Application of Value Analysis Method in Service Problem

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ABSTRACT

Value analysis method is considered one of the best tools to decision making process and steps to be applied based on the nature of the problem. In this work, an approach to solve value analysis problem in services field has been suggested which consist of three stages, each stage has number of steps/phases that lead to analysis and improve the value of the problem. It has been used "analytical hierarchy process (AHP)" method as a support tool for decision making process and used "Expert Choice V.11" software which is designed based on AHP method and professional user interface. The suggested steps are applied on practically case taken from ministry of water resources. The problem is selecting the best alternative from a number of suggested alternatives for improving the irrigation method in areas of middle Tigris project. After applying the suggested steps and using "Expert Choice V.11" software, the result is: the irrigation by pumping is the best one based on its value.

Keyword: value analysis, analytical hierarchy process (AHP).

INTRODUCTION:

Value analysis is one of tools used in decision making process in many applications and for improvement process. The organizations are facing severe challenges that lie in improving economic competitiveness, while achieving a variety of the highest quality, lowest-cost, and as much as environmentally. In such a constrained value analysis method considered a simple and smart methodology for a detailed and differential economic analysis of an industrial system under any market and environmental conditions [1]. Value analysis, as defined by the Society of American Value Engineers International (SAVE International), is "the systematic application of recognized techniques by multi-disciplined teams that identifies the function of a product, project or service; establishes a worth for that function; generates alternatives through the use of creative thinking; and provides the needed functions, reliably, at the lowest overall cost" [2]. The value analysis method which is consist of a three stages: Pre study, Value analysis job plan and Post study, it is different in details and application from problem to other and between researcher, but the aim is the same: increase the value and decrease the cost [3].

Related Literature Review:

In the literature, different studies published in the last years which start from the oldest to the current years in ascending order that utilize different steps for solving value analysis problem.

Vamosi (2011) [4]. Presented Combining Innovation and Value Analysis in the Pharmaceutical R&D Field. This research discussed the application of VA in Pharmaceutical field to reduce the cost of the restriction, combined with innovative pharmaceutical research

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expenditures and the time factor, which is considered a big problem for the pharmaceutical industry.

Jauhar (2012) [5] presented Value Analysis in Galvanization Process: A Cost Reduction approach. The author described the steps of VA process and how can be applied in this field and described how can improve the value of the process by changing exciting process and select the best alternative that saving money and improve the performance, therefore the author approved that the VA is the best technique for reduction cost of any aspect of organization.

Kmetty and Paley (2012) [6] presented What Makes Value Methodology Work? An Analysis of Function Analysis. This paper dissected how function analysis and function analysis system technique (FAST) diagram contribute to make the solution of the problems simple and obvious and make the best decision. A Railroad Bridge has been taken as a case study and explained how FAST and function analysis contributes to better understand the problem.

Gheorghe et al (2013) [7] presented a Value Analysis Method, Leverage for Cost Reduction and Technological Change in the Electrical Engineering Field. In this study the authors presented the implementation of VA method to reduce production cost and technological change to a product. The product at this study was electrical motors, with application for the flameproof motors.

Uchida (2014) [8] presented Numerical Value Analysis and Evaluation Techniques of the Esteem Function. In this study the author has been described a method for analysis and evaluation of Esteem Function. This method depended on the "sense" of the users, although the sense of the users difference between users, but the author developed a range from maximum tolerable value to minimum tolerable value, thus as author Esteem Function can be quantified.

Stages of the Proposed Method:

To resolve the problem by value analysis method stages will be suggested which aims to select best alternative based on its value from a number of ideas/alternatives have been created for improvement process by use the value index:

$$V = \frac{\qquad\qquad}{\qquad\qquad} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

It consists of three stages, each stage has number of activities that lead to analysis the value of the alternatives and select the best one.

Stage One: Pre-Study defines the project and scope of the problem.

Stage Two: Value Analysis Job Plan, this phase consists of four phases: information was the data are formulated in matrices form: [P] pairwise comparison matrix for criteria and [A] pairwise comparison matrix for alternatives based on each criterion, function analysis, creativity and development. At development phase using analytical hierarchy process (AHP) as a support tool. *Stage Three: Post Study*.. Figure (1) shows the Stages of the Proposed Method.

