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COMPUTERIZED MULTIPLE CRITERIA DECISION MAKING MODEL FOR PROJECTS PLANNING & IMPLEMENTATION

BY

ALIREDA A. AL-JAROUDI

A Thesis Presented to the

FACULTY OF THE COLLEGE OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

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This thesis, written by ALIREDA AHMED AL-JAROUDI under the direction of his Thesis Advisor and approved by his Thesis Committee, has been presented to and accepted by the Dean of College of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING & MANAGEMENT.**

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I dedicate this thesis to my father, my mother, and especially to my wife and my children: Wela'a, Atheer, Ala'a and Ahmed. Their continuous support, patience and encouragement have helped me to accomplish this research successfully.

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NAME OF STUDENT : ALIREDA A. AL-JAROUDI

TITLE OF STUDY : Computerized Multiple Criteria Decision Making Model For Projects Planning and Implementation

MAJOR FIELD : Construction Engineering & Management

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Projects are initiated and implemented to promote investment and maintain the competitiveness of the company. In order for projects to be successful, the company management must come up with the best decisions during the planning and implementation phases of these projects. Quite often these decisions are inadequate, lack consistency and fail to consider all the relevant criteria. In this research, a computerized multi-criteria decision-making model based on the Analytic Hierarchy Process (AHP) has been developed to assist in decision making for projects. This process incorporates the quantitative and qualitative aspects of the decision-making problem and provides a measure for determining the consistency of the decision-maker. Additionally, a survey has been conducted to gather information about the criteria that influence the decisions for ranking and evaluating telecommunications projects alternatives. Selected professional who play a major role in decision making were asked to participate in this survey. To demonstrate the usefulness and application of the model, it has been applied on a telecommunications project for a major industrial company using the criteria that resulted from the questionnaires.

MASTER OF SCIENCE DEGREE

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DECEMBER 1998

خلاصة الرسالة

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عنوان الرسالة : نموذج مبرمج بواسطة الحاسب الآلي للمساعدة
في إتخاذ القرارات المتعددة المعايير لتخطيط
وتنفيذ المشاريع

التخصص : هندسة وإدارة التشييد

تاريخ الشهادة : ديسمبر ١٩٩٨

ترسى المشاريع وتنفذ لزيادة الاستثمارات وللبقاء على روح المنافسة لمواكبة متطلبات الحاضر والمستقبل. لضمان نجاح هذه المشاريع يجب على إدارة الشركة والمستثمرين في الشركة اخذ قرارات نهائيه لإختيار أفضل الخيارات المطروحة لتخطيط وتنفيذ هذه المشاريع . هذه القرارات غالباً ما تكون غير مبنية على أساس موضوعي ولا تأخذ في الإعتبار كل العوامل المؤثرة في إتخاذ القرار. وهنا تبدو الحاجة إلى البحث عن إسلوب منهجي وعلمي يأخذ في عين الإعتبار كل العوامل المؤثرة للمساعدة في أخذ هذه القرارات. في هذه الرسالة تم تطوير نموذج مبني على أساس نظرية التحليل الهرمي بواسطة الحاسب الآلي للمساعدة في إتخاذ هذه القرارات. هذا النموذج يأخذ في الاعتبار التحليل الكمي والنوعي للعوامل المؤثرة في القرار. كما تم عمل استبيان لاستكشاف المعايير المؤثرة في إتخاذ القرار وتم توزيعه على مجموعة مختارة من المهندسين ذوي الخبرة والذي يكون إتخاذ القرار جزء من عملهم. وتم تطبيق هذا النموذج مستخدما المعايير التي نتجت عن الإستبيان على أحد مشاريع الاتصالات لإحدى الشركات الصناعية الكبرى لعرض كيفية استخدامه وفوائده .

درجة الماجستير في العلوم

جامعة الملك فهد للبترول والمعادن

الظهران , المملكة العربية السعودية

بسم الله الرحمن الرحيم

CHAPTER ONE

DECISION MAKING PROCESS

1.1 INTRODUCTION

Projects are implemented to achieve certain goals. These goals may include increasing the company's profit or enhancing its competitiveness in order to survive the future. In order for projects to be successful, the company must come up with the best project alternative to achieve the business objectives.

At the time of the preliminary engineering study, the decision making team is faced with a dilemma in which more than one objective needs to be satisfied in its decision making process. The need to satisfy these objectives simultaneously is a major factor in determining their order of preference for the available project alternatives.

Although the project goals are defined, it is not clear as to how such goals can be measured or achieved. They are usually stated in an abstract, elusive and unclear manner, (8).

Problems that might be encountered during the decision making process may include: complexity of the decision, inconsistency of the decision maker, political favors and hidden agenda by the decision maker, overlooking the objective of the project, conflict between individuals, variation of perception from one individual to another, just to name a few. To avoid these problems and improve the decision-making process, a structured and comprehensive computerized Multi-Criteria Decision-Making Model based on the Analytic Hierarchy Process (AHP) that assists in selecting the best project alternative is presented in this research. The

model will help to focus the decision-maker's attention on the main objective of the project. It has been applied to a case study to demonstrate its usefulness.

The research will consider only telecommunications projects. Factors that are considered in the decision-making model are the factors that influence the decision making with regard to the system selection and the project. These factors are obtained from literature review, survey and previous telecommunications projects documentation.

The next section discusses the problem statement. Previous studies are discussed in chapter two, the AHP methodology is presented in chapter three, factors that influence the decision are discussed in chapter four, and analysis and results are presented in chapter five. Chapter six discusses the computerized model. The program structure is presented through an application example to rank telecommunications projects in chapter seven. Finally, summary and concluding remarks are discussed in chapter eight.

1.2 PROBLEM STATEMENT

During the preliminary engineering phase of a project, its impact on the company should be kept in proper perspective. Usually, there is an array of possible alternative solutions to any project design problem. Deciding on which alternative is difficult.

Quite often, owners do not consider alternatives to their investment projects for comparison. When owners do consider alternatives to their projects, they may compare cost only, or conduct the type of cost benefit analysis, which has been traditionally employed, (4). However, projects involve environmental, political, and other intangible factors, which are usually ignored in the cost-benefit analysis

because they cannot be measured in monetary units. Such decisions dealing with cost-benefits only are inadequate decisions.

During the decision making process, conflict may exist among the decision-makers because of their different concerns and goals which may not match the stated organizational objectives, (4,1). Variations in the perception of the (various) individuals involved is another problem. What is new technology to one individual might not be so new to another, (3).

Other problems might be encountered if the decision making team does not consider the specific requirements of the organizations that will be affected by the project. For example, if the decision-makers overlook the operational aspects of a chosen system or the requirements of the end users then the decision will be wrong and have an adverse impact on the company.

Therefore, to avoid these problems and improve the decision-making process, it is recommended that a structured and comprehensive computerized decision-making approach be developed to ensure that the best project is selected for the alternatives available during the preliminary engineering phase. Additionally, this model can assist in all decision situations for the project.

By following this approach, the team can quantify the subjective measurements, proceed logically and come up with the most feasible solution.

1.3 RESEARCH OBJECTIVE, SCOPE & LIMITATION

The objective of this research is to develop a computerized Decision Support Model based on a Multi-Criteria Decision making approach to assist in all decision making situations that involve selection of alternatives. This model will be applied to a case study to demonstrate its feasibility. The research will consider only telecommunications projects that are implemented by Saudi Aramco. Factors that will be considered in the decision model will be the factors that influence the decision making with regard to the system selection and project implementation. These factors are obtained from literature review, survey and documentation associated with previous telecommunications projects.

1.4 RESEARCH METHODOLOGY

1.4.1 Determine the evaluation criteria for selecting project alternatives. These will be obtained from the literature review, and documentation of previous projects.

1.4.2 Conduct a survey by distributing questionnaires to gather information pertaining to the evaluation criteria and their relative importance in the decision making process.

1.4.3 Present the selected method and discuss its mathematics and applications.

1.4.4 Develop a computerized model based on the selected method.

1.4.5 Apply the computerized model on a real project to demonstrate its usefulness and application.

CHAPTER TWO

PREVIOUS STUDIES

Previous studies were found in the literature that talked about methods of selecting project alternatives. Such methods have been used in Value Engineering. AL-Sughaiyer conducted a study, (1987), where he talked about the application of Value Engineering on public construction projects in Saudi Arabia, (28). In the Value Engineering study, alternatives are compared by using weighted evaluation to help in selecting the best alternative from the many alternatives available. It enables many factors other than cost to be considered in the evaluation of alternatives. Parker in his book, Value Engineering Theory, (1985), presented this method, (7). The method consists of two processes, the Paired Comparison Criteria Weighting Process and the Evaluation Matrix.

Under the Paired Comparison Criteria Weighting Process, criteria that influence the decision making for selecting an alternative are listed. Then the importance of each of these criteria to the decision-maker is determined. Each criterion is assigned a letter of the alphabet. When selecting between two criteria, the degree of importance of one criterion over another can be:

- *Major* *(3 points),*
- *Medium* *(2 points),*
- *Minor* *(1 point),*
- *No preference* *(0 point).*

For example if criterion (A) is considered to be less importance than criterion (D), then criterion (A) receives a score of 2. Therefore, the comparison between (A) and

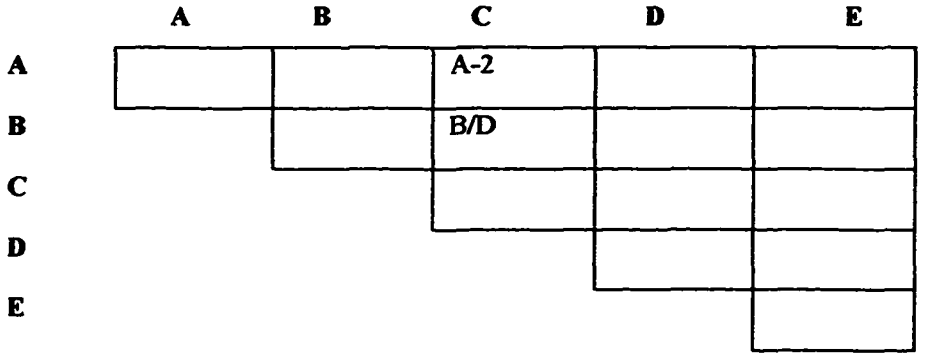
(D) in the criteria-scoring matrix is recorded with the notation A-2. If it is not possible to decide/differentiate between two criteria, each will receive as an example (s) one point, criterion (D) and criterion (B), the notation will be recorded in the matrix as D/B.

The raw score of all criteria is then adjusted to a scale of 1-10 with, 10 assigned to the criteria with the highest raw score and other scores adjusted accordingly.

Once the criteria elements and their weights have been established, they are entered in what is called an Evaluation Matrix as shown in figure 2. First each criterion is ranked against each alternative. A scoring scale of 1-5 is used as follows:

Excellent	=	*5*
Very Good	=	*4*
Good	=	*3*
Fair	=	*2*
Poor	=	*1*

Then the rank of each alternative with the weight of criterion is multiplied and the result is entered in the Matrix. After that, the total score is summed up for each alternative and ranked for selection. The Alternative with the highest total score is the one to be selected.



Criteria	Raw Score	Assigned Score
Criteria A		
Criteria B		
Criteria C		
Criteria D		
Criteria E		
Criteria F		

***Figure 2.1** the Paired Comparison*

Alternative : The Evaluated Alternative

Criteria	*Weight*	*Excellent*	*V.Good*	*Good*	*Fair*
Criteria A					
Criteria B					
Criteria C					
Criteria D					
Criteria E					
Criteria F					

Figure 2.2 Evaluation Matrix

The author of this thesis, Maqbool Ahmed and Ghadri, (10), conducted a value engineering study for the Riyadh-Pump Station No.3 Fiber Optic System Project for Saudi Aramco, where they used the weighted evaluation as discussed by Parker in his book. The purpose of their study was to select the best alternative for the fiber optic project. In that study using the weighted criteria method, few criteria were considered. The decision criteria for selecting alternatives for the fiber optic system included Initial Cost, Operation & Maintenance Cost, Technological Life, System Compatibility, Field Proven, Saudi Aramco Ownership & Control and Replacement.

This method can handle only a few / a limited number of decision criteria and it is sometimes difficult to use. Additionally, it has a limitation on its scale; using only a 5-point scale in making judgment.

Other studies used the Fuzzy Multi-criteria concept for Comparing Projects using the fuzzy set theory. Zadeh, (19), initiated the fuzzy set theory in 1965. With this theory, values are assigned a membership from 0 to 1 in the set, where 1 indicates means membership in the set and 0.5 means that it is equally likely to be in the set or out of the set. For example, the value for the system capacity could be defined as 0.8 low, 0.4 medium and 0.1 high. The Fuzzy set theory lays out the means relating the fuzzy sets and manipulating fuzzy relations, (19). D.E. Mitali DE and Hipel (1987) developed and applied a Fuzzy Multicriteria Model for Comparing Energy Projects, (4). In their study, they presented a fuzzy set approach to multi-criteria modeling for selecting alternative solutions to a large-scale engineering project. The specific problem investigated in their study using a fuzzy multi-criteria model based upon socio-economic factors. Four evaluation criteria were considered for the purpose of ranking the possible site based on initial assessment of community attitudes obtained from a non-scientific sampling of fifteen key informants. The criteria identified by the study were: labor supply in the impact area, relative economic need in the impact area, supply of key public services, and benefits versus

cost. Weights for each criterion were assigned according to the relative importance of the criteria by the decision-makers. However, the authors recommended the use of Analytic Hierarchy Process (AHP) proposed by Saaty for assigning weights to the criteria.

Generally, the practical application of fuzzy set theory can be difficult because of coding the relationships and the quantification of membership sets and fuzzy relationship becomes a much more intricate and ad hoc process (27). The more fuzzy logic you have the more difficult it is to implement. Additionally, it requires that the decision-makers express their choices in precise quantitative terms that most decision-makers are not ready for.

Others used the multi attribute utility function as a decision making tool. Romero (1996), developed a Multi-criteria Decision-Making Model that dealt with environmental economics. His methodology was underpinned by Compromise Programming together with optimization of the utility function. In his study, two cases were presented. These were the reconciliation between economic, environmental and recreational objectives inherent to the management of an environmental asset such as a forestry system and its application to the appraisal of environmental improvements or damage when non-monetary objectives are involved. This study used the utility theory, which is based on derived equations that represent the utility of a given property. Utility assessment begins by assigning the worst outcome a utility of 0 and the best outcome a utility of 1. Any other outcomes will have a utility value between 0 and 1. These utility values are then assessed using the indifference approach. This technique requires the decision-maker to assess an outcome that will make him indifferent between this outcome and a 50-50 gamble of two other outcome that have a utility value.

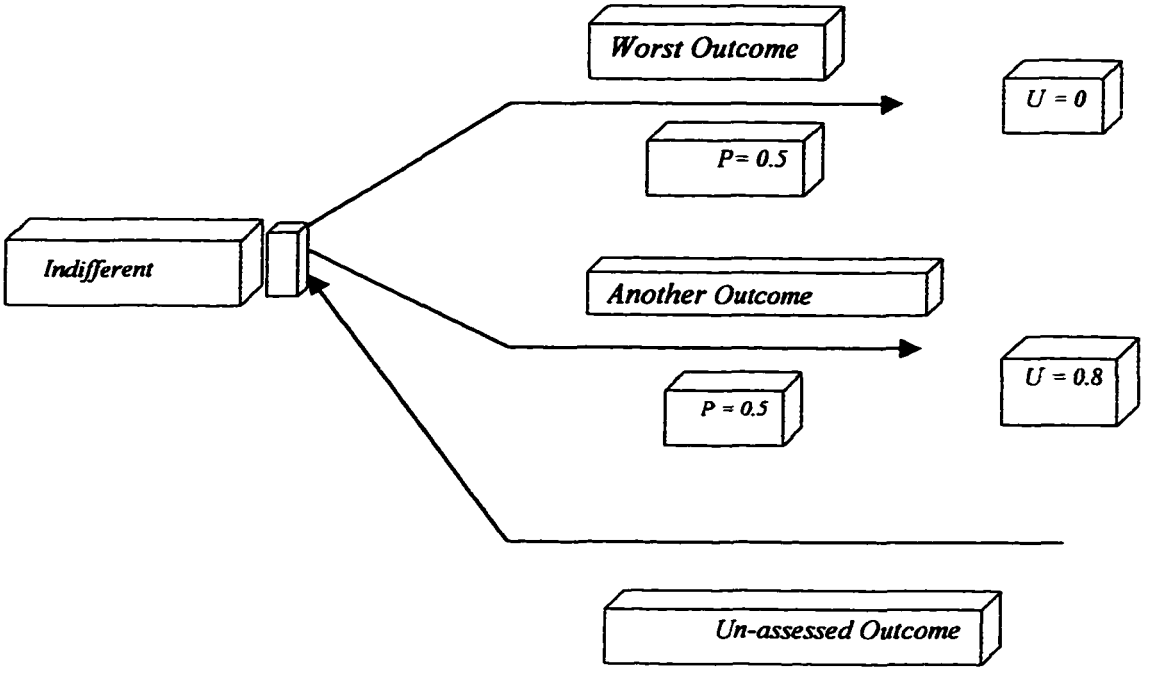


Figure 2.3 - Utility Function

From the diagram the un-assessed outcome becomes as follows:

U(un-assessed outcome) = (0.5) (Utility of the worst outcome) + (0.5) (utility of other outcome) = 0.5(0) +(0.5)(0.8) = 0.4

If you are truly indifferent between the utility of the un-assessed outcome and the assessed outcome, then the utility of the un-assessed outcome must be equal to the expected utility of a 50-50 gamble of the two assessed outcome.

The major problem with the utility function is that it is difficult to assign and determine the weight of each attribute. Sometimes decision-making is based on subjective criteria, which can not be quantified in the utility function.

Chanddrasekaran and Ramesh, (5), in their article entitled, Microcomputer Based Multiple Criteria Decision Support System for Strategic Planning, developed a Multiple Criteria Decision Making Model (MCDM) for marketing two products by eight firms competing in two geographical areas. Four criteria were considered in their model. These were marketing, production, finance and material planning. The decision situation was to maximize product market share, net income and share prices. The constraint in their study related to capacity of plant, financial resources, product price ceiling, minimum volume requirements level constraints. Their study dealt with a decision-making situation where the objectives had to be simultaneously maximized subject to several constraints. Such an approach which is different than the approach of this thesis, which concentrate on the Goal Programming (GP) method.

GP provides an optimal solution for dealing with a multi-criteria decision-making problem. The procedure used to formulate the GP model starts with specifying a target for each objective, thus transforming all objectives into goals. There are three major steps in formulating a linear programming problem:

1. *Identification of solution variables*
2. *Development of objective function*
3. *Determination of system constraints.*

Although GP incorporates multiple objectives and arrives at an optimal solution, its major drawback is that the decision-maker must specify goals and priorities, (28). Additionally, GP lacks a systematic approach to set priorities and trade-off among objectives. This shortcoming is more obvious when the tangible and intangible criteria need to be considered and many people are involved in the decision making process.

Grandzol and Gershhon in their study entitled Multiple Criteria Decision-Making, G & G reposed alternatives to the machines used by the Department of Defense (DOD) Navy base in Pennsylvania. Criteria were developed for evaluating the alternatives and the team based on their experience assigned weights and the alternatives were ranked. In comparing alternatives, the team used the Electra technique, which compares a pair of alternative actions and ranks them by weighted scores for criteria for which a given alternative action is better (concordance) and scaled scores for criteria for which the alternative action is worse (discordance). Alternative actions that are better in the weighted criterion and not too much worse in the other criteria rank highest. The study team decided on 0.8 level of concordance and a 0.2 level of discordance for alternative action to qualify. The formulas for concordance and discordance calculations follows:

Concordance of two alternative action i and j:

$$C(i,j) = \frac{\text{Sum of weights for criteria where } i>j}{\text{Total sum of weights}}$$

Discordance of two alternative action i and j:

$$D(i,j) = \frac{\text{Maximum interval where } i>j}{\text{Total range of scale}}$$

In this study, forming decision based on their experience the study team assigned the weights and alternatives were then ranked by the use of the above equations.

Other studies were found in the literature that applied the analytic hierarchy process (AHP) for alternative selection in areas other than construction. A study by Albyarakoglu, (26), presented an AHP model for justifying new manufacturing technologies. In his study A classified manufacturing technologies and presented the strategies aspects of the problem of justifying a new manufacturing system. In

his model, environmental, organizational, and technological factors were incorporated within the strategic framework. The output of the model was a manufacturing technology that should be implemented given these factors. Using Expert Choice (EC) software, version 8, he carried out the application of his model.

In construction, the AHP was applied in the areas of project assessment and bidding decisions. A study by Mustafa and Al-Bahar (1991), (30), in which they applied AHP in the assessment of the risk involved in constructing the Jamuna multipurpose bridge in Bangladesh.

Abdelrazig (1996), (31), presented a structured methodology to help contractors in Saudi Arabia to make their bid/no-bid decisions by using AHP. The Computer software Expert Choice based on the AHP and the bid / no-bid decision was used to develop and solve the bid/no-bid decision model.

In the area of project there are also studies which deal with alternative selection using the AHP. A study by Mitta (1993), (27), applied the AHP to rank five computer interface systems on the basis of the user's perceptions: usability and learnability. Hanratty and Joseph (1992), (19), demonstrated the use of AHP for solving the problem of a chemical laboratory reactor selection. AHP was applied to select one of many alternatives to the reactor configurations.

Reza and Yvon (1988), (21), developed an integrated approach for the selection and evaluation of projects by using AHP to set priorities and trade-off among objectives, the Delphi technique to determine the objectives and their aspiration levels, and Goal Programming (GP) to evaluate the different alternatives.

CHAPTER THREE

THE ANALYTIC HIERARCHY PROCESS (AHP)

3.1 INTRODUCTION

The decision-making approaches that have been discussed in the previous chapter have their own shortcomings that can be alleviated by the AHP. Under the utility function, it is difficult to assign and estimate the weights of each attribute. Sometimes the decision making is based on subjective criteria, which cannot be quantified in the utility function. Goal programming lacks a systematic approach to set priorities and trade-offs among objectives. Fuzzy set theory is difficult to implement. Additionally, it requires that the decision-makers express their choices in precise and quantitative form that most decision-makers are not ready for.

