table (2) and since the number of available alternatives amounted to four alternatives, the value of the random index is 0.90) for the matrices of alternatives, while the matrix of criteria, which number six criteria, the value of the random index is (1.25) **as shown in Table** (2) and using the equation:

$$C.R = \frac{C.I.}{R\ I}$$

$$C.R = \frac{0.022}{0.90} = 0.024$$

Below **is the calculation of the stability ratio of the projects matrix for the quality standard, and in the same way, the stability ratio of the rest of the project matrices is calculated for the rest** of the standards, as well as the stability ratio of all standards according to the overall goal as in Figure (17).

Table 17 Stability Ratios for the Matrix of Alternatives and Criteria

Stability ratio	Matrix
0.024	Matrix of projects for quality standard
0.070	Project matrix for earnings criterion
0.028	Project matrix for cost criterion
0.087	Project Matrix for Sustainability Standard
0.094	Project matrix for geolocation criterion
0.030	Project matrix for standard delivery on time
0.056	Matrix of all criteria according to the overall objective

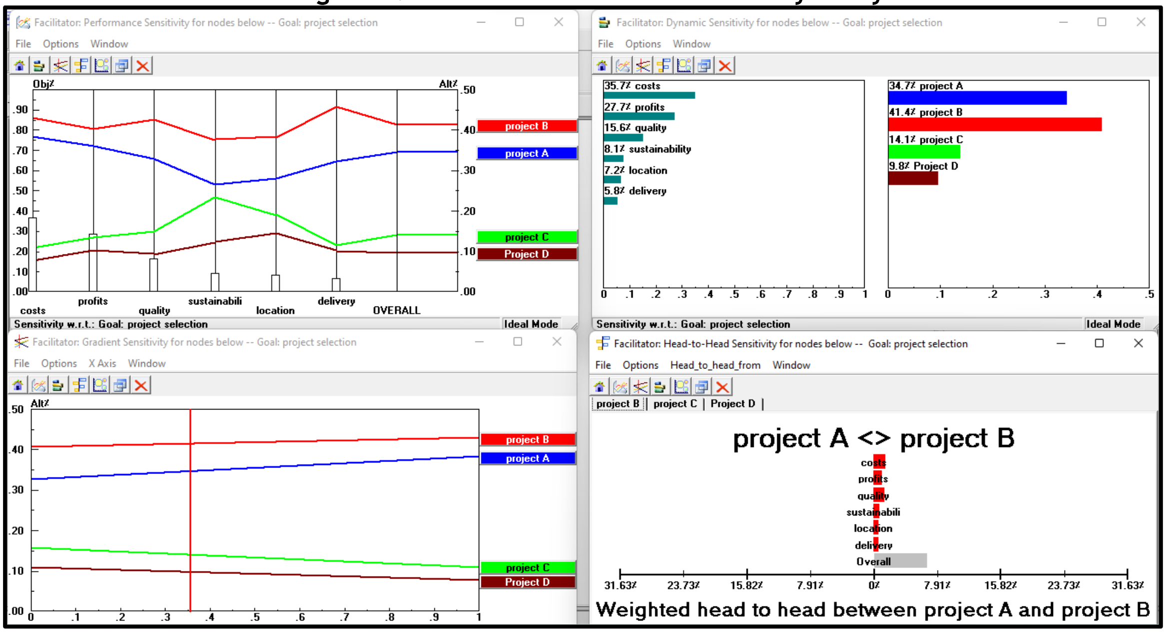
Who is it

Table (17) shows that all matrices have achieved the imposed stability ratio, which does not exceed (0.1) and this allows us to **move** to the last step, which is decision-making, and if the stability ratio

of the matrices or some of them is not achieved, the decision maker must reconsider the values of the binary comparisons of those matrices only without changing the values of the binary comparisons of the matrices that Achieved the required stability ratios.
All results and operations were performed by Microsoft Office Excel 2007.

Step Five: Sensitivity Analysis
A series of sensitivity analyses were conducted to investigate the impact of changing the priority of criteria on the order of projects, as the (Expert Choice) program can deal with these changes and there are several ways to display the results of these changes as shown in Figure (3), sensitivity analysis was tested for four different methods, namely the performance method, dynamics, regression and head-to-head method to find out the stability of the ranking of competing investment projects by making minor changes to the Each criterion, and proved the validity of the selection of the investment project (B) iron and steel factory, which received the highest score each time the level of importance of each of the criteria is increased by 0.5, which was used in the evaluation and differentiation process.