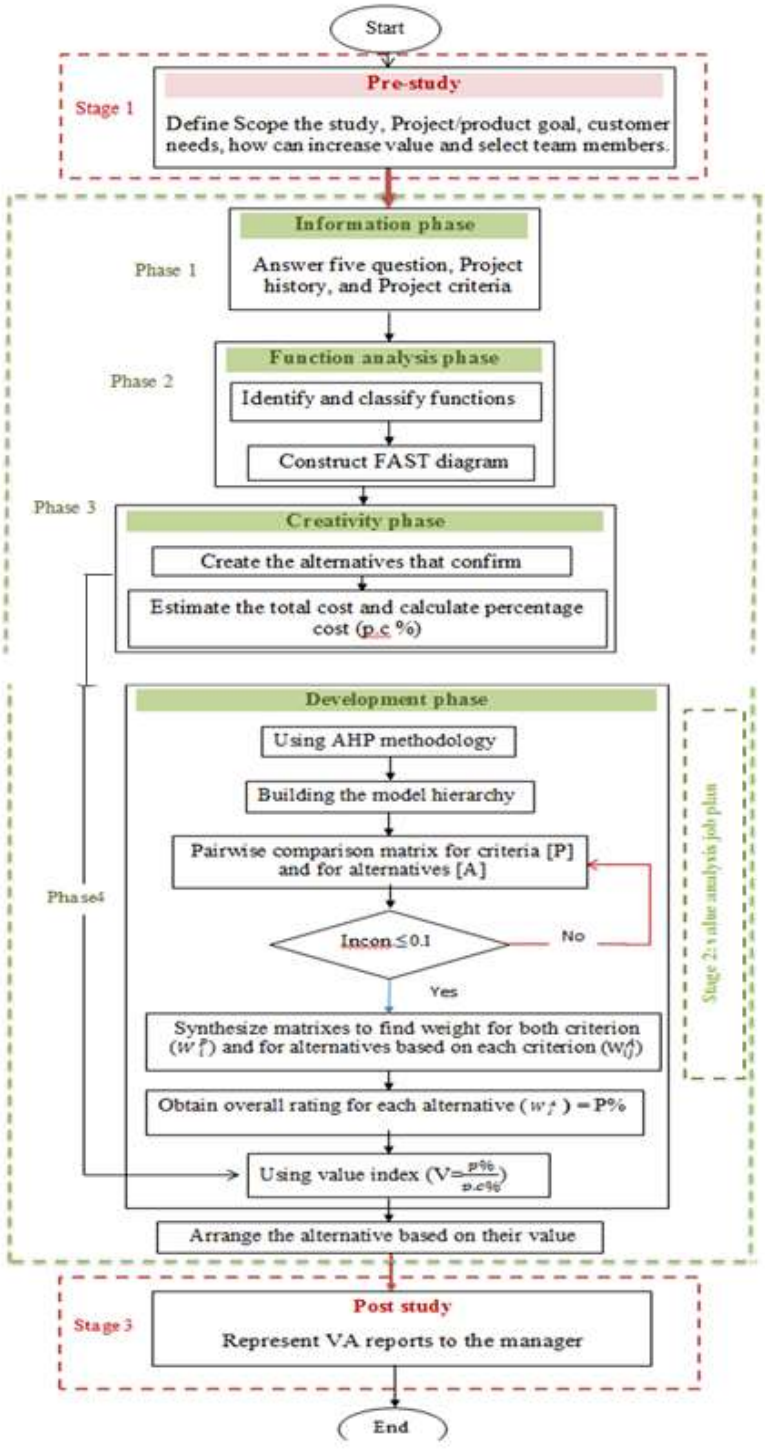

Figure (1): Stages of the Proposed Method

Problem Description:

The work problems have been applied in the ministry of water resources at Irrigation of Middle Tiger Project (IMTP), the problem was how can improve the irrigation method which is used now because there is a lot of amount of water has been loosed. Figure (2) shows the Map of IMTP location.