To overcome those shortcomings, the AHP is recommended as a viable decision making tool. It will be presented as such and used in this study. The AHP is a robust and flexible multi-criterion decision-making tool used for prioritizing alternatives associated with a system and determining trade-off among them. Hierarchical structure models the system of interest and an intermediate objective is to determine the influence that the alternatives in one level in the hierarchy exert on the next higher level, (27).

Saaty developed the Analytic Hierarchy Process (AHP) in 1977 and 1986. It aids in the decision-making analysis and it is designed to solve complex problems involving multiple criteria. It has been used in the analysis of decisions involving both tangible and intangible criteria to rank alternatives on the basis of cost, benefit and risk. It has been applied in many areas where it was used to solve highly complex and elusive decision making problems. These areas include economics and

planning, energy policies, health, conflict resolution, arms control, material handling and purchasing, manpower selection and performance measurements, marketing, consulting and other areas, (25). All these areas share one problem, which is a decision making problem, which has to do with rating decision alternatives, selection or prediction.

The decision making process in the AHP context requires the decision-maker to provide judgments about the relative importance of each criterion and then specify a preference for each decision alternative on each criterion. The output of the AHP is a prioritized ranking indicating the overall preference for each of the decision alternatives.

A decision hierarchy in the AHP context is a linear structure, which represents the decision elements and their relationships and influence.

In summary the whole decision making process involves, criteria, sub-criteria and alternatives. The sub-criteria could be at more than one level depending on the complexity of the decision problem.

3.2 THE AHP STEPS

The AHP involves four steps. These are:

1. Constructing a decision hierarchy by breaking down the decision problem into a hierarchy of inter-related elements.
2. Performing pairwise comparisons of the decision elements.
3. Estimating the weights of the decision elements by using eigenvalue method.
4. Aggregating the relative weights of the decision elements to Provide a set of ratings for the decision alternatives.

The first step involves the formulation of the decision problem in a hierarchical structure. A decision problem is broken into a hierarchy of interrelated decision elements. Figure three (3), illustrates such a hierarchy.

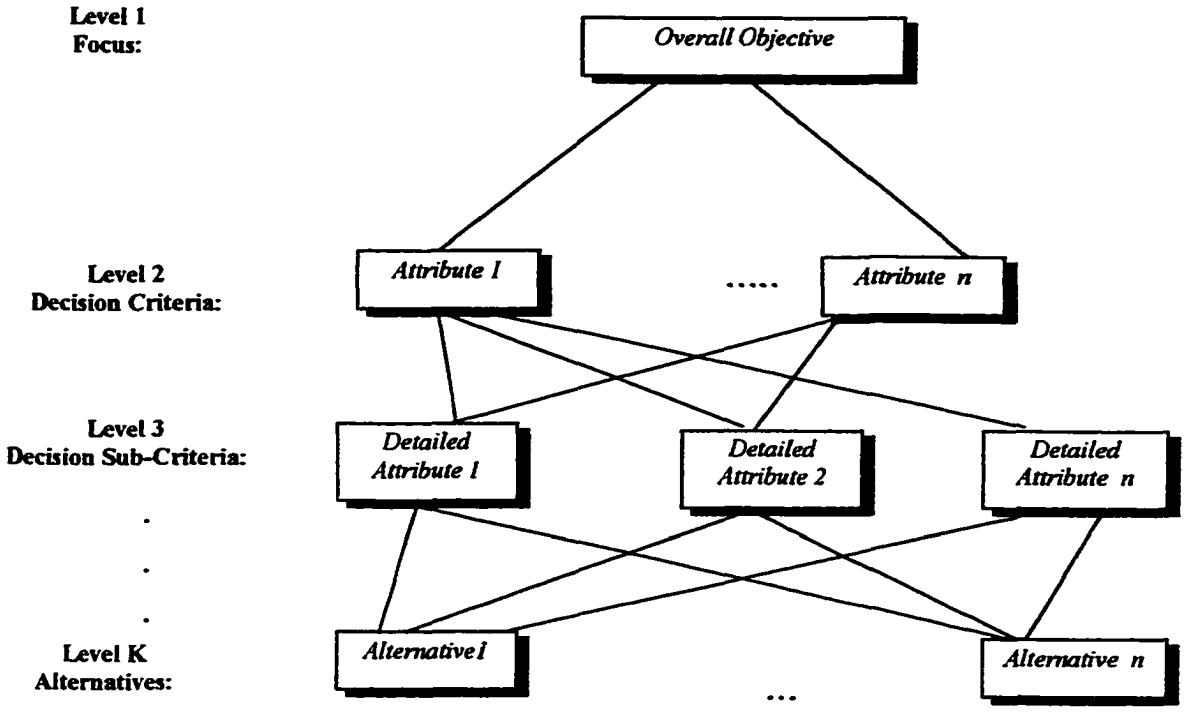


Figure 3.1: *Standard Hierarchical Structure*

At the top of the hierarchy lies the most general objective of the problem, such as the objective of making the best decision or selecting the best alternative.

The number of levels depends on the complexity of the problem and on the degree of detail. Each level of the hierarchy contains attributes or objectives that influence the decision. Details of the attributes increase at hierarchy. The last level of the hierarchy contains alternatives or selection choices.

Nodes in the hierarchy represent main criteria that may have sub-criteria or decision alternatives in the immediate lower level to be prioritized. Lines between any two levels reflect the relationship between the decision elements.

Each relationship is weighted according to the strength of influence an alternative or criterion at the same level, let us say K exerts on an alternative or criterion at level k-1, where K = 1, 2,3, ..., N-1, N. The more general, risky and uncertain the decision elements, the higher the levels are. The elements in each level are influenced or controlled by the elements in the level immediately above.

Influence is distributed downwards from the top, which is the main objective. The main objective has the greatest influence with a value of one. This value is divided among the decision elements of the second level and the values of each level down below down to the level of alternatives, the last level in the hierarchy.

The degree of influence is measured on a nine-point scale and the final solution results in the assignment of weights to the alternatives located at the lowest hierarchical level (level K). These weights prioritize the alternatives according to a ratio scale.

The 1 to 9 scales is used as follows:

1. *One (1) for equal importance of the two evaluated elements.*
2. *Three (3) for moderate importance of one element over the Other.*
3. *Five (5) for strong importance of one element over the other.*
4. *Seven (7) for very strong importance of one element over the Other.*

5. *Nine (9) for extreme importance of one element over the other.*
6. *2, 4,6,8 for compromise.*
7. *Reciprocals for the inverse comparison.*

The second step involves the pairwise comparison of the decision elements for each group headed by a main criterion (node). The comparison is done in pairs and placed in matrix **A** of the following form; this is what we refer to as the pairwise comparison. Pair wise comparisons are fundamental building blocks of the AHP.

$$A=\begin{bmatrix} 1 & a_{12} & .. & a_{1n} \\ 1/a_{12} & 1 & .. & a_{2n} \\ : & : & :: & : \\ 1/a_{1n} & 1/a_{2n} & .. & 1 \end{bmatrix}$$

Each a_{ij} entry of **A** reflects the factor by which alternative i dominates alternative j as follows:

1. $a_{ij} = 1/a_{ji}$, for $a_{ij} \neq 0$
2. $a_{ii} = 1$, for $i = j$ and $i, j = 1, 2, \ldots\ldots, n$.

Thus **A** is a reciprocal matrix. The evaluator has the option of expressing preferences as mentioned above, between the two as equally preferred, weakly preferred, strongly preferred, or absolutely preferred, which would be translated into pairwise weights of 1,3,5,7 and 9, respectively, with 2,4,6 and 8 as intermediate values.

In the 3rd step the eigen value method is used to estimate the relative weights of the decision elements.

If the judgment of the evaluator is perfect in each comparison, $a_{ik} = a_{ij}a_{jk}$ for all values of i, j, k and **A** is referred to as a consistency matrix. The principal eigenvalue of **A** is used to measure judgment consistency. The principal eigenvector of **A** is the ratio scale defining these weights and is defined as:

$$\mathbf{w} = [w_1\ w_2 \ldots w_n]^T$$

and it is the vector of actual relative weights. In order to determine **w**, the following equations must be satisfied:

$$\mathbf{A.w} = \lambda_{max}\ \mathbf{w}, \qquad (1)$$

Where **A** is the observed matrix of pairwise comparison, λ_{max} is the principal eigenvalue of **A**; **w** is its right eigenvector .

Perfect consistency is very difficult to achieve and some inconsistency is expected to exist in every pairwise comparison. To handle this, the AHP provides a method for measuring the degree of consistency among the pairwise comparisons (judgments) provided by the decision-maker. If the degree of consistency is acceptable, the decision process can continue. If it is not acceptable, the decision-maker should revise the pairwise comparison judgment. A consistency ratio of 0.10 or less is considered to indicate a reasonable level of consistency in the pairwise comparison.

In equation (1), the closer the value of λ_{max} is to n, the more consistent are the observed values of **A**. Thus the algebraic difference between λ_{max} and n is a measure of consistency. Saaty (1980) suggests the following consistency index:

$$C.I = \frac{\lambda max - n}{n - 1} \qquad (2)$$

and the following consistency ratio (CR):

$$CR = (CI / ACI)*100, \qquad (3)$$

where ACI is the average index of randomly generated weights (Saaty 1980). A CR value of 10% or less is acceptable. Otherwise, it is recommended that **A** be re-observed to resolve inconsistency in pairwise comparison.

In the last step of the AHP, the relative weights of various levels are aggregated. The results produce a vector of composite weights, which will serve as a ranking of the decision alternatives. The composite relative weight vector of elements at kth level with respect to that of the first level may be computed by:

$$C[1,K] = \prod_{I=2}^{k} B_{I.} \qquad (4)$$

Where C [1,k] is the vector of composite weights of element at level k with respect to the element on level 1, and $B_{I.}$ is the n_{I-1} by n_I matrix with rows consisting of estimating **W** vectors. n_I represents the number of elements at level i.

3.3 MATHEMATICAL EXPLANATION OF THE METHOD

Assume that we have **n** alternatives or factors that influence certain decision, let F_1, F_2, ... F_n be the set of factors. The quantified judgement on pairs of factors F_i, F_j are represented by an **n** - by - **n** matrix. Let's call it **A** matrix.

$$\mathbf{A} = (a_{ij}),\ (i, j = 1, 2, .., n)$$

The entries a_{ij} are defined by the following:

1. If $a_{ij} = x$ then $a_{ji} = 1/x,\ x \neq 0$
2. If F_i is judged to be of equal relative importance as F_j then

   $a_{ij} = 1,\ a_{ji} = 1$, in particular, $a_{ii} = 1$ for all i.

Thus **A** is a reciprocal Matrix. The matrix **A** has the following form:

$$A = \begin{bmatrix} 1 & a_{12} & .. & a_{1n} \\ 1/a_{12} & 1 & .. & a_{2n} \\ .. & .. & .. & .. \\ 1/a_{1n} & 1/a_{2n} & .. & 1 \end{bmatrix}$$

After recording the quantified judgements on pairs (F_i, F_j) as numerical entries a_{ij} in Matrix **A**, now it is time to assign weights W_1, W_2, ... , W_n to reflect the recorded judgements.

These weights should reflect quantified judgements of the group. We would then like to know how the weights (W_i) relate to the judgements a_{ij}. This can be explained in the following three steps:

STEP 1: Assume the judgements are precise measurements:

Let us say for $F_1 = 8, F_2 = 4$ $F_1 / F_2 = 2$. The judgement would be F_1 is twice F_2. In other words, F_1 is twice as important as F_2. Then a_{12} is recorded as 2. Thus in the ideal case, the relation between W_i and the judgements a_{ij} is given by:

$$w_i / w_j = a_{ij} \ (for \ i,j = 1, 2, \ldots, n) \quad (1) \qquad \text{and}$$

$$A = \begin{bmatrix} w_1/w_1 & w_1/w_2 & .. & w_1/w_n \\ w_2/w_1 & w_2/w_2 & .. & w_2/w_n \\ \vdots & \vdots & \vdots & \vdots \\ w_n/w_1 & w_n/w_2 & .. & w_n/w_n \end{bmatrix}$$

STEP 2: In order to make allowances for the judgements, consider the following:

The entries of the i^{th} row in a Matrix **an** are:

$$a_{i1}, a_{i2}, \ldots, a_{ij}, \ldots .., a_{in}$$

In the ideal case, these values are the same as the ratios:

$$\frac{W_i}{W_1}, \quad \frac{W_i}{W_2}, \ldots \frac{Wi}{W_j} \ldots ., \frac{W_i}{W_n}$$

In the ideal case, if we multiply the first entry by w_i and the second entry by w_2, and so on, we would obtain:

$$(w_i / w_1).w_1 = w_i, \quad (w_i / w_2).w_2 = w_i,$$

$$\ldots ., (w_i/w_n).w_n = w_i$$

The result is a row of identical entries: $w_i, w_i, \ldots . w_i$

While in the general case, the row entries would represent values scattering around w_i. In that case we should equal the average of these values.

The more realistic relations for the general case would be:

$$\frac{a_{i1}.w_1 + a_{i2}.w_2 + \ldots, a_{in}.w_n}{n} = wi \quad \text{or}$$

$$wi = 1/n \sum_{j=1}^{n} a_{ij}\, w_j \; (i = 1, 2, \ldots, n) \qquad \textbf{(2)}$$

This equation represents a substantial relaxation of the more stringent relation of equation (1), but we need to know whether this relaxation is sufficient to ensure a solution.

STEP 3: To answer the question, it is imperative to express equation **(2)** in another form:

As a_{ij} changes, it turns out that there would be a corresponding solution of (2) (i.e., w_i and w_j can change to accommodate this change in a_{ij} from the ideal case). If **n** were also to change. We would denote this value **n** by λ_{max}.

Thus the problem becomes:

$$w_i = \frac{1}{\lambda_{max}} \sum_{j=1}^{n} a_{ij}\, w_j \; i = 1, 2, \ldots, n$$

This equation has a solution that turns out to be unique. Deviation in the a_{ij} can lead to a large deviation both in λ_{max} and wi. We start the problem with the model of the AHP, $Aw = \lambda_{max} w$. Consider **A** as a reciprocal matrix, where λ_{max} is the largest eigenvalue of **A**. Then solve for w in the left-hand side of the equation.

3.4 CONSISTENCY

If we have a comparison of a_{ij}, then the $a_{ji} = 1/a_{ij}$, then the matrix A is called the reciprocal matrix. If our judgement is perfect in all comparisons, then $a_{ik} = a_{ij} \cdot a_{jk}$ for all i, j, k, and we call the Matrix A consistent.

When it is consistent, the weight is known and this can be shown as follows:

$$a_{ij} = W_i / W_j \qquad i, j = 1, 2, \ldots, n \qquad (1)$$ and then

$$aij.ajk = (w_i/w_j).(w_j/w_k) = w_i/w_k = a_{ik}$$

also

$$a_{ij} = w_j / w_i = 1 / (w_i / w_j) = 1 / a_{ij}$$

and we have the matrix equation as follows:

$$\mathbf{A} \cdot \mathbf{X} = \mathbf{Y}$$

Where $X = (X_1, X_2, \ldots, X_n)$ and $Y = (Y_1, Y_2, \ldots, Y_n)$

$$\sum_{j=1}^{n} a_{ij} X_i = Y_i \qquad i = 1, 2, \ldots, n$$

from equation **(1)** we obtain:

$$a_{ij} \cdot w_j / w_i = 1 \qquad i, j = 1, 2, \ldots, n$$

and then:

$$a_{ji} \cdot (w_i / w_j) = 1 \qquad i, j = 1, 2, \ldots, n$$

$$\sum_{j=1}^{n} a_{ij} w_j / w_i = n$$

or

$$\sum_{j=1}^{n} a_{ij} w_j = n w_i \qquad i = 1, 2, \ldots, n$$

which is equivalent to : $\mathbf{AW} = \mathbf{nW}$ **(2)**

In the matrix theory, this formula expresses the fact that W_i is an eigenvector of **A** with the eigenvalue n.

$$\mathbf{A} = \begin{array}{c} \\ A_1 \\ A_2 \\ \cdot \\ A_n \end{array} \begin{bmatrix} \mathbf{A1} & \mathbf{A2} & \ldots & \mathbf{A} \\ w_1 / w_1 & w_1 / w_2 & \ldots & w_1 / w_n \\ w_2 / w_1 & w_2 / w_2 & \ldots & w_n / w_n \\ \ldots & \ldots & \ldots & \ldots \\ w_n / w_1 & w_n / w_2 & \ldots & w_n \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \cdot\cdot \\ w_n \end{bmatrix} \quad \mathbf{n} \begin{bmatrix} w_1 \\ w_2 \\ \ldots \\ w_n \end{bmatrix}$$

Any matrix with only one column or one row is called a column vector or a row vector respectively.

In an other case, when the a_{ij} is not based on exact measurements, (which is immediately the practical way and a subjective judgement) it will deviate from the "ideal" ratios w_i / w_j and therefore equation **(2)** will no longer hold.

In the matrix theory, if $\lambda_1, \lambda_2, \ldots, \lambda_n$ are the numbers satisfying the following equation:

$$\mathbf{AX} = \lambda \mathbf{X}$$

Where **A** is the **n** matrix and X is a column vector, i. e. they are the eigen value (or characteristic values) of **A**, and if $a_{ii} = 1$ for all i, then

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

If equation (2) holds, then all eigen values are zero, except for **n**, (which means inconsistent case) , where **n** is the largest eigen value of **A**.

If the entries a_{ij} of a positive reciprocal Matrix **A** change by small amounts, then the eigen values change by small amounts.

Combining these two results we find that if the diagonal of a Matrix **A** consists of the value 1 ($a_{ii} = 1$) and if **A** is consistent, then small variations of the a_{ij} keep the largest eigen value, λ_{max} close to **n** and the remaining eigen values close to zero.

Therefore, our problem is this: if **A** is the matrix of pairwise comparison values, in order to find the priority vector, we must find the vector **W** which satisfies the following:

$$\mathbf{A}w = \lambda_{max}\,\mathbf{W}$$

Since it is desirable to have a normalized solution, we alter **W** slightly by setting:

$$\phi = \sum_{i=1}^{n} wi$$

and replacing w by $(1/\phi)$ w. This ensures uniqueness and results in (the equation):

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

Since small changes in a_{ij} imply a small change in λ_{max}, the deviation of the latter from **n** is a measure of consistency.

Thus:
$$\frac{\lambda max - \mathbf{n}}{\mathbf{n} - 1}$$

We take it as our own consistency index, as our indicator of " the closeness to consistency". In general if this number is < 0.1, we may be satisfied with our judgement.

3.5 PRIORITIZATION

The AHP sometimes is difficult to deal with when certain members of a decision making team have political favors and/or a hidden agenda. In such as state, group interaction and cooperation would be difficult. However, the AHP is a powerful tool for those who want to assess their own and their opponents' strategies.

In a cooperative undertaking, the process moves faster when the participants have the following in common:

(1) Shared goals
(2) Intimate long term contact
(3) Social acceptance of each other in the workplace
(4) Equal status when participating

3.6 DECOMPOSITION AND AGGREGATION OR CLUSTERING

It is to break things down into large groupings or cluster and then break each of these into smaller clusters and so on.

A useful way to deal with a larger number of elements which fall in a level of a hierarchy is to group them into clusters according to their relative importance. Thus, one would have one cluster of the most important (most similar or closest) elements, another of those of moderate importance, and another of those of low importance.

Saaty proved from theory that the elements to be compared should not exceed seven. Let us assume that we have a set of **n** elements. Comparing them in pairs we would then have $(n^2 - n)/2$ judgements. Suppose now as an example (cited in Saaty) that we have 98 elements. Then we have to have

$\frac{98^2 - 98}{2} = 4{,}753$ judgements or comparisons.

On the other hand, if we divide them into seven (7) clusters of 14 elements each, then do comparisons of seven clusters we need

$$\frac{7^2 - 7}{2} = 21 \qquad \text{comparisons}$$

Each cluster can now be divided into two (2) clusters each with seven elements two clusters falling under each of the 14 elements may be compared. Clusters require one comparison, but there are seven of them Hence, we require 7 comparisons on this level and then 14 x 21 = 294 comparisons on the lowest level.

The total number of comparisons in the hierarchical decomposition is 21 + 7 + 294 = 322 comparisons as compared to 4,753 comparisons without clustering.

Clustering has two advantages:

1. Great efficiency in making pairwise comparisons.
2. Greater consistency under the assumption of a limited capacity of mind to compare more than 7 ± 2 elements simultaneously.

3.7 AHP CALCULATION STEPS

Suppose we have an objective, we begin by writing an **n x n** matrix (pairwise comparison matrix) A. The entry in row $_i$ and column $_j$ of A, called a_{ij}, indicates how much more important objective $_i$ is than objective $_j$. Importance is to be measured on an integer - valued 1-9 scale.

Satty pointed out in his book that the upper limit of 9 in the scale is reasonable due to several reasons, one of which is:

That the psychological limit of 7 ± 2 items in a simultaneous comparison suggests that if we take 7 ± 2 items and if they are all slightly different from each other, we would take 9 points to distinguish these differences. (G. A. Miller, 1956)

To approximate $\mathbf{W_{max}}$, we use the following steps:

Step 1: For each of A's columns, do the following. Divide each entry in column i of **A** by the sum of the entries in column i. This yields a new matrix, normalized matrix $\mathbf{A_{norm}}$ in which the sum of the entries in each column is 1.

Step 2: To find an approximation to $\mathbf{W_{max}}$ to be used as our estimate of **W**, we proceed by estimating the average of the entries in row i of $\mathbf{A_{norm}}$. This yields the weights of each objective.

Checking for Consistency

1. Compute $\mathbf{AW^T}$. Where **A** is a pairwise comparison matrix, $\mathbf{W^T}$ is the transpose weight matrix obtained in Step 2 above.