Figure 3: The Four Methods of Sensitivity Analysis



Source: Prepared by the researchers based on the program (Expert Choice)

Step Six: Decision Making
) After making sure that the required stability ratios have been achieved, which should not exceed 0.1we will ,(take the decision related to choosing the best investment project according to the preferred criteria of the company (under study) through the committee that was selected for the evaluation process, by doing the synthesis of priority) by multiplying the initial preference vector matrix W). vectors first preference in the (.for criteria, and choose the project that achieves the highest value

Project	deliverable	Site	Sustainability	Costs	Earnings	Quality	0.254
							0.288
Project A	0.323	0.285	0.270	0.330	0.357	0.383	0.161
Project B	0.456	0.379	0.363	0.422	0.403	0.428	0.151
Project C	0.118	0.188	0.242	0.152	0.135	0.111	0.069
Project D	0.103	0.148	0.126	0.096	0.105	0.078	0.077

So the final results will be as follows:

Project A = (Residential Towers Complex) 0.254 (0.383) +0.288 (0.357) +0.161 (0.330) + 0.151 (0.270) +0.069 (0.285) + 0.077 (0.323) = 0.339

Project B (iron and steel plant) = 0.254 (0.428) +0.288 (0.403) +0.161 (0.422) + 0.151 (0.363) +0.069 (0.379) + 0.077 (0.456) = 0.409

Project C (Low Cost Role) = 0.254 (0.111) + 0.288 (0.135) +0.161 (0.152) + 0.151 (0.242) +0.069 (0.188) + 0.077 (0.118) = 0.150

Project D = 0.254 (0.078) +0.288 (0.105) +0.161 (0.096) + 0.151 (0.126) +0.069 (0.148) + 0.077 (0.103) = 0.102

S: Synthesis of Priority

The sum of the Synthesis of priority values must be equal to 1.

Thus, project B is the best project, followed by Project A, then Project C, then Project D, i.e. the project that achieved the highest priority rate is chosen from the four competing projects, while the investment projects were evaluated by the company (subject of study) using the net present value method to obtain the project (C) The role of low cost on the highest net present value among the competing projects, and the reason is due to the use of financial and non-financial criteria in the evaluation and comparison process in the hierarchical analysis process and taking into account the relative importance of each criterion in the comparison process and its impact on decision-making.

Table (18) Ranking of Investment Projects by Priority Ratio

Priority ratio	Project Name	Project Code	t
0.409	Iron and Steel Factory	B	1
0.339	Residential Towers Complex	A	2
0.150	Low-cost roles	C	3
0.102	Specialized Medical University	D	4

6. Conclusions

The rationalization of investment decisions is a strategic capitalist process that determines the fate of the company and is considered one of the most important administrative processes. The success and failure of the company in the contemporary business environment, which is dominated by conditions of risk and uncertainty, depends on the validity of the decisions taken, especially the strategic ones. The analytical hierarchy process (AHP) is not a substitute for the traditional methods of evaluating investment projects, especially the net present value (NPV). Influencing the investment decision-making consideration, as is the current in the analytical hierarchical process (AHP). The hierarchical analysis process (AHP) is characterized by ease of application and use and does not require a specific academic specialization, and it can balance between financial and non-financial (objective) criteria such as subjective preferences, experience, and intuition in a logical and organized manner, and determines the relative importance of each of the criteria influencing decision-making and the comparison between alternatives. The results of the hierarchical analysis process (AHP) showed that project (B), the iron and steel plant, achieved the highest priority rate out of the four competing projects, despite not obtaining the first rank when evaluating investment projects in the net present value (NPV) method, after merging a group of Financial and non-financial criteria in the process of evaluation and comparison between alternatives. The company (the subject of the study) prefers the profits criterion in the first degree, given that the investment companies aim at profitability and maximizing the value of the owners and shareholders, but at the same time, they prefer the quality criterion, which came second over the cost criterion, which came third in the order, since the company (study) adheres to the certificate of conformity and quality management Iraqi and international. The criterion of sustainability comes in fourth place because the company (the subject of the study) is committed to the dimensions of sustainability, whether economic, social, or environmental, in the implementation of its investment projects, while it preferred the criterion of delivery on time, which came fifth over the criterion of geographical location, which came sixth by a slight difference, since the company (subject of study) It is committed to fulfilling its commitments by completing its investment projects on time, especially about its housing projects.

Therefore, it is necessary to adopt modern scientific methods in multi-criteria decision-making, such as the analytical hierarchical process (AHP) to evaluate projects and not be satisfied with traditional methods, because decision-making according to a sound scientific method leads to raising the level of performance in the investment company (subject of study), so it must be given great importance to the process of evaluating and selecting investment projects. It should also focus on many criteria when choosing between a group of investment projects, especially non-financial ones, and not focus on financial criteria only such as costs and future cash flows of the project as a basis for the comparison process among the available alternatives. It is important to use the Analytical Hierarchical Process (AHP) in this study. It requires training the specialized employees in the company and introducing them to the theory of hierarchical analysis in concept and application, and how to use the (Expert Choice) program. Technology within the training programs prepared for the future. The difference in the criteria used in the Analytical Hierarchical Process (AHP) to evaluate investment projects leads to a change in the decision taken, and therefore there must be an appropriate mechanism by the competent government agencies to set specific criteria commensurate with the goals of economic development and the interests of investors. It is possible to use the Fuzzy Hierarchical Analysis Process (FAHP) method to ensure the validity of individual perceptions in terms of binary comparisons of criteria and alternatives and to address ambiguity in the estimated data.

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