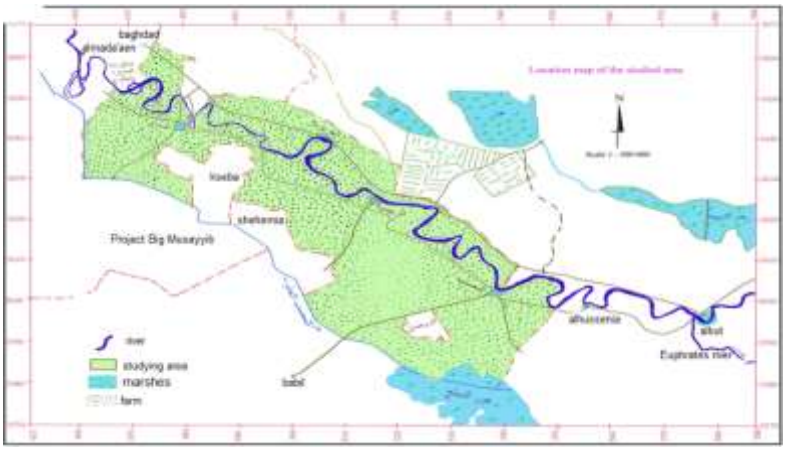

Figure (2) Map of IMTP Location

Implementation of Proposed Method in Ministry of Water Resources:

As it was mentioned, the proposed method consists of three main stages, these stages are explained in detail for this practical case as the follows**:**

Stage One: Pre-Study

This stage is a pre study of the problem and identifies the main data about the problem such as: team members: identifying and selected based on the nature of the problem, project scope and project goal in this problem the project goal is: to improve the irrigation method; reclaim of the soil and investment the areas of middle Tigris.

Stage Two: Value Analysis Job Plan

As previously mentioned, the job plan consists of four phases as following:

Information phase

All information about the project must be gathered in this phase, such information is:

Five Question

The five questions of this stage have been answered about IMTP are:

1. **What is the project?**
   Irrigation of middle Tigris project
2. **How much it costs almost?**
   1500000 (million dinar)
3. **What is the basic function?**
   Reactivate the economic level
4. **What is the secondary function?**
   Reclamation the soil
5. **What is almost alternative cost?**
   1600000 (million dinar)

Project Criterion

Depending on the type of the project, most common and important criteria gathered to be taken into consideration; these criterions are defined by the researcher and the team of engineers in the ministry of water resources. Table (1) shows the criterions with their symbols.

Table (1) :Criteria of the (IMTP) With Their Symbols

No.	Criterion Name	Criteria Symbol
1	Initial cost	P1
2	Performance	P2
3	Owner preference	P3
4	Maintenance and operation cost	P4
5	Aesthetics	P5
6	Environmental impact	P6
7	Energy cost	P7
8	Time and cost of redesign	P8
9	Implementation time	P9
10	Safety and reliability	P10
11	Quality	P11
12	Net present value (NPV)	P12
13	Benefit Cost Ratio (BIC)	P13
14	Internal Rate Of Return (IRR)	P14
15	Pay Back Period	P15

The researcher conducted a questioner of engineers were selected from ministry of water resources. Each engineer has been given their opinions as weights of AHP process, as shown in matrix (1).

Criteria/Criteria	Initial cost	Performance	Owner preference	Maintenance and operation cost	Aesthetics	Environmental impact	Energy cost	Time and cost of redesign	Implementation time	Safety and reliability	Quality	Net present value (NPV)	Benefit Cost Ratio (BIC)	Internal Rate Of Return (IRR)	Pay Back Period
Initial cost		3	7	5	7	5	1	3	7	1/3	3	1/2	1/3	1/3	1/5
Performance			5	5	5	1	3	5	1	1	3	1/3	1/3	1/5	1/5
Owner preference				1/3	5	1/3	1/3	5	1/4	1/5	1/3	1/3	1/3	1/5	1/5
Maintenance and operation cost					5	1/5	1	3	1/3	1/5	1/3	1/3	1/5	1/4	1/5
Aesthetics						1/5	1/7	1/3	1/5	1/5	1/3	1/5	1/5	1/5	1/7
Environmental impact							1/3	3	1/4	1/4	1/3	1/5	1/5	1/5	1/5
Energy cost								1	1/5	1/5	1/3	1/3	1/5	1/3	1/5
Time and cost of redesign									1/3	1/5	1/3	1/5	1/5	1/5	1/7
Implementation time										1/3	4	1/3	1/3	1/3	1/5
Safety and reliability											5	1/3	1/3	1/3	1/7
Quality												1/3	1/5	1/5	1/7
Net present value (NPV)													1/3	1/5	1/7
Benefit Cost Ratio (BIC)														1	1/5
Internal Rate Of Return (IRR)															1/3
Pay Back Period															