2. Compute:

$$\frac{1}{n} \sum_{i=1}^{i=n} \frac{i^{th} \text{ entry in } \mathbf{A}w^T}{i\text{th entry in } w^T}$$

to get λ_{max}, the principal eigenvalue.

3. Compute the Consistency Index (CI)

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

4. Compare CI to the Random Index (RI) for the appropriate value **n** Shown in Table 2.

For a perfectly consistent decision-maker, i^{th} entry in $\mathbf{A}W^T = n$ (i^{th} entry of W^T). This implies that a perfectly consistent decision-maker has CI = 0.

If $\frac{CI}{RI} < 0.1$, the degree of consistency is satisfactory, but

if $\frac{CI}{RI} > 0.10$,

serious inconsistency may exist, and the AHP may not yield meaningful results.

Table 3.1: Random Index (Ri) Values

RID	RINDEX
1	0
2	0.1
3	0.58
4	0.9
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

CHAPTER FOUR

DECISION CRITERIA FOR THE SELECTION OF PROJECTS ALTERNATIVES

4.1 INTRODUCTION

The following criteria were obtained from the literature review, documentation of previously implemented telecommunications projects, a survey and informal interviews with the people who are responsible for conducting telecommunications projects. These criteria are based on a generic telecommunications system. There are other criteria that can be included, which are system specific. However, these criteria are common for every telecommunications system.

4.1.1 Cost

These costs will be broken down as follows:

- *Initial Cost*
- *Operating And Maintenance Cost*
- *Replacement Cost*
- *System Upgrading Costs*
- *Leasing Cost*
- *Decommissioning Cost*

The cost criteria include all the costs associated with system installation, replacement, operation and maintenance. Initial cost is the cost associated with engineering, acquisition, and installation, commissioning, and operation of the system.

Operation cost includes the costs associated with the system ope, power consumption and HVAC usage.

Maintenance costs are the cost involved in maintaining the system including the preventive maintenance and repair cost.

Replacement cost is the cost associated with replacement of the components of the system and supporting systems such as the electrical system and HVAC.

System upgrading cost includes the costs that are required for upgrading the system for increasing the system capacity or upgrading the hardware or software of the system to ensure that it runs more efficiently.

Leasing cost involves the cost of leasing system components or space for housing the system equipment. For example, if a company use to lease fiber optic cable from the Ministry of Post Telephone & Telegraph (MoPTT), the company would provide only the terminal equipment.

Decommissioning cost is the cost that is incurred when the system is removed from service at the end of its life.

4.1.2 Life

The sub-factors are as follows:

- *Technological Life*
- *Working Life*
- *Economical Life*

The life of the implemented system includes the working, economical and technological life. Technological life is dependent on the life expectancy of a communications system based on anticipated vendor support. Some vendors discontinue manufacturing certain products after a limited number of years due

discontinue manufacturing certain products after a limited number of years due either to bankruptcy or the introduction of a new product that meets the demands at the at time. Due to rapid advances in telecommunications industry, communications systems become obsolete due to the lack of vendor support. The newer the technology is the greater the life expectancy and vice versa, (13).

Economical life is the period of time during which the system provides benefits. It relates time and benefits, (2).

Working life is the period of time during which the system is in operation. Some times a company may shut down a communications system. As an example temporary communications system installed to support a specific operation for a limited time.

4.1.3 Ownership and Control

This criterion considers the importance of ownership of the system and control, (13). The company may decide to lease the services from other entity, such as MoPTT, SCECO or any other government agency. The problem associated with this choice is the lack of system control by the company. If an outage happens somewhere in the system at certain time, repair might not take place immediately because the leasing entity has assigned it a low priority rating. As a result of this, the company may incur a great deal of loss of revenue due to the lack of production of oil and gas.

4.1.4 Technology

Technology compares new systems with little operational history background to older systems with known established operational characteristics. It may include sub-factors such as Filed Proven technology, technology under research and development, and new technology that is still not yet used on a large scale, (13,22).

4.1.5 System Features

The system features include:

- *Mandatory Features*
- *Optional Features*

Each communications system offers a unique variety of features because of the characteristics of each system, (13). Mandatory features include the features that are essential for successful operation of the system and included in the customers' initial list of requirements. Optional features are redundant, not part of the customer requirements. The vendor usually offers these features in the proposed systems.

4.1.6 Ease of Migration

This is a measure of system flexibility which provides the ability to transfer from one frequency band to other in the case of radio equipment, or the ability to transfer to future system developments without the need of replacing the system. Stated differently, it is the responsiveness of the system to future changing needs. It includes system capacity, conformance to new standards and protocols and the upgradability of the system, (13,22).

Sub-criteria may include system modularity or system software upgrade. System modularity is the addition of the system modules or subsystem when an expansion or modification is required without the need for changing the existing system components. Software upgrade is the addition to the system software to upgrade the system to meet the future demands or changes which may be incorporated without the changing or altering the system components.

4.1.7 Protection during Failures

The ability of the system to recover from failure. It basically includes the provisioning of the critical system components on a N+1 with automatic switchover in the event of failure.

4.1.8 Compatibility

The compatibility is the ability of the system to interface with the existing system and future systems. This includes the compliance of the system with internationally known standards and protocols. If the system complies with these standards and protocols then no problems will be encountered when interfacing with other systems that comply with these standards and protocols.

4.1.9 Reliability

The reliability of the system includes the Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR). MTBF is the time it takes the system to recover from failure. MTTR is the time it takes to repair the system after failure, (14,19,22). The less the MTTR or the MTBF is the more reliable the system is.

4.1.10 Availability

It is the time it takes the system to operate continuously without breakdown or it is the percentage of time the system meets performance requirements; unavailability is the percentage of time the system does not meet the requirements. Unavailability of the system usually occurs from equipment failure, power failure and supporting facilities failure, and may be due to weather, interference or human activities, (14,19,22, 27).

4.1.11 System Security

The security of the system includes the security of the system files and the security of the transmitted voice or data. How secure the system is? . Is it vulnerable to intruders, can it be accessed by unauthorized personnel?. Does it have Password Protection? Does it have multiple security levels with data and voice encryption for the users, (21).

4.1.12 Equipment Dimension

Dimension of the system equipment includes height, width and depth. Some equipment might not fit in the provided space available at certain communications sites. As a result of this difference, modification might be required to the communication site to accommodate the equipment or to the equipment to fit in the available space.

4.1.13 Equipment Weight

It is the nominal weight of the system equipment. The lighter the weight of the equipment the more desirable it is.

4.1.14 Physical Configuration and Appearance

This criterion considers whether the equipment is designed for in-door installation such as desktop or rack-mounted or out-door installation for post installation. The in-door desktop is similar to the computer or radio base station. Equipment could be mounted in a rack, cabinet or on the floor. The outdoor post-mounted equipment is similar to equipment that is used for oil and gas flow, such as Remote Terminal Units (RTUs). Obtaining/specifying equipment of this type will eliminate the need for new building with its supper facilities to house the equipment.

The appearance of equipment is concerned basically with color of the equipment. Sometimes this is so that it matches the color of the equipment already on the site.

4.1.15 Climatic and Environmental Requirements

Ambient operating temperature and relative humidity. The ambient temperature is the temperature that the system can operate under without affecting its performance. The relative humidity is the humidity the system can operate under without affecting its performance.

4.1.16 Power Requirements

The system should operate at a specified power either -48 VDC (nominal) or 120 VAC, 60 Hz or as specified. The system should be able to switch automatically to the backup power in the event of the main power failure. Sometimes solar energy is required instead of the conventional power.

4.1.17 Heat Dissipation

A measure for the equipment heat dissipation is BTU per Hours. The less heat the equipment dissipates the lower the requirements for HVAC to cool the equipment for in-door installation.

4.1.18 Acceptance of the Project with Proposed System

It includes satisfaction or acceptance of the proposed system by:

- *Owner (Operating Organization)*
- *Project Management Team (PMT)*
- *End-User*
- *Public*
- *Government*

Quite often, the end user or the operating organization may require a different system than the proposed system, due to certain constraints that the proposed one could not meet. These constraints may include political, budget or schedule factors.

4.1.19 Permits

The permits include:

- *Equipment importation Permits*
- *Land Use permit*

The equipment must be granted an import permit by the government before the user can use it. The import permits are difficult to get sometimes due to the limitation imposed on the company by the MoPTT. Often these permits are delayed which lead to delays in the delivery and installation of the equipment, especially, wireless communications equipment.

The land use permits are required when the system is installed in areas that do not belong to Saudi Aramco. This requires leasing, buying the land from others or applying for a land use permit when the government owns the land.

If these permits cannot be granted the project cannot be implemented or if they get delayed, then the project will be delayed.

4.1.20 Waivers

Occasionally, users have unique requirements that cannot be satisfied within Saudi Aramco Standards. In such a case, the user organization applies to the Consulting Services Department for a waiver. For example, an organization might ask for a waiver of the technical standards in order to employ a non-standard bandwidth

configuration of a microwave system, (22). If these waivers are not approved, the project can not be implemented.

4.1.21 Vendor Support

This criterion includes: the vendor's experience and reputation; the vendor's capability to support its products through warranties, on site maintenance, hot-line support, user training, consulting, and documentation; and the product pricing structure, (21).

4.1.22 Time to Implement

The time required to place the system in operation. The time might be affected by delays in approvals of waivers, import permits, land use permits or the completion of the construction of the supporting facilities.

4.1.23 Equipment Safety

This criterion is associated with the safety of the equipment. The evaluator needs to find out if the equipment is intrinsically safe. When it is confirmed that the equipment is intrinsically safe, it means that the equipment is approved to operate in areas in which hazardous concentrations of flammable gasses exist continuously, intermittently, or periodically as described in the National Electric Code-Class I-Division 1-Group D.

4.1.24 Compliance

This constitutes compliance of the system to the owner's standards as well as internationally known standards.

4.1.25 Project Location

This criterion specifies the location of the project. Generally, the project location could have a considerable impact on the economic growth of the area where the site will be located. For one reason or another, the owner or the operator of such a site would not agree on a particular location due to its remoteness or it was not considered to be a strategic location.

CHAPTER FIVE

SURVEY AND DATA ANALYSIS

A survey was conducted to determine the criteria that influence the decisions for telecommunication projects. To achieve this, thirty (30) questionnaires were distributed to selected professionals who play a major role in the decision making process for telecommunication projects. The purpose of the questionnaire was to collect data to identify the decision factors and to determine their overall importance in the decision making process. Appendix A includes information pertaining to the survey and the collected data.

The participants constitute a mixture of the engineers who deal with all aspects of communications systems, such as fiber optic systems, mobile radio systems, telephone and switching, satellite and microwave systems. They represent project management, communications and computer engineering and communications and computer services.

Table 5.1 - Participants List

Organization	No. Of Quest.	No. Of Replies
Consulting Service Department / Computer & Communications Group	2	0
Computer and Communications Engineering Division	5	3
Communications and Computer Services Division	5	3
Communications Projects Division	18	17
Total	**30**	**23**

The number of questionnaire that was sent to each organization was determined by the degree of involvement of each organization in the decision-making process. Only twenty-three (23) replied. This number of respondents constitutes about 77% of the questionnaires distributed.

The questionnaire started by asking the position of the participants and the extent of his involvement in the recommendation and decision making for selecting and/or recommending telecommunications projects or technologies.

Then each participant was asked to review the list of criteria and determine if the list was complete or if there was any criterion that needed to be added or deleted from the list. Each participant is asked to determine the influence of each factor on the overall decision by assigning a number that represented the influence on a scale of 1 to 9.

The next tables show the mean influence and the variance of the decision criteria that were resulted from the survey.

Table 5.2 - Criteria and sub - criteria list with mean influence

Decision Criteria	Total	Mean Influence	Variance	Standard Deviation
1. Cost				
Initial Cost	163	7.1	2.9	1.7
Operating And Maintenance Cost	149	6.5	4.1	2.0
Alteration And Replacement Costs	121	5.3	2.8	1.7
Leasing Cost	107	4.7	4.3	2.1
Decommissioning Cost	73	3.2	4.4	2.1
System upgrade cost	119	5.2	3.4	1.8
Composite Values -- Cost		5.3	3.6	1.6
2. Project Location	122	5.3	6.3	2.5
3. Ownership and Control	158	7.0	2.4	1.5
4. Life				
Technological Life	163	7.1	1.2	1.1
Working Life	155	6.7	1.7	1.3
Economical Life	164	7.1	1.5	1.2
Composite Values--- Life		7.0	1.5	1.2
5. Technology	162	7.04	3.3	1.8
6. Ease of Migration	141	6.1	3.4	1.8
7. System Features				
Mandatory Features	173	7.5	3.8	3.8
Optional Features	92	4	3.6	2.0
Composite Values--- Features		5.8	3.7	2.9
8. Ease Of Protection During Failure	154	6.7	3.6	1.9
9. Compatibility	171	7.4	3	1.7
10. Reliability	159	6.9	1.6	1.3
11. Availability	166	7.2	2.7	1.6
12. System Security	130	5.6	3.4	1.8
13. Equipment Dimension	87	3.8	3.4	1.8

Table 5.2 - Criteria and sub - criteria list with mean influence – Continued

Decision Criteria	Total	Mean Influence	Variance	Standard Deviation
14. Equipment Weight	75	3.3	3.5	1.9
15. Physical Configuration	75	3.3	2.7	1.6
16. Climatic and Environment Req.	123	5.3	4.5	2.1
17. Power Requirements	110	4.8	3.0	1.7
18. Heat Dissipation	111	4.8	4.4	2.1
19. Acceptance				
By Owner (Operating Organization)	176	7.7	1.8	1.3
By Project Manag. Team(PMT),	153	6.7	2.0	1.4
By End-User	142	6.2	5.5	2.3
By Government	133	5.8	8.5	2.9
By Public	99	4.3	6.3	2.5
Composite Values —— Acceptance		6.1	4.8	2.1
20. Permits				
Equip. Importation Permits	131	5.7	6.2	2.5
Land Use permit	137	6.0	8.7	3.0
Composite Values — Permits		5.8	7.5	2.8
21. Vendor Support				
Warranties	147	6.4	3.6	1.9
On-Site Maintenance	137	6.0	6.1	2.5
Consulting	120	5.2	4.1	2.0
Documentation	149	6.5	4.1	2.0
Hot-Line Support	100	4.3	3.5	1.9
User Training	147	6.4	4.7	2.2
Composite Values — Vendor Support		5.8	4.4	2.1

Table 5.2 - Criteria and sub - criteria list with mean influence – Continued

Decision Criteria	Total	Mean Influence	Variance	Standard Deviation
22. Waivers	140	6.1	2.2	1.5
23. Time to implement	150	6.5	2.3	1.5
24. Intrinsic Safety	170	7.4	2.3	1.5
25. Compliance				
Owner Standards	160	7.0	2.4	1.5
International Standards	152	6.6	2.8	1.7
ITU	162	7.0	2.7	1.6
Composite Values — Compliance		6.9	2.6	1.6

Table 5.3 - Main Criteria Influence

	Decision Criteria	Mean Influence	Variance	Standard Deviation
1	Cost	5.3	3.6	1.6
2	Project location	5.3	6.3	2.5
3	Ownership and control	7.0	2.4	1.5
4	Life	7.0	1.5	1.2
5	Technology	7.0	3.3	1.8
6	Ease of Migration	6.1	3.4	1.8
7	Systems Features	5.8	3.7	2.9
8	Ease of Protection During Failure	6.7	3.6	1.9
9	Compatibility	7.4	3	1.7
10	Reliability	6.9	1.6	1.3
11	Availability	7.2	2.7	1.6
12	System Security	5.6	3.4	1.8
13	Equipment Dimension	3.8	3.4	1.8
14	Equipment Weight	3.3	3.5	1.9
15	Physical Configuration	3.3	2.7	1.6
16	Climatic and Environment Requirement	5.3	4.5	2.1
17	Power Requirement	4.8	3.0	1.7
18	Heat Dissipation	4.8	4.4	2.1
19	Acceptance	6.1	4.8	2.1
20	Permit	5.8	7.5	2.8
21	Vendor Support	5.8	4.4	2.1
22	Waivers	6.1	2.2	1.5
23	Time to Implement	6.5	2.3	1.5
24	Intrinsic Safety	7.4	2.3	1.5
25	Compliance	6.9	2.6	1.6

The next table presents the ranking of the criteria mean influence along with variance and standard deviation from highest to lowest. From the analysis, we find that the range of the mean is between 3 and 7. We find that none of the criteria is at the values of 8, 9,1 or 2.

Table 5.4 - Main Criteria Influence Ranked from Highest to Lowest.

Decision Criteria	Mean Influence	Variance	Standard Deviation
9. Compatibility	*7.4*	*3*	*1.7*
24. Intrinsic Safety	*7.4*	*2.3*	*1.5*
11. Availability	*7.2*	*2.7*	*1.6*
10. Reliability	*6.9*	*1.6*	*1.3*
5. Technology	*7.0*	*3.3*	*1.8*
4. Life	*7.0*	*1.5*	*1.2*
3. Ownership and Control	*6.9*	*2.4*	*1.5*
25. Compliance	*6.9*	*2.6*	*1.6*
8. Ease Of Protection During Failure	*6.7*	*3.6*	*1.9*
7. System Features	*6.5*	*3.7*	*2.9*
23. Time to implement	*6.5*	*2.3*	*1.5*
6. Ease of Migration	*6.1*	*3.4*	*1.8*
22. Waivers	*6.1*	*2.2*	*1.5*
19. Acceptance	***6.1***	***4.8***	***2.1***
21. Vendor Support	*5.8*	*4.4*	*2.1*
20. Permits	***5.8***	***7.5***	***2.8***
12. System Security	*5.6*	*3.4*	*1.8*
1. Cost	*5.3*	*3.6*	*1.6*
16. Climatic and Environment Requirements	*5.3*	*4.5*	*2.1*
2. Project Location	*5.3*	*6.3*	*2.5*
18. Heat Dissipation	*4.8*	*4.4*	*2.1*
17. Power Requirements	*4.8*	*3.0*	*1.7*
13. Equipment Dimension	*3.8*	*3.4*	*1.8*
15. Physical Configuration	*3.3*	*2.7*	*1.6*
14. Equipment Weight	*3.3*	*3.5*	*1.9*

Although, some of the participants evaluated some of the criteria at 8, 9 or 1, the majority evaluated the criteria at a range of 3 to 7. This resulted in the overall result in the neighborhood of seven (7) at one extreme and three (3) at the other extreme. This shows a tendency of most of the participants to use a five-point scale disregarding the upper or lower limits. This may have to do with the participants' perception and habit of using a 5-point scale all the time; with outstanding being 5 and 1 being poor. This may represent the fact that scales for any evaluation do not exceed five points.

Additionally, the analysis shows that cost did not receive a high rating. This reflects the fact that, in Saudi ARAMCO, cost is not as important as other factors when implementing telecommunications projects because communications projects constitute a small portion of any oil and gas project. The emphasis of the company appears to be on the major carrying-cost items related to the oil and gas facility which may include vessels, booster pumps, gas compressors, anti-blast buildings and so forth. For example the author of this thesis has been assigned a telecommunications project that is part of a Gas & Oil Separation (GOSP) Project, where the estimated cost of the communications portion was only about 4% of the total cost of the plant.

Therefore, the management effort to save money will be concentrated on the major items that incur most of the cost. The communications system is essential to running the daily oil and gas production in this kind of environment. Communications can not be compromised, as far as the rapid advances and evolution of the electronics are concerned. On the other hand, advances in oil and gas related equipment is slow when compared to development in communications systems.

Also, it can be noted that the first six factors that were evaluated to be very strongly Important with rating ranging from 7 to 7.4, carry with them hidden costs.

The first factor is compatibility. If the system is not compatible then the company will have to replace the existing system in order for both systems to interface without any problem. Replacing the existing system will incur additional costs for buying the new system and for decommissioning the old system. Additionally, the life of the old system will be cut short, where it will not provide the benefits it was intended to provide.

The second factor, intrinsic safety, with a rating of 7.4, is as important as the compatibility. Safety is always first in our daily life. Safety cannot be compromised, especially when dealing with end user communications equipment in a plant area. This equipment should be safe to operate in areas with a high concentration of flammable gasses, where a small spark from a battery of equipment might cause major damage to the plant, thereby incurring large repair or replacement costs.

Availability and reliability come next in order with a 7.2 and 7.0 rating respectively. Availability is essential to insure the continuity of service. If it is jeopardized by the poor performance of the system, it will force the oil & gas production to lie idle, because every thing depends on communications. If the system is not reliable, it will affect availability and efficiency, thereby adversely affecting daily business. All of these effects will result in big loss of revenue, so this is a cost impact in the long run.

System life and technology come next in line with a rating of 7.0. If the company buys a system with a technology that is emerging or under research and development, then this technology will bring with it schedule risks and the possibility that it may not work as expected. This may result in additional cost due

to delays if the system does not work or arrives on the market after the expected date.

The next set of factors was evaluated with a rating ranging from, 6.1 to 6.9. The first two factors were ownership, control, and compliance. The first factor is related to cost. If the communications system is owned by some other entity whether it is a government or private agency, the system will not be on the priority list when it comes to maintenance or restoration of the system after failure. If the system is not maintained or restored in a timely manner, that will cause delays in oil production. This in turn incur a big loss of revenue. On other hand, if the company owns and controls the system, it will receive the required attention immediately.

The other factors in this range include ease of migration, system features, time, migration, waivers and acceptance. The acceptance factor includes sub-factors, one of which is the acceptance by government. If the government does not accept the project, the company can not implement the project.

Vendors support, permits, cost, climatic and environment requirements and project location with ratings ranging from 5.3 to 5.8 are next. If permits cannot be granted then the company cannot implement the project. If the vendor support is discontinued, the system needs to be replaced, which will result in additional cost for buying new system.

Heat dissipation and power requirements factors got 4.8 points, between strongly and weakly important. The last three factors are the lowest in the ranking and they can be dropped from the analysis.

The list of criteria can be broken into three groups. Project related factors, system related factors and vendor / manufacturer related factors.

After the data analysis had been done, another review of the factors was conducted with some of the participants and it was agreed that vendor criteria should be modified as shown below:

Vendor Reputation

1. Availability of technical literature
2. Responsiveness to customers
3. Consultation

Vendor Support During Implementation

1. Availability of technical expertise
2. Quality of engineering work
3. On site support for installation and commissioning

Vendor Support After Commissioning

1. Warranty
2. On site maintenance
3. Documentation
4. Hot line support
5. User training

The next tables show the final grouping of criteria for each group. The final grouping of the sub-criteria are shown in the decision hierarchy in figure 7.1.

Table 5.5 – Project Related Criteria

Project Related Factors
Cost
Time to Implement
Ownership and Control
Project Location
Acceptance
Permits

Table 5.6 – Vendor Related Criteria

Vendor Related Factors
Vendor Reputation
Vendor Support During Implementation
Vendor Support After Commissioning

Table 5.7 – System Related Criteria

System-Related Factors
Operability
Mechanical Characteristics
Compliance
Life &Technology

CHAPTER SIX

COMPUTERIZED DECISION MAKING MODEL

6.1 INTRODUCTION

The computerized decision making model was created in visual basic. The program consists of six modules. These are:

1. Start Module
2. Initial Data Module
3. Criteria Pairwise Comparison Module
4. Initial Alternatives Data Module
5. Alternative Pairwise Comparison Module
6. Synthesis Module

All the input data and output data are saved automatically in a Microsoft Access file called Alirezam.mdb. The output data is plotted immediately after performing the pairwise comparison and obtaining the weights for the criteria. The consistency check is done every time the pairwise comparison is performed. The data must be entered in the initial data module and in the alternative initial data module and not in the Access files.

The program has the capability to retrieve the files from database via the pop-up menu. The print command prints the image of the sheet only. The following is a flow chart showing the basic steps of the program.

6.2 Program Limitations

The program is limited to decision problems that have :

- Hierarchies of five (5) levels or less.
- Criteria groups with ten (10) sub-criteria or less.

There is no restriction on the number of alternatives, but it is recommended that the number of alternatives should not exceed more than ten (10) alternatives.

1.3 Flow Chart of the Program (Step by Step Calculation)

The next figures show the step by step instructions. The program has mainly 12 steps. Once the program is loaded it initializes the output data files and then proceeds with the calculations after the user has input the data. The next section explains this process in full detail.

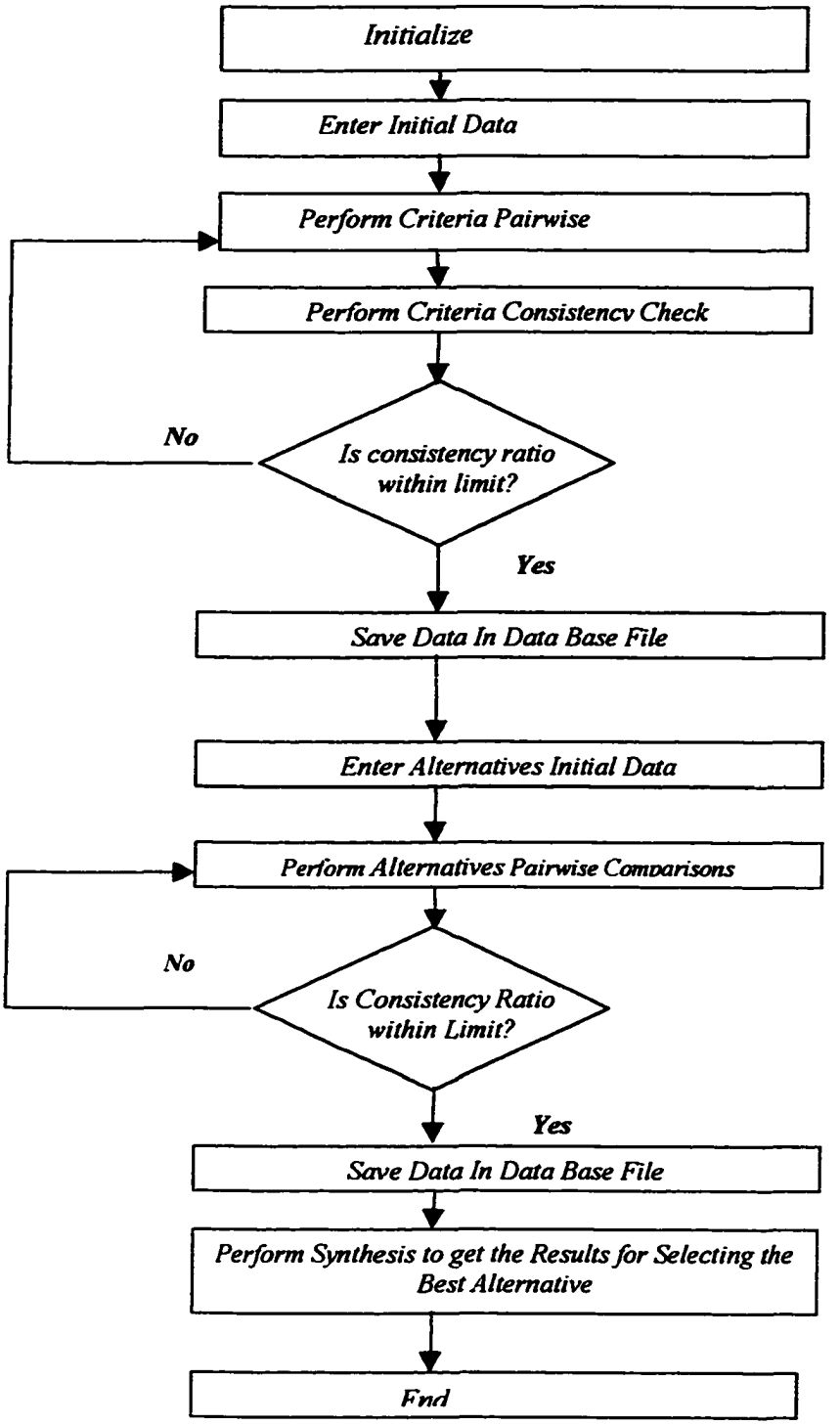
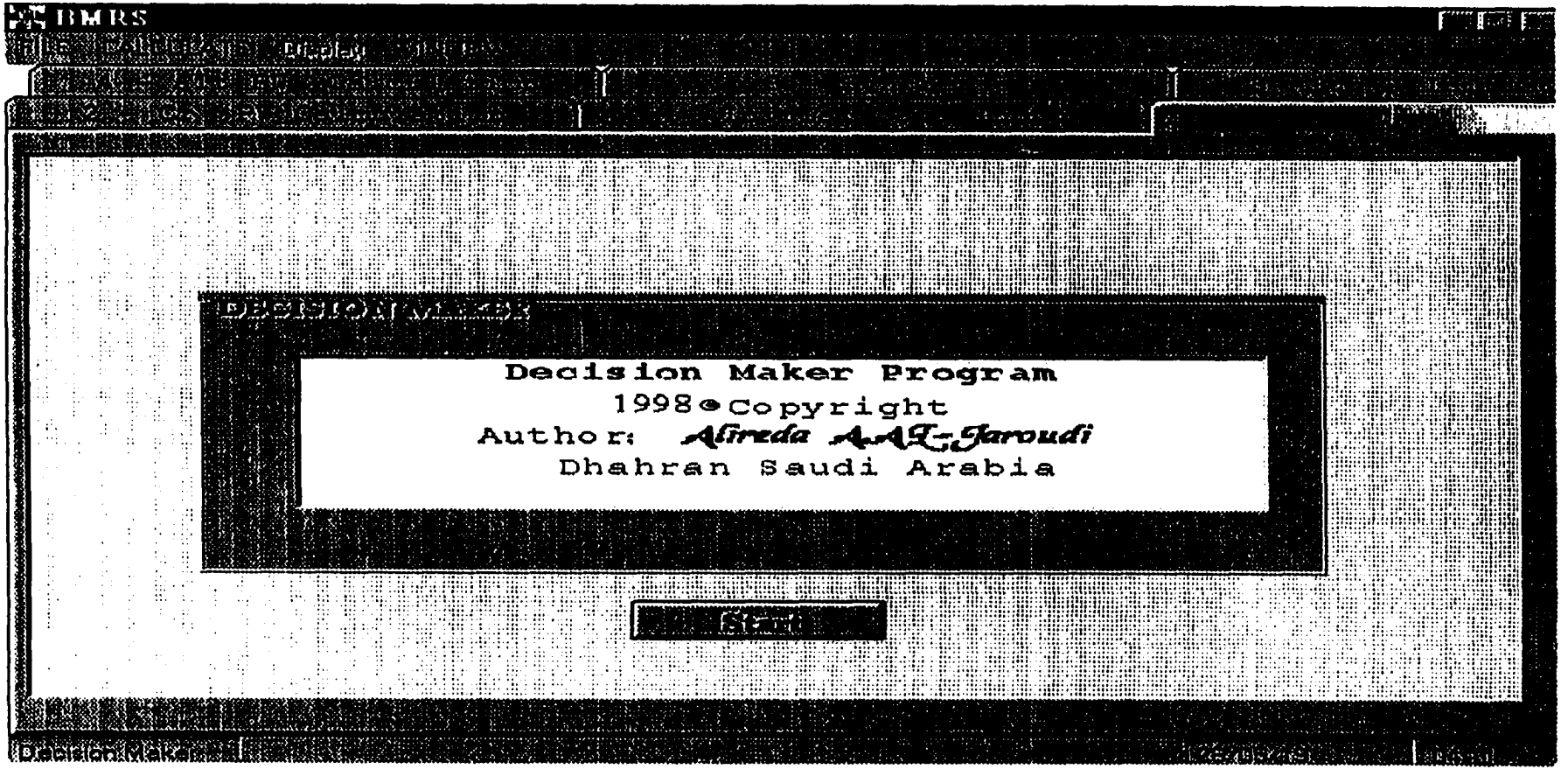


***Figure 6.1** – The Program Steps*

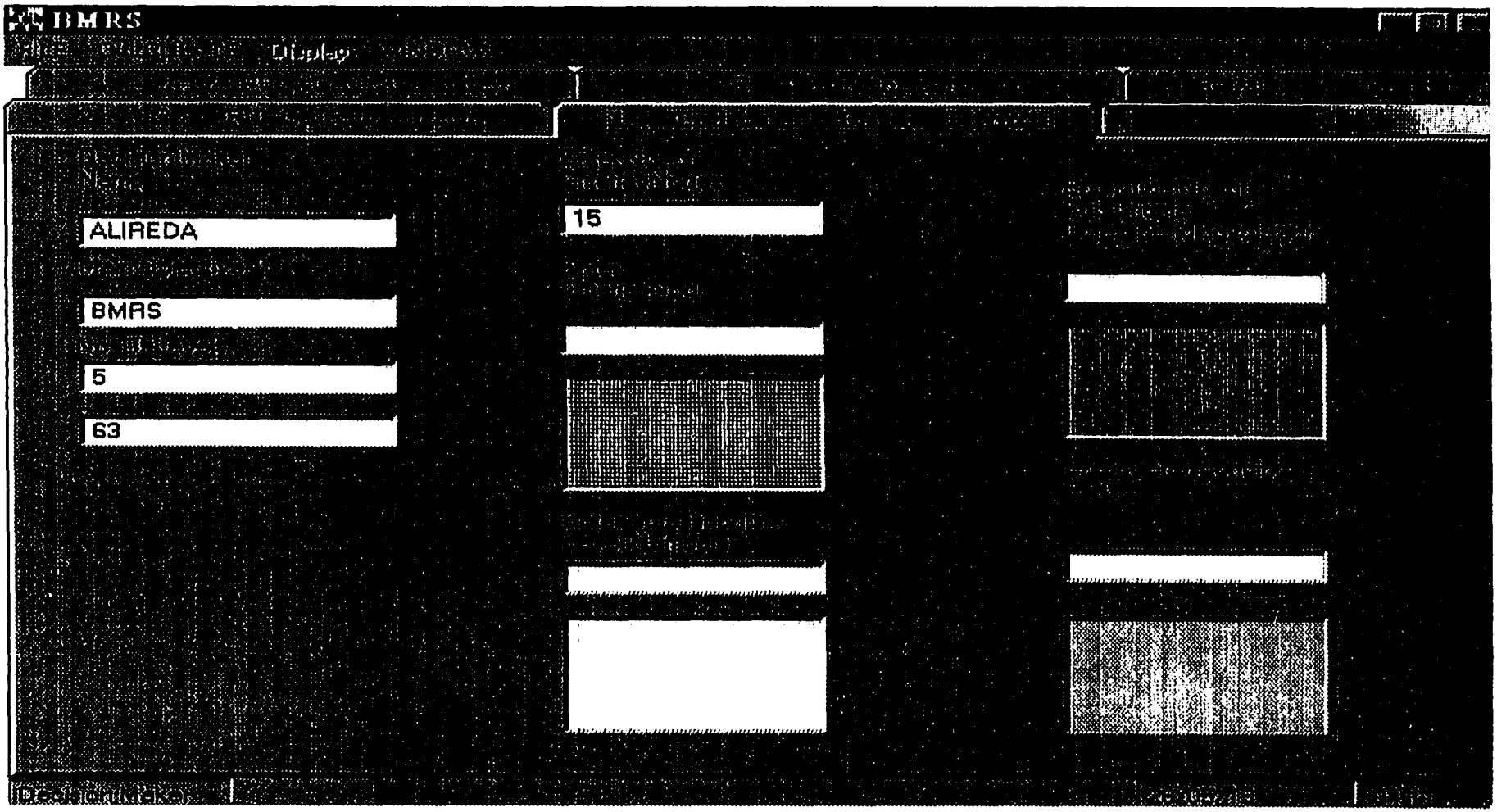
6.4 PROGRAM STEP BY STEP CALCULATIONS

The first module as shown below shows information about the program and shows the start button which should be clicked first to start the program.

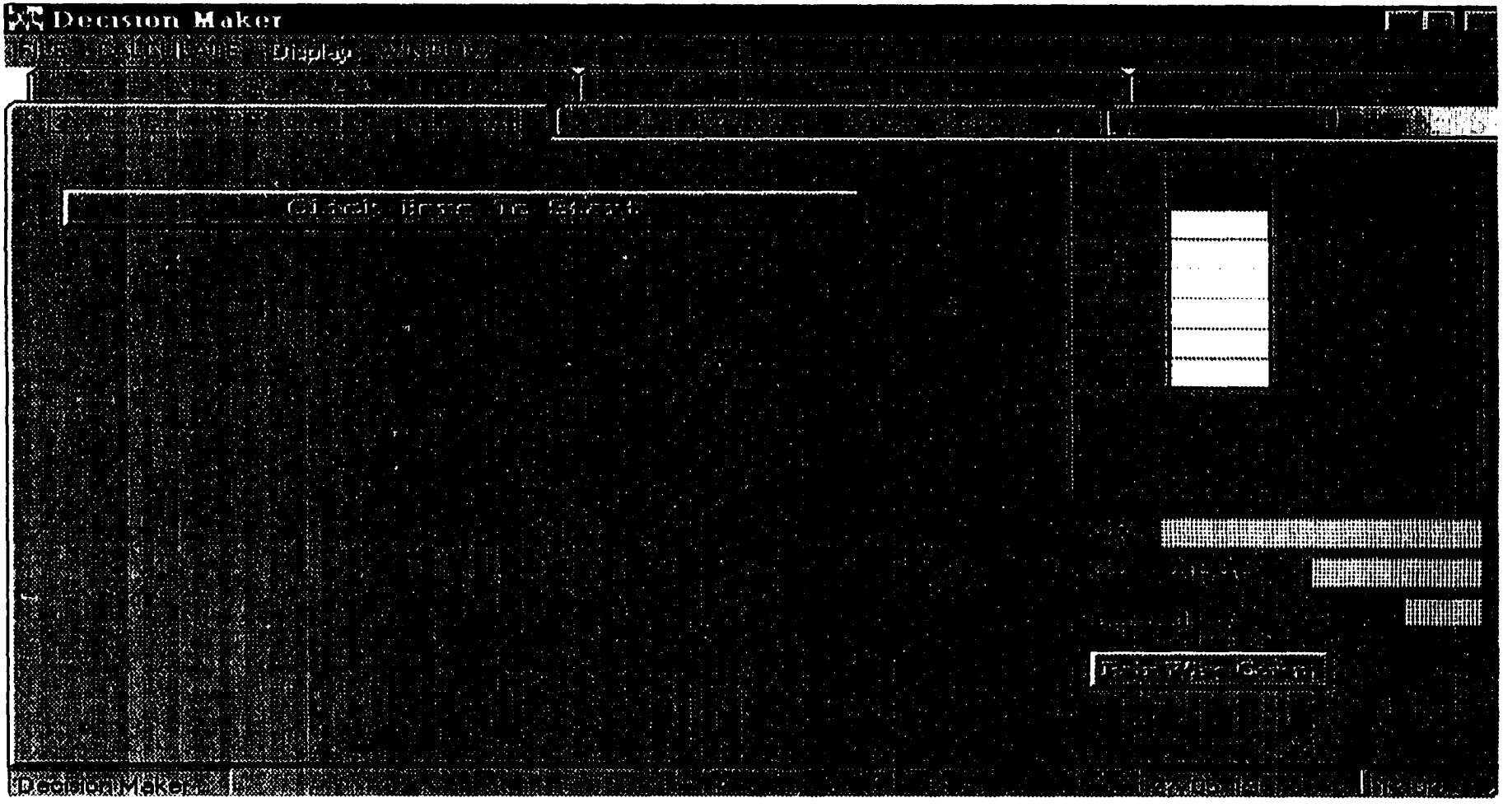


The second module "Initial Data Input" includes eight input boxes. The input text data should not exceed more than six (6) characters. These are:

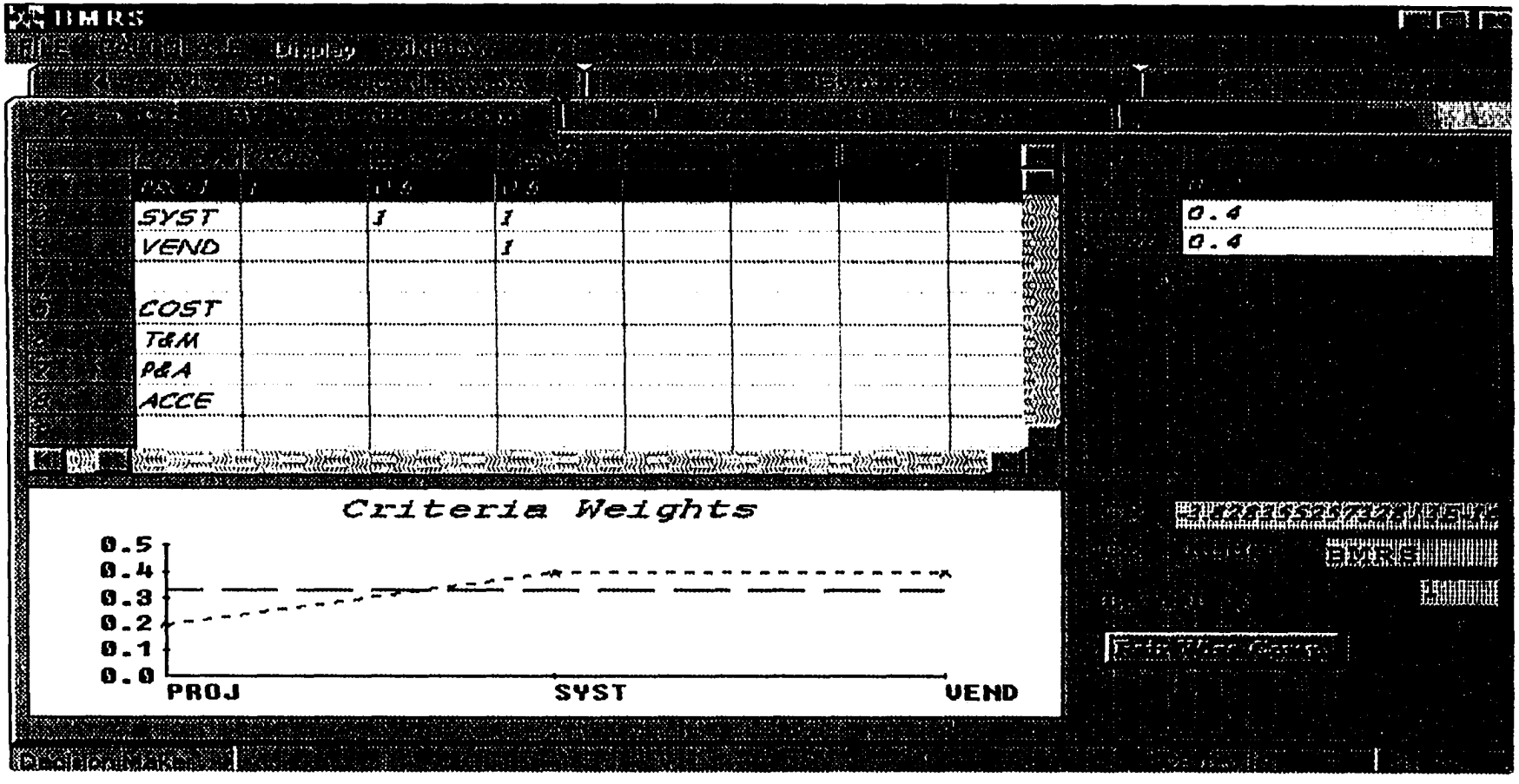
- *Decision maker name*
- *Main objective*
- *Number of levels*
- *Number of criteria nodes*
- *Name of the criteria nodes*
- *Corresponding level number for each criteria node*
- *Number of sub-criteria for each criteria node*
- *Names of the sub-criteria for each criteria node*



The third module is the criteria pairwise comparison. This module is enabled by clicking first the "click to start button" as shown below.