Matrix (1) Pairwise Comparison Matrix for IMTP Criterion [P]

Function Phase

This phase is the cornerstone of the Value Analysis method. The functions are described by a ***verb*** and ***noun***; this description should be general, so that it does not imply a solution but only the required function. The researcher was made a questioner about the basic and secondary function of the project. As shown in Table (2) and from which the functions have been analyzed to construct FAST diagram as showing in Figure (3).

Table (2): Basic and Secondary Function of IMTP

No.	Name of function		Basic	Secondary
	verb	Noun		
1	Active	Economic level	√	
2	Active	Social level	√	
3	Reclaim	Soil		√
4	Raises	Animal production	√	
5	Raises	Production plant	√	
6	Occupy	The peasants	√	
7	Occupy	Workers	√	
8	produce	Feed		√
9	Active	Markets		√
10	Increase	Green area		√
11	Decrease	Dust and dust storms		√
12	Decrease	Pollutants		√
13	Decrease	Epidemics and diseases		√
14	Decrease	Unemployment		√
15	Active	Transportation		√
16	Active	Industry		√
17	Resettle	Population		√
18	Decrease	Import		√
19	Active	Export		√
20	Improve	Environment		√
21	Raises	Living		√
22	Increase	Cultural awareness		√
23	Produce	Seeds		√
24	Decrease	Desertification		√

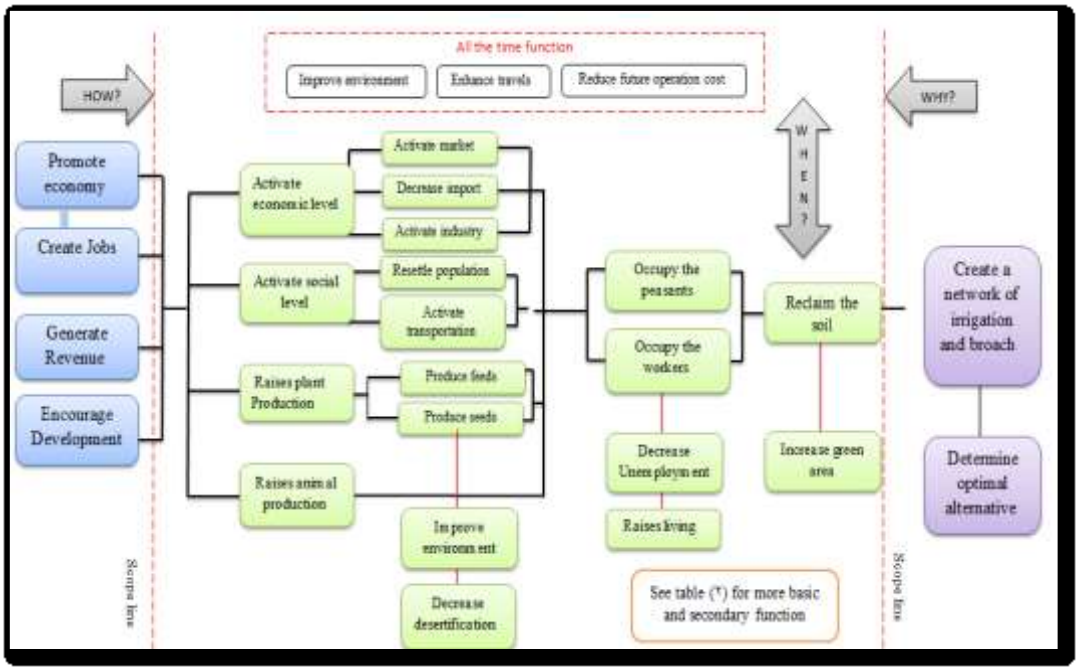

Figure (3): FAST Diagram for IMTP

Creativity Phase

The team members of the IMTP have been listed three alternatives/ideas for development the project: Surface Irrigation (A1), Irrigation by pumping (A2), Groundwater irrigation (A3).
The cost of each alternative has been identified by forecast the cost of each category of cost, then the percentage cost (p.c %) has been calculated as show in table (3).