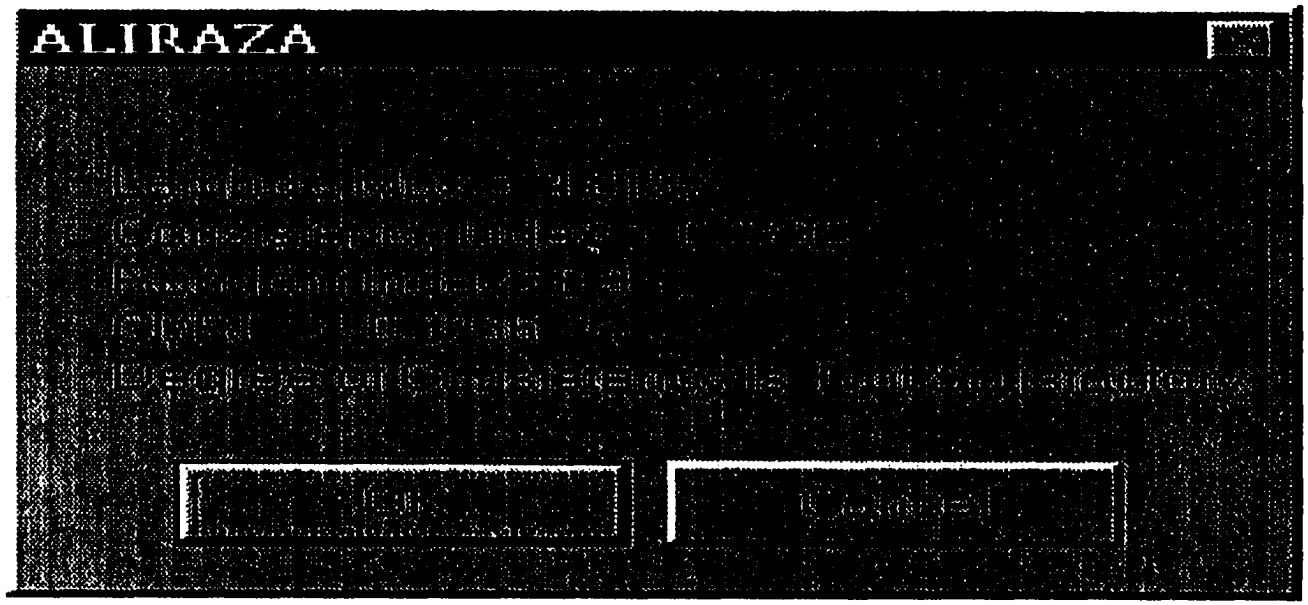


Once the button is pressed the data is entered automatically in the spread sheet. The pairwise data entered in the memory by double clicking on the first cell that corresponds

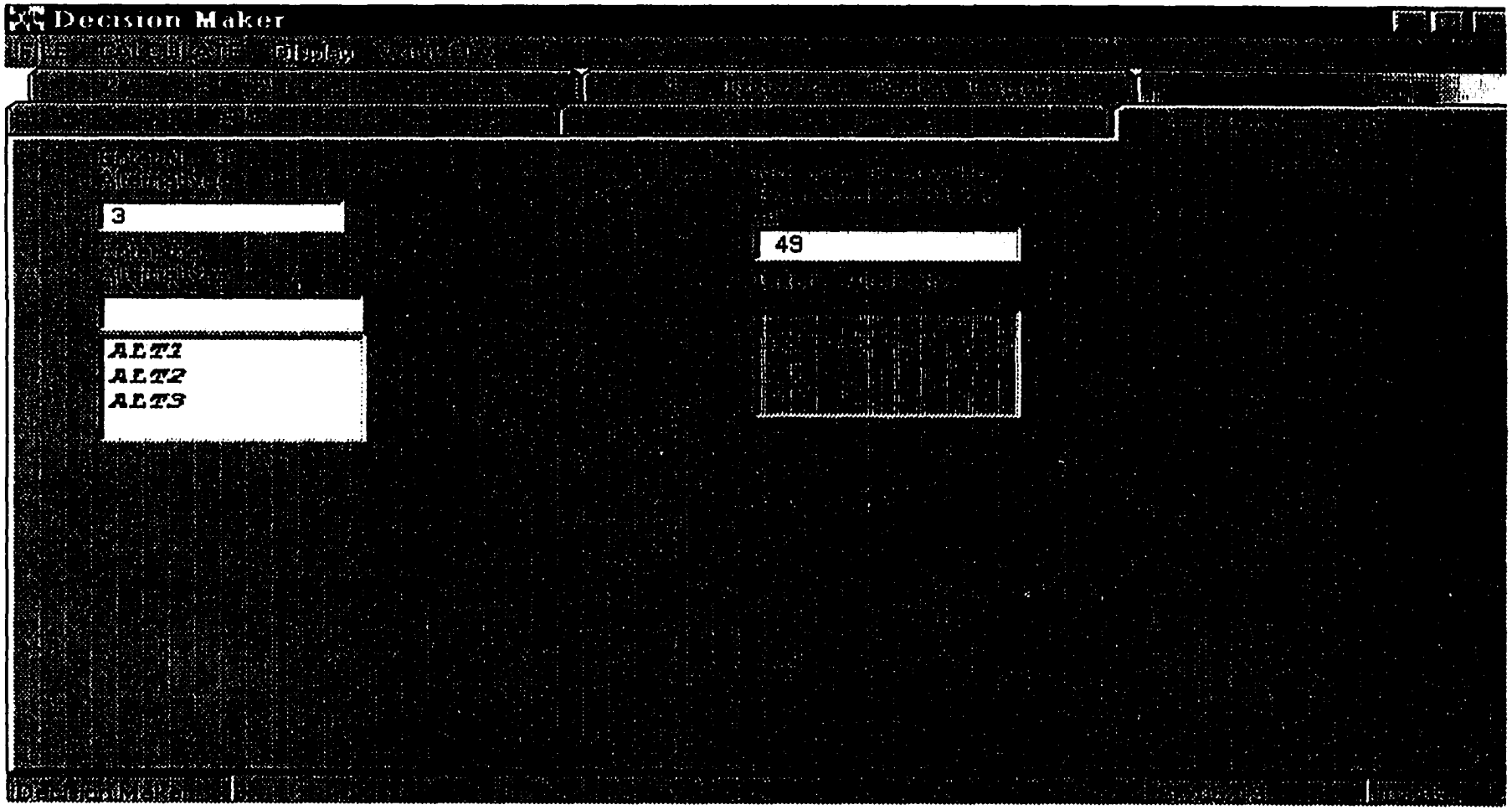


to each criteria group on the first column . Another click is necessary to make the data ready for calculation. If the wrong cell is clicked then an error message will appear. After having done that the pairwise comparison button is pressed to perform the calculation.

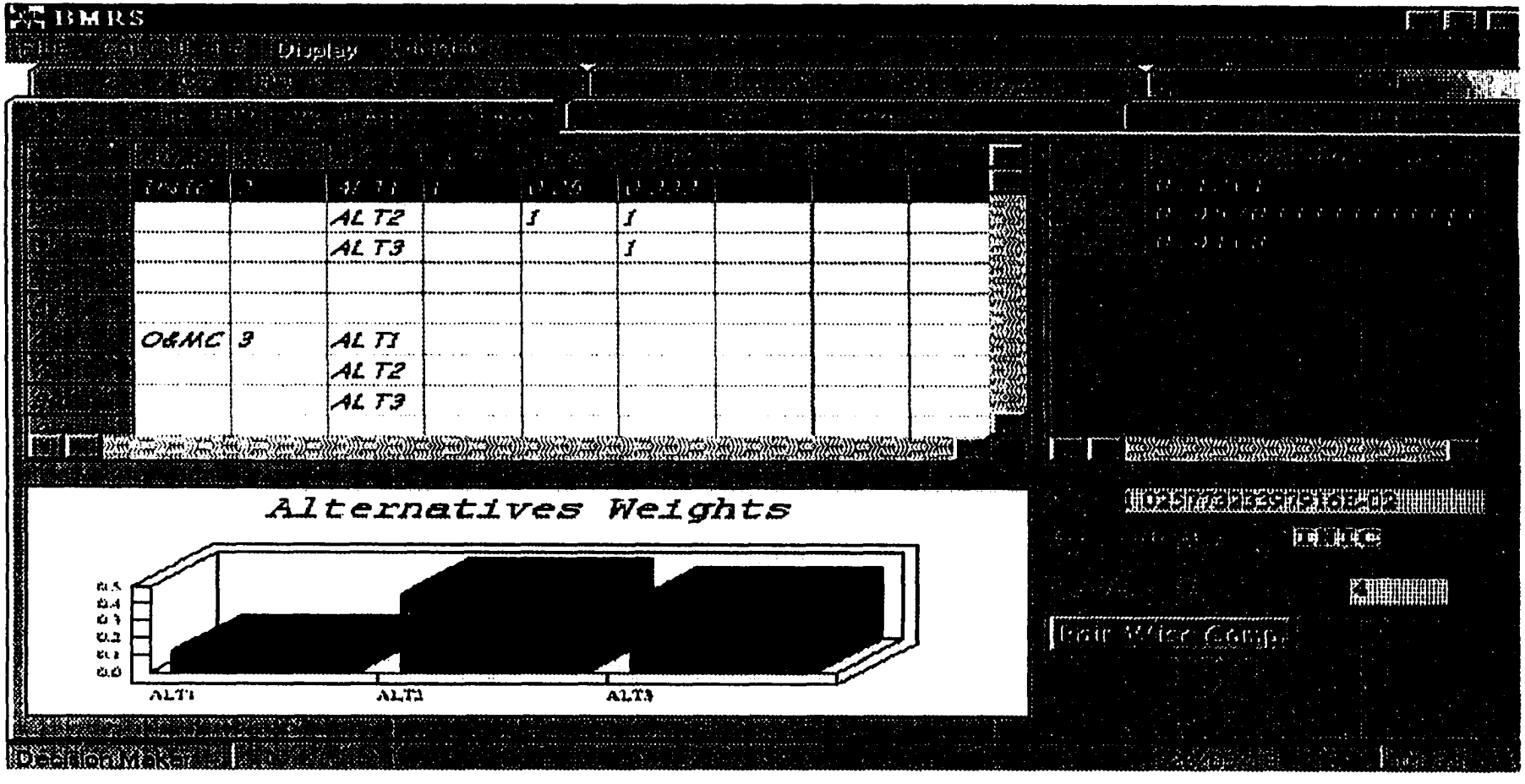
A message will appear giving the consistency ratio as shown below. If the ratio is within the acceptable limit the "OK Button" is pressed. Otherwise the "Cancel Button" is pressed and the calculation is repeated.



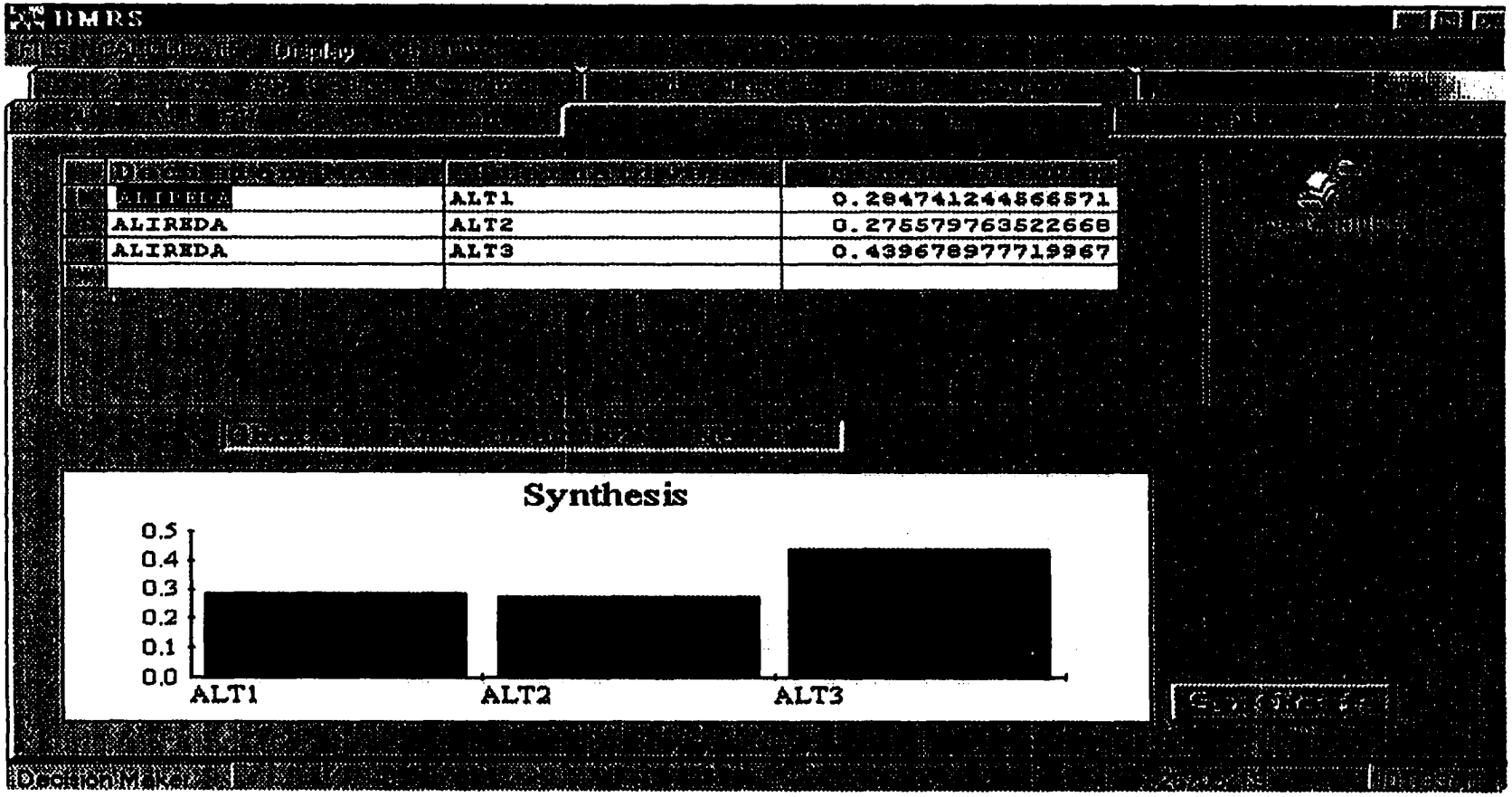
The fourth module is the initial alternative data. In this module, the alternatives are entered in the " alternatives box".



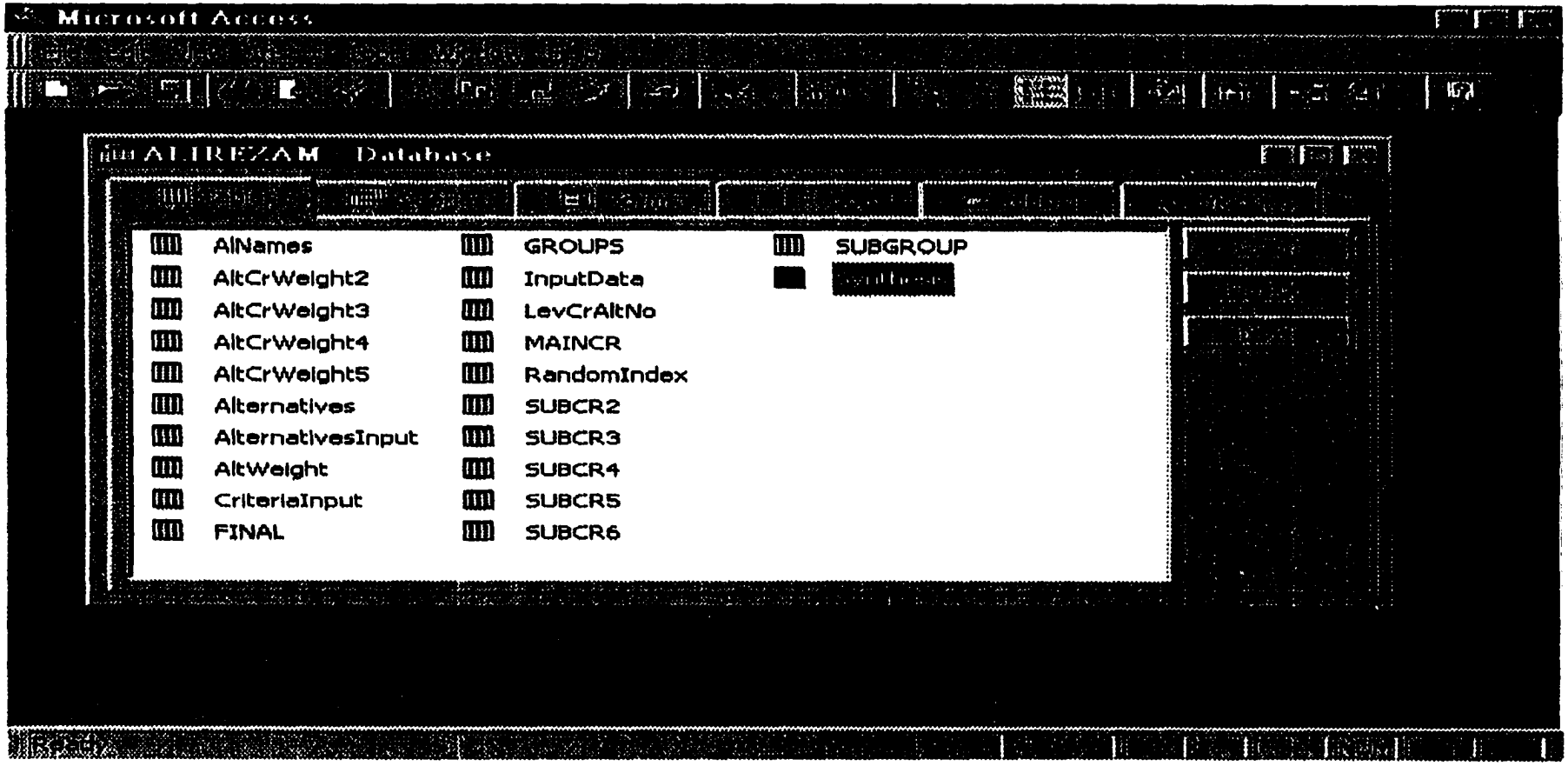
In the fifth module, the alternatives pairwise comparison is performed. The same steps are followed here as of the criteria pairwise comarison module.



The last module, the "synthesis", calculates the results and determines the best alternative that the decision maker should consider. The module is shown below.



Having done the final calculation, the input data files should be saved by clicking on the save command under the file comand in the menu. The synthesis module includes the data files button. With one click the user can go to the data files. Then the list of files appears then the user can choose the required files from the data base.



6.5 Program Description

The program was created in Visual Basic (VB) which is based on the concept of object-oriented programming. Objects are control elements that interface with the users. One distinguishing property of the object-oriented programming is that each object can have an event by which it can be activated. The events for the objects under this program include mainly, click, and double click, key press, change and mouse move.

Mouse Move Event

Occurs when the user moves the mouse.

Mouse Click Event

Occurs when the user presses and then releases a mouse button over an object. It can also occur when the value of a control is changed.

Change Event

Indicates that the contents of a control have changed. How and when this event occurs varies with the control

Key-press Event

Occurs when the user presses and releases an ANSI key.

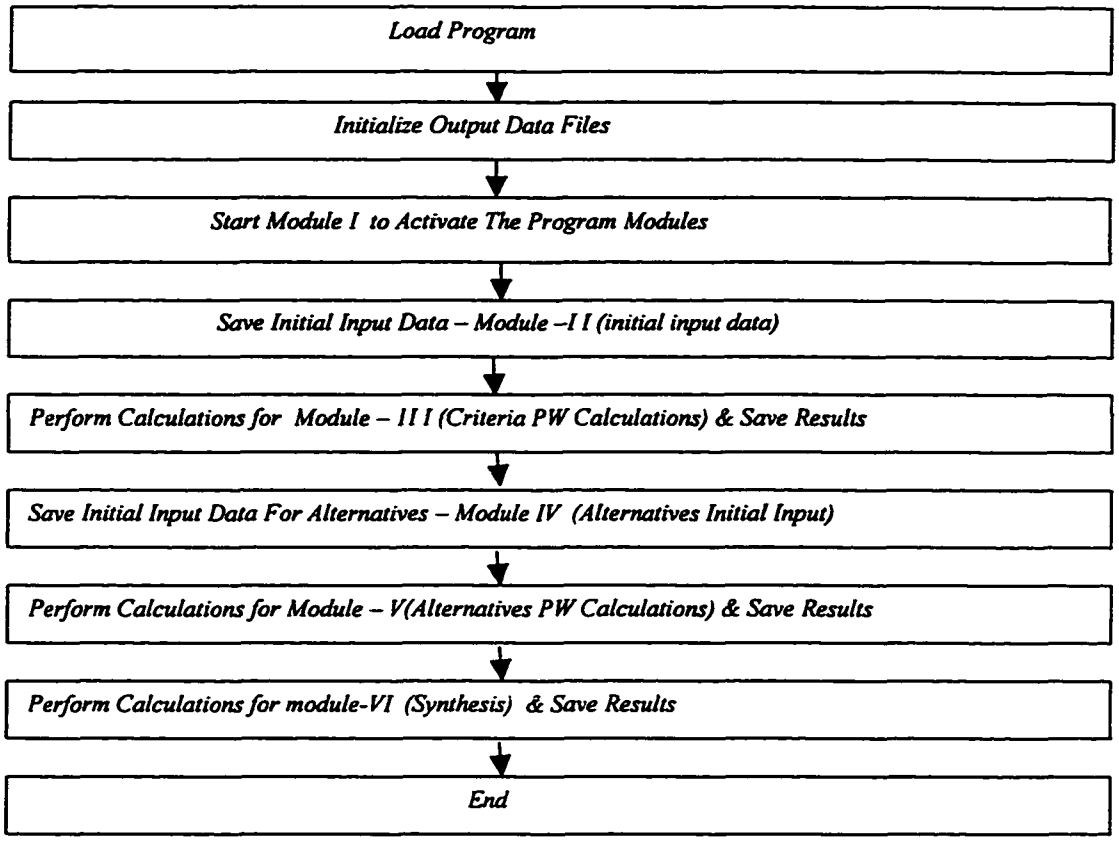


Figure 6.2 – The Program Structure

6.5.1 The Program Subroutines

This section discusses the sub-routines of the program.