Table (3) :The Total Cost and Percentage Cost for Each Alternative of IMTP Development (Million Dinars)

Alt. name	capital cost (million dinars)	Annual cost (million dinars)	Total cost	Percentage cost (p.c)%
Irrigation Alchrista (A1)	1478300	59374	1537674	0.322
Irrigation by pumping (A2)	1340600	67219	1407819	0.295
Groundwater irrigation (A3)	1754500	73960	1828460	0.383
∑			4773953	1

The matrixes of weight of each alternative based on each criterion are created from questioner of engineers. As shown in figure (4).

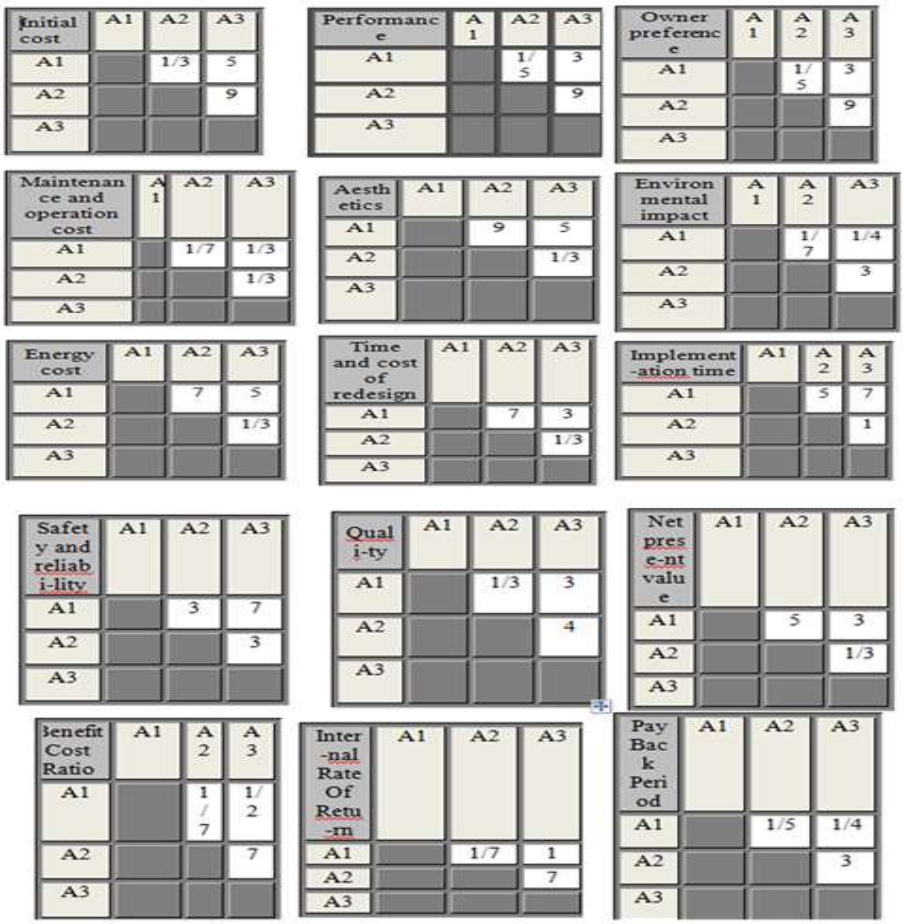

Figure (4): Pairwise Comparison Matrixes for Alternatives Based on Each Criterion

Development phase

This phase is identifying which alternative has the maximum value and consists of two steps (AHP Methodology and Use Value Index) as follows:

AHP Methodology

Because the development phase is a decision to select best alternative based on its value, therefore AHP is used to assist in determining the best choice. The computerized decision supports software based on AHP, namely Expert Choice V.11, is proposed to determine weights of the criteria and overall priority the procedure of AHP as following:

Input Data and Find Weight of Criteria and Alternative Based On Criteria

To synthesize the weight of each criteria , input the weight of matrix (1) in the expert choice comparison matrix as shown in figure (5).