Subroutine form-load

This subroutine disables all modules except the first module, "the Start Module" and initializes the output data files.

SS Command 11_Click,

This is a command control object. It activates all the program modules once the Start command button is clicked with the mouse.

6.5.1.2 Initial input data module subroutines

They include different types of subroutines that each deal with a specific function at different events. These subroutines have mainly, click, change and key press events.

The following table shows the name of each subroutine that belong to the "Initial Input Data Module", the event that is required to activate it and the action it performs.

Table 6.1—Initial Input Data Module Subroutines

Item No.	Subroutine	Event	Action
1	NoOfCrNode_Change	Change in the input data	Erases the data in the criteria PW calculation spreadsheets and hides the spread sheets when the data at the " number of criteria text box " is changed.
2	CrNodeName_Change	Change in the input data	Erases the data in the criteria PW calculation spreadsheets and hides the spread sheets when the data at the " Criteria Nodes Names text box " is changed.
3	LevelNo_change	Change in the input data	Erases the data in the criteria PW calculation spreadsheets and hides the spread sheets when the data at the " Level Number text box " is changed.
4	TxtNoOfCriteria_Change	Change in the input data	Erases the data in the criteria PW calculation spreadsheets and hides the spread sheets when the data at the " number of sub-criteria text box " is changed.
5	TxtCriteria_Change	Change in the input data	Erases the data in the criteria PW calculation spreadsheets and hides the spread sheets when the data at the " names of sub-criteria text box " is changed.
6	DecisionMakerName_KeyPress	Pressing enter key	Saves the "Decision Maker Name" in the memory after pressing the enter key
7	MainObjective_KeyPress		Saves the "Main Objective" in the memory after pressing the enter key
8	TxtNoOfLevels_KeyPress	Pressing enter key	Saves the "Number of Levels" in the memory after pressing the enter key
9	NoOfCrNode _KeyPress	Pressing enter key	Saves the "Number of Criteria Nodes" in the memory after pressing the enter key
10	CrNodeName_KeyPress	Pressing enter key	Saves the "Criteria Node Names" in the memory after pressing the enter key

Table 6.1—Initial Input Data Module Subroutines—Continued

Item No.	Subroutine	Event	Action
11	LevelNo_KeyPress	Pressing enter key	Saves the "level number for each coressponding criteria node" in the memory after pressing the enter key
12	TxtNoOfCriteria_KeyPress	Pressing enter key	Saves the "coressponding number of sub-criteria" in the memory after pressing the enter key
13	TxtCriteria_KeyPress	Pressing enter key	Saves the "sub-criteria that belongs to each criteria nodes" in the memory after pressing the enter key
14	LstCrNodes-DblClick	Double click by the mouse	Erases the list of criteria nodes data in the list box once the mouse is clicked twice on the list box
15	LstLevels-DblClick	Double click by the mouse	Erases the levels numbers data in the list box once the mouse is clicked twice on the list box
16	NofCrList-DblClick	Double click by the mouse	Erases the no. of criteria data in the list box once the mouse is clicked twice on the list box
17	IstCriteria-DblClick	Double click by the mouse	Erases the list of criteria data in the list box once the mouse is clicked twice on the list box

6.5.1.3 Criteria Pair wise Calculation Module

This module includes subroutines that are related to the calculation of the weights of the criteria, calculating the consistency ratios, testing the consistency of judgements, saving the output data in the data base files and plotting the results. The following table lists the related subroutine, describes the event for each subroutine by which it is activated, and the action it takes to implement that part of the program.

Table 6.2 – Criteria PW Comparisons Module Subroutines

Item No.	Subroutine	Event	Action
1	SSCommand3_Click	Button click event by a mouse	Shows the criteria pairwise calculation spread sheet and retrieves the initial input data and place that data in the spreadsheet.
2	GridInputData-DblClick	Double Click event by a mouse on the first cell in the first column that corresponds to each criteria group	Places each criteria group in a matrix form where the criteria names are displayed horizontally.
3	GridInputData-Click	Click by a mouse on the first cell in the first column that corresponds to each criteria group	Saves the data in the memory and makes it ready for calculation.
4	GridInputData-KeyPress	Key press event by the enter key	Changes the size of the cells on the grid (spread sheet) to a bigger size.
5	PairWiseComp-click: PairwiseCompariosn, ConsIndex, PlotData	Button click event by a mouse	Activates pairwiseComparison, ConsIndex and PlotData subroutines to perform the criteria weights calculation, consistency calculation and test, plot the data and save the output data in the Microsoft Access output data files.

Table 6.2 – Criteria PW Comparisons Module Subroutines—Continued

Item No.	Subroutine	Event	Action
6	PairwiseComparison: Anormal, Weight, Consistency	N/A	Performs the pairwise calculations for each criteria group and shows the results(criteria weights) at the criteria weight grid(spread sheet). At the first of this subroutine, it normalizes the pairwise comparisons matrices by calling subroutine "Anormal". At the second step, it performs the pairwise calculation to come up with the weights for criteria. At the third step it performs the consistency ratio calculations by calling subroutine consistency .
	ConsIndex: FileSave1	N/A	Performs the consistency test and display the results to the user. If the user accepts the results then the subroutine will call filesave1 to save the data in the output data file.
7	FileSave1: AddGroup AddSubGroup AddMCWeight1 AddSCWeight2 AddSCWeight3 AddSCWeight4	N/A	Saves the data in the output data base files. Checks if the level number is one (1) then the subroutine will call AddMCWeight1 to save the criteria weights in main criteria output data file (MAINCR); if the level number is two (2) then the subroutine will call AddSCWeight2 to save the criteria weights in level 2 sub-criteria output file (SUBCR2); if the level no. is three (3) then the subroutine will call AddSCWeight3 to save the data in level3 sub-criteria output data file (SUBCR3); if level number is 4 then the subroutine will call AddSCWeight4 to save the level no. 4 sub-criteria output data file(SUBCR4).
8	Cmbtype-Click	Click by the mouse on the list box	Changes the chart type as selected in the combo box

6.5.1.4 Alternatives Initial input data module subroutines

They include different types of subroutines that each deal with a specific function at different events. These subroutines have mainly, click, change and key press events.

The following table shows the name of each subroutine that belong to the "Alternatives Initial Input Data Module", the event that is required to activate it and the action it performs.

Table 6.3 –Alternatives Initial Input Data Module Subroutines

Item No.	Subroutine	Event	Action
1	TxtNoOfAlternatives-Change	Change in the input data	Any change in the No. Of Alternatives data box would cause this subroutine to erase the data in the Alternatives PW calculation spreadsheets located in the Alternative PW Comparison Module and hide that spread sheet. This is done to enable the user to enter new data without the need for erasing the previous data manually.
2	Alternatives-Change	Change in the input data	Same action above
3	Alternatives-List-DlClick		Erases the alternatives list once the user clicks the mouse twice to make the list for new input.

6.5.1.5 Alternatives Pair wise Calculation Module Subroutines

This module includes subroutines that are related to the calculation of the weights of the alternatives, calculating the consistency ratios, testing the consistency of judgements, saving the output data in the data base files and plotting the results. The following table lists the related subroutine, describes the event for each subroutine by which it is activated, and the action it takes to implement that part of the program.

Table 6.4 – Alternatives PW Comparisons Module Subroutines

Item No.	Subroutine	Event	Action
1	SSCommand2_ Click	Button click event by a mouse	Shows the alternatives pairwise calculation spread sheet and retrieves the initial input data and place that data in the spreadsheet.
2	GrdInAltDat1-DblClick	Double Click event by a mouse on the first cell in the first column that corresponds to each group	Places each alternatives group in a matrix form where the alternatives names are displayed horizontally.
3	GrdInAltDat1-Click	Click by a mouse on the first cell in the first column that corresponds to each alternatives group	Saves the data in the memory and makes it ready for calculation.
4	GridInputData-KeyPress	Key press event by the enter key	Changes the size of the cells on the grid (spread sheet) to a bigger size.
5	CmdAlternative -click: AltCompariosn, AltConsIndex, PlotAltData	Button click event by a mouse	Activates AltComparison, AltConsIndex and PlotAltData subroutines to perform the alternatives with respect to criteria weights calculation, consistency calculation and test, plot the data and save the output data in the Microsoft Access output data files.

Table 6.4 – Alternatives PW Comparisons Module Subroutines--Continued

Item No.	Subroutine	Event	Action
6	AltComparison: AltAnormal, AltWeight1, AltConsistency	N/A	Performs the pairwise calculations for each alternative groups and shows the results(alternatives weights) at the alternatives weight grid(spread sheet). At the first step, this subroutine calls subroutine "AltAnormal" to normalize the pairwise comparisons matrices . At the second step, it calls AltWeight1 to perform the pairwise calculation to come up with the weights for alternatives with respect to criteria. At the third step it calls subroutine "Altconsistency" to perform the consistency ratio calculations .
	ConsIndex: FileSave1	N/A	Performs the consistency test and display the results to the user. If the user accepts the results then the subroutine will call filesave11 to save the data in the output data file.

Table 6.4 – Alternatives PW Comparisons Module Subroutines- Continued

Item No.	Subroutine	Event	Action
7	FileSave11: AltAdd2 AltAdd3 AltAdd4 AltAdd5	N/A	Saves the data in the output data base files. Checks if the number of levels in the decision hierarchy is two (2) then the subroutine will call AltAdd2 to save the alternatives weights in AltVCrWeight2 file; if the number of levels in the decision hierarchy is three (3) then the subroutine will call AltAdd3 to save the alternatives weights in AltVCrWeight3 data base file; if the number of levels in the decision hierarchy is four (4) then the subroutine will call AltAdd4 to save the alternatives weights in AltVCrWeight4 data base file; if the number of levels in the decision hierarchy is five (5) then the subroutine will call AltAdd5 to save the alternatives weights in AltVCrWeight5 data base file.
8	Cmbtype2-Click	Click by the mouse on the list box	Changes the chart type as selected in the combo box

6.5.1.6 Synthesis Calculations Module Subroutines

This module performs the calculations for the final results. The following table explains about the related subroutine for this module.

Table 6.5 – Subroutines for the Synthesis Module

Item No.	Subroutine	Event	Action
1	SSCmdSynthesis_Click: SynthesisF PlotDataSynthesis	Button click event by a mouse	Calls SynthesisF to Perform the synthesis calculations where all the weights are aggregated in order to come up with a rating for all the alternatives. Additionally it saves the results in the output data file--Synthesis". After having done that it calls PlotDataSynthesis to plot the data.

CHAPTER SEVEN

PROJECT ALTERNATIVES EVALUATION PROBLEM CASE STUDY

7.1 SCOPE

In this chapter, a case study is presented to demonstrate the application of the developed computerized decision-making model. The model is applied here to rank project alternatives, however, this model can be applied to all aspects of the project.

Under the scope of he study, a major industrial company has decided to replace its current mobile radio communications system, infrastructure and end user equipment with a new state of the art mobile radio system. This project is viewed as a big investment by the company which it will enhance the production of oil and place the company at the competitive edge.

7.2 ALTERNATIVES

Three mobile radio system alternatives were investigated. These are: 1) to replace the current system with an analog system which has been tried, field proven and used by other entities; 2) to replace the current system with open system architecture. This alternative might end up in potential cost and schedule risks; 3) to replace the current system with proprietary system architecture. This alternative may carry with it discontinued vendor future support due to using non-standard equipment.

The next section describes how the AHP and the developed program can be used to assist the company in ranking these alternatives.

The main objective of this decision making process is to determine the most viable alternative for implementing the project. The objective is located at level one (1) of the hierarchy as depicted in the next figure and this is called the objective node. The factors were divided into three main groups as explained in the previous chapter.

Weights that reflect the influence of the major decision elements: the project, system and vendor which constitute the major key elements in the overall decision can be assigned by performing the pairwise comparison at each level of the hierarchy. These weights were calculated by using the program developed by the author.

7.3 METHODOLOGY APPLICATIONS AND DISCUSSION

Starting with the first step, the decision problem is formulated in a hierarchical structure. The decision problem is broken into a hierarchy of interrelated decision elements.

The next diagram shows the structure of the hierarchy based on the distribution of the decision elements per the related groups. At the top lies the most important objective, which is the selection of the most appropriate telecommunications project or technology to meet the oil and gas production demand.

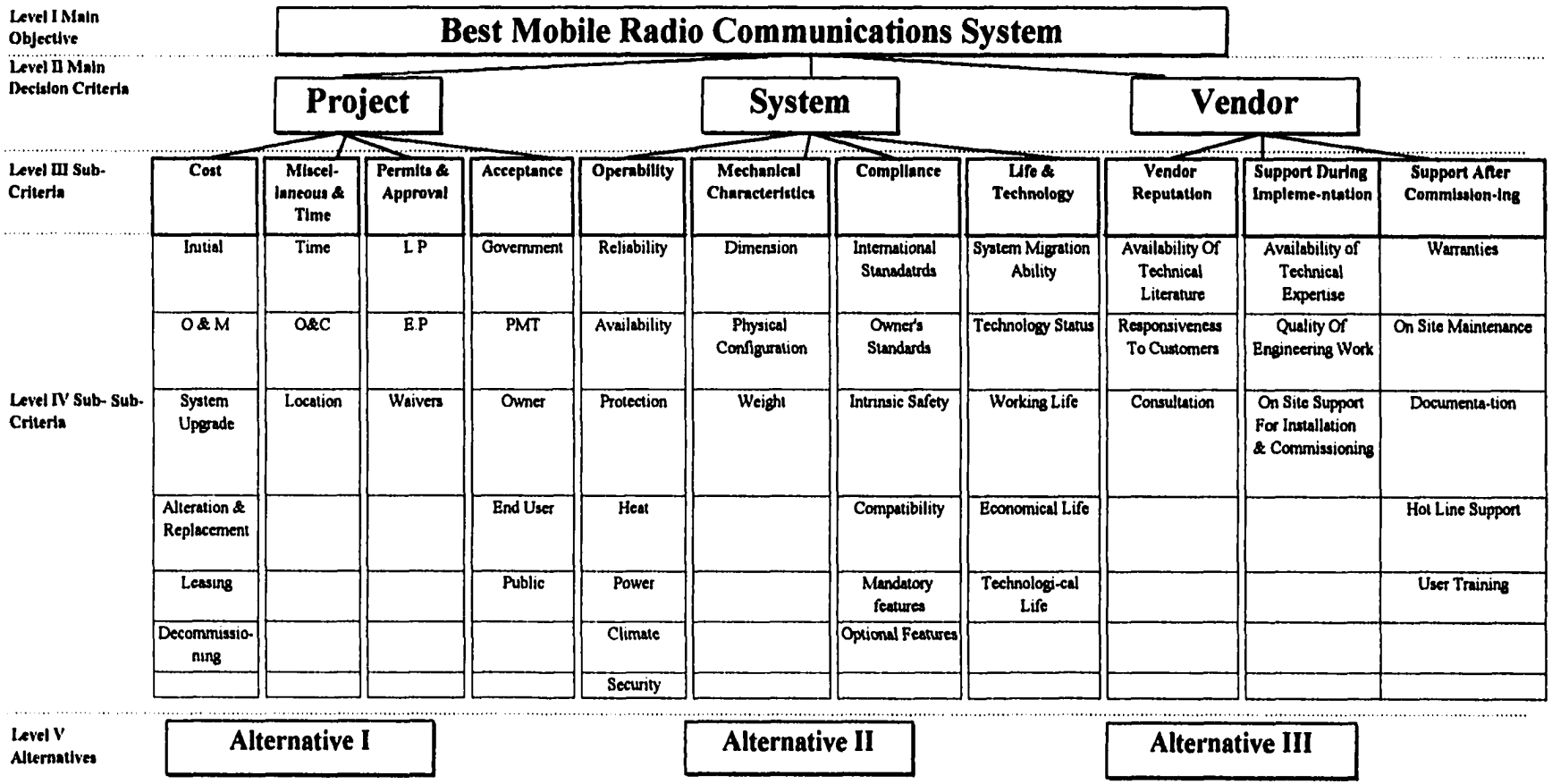


Figure 7.1 -- DECISION HIERARCHY

In the second level of the hierarchy, the main criteria, the less controllable, the more risky and uncertain are listed. These are project criterion, system criterion and vendor criterion.

Each of these criteria is broken down to sub- criteria in the next level, level number three. In the third level, project criterion is broken down into six (6) sub- criteria. These are total cost of the project, miscellaneous & time to implement the project, permits, approvals, and acceptance of the project by the members who are concerned with the project.

The decision-maker has to judge if any of these criteria has more influence or importance than other criteria. The owner might decide that time is the most important factor, as without it the objective of the project cannot be met. For example, when launching a new product, the development and implementation processes have to be within a certain period of time in order to launching the product at the required time. Otherwise, losses can be incurred.

System criterion is broken into four (4) sub- criteria in the next level, level number three. These are operability or operation characteristics, mechanical characteristics, and compliance of the equipment to standards and specifications and life & technology of the system equipment.

Vendor criterion is broken into three (3) sub- criteria. These are vendor reputation (i.e., is the vendor responsive to customers, does he/she provide technical information about his products etc.), vendor support during commissioning and support after commissioning.

The sub- criteria in the third level are broken further to sub-sub- criteria in the fourth level. Cost is broken further into six (6) elements. These are initial cost to engineer, constructing, testing and commissioning the system, operation & maintenance cost, future system upgrade cost, alteration and replacement cost, leasing cost in the event that some elements will be leased and decommissioning cost.

Miscellaneous & time is broken further into three (3) sub- criteria. These are, time ownership & control and location of the project.

Permit and approval under project criterion is broken into three elements. These are land use permits, equipment importation permit, and waiver to use non-standard equipment or implementation/construction method.

Acceptance is broken into five (5) elements in the fourth level, the elements include, acceptance by the government, acceptance by the Project Management Team, acceptance by the owner, acceptance by the end user and acceptance by the public. The most dominant factor here is acceptance by the government, if the system is not accepted by the government then the project can not be implemented.

Operation characteristic is broken further into seven (7) sub- criteria: reliability, equipment availability, equipment protection during failure, heat, power, climatic criterion and security of the equipment during operation.

Mechanical characteristic is broken into three criteria. These include dimension of the equipment, physical characteristic and the weight of the equipment. As mentioned above these criteria can be dropped from the analysis since they received very low importance as indicated from the survey results. For the sake of the study, these will be included in the analysis.

Compliance is broken into six (6) sub- criteria. The sub- criteria include system compliance to international standards, compliance to owner standards, intrinsic safety, compatibility to the existing system, mandatory and optional features compliance.

Life and technology is broken into five (5) factors. These are system migration ability to future upgrades and developments, the technology status of the system equipment, system working life, and system economical life and system technological life.

Vendor reputation (vendor support to customers before implementation) under the vendor criterion is broken further into these sub- criteria: availability of technical literature, responsiveness to customers and consultation.

Vendor support during implementation is broken into availability of technical expertise, quality of engineering work, and on site support for installation.

Finally, Vendor support after commissioning is broken into warranties, on site maintenance, documentation, hot line support and user training.

The next table shows the criteria grouping with their sub- criteria and their abbreviations.

Table 7.1 - criteria Grouping and their Abbreviations

Best Mobile Radio System	BMRS	1	3	Project	PROJ
				System	SYST
				Vendor	VEND
Project	PROJ	2	4	Cost	COST
				Time & Miscellaneous	T&M
				Permits and Approvals	P&A
				Acceptance	ACCE
System	Syst	2	4	Operation Characteristics	OPER
				Mechanical Characteristics	MC
				Compliance	COMPL
				Life & Technology	L&T
Vendor	VEND	2	3	Vendor Reputation	VR
				Vendor Support During Implementation	VSDI
				Vendor Support After Commissioning	VSAC
Cost	COST	3	6	Initial Cost	INITC
				Operation & Maintenance Cost	O&MC
				System Upgrade Cost	SUC
				Alteration & Repair Cost	A&RC
				Leasing Cost	LEAC
				Decommissioning Cost	DECC
Time & Miscellaneous	T&M	3	3	Time	Time
				Ownership & Control	O&C

Table 7.1 - Continued

Criteria Node	Abbreviation	Level No.	Number Of Sub-Criteria	Sub-Criteria	Abbreviation
				Location	Loca
Permits & Approval	P&A	3	3	Land Use Permit	LP
				Equipment Import Permit	EP
				Waiver	WAIV
Acceptance	ACCE	3	5	Government Acceptance	GOVA
				PMT Accept.	PMTA
				Owners Accept.	OWNA
				End User Accept.	EUA
				Public Acceptance	PUBA
Operation Characteristics	OPER	3	7	Reliability	RELI
				Availability	AVAI
				Protection During Failure	PROT
				Heat	HEAT
				Power	POWE
				Climatic Condition Compliance	CLIM
				Security	SECU
Mechanical Characteristics	MC	3	3	Dimension	DIME
				Physical Characteristics	PC
				Weight	WEIG
Compliance	COMPL	3	6	International Standards	ITAN
				Owner's Standards	OSTA
				Intrinsic Safety	IS

Table 7.1 – Continued

Criteria Nodes	Abbreviation	Level No.	Number Of Sub-Criteria	Sub-Criteria	Abbreviation
				Compatibility	COMPAT
				Mandatory Features	MF
				Optional Features	OF
Life & Technology	L&T	3	5	System Migration Ability	SMA
				Technology Status	TECS
				Economical Life	EL
				Working Life	WL
				Technological Life	TL
Vendor Reputation	VR	3	3	Availability of Technical Literature	AOTL
				Responsiveness to Customers	RTC
				Consultation	CONS
Vendor Support During Implementation	VSDI	3	3	Availability of Technical Expertise	AOTE
				Quality of Engineering Work	QOEW
				On Site Support For Installation & Commissioning	OSSFI
Vendor Support After Commissioning	VSAC	3	5	Warranty	WARR
				On-Site-Maintenance	OSM
				Documentation	DOCU
				Hot Line Support	HLS
				User Training	UT

7.4 CRITERIA PAIRWISE COMPARISON

In the next step, the pairwise comparison was performed for all the criteria. The next tables (tables 7.2 - 7.16) show the criteria pairwise comparison.