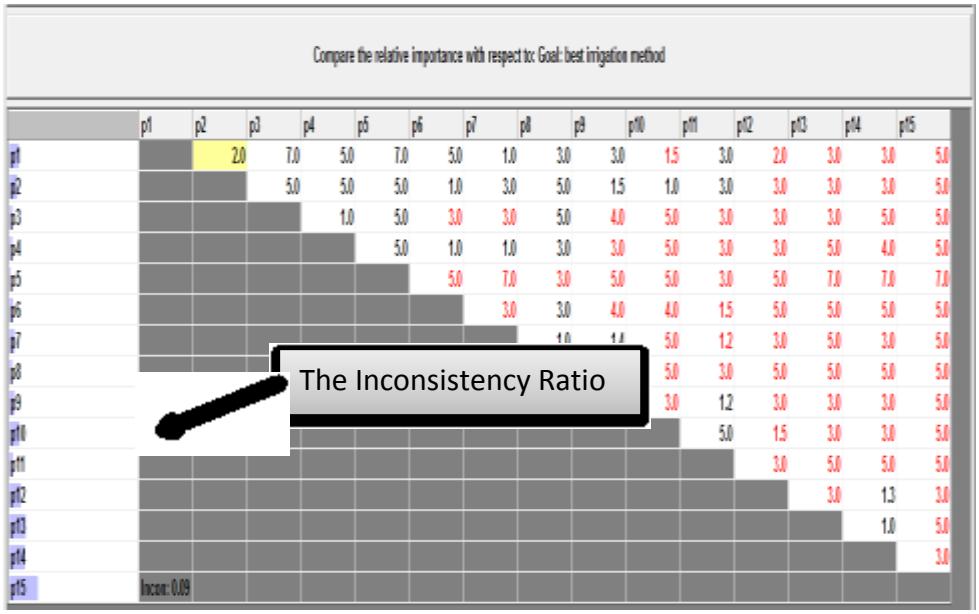

Figure (5): The Priority of The Criterion

The Incon. is **0.15** (above 0.10); the reconsideration process either by the engineers or by Expert choice which can suggest a value of cells that need reconsider. After reconsidering the priorities by the expert choice, the incon. is (0.09).
When Synthesize the [P] results the priority of each criteria as shown in figure (6).

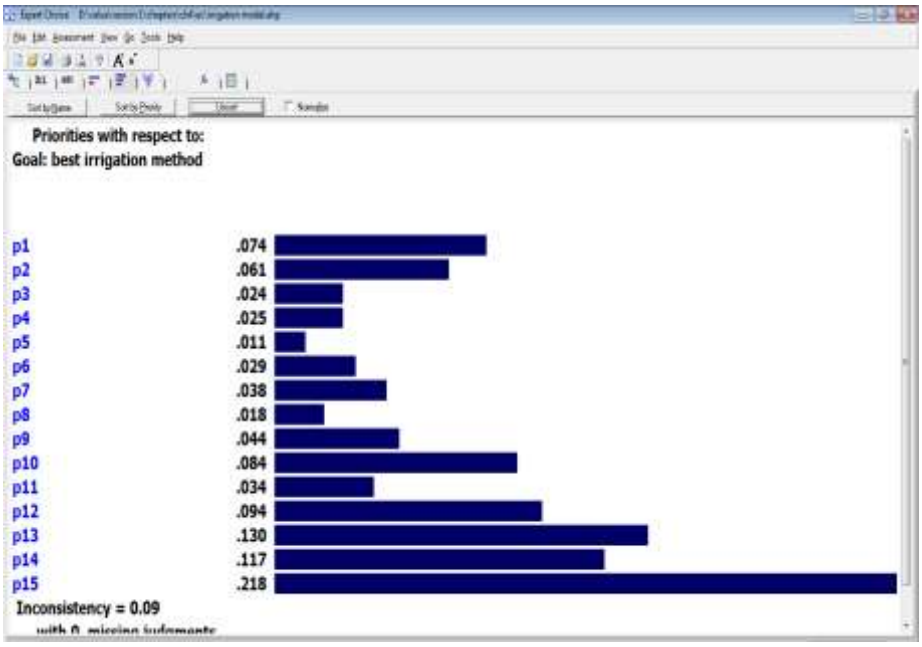

Figure (6): The Result of Synthesize [P]

Also the data of Pairwise comparison matrixes for alternatives based on each criterion in figure (4) to synthesize the result of weight of each alternative based on each criteria, all these result are summrized in table (4) and figure (7) to show the area of importance of each alternative for all criterions.