Table 7.2 – Main Criteria Pairwise Comparison

	PROJ	SYST	VEND
PROJ	*1*	*0.5*	*0.5*
SYST		*1*	*1*
VEND			*1*

Table 7.3 – Project Sub- Criteria Pairwise Comparison

	COST	T&M	P&A	ACCE
COST	*1*	*1*	*0.5*	*0.5*
T&M		*1*	*0.2*	*1*
P&A			*1*	*1*
ACCE				*1*

Table 7.4 – System Sub- Criteria Pairwise Comparison

	OPER	MC	COMPL	L&T
OPER	*1*	*4*	*1*	*1*
MC		*1*	*0.143*	*0.143*
COMPL			*1*	*1*
L&T				*1*

Table 7.5 – Vendor Sub- Criteria Pairwise Comparison

	VR	VSDI	VSAC
VR	1	0.5	0.5
VSDI		1	1
VSAC			1

Table 7.6 – Cost Sub- Criteria Pairwise Comparison

	INIC	O&MC	SUC	A&RC	LEAC	DECC
INIC	1	0.5	2	2	2	4
O&MC		1	2	1	2	4
SUC			1	0.5	1	6
A&RC				1	2	3
LEAC					1	2
DECC						1

Table 7.7 – Time & Miscellaneous Sub- Criteria Pairwise Comparison

	TIME	O&C	LOCA
TIME	1	0.333	2
O&C		1	4
LOCA			1

Table 7.8 – Permits & Approval Sub- Criteria Pairwise Comparison

	LP	EP	WAIV
LP	1	1	2
EP		1	2
WAIV			1

Table 7.9 – Project Acceptance Sub- Criteria Pairwise Comparison

	GOVA	PMTA	OWNA	EUA	PUBA
GOVA	1	2	2	2	2
PMTA		1	0.5	0.333	0.333
OWNA			1	0.333	0.25
EUA				1	0.5
PUBA					1

Table 7.10 – Operation Characteristics Sub- Criteria Pairwise Comparison

	RELI	AVAI	PROT	HEAT	POWE	CLIM	SECU
RELI	1	1	2	4	5	4	1
AVAI		1	2	2	2	4	1
PROT			1	2	2	3	1
HEAT				1	1	1	1
POWE					1	1	1
CLIM						1	1
SECU							1

Table 7.11 – Physical Characteristics Sub - Criteria Pairwise Comparison

	DIME	PC	WEIG
DIME	1	1	1
PC		1	1
WEIG			1

Table 7.12 Compliance Sub- Criteria Pairwise Comparison

	ISTA	OSTA	IS	COMPA	MF	OF
ISTA	1	0.25	0.25	0.2	0.5	1
OSTA		1	1	1	1	2
IS			1	1	1	4
COMPA				1	1	2
MF					1	2
OF						1

Table 7.13 – System Life & Technology Sub - Criteria Pairwise Comparison

	SMA	TECS	EL	WL	TL
SMA	1	1	0.333	0.25	1
TECS		1	1	1	1
EL			1	2	1
WL				1	1
TL					1

Table 7.14 –Vendor Reputation Sub – Criteria Pairwise Comparison

	AOTL	RTC	CONS
AOTL	1	0.25	0.333
RTC		1	1
CONS			1

Table 7.15 – Vendor Support During Implementation Sub - Criteria Pairwise Comparison

	AOTE	QOEW	OSSFI	WARR	OSM
AOTE	1	0.5	0.5	1	0.2
QOEW		1	1	2	2
OSSFI			1	2	1
WARR				1	0.333
OSM					1

Table 7.16 – Vendor Support After Commissioning Sub - Criteria Pairwise Comparison

	DOCU	HLS	UT
DOCU	1	0.2	0.333
HLS		1	1
UT			1

7.5 ALTERNATIVES WITH RESPECT TO CRITERIA PAIRWISE COMPARISONS

The next tables (Tables 7.17-7.65) show the alternatives with respect to criteria pairwise comparisons.

Table 7.17 – Alternatives With Respect to Initial Cost Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
INIC	3	ALT1	1	0.25	0.333
		ALT2		1	1
		ALT3			1

Table 7.18 – Alternatives With Respect to Operation & Maintenance Cost Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
O&MC		ALT1	1	0.333	0.333
	3	ALT2		1	1
		ALT3			1

Table 7.19 – Alternatives With Respect to Systems Upgrade Cost Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
SUC	3	ALT1	1	0.5	0.167
		ALT2		1	0.143
		ALT3			1

Table 7.20 – Alternatives With Respect to Alteration & Repair Cost Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
A&RC	3	ALT1	1	0.5	0.2
		ALT2		1	0.2
		ALT3			1

Table 7.21 – Alternatives With Respect to Leasing Cost Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
LEAC	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.22 Alternatives With Respect to Decommissioning Cost Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
DECC	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.23 – Alternatives With Respect to Time Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
TIME	3	ALT1	1	1	4
		ALT2		2	4
		ALT3			1

Table 7.24 – Alternatives With Respect to Ownership & Control Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
O&C	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.25 – Alternatives With Respect to Location Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
LOCA	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.26– Alternatives With Respect to Land Permit Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
LP	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.27 – Alternatives With Respect to Equipment Permit Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
EP	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.28 - Alternatives With Respect to Waivers Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
WAIV	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.29 – Alternatives With Respect to Government Acceptance Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
GOVA	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.30 – Alternatives With Respect to PMT Acceptance Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
PMTA	3	ALT1	1	2	4
		ALT2		1	4
		ALT3			1

Table 7.31 – Alternatives With Respect to Owner Acceptance Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
OWNA	3	ALT1	1	2	4
		ALT2		1	4
		ALT3			1

Table 7.32 – Alternatives With Respect to End Users Acceptance Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
EUA	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.33 – Alternatives With Respect to Public Acceptance Pairwise Comparison

Gr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
PUBA	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.34– Alternatives With Respect to Reliability Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
RELI	3	ALT1	1	1	0.2
		ALT2		1	0.2
		ALT3			1

Table 7.35 – Alternatives With Respect to Availability Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
AVAI	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.36 – Alternatives With Respect to Protection Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
PROT	3	ALT1	1	1	0.2
		ALT2		1	0.2
		ALT3			1

Table 7.37 – Alternatives With Respect to Heat Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
HEAT	3	ALT1	1	1	0.333
		ALT2		1	0.333
		ALT3			1

Table 7.38 – Alternatives With Respect to Power Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
POWE	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.39 – Alternatives With Respect to Climatic Condition Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
CLIM	3	ALT1	1	0.333	0.2
		ALT2		1	0.25
		ALT3			1

Table 7.40 – Alternatives With Respect to Security Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
SECU	3	ALT1	1	0.5	0.5
		ALT2		1	1
		ALT3			1

Table 7.41 – Alternatives With Respect to Dimension Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
DIME	3	ALT1	1	1	0.2
		ALT2		1	0.25
		ALT3			1

Table 7.42 – Alternatives With Respect to Physical Configuration Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
PC	3	ALT1	1	1	0.2
		ALT2		1	0.2
		ALT3			1

Table 7.43 – Alternatives With Respect to Weight Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
WEIG	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.44– Alternatives With Respect to International Standards Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
ISTA	3	ALT1	1	0.167	0.143
		ALT2		1	0.5
		ALT3			1

Table 7.45 – Alternatives With Respect to Owner Standards Pairwise Comparison

G-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
OSTA	3	ALT1	1	0.5	0.143
		ALT2		1	0.5
		ALT3			1

Table 7.46 – Alternatives With Respect to Intrinsic Safety Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
IS	3	ALT1	1	4	4
		ALT2		1	1
		ALT3			1

Table 7.47 – Alternatives With Respect to Compatibility Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
COMPA	3	ALT1	1	0.2	0.2
		ALT2		1	0.5
		ALT3			1

Table 7.48 – Alternatives With Respect to Mandatory Features Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
MF	3	ALT1	1	1	0.333
		ALT2		1	0.5
		ALT3			1

Table 7.49 – Alternatives With Respect to Optional Features Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
OF	3	ALT1	1	0.5	0.333
		ALT2		1	0.5
		ALT3			1

Table 7.50 – Alternatives With Respect to System Migration Ability Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
SMA	3	ALT1	1	0.5	0.5
		ALT2		1	1
		ALT3			1

Table 7.51– Alternatives With Respect to Technology Status Pairwise Comparison

Cr-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
TECS	3	ALT1	1	2	4
		ALT2		1	2
		ALT3			1

Table 7.52 Alternatives With Respect to Economical Life Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
EL	3	ALT1	1	0.333	0.25
		ALT2		1	0.5
		ALT3			1

Table 7.53 – Alternatives With Respect to Working Life Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
WL	3	ALT1	1	0.5	0.333
		ALT2		1	0.5
		ALT3			1

Table 7.54 Alternatives With Respect to Technological Life Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
TL	3	ALT1	1	0.333	0.25
		ALT2		1	0.5
		ALT3			1

Table 7.55 Alternatives With Respect to Availability of Technical Literature Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
AOTL	3	ALT1	1	2	2
		ALT2		1	1
		ALT3			1

Table 7.56 Alternatives With Respect to Responsiveness to Customers Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
RTC	3	ALT1	1	2	1
		ALT2		1	0.5
		ALT3			1

Table 7.57 Alternatives With Respect to Consultation Pairwise Comparison

C-Alt-Node	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
CONS	3	ALT1	1	2	1
		ALT2		1	0.333
		ALT3			1

Table 7.58 Alternatives With Respect to Availability of Technical Expertise

Pairwise Comparison

C-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
AOTE	3	ALT1	1	1	0.2
		ALT2		1	0.25
		ALT3			1

Table 7.59 Alternatives With Respect to Quality of Engineering Work

Pairwise Comparison

C-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
QOEW	3	ALT1	1	2	1
		ALT2		1	0.5
		ALT3			1

Table 7.60 Alternatives With Respect to On Site Support for Installation

Pairwise Comparison

C-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
OSSFI	3	ALT1	1	1	0.2
		ALT2		1	0.25
		ALT3			1

Table 7.61 Alternatives With Respect to Warranty Pairwise Comparison

C-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
WARR	3	ALT1	1	1	0.25
		ALT2		1	0.5
		ALT3			1

Table 7.62 Alternatives With Respect to On Site Maintenance Pairwise Comparison

C-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
OSM	3	ALT1	1	0.5	0.333
		ALT2		1	0.333
		ALT3			1

Table 7.63 Alternatives With Respect to Documentation Pairwise Comparison

G-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
DOCU	3	ALT1	1	4	4
		ALT2		1	1
		ALT3			1

Table 7.64 Alternatives With Respect to Hot Line Support Pairwise Comparison

G-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
HLS	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

Table 7.65 Alternatives With Respect to User Training Pairwise Comparison

G-AltNode	No-Of-Alt	Alternative	ALT1	ALT2	ALT3
UT	3	ALT1	1	1	1
		ALT2		1	1
		ALT3			1

The next figures show the step by step instructions for entering the data and performing the criteria and alternatives pairwise comparisons calculation along with a consistency check. Starting with the initial data input, refer to the next figure.

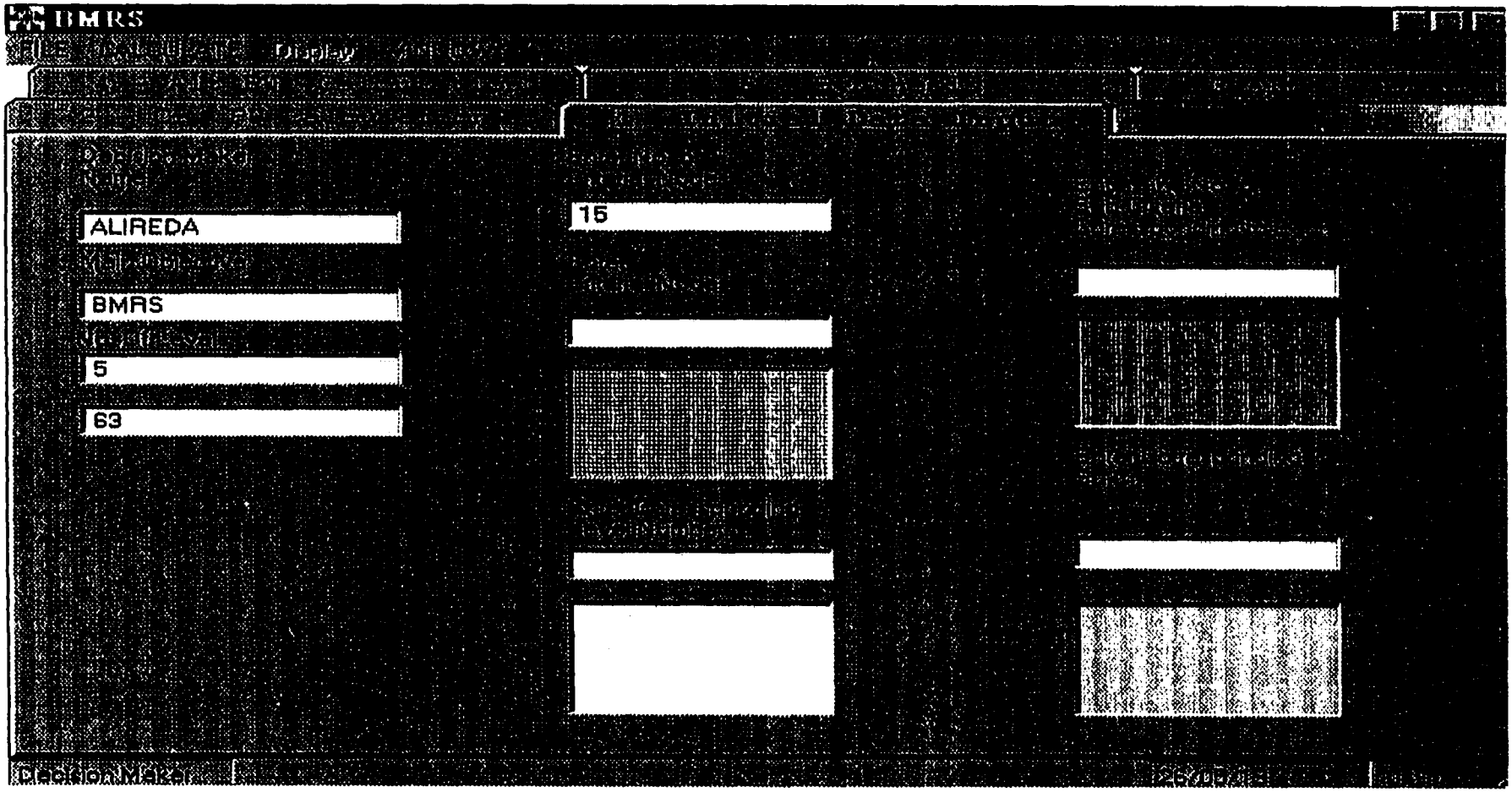


Figure 7.2 Initial input Data

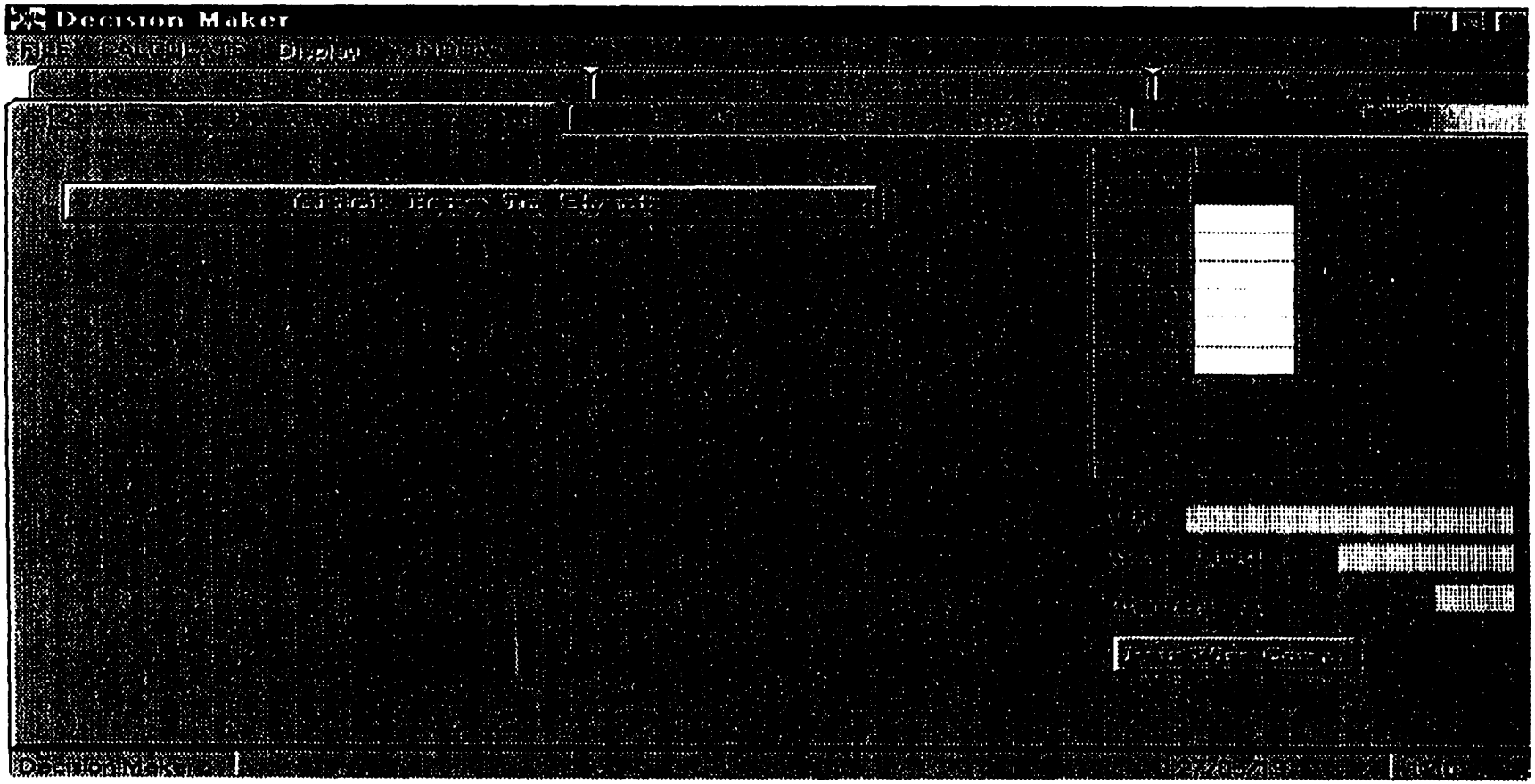


Figure 7.3 – Criteria Pairwise Comparison & Consistency Test

The process continues with pairwise comparison, ranking of criteria, and alternatives with respect to criteria and consistency check as shown in the figures. The last step involves the aggregation of results, the synthesis. The last figure shows the final results. Alternative no. 3 is the most appropriate for the company to decide on.

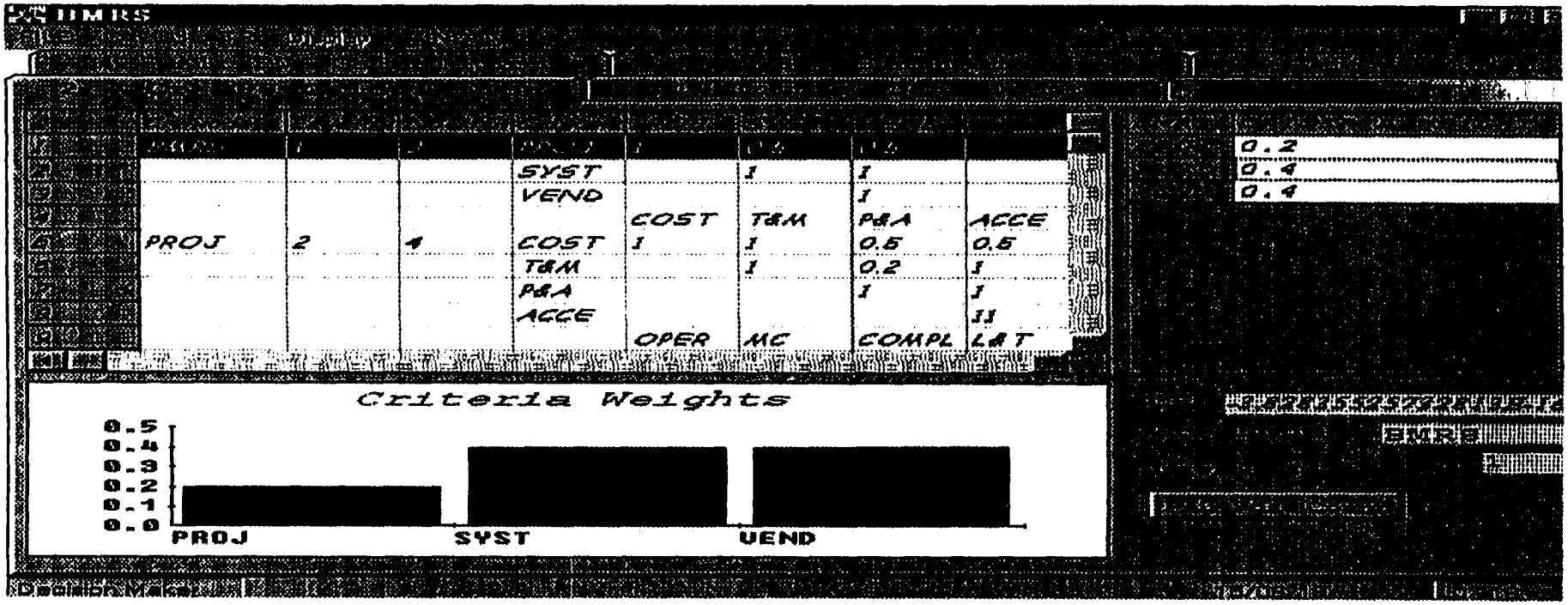


Figure 7.4– Judgments and Priorities of the Model's Main Criteria with respect to the Main Objective.