Table (4) :The Value of Importance of Alternative for Each Criteria

criteria	A1	A2	A3
P1	0.265	0.672	0.063
P2	0.178	0.751	0.07
P3	0.178	0.751	0.07
P4	0.088	0.669	0.243
P5	0.751	0.07	0.178
P6	0.079	0.659	0.263
P7	0.731	0.081	0.188
P8	0.669	0.088	0.243
P9	0.747	0.134	0.119
P10	0.669	0.243	0.088
P11	0.268	0.614	0.47
P12	0.637	0.105	0.258
P13	0.088	0.773	0.139
P14	0.111	0.778	0.111
P15	0.094	0.627	0.28

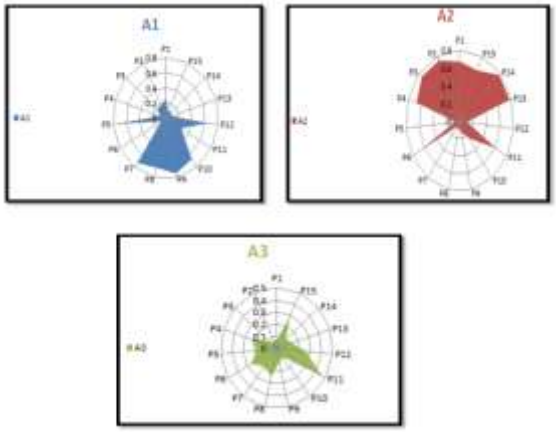

Figure (7): The Area of Importance of Each Alternative for All Criteria

Synthesis to find the overall results

This is the final step, the expert choice use to find the overall arrangement of the alternative and select the best one, as shown in figure (8).

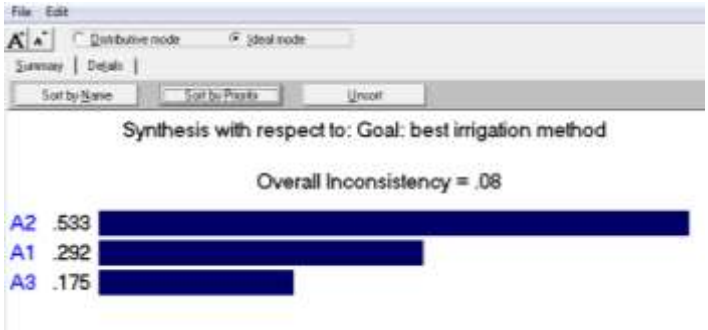

Figure (8) :The Overall Result of Best Irrigation Method Sorted Accorded to Priority

Use Value Index

After finishing the first step, the performance (P%) has been determined and can be applied in value index by divided to percentage cost (p.c%) that calculated in creativity phase to calculate the value for each alternative and select the alternative which has the maximum value as showing in table (5).

Table (5) :Value Index for Alternatives of IMTP Improvement

Alt. Name	P%	p.c%	V=——
Surface irrigation (A1)	0.292	0.322	0.906
Irrigation by pumping (A2)	0.533	0.295	1.806
Groundwater irrigation (A3)	0.175	0.383	0.456

Post Study (Value Analysis Report)

The result of VA study is as following:

1. There are three alternatives to improve Irrigation of Middle Tiger Project; the second alternative (irrigation by pumping) is the best one.
2. The second alternative (irrigation by pumping) is the best based on its value
3. The third alternative (Groundwater irrigation) has very law value; which should be excluded by the project manager .

Conclusions and Recommendations

From the results, the second alternative (irrigation by pumping) is the best based on its value. The AHP process is a very useful tool and gives precise results specially if used by software but in this process the data of the problem should be corrected precisely because the decision will be affected by any data about the problem and finally the study become not trusted.

As a further future work the following recommendation are important:

1. AHP method is become very precise if structured into criteria and sub criteria.
2. Apply VA in process problem.
3. Many studies can conduct in VA method such as: application of VA method by using AHP and application of VA method in assembly process.
4. Studying the different steps of value analysis method on any problem and see if different steps give different results?
5. It necessary to apply value analysis method in different organizations in Iraq as important tool in decision making process.

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