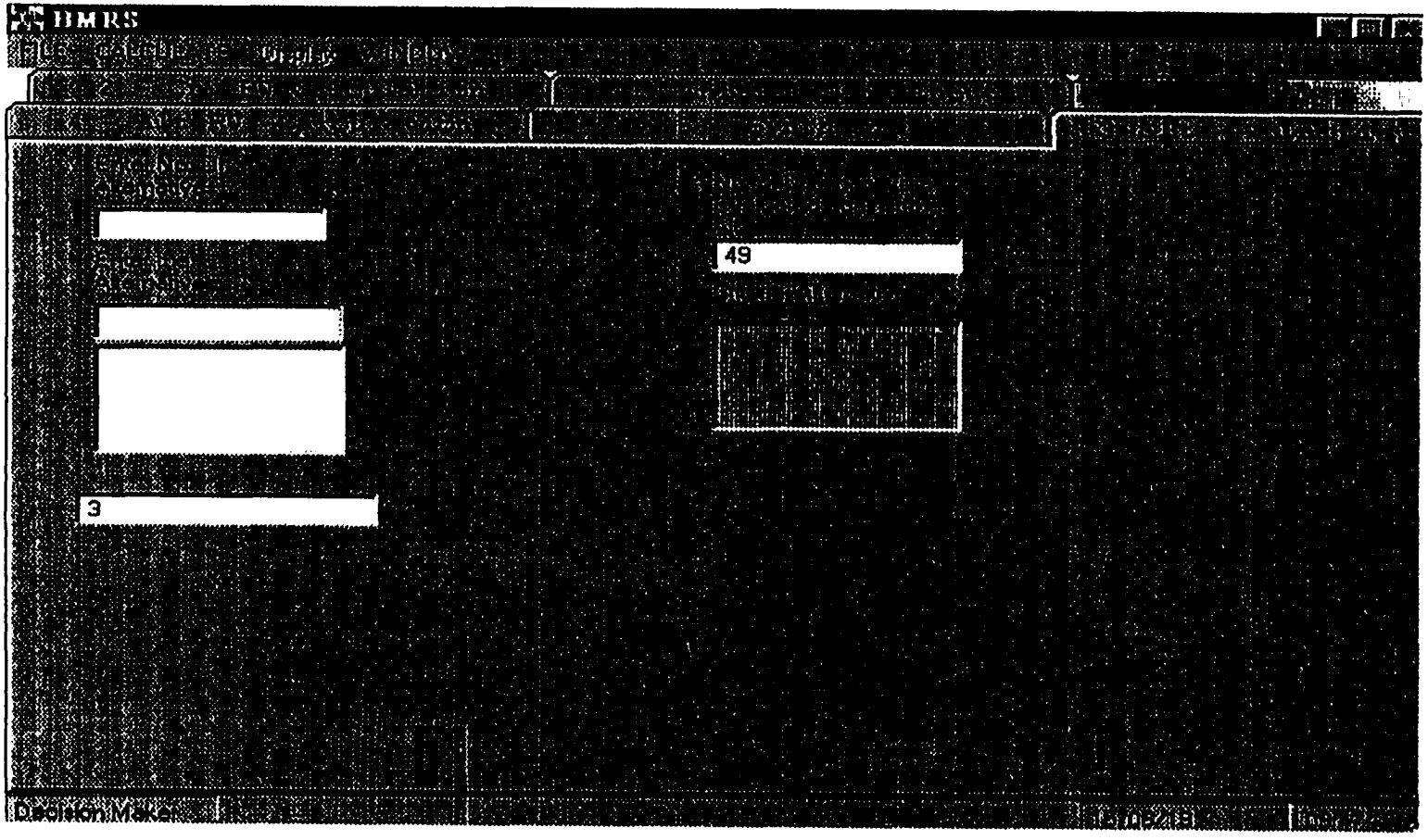


Figure 7.5 – Alternatives Initial Input Data

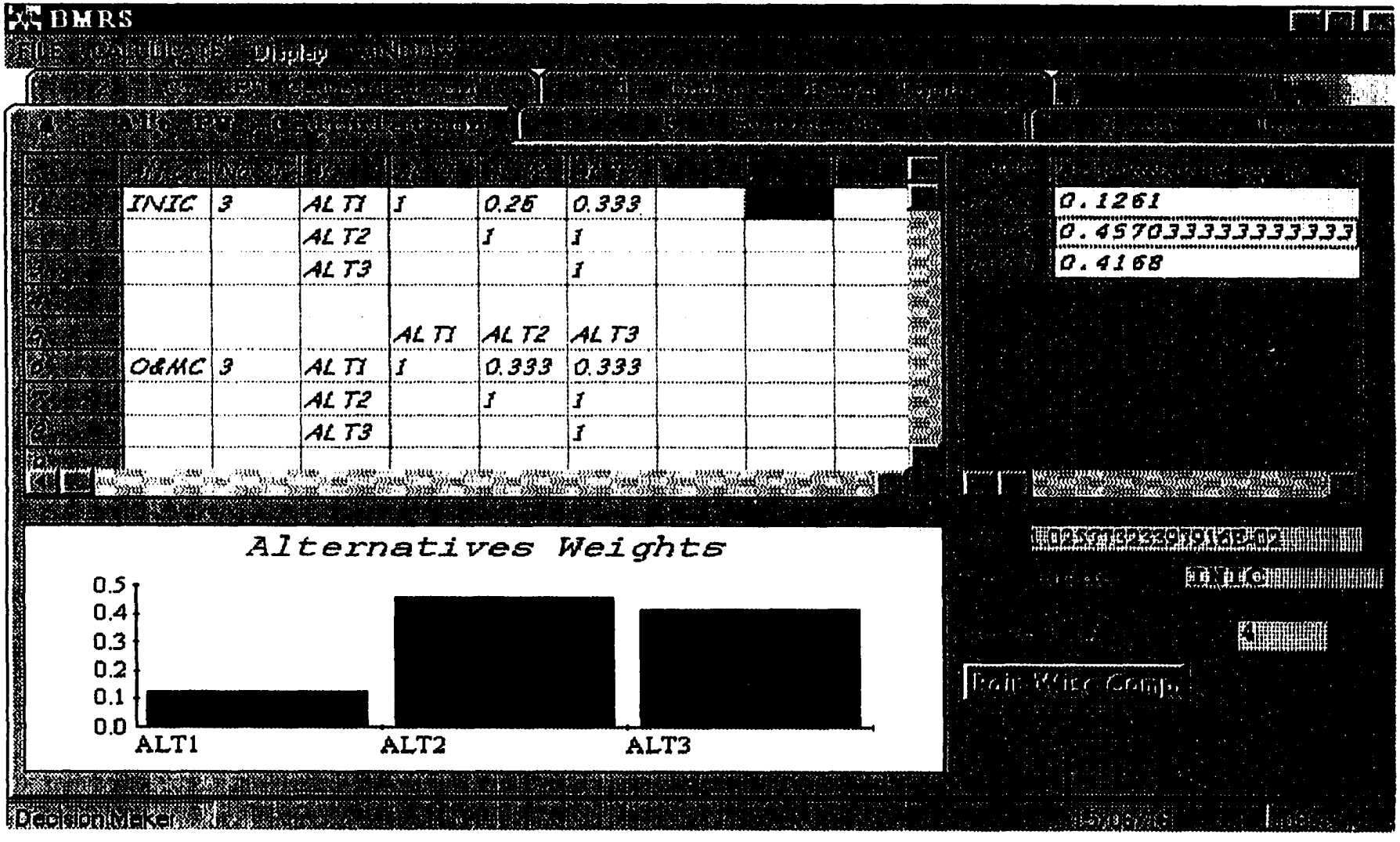


Figure 7.6– Judgments and Priorities of Alternatives with respect to Initial Cost Criterion.

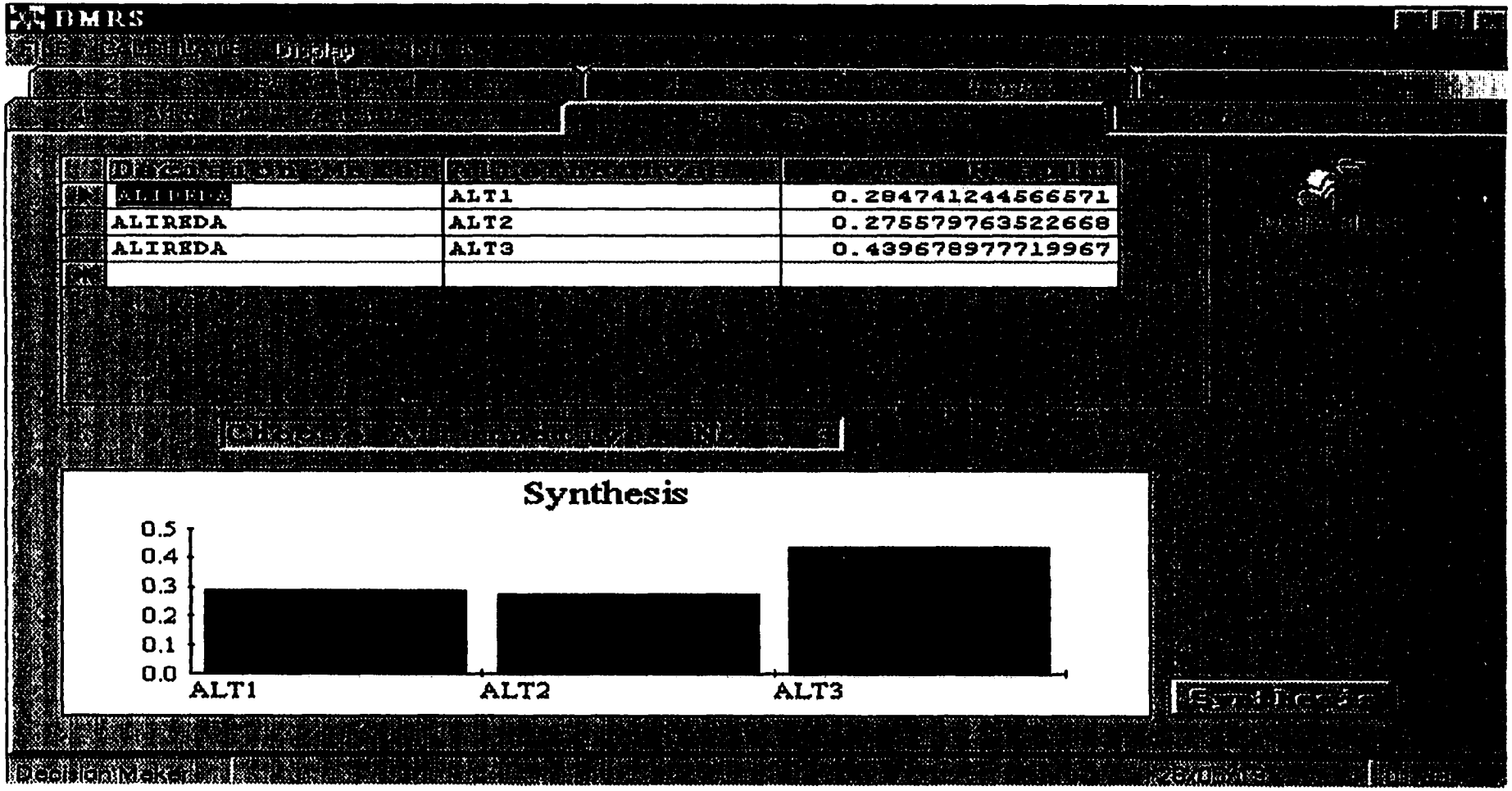


Figure 7.7 – Synthesis – Final Results

CHAPTER EIGHT

SUMMARY, CONCLUSION & RECOMMENDATION

8.1 SUMMARY

Oil and Gas companies like other industrial companies desire to stay ahead of their competitors. They seek to maintain their competitiveness and increase their profitability in order to survive the future. To do so, companies must initiate and implement investment projects to increase production, improve quality, enhance performance or minimize production costs. The initial feasibility of such an investment must be determined at an earlier stage of the project. Conducting the initial feasibility studies usually requires the determination or selection of the best alternative for any investment project. This can be accomplished by the use of multi-Criteria decision making approach that considers the tangible and intangible decision Criteria.

In this research a Computerized Multiple Criteria Decision-Making Model based on the AHP methodology was developed. This model was applied to rank telecommunications project alternatives for a major oil and gas company in the region. The ranking of the project alternatives will focus management attention on the best alternative and permit them to proceed with implementation confidant of the success of the project.

The model was programmed in Visual basic and the data files are automatically saved in Microsoft Access. The program is user friendly and provides the user with the ability to change the evaluation scale. It does not restrict the user to certain decision factors. The user has the freedom to list any factors that he/ she thinks are appropriate to any decision-making situation.

8.2 CONCLUSION

The developed computerized model gives the user a structured and systematic decision making approach for evaluating and selecting project alternatives. Additionally, this model can be used throughout the phases of the project. The areas in which this model can be applied include but, are not limited to:

1. Preliminary Engineering Phase to:
    - Determine the initial feasibility of project alternatives.
    - Evaluate technology alternatives.
2. Contract Development and Bidding Phase to:
    - Perform contractors' pre-qualification.
    - Evaluate technical bids.
3. Evaluation Phase of the Value Engineering Phase.

The application and the use of this decision making approach is straightforward. However, the difficulty lies in the construction of the decision hierarchy which depends mainly on the decision-maker's experience.

8.3 RECOMMENDATIONS FOR FUTURE RESEARCH

Additional research on the developed Computerized Multiple Criteria Decision-Making Model should be conducted. This can include application of this model on other aspects of project management such as the areas mentioned above.

It is recommended that this computerized model should be developed further to be part of an expert system that includes all the criteria that influence the various

decisions for all aspects of the project. It should be noted that the developed model in this research is based on a deterministic approach to decision making. It does not consider uncertainties. Therefore, it is recommended that future research incorporate such uncertainties.

APPENDIX A

Survey & Survey Results

TO : PARTICPANTS

DATE : NOVEMBER 22, 1997

SUBJECT : **Research Topic:** *Multiple Criteria Decision Making For Evaluating Telecommunications Project Alternatives*

Dear Sir:

A study is being conducted on decision making in the area of projects planning and evaluation. The purpose of the study is to develop a computerized Multiple Criteria Decision-Making (MCDM) model for evaluating project alternatives in terms of criteria that are crucial to the owner (proponent) and to the success of the project.

Enclosed to this letter is a questionnaire for this study. The objective of this questionnaire is to seek your opinion about the criteria (factors) that are essential for evaluating telecommunications projects alternatives.

The list of evaluation criteria is attached to this letter. Your input is required to determine if the list is inclusive or if there are any other criteria that need to be added. Additionally, the impact of each factor on the overall decision based on a scale of 1 to 9 is required. The following table explains the meaning of each point on the scale.

Scale points	*Description*
9	*Absolutely important*
7	*Very strongly important*
5	*Strongly important*
3	*Weakly important*
1	*Less important*
2,4,6,8	*Intermediate values, for example, a value of 8 means that the degree of importance is between very strongly important which is (7) and absolutely important which is (9).*

Your input to this questionnaire will lead to a better understanding of the criteria that influence the decision for selecting the best alternative among many project alternatives.

Your assistance is kindly requested to complete this questionnaire by no later than November 24, 1997. An accurate and thorough response will improve telecommunication projects planning and implementation.

Please note that only your input will be utilized in the study. Any information pertaining to your name or position will be kept confidential. Your assistance in this effort will be highly appreciated. For further information on this subject, please call me on 862-2980.

ALIREDA A. AL—JAROUDI

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

1. Project Cost										
• **Initial Cost** : Cost of engineering, acquisition, installation and commissioning of telecommunications system										
• **Operating and Maintenance Cost**: Cost of operation, preventive maintenance, repair, power consumption and HVAC usage.										
• **Alteration and Replacement Costs**: Cost associated with replacement of the components of the system and associated systems such as electrical and HVAC.										
• **Leasing Cost**: Cost associated with leasing system components or space (i.e., leasing the fiber optic cable from PTT, while Saudi Aramco owns the terminal equipment).										
• **De-Commissioning Cost**: the cost of removing the system from services at the end of its life.										

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

• **System Upgrade Cost**: Cost for increasing the system capacity or enhancing the system hardware or software to run more efficiently.										
• **Other**_____										
• **Other**_____										
• **Other**_____										
2. Project Location										
3. **Ownership and Control:** Whether the System / project is exclusively owned or partly owned by the Company. If owned fully by the company, the company will be in full control of the system.										
4. Life of the proposed system										
• **Technological Life:** Life expectancy of the system based on vendor support.										
• **Working Life:** Operational life of the system. For example the working life of construction communications ends at the completion of construction.										
• **Economical Life:** The period of time the system provides benefits to the company.										

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

5. Technology: This factor is related to status of technology whether field proven, under R&D or premature.										
6. Ease of Migration: This is a measure of system flexibility. The ability of the system to migrate from one frequency band to another or the ability to migrate to future system development without the need to replace the system.										
7. System Features										
• **Mandatory Features**: Essential for the system operation and the customers' requirements.										
• **Optional Features**										
8. Ease of Protection During Failure										
9. Compatibility: The ability to interface with existing and future system.										

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

10. Reliability: It is a measure for the Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR). The less the MTBF and MTTR the more reliable the system is.										
11. Availability: This measure is related to the time it takes the System equipment to operate continuously without failure.										
12. System Security										
13. Equipment Dimension										
14. Equipment Weight										
15. Physical Configuration and Appearance										
16. Climatic and Environmental Requirements										
17. Power Requirements										
18. Heat Dissipation										
19. Acceptance of the System / Project										
• By Owner (Operating Organization)										

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

• By Project Management Team (PMT)											
• End User											
• By End User											
• By Public											
• By Government											
20. Permits											
• Equipment Importation Permits											
• Land Use Permit											
21. Vendor Support											
• Warranties											
• On-Site Maintenance											
• Consulting											
• Documentation											
• Hot-Line Support											
• User Training											
22. Waivers: As an example, the system owner might ask for a waiver in order to employ a non-standard bandwidth configuration for a microwave system for special uses.											

QUESTIONNAIRE

CRITERIA THAT INFLUENCE THE DECISION MAKING PROCESS FOR EVALUATING TELECOMMUNICATIONS PROJECTS ALTERNATIVES

23. Time To Implement: Time it takes to implement the project and placing it in operation.										
24. Safety Rating: Intrinsic safety.										
25. Compliance										
• Saudi Aramco Standards										
• International Standards										
• ITU										
26. Other Factors:										
•										
•										
•										
•										

Project Cost:	Initial Cost	Operating and Maintenance Cost	Alteration and Replacement Costs	Leasing Cost	De-Commissioning Cost	System Upgrade Cost	Project Location	Ownership and Control	System Life:	Technological Life	Working Life	Economical Life	Technology	Ease of Migration	System Features:	Mandatory Features	Optional Feature	Ease of Protection During Failure	Compatibility	Reliability	Availability	System Security	Equipment Dimension	Equipment Weight	Physical Configuration and Appearance
	8	7	6	6	1	5	7	5		7	6	5	7	5		5	0	5	7	5	5	4	2	5	3
	9	9	6	7	8	6	9	6		7	6	7	7	6		7	3	5	5	6	5	6	4	3	4
	7	5	5	4	2	5	3	8		6	5	7	7	6		7	5	5	7	8	8	6	5	3	4
	7	7	5	3	5	5	5	3		5	5	7	5	5		9	3	5	4	5	7	5	3	1	3
	3	6	2	5	1	3	6	6		7	6	7	8	4		8	5	7	9	9	9	8	2	5	2
	9	3	3	5	1	2	8	8		7	7	9	1	1		7	3	2	9	9	8	8	5	1	1
	7	4	4	3	3	4	1	5		5	5	5	4	2		5	2	8	4	7	5	4	1	1	1
	9	9	9	9	9	9	6	9		9	9	9	5	7		9	3	6	7	5	9	5	1	4	7
	5	5	5	7	4	7	5	7		8	8	8	8	7		9	7	7	9	6	8	5	7	8	1
	6	6	6	6	6	6	7	5		8	8	8	8	8		6	9	6	7	7	7	8	3	3	4
	9	5	4	5	3	6	8	7		8	6	7	8	6		9	6	7	8	7	8	6	8	5	8
	7	9	6	3	3	7	3	9		8	9	6	9	6		9	4	9	8	8	7	9	3	7	2
	9	5	5	5	4	8	7	7		9	7	7	9	8		9	5	5	9	7	8	2	6	2	3
	8	9	2	8	2	8	8	9		6	6	5	7	7		9	6	9	9	6	2	6	2	3	3
	9	8	7	7	2	3	0	8		8	9	8	9	5		1	3	4	8	8	8	9	6	4	4
	6	3	4	1	3	5	4	7		6	6	7	7	9		5	2	8	9	9	9	7	4	5	4
	6	3	4	1	3	5	1	7		8	8	6	7	6		8	5	9	6	8	8	4	4	2	3
	4	7	6	5	2	6	8	9		7	7	7	7	8		8	4	8	9	6	8	4	3	1	3
	5	6	6	3	1	5	3	7		7	6	9	7	7		9	3	8	9	7	7	6	3	3	3
	8	9	8	5	4	5	6	6		8	8	9	8	8		8	5	9	9	5	9	6	2	2	3
	9	9	7	4	2	4	8	5		6	7	8	8	7		8	4	8	9	8	7	5	5	1	4
	7	8	6	3	3	3	5	8		6	5	7	9	6		9	2	9	5	7	8	4	6	3	3
	6	7	5	2	1	2	4	7		7	6	6	7	7		9	3	5	5	6	6	3	4	3	2
Sum	163.0	149.0	121.0	107.0	73.0	119.0	122.0	158.0		163.0	155.0	164.0	162.0	141.0		173.0	92.0	154.0	171.0	159.0	166.0	130.0	89.0	75.0	75.0
Mean	7.087	6.4783	5.2609	4.6522	3.1739	5.1739	5.3043	6.8696		7.087	6.7391	7.1304	7.0435	6.1304		7.5217	4	6.6957	7.4348	6.913	7.2174	5.6522	3.8696	3.2609	3.2609
VARIANCE	2.949	4.1626	2.8015	4.3138	4.4045	3.3611	6.2987	2.3743		1.2098	1.6711	1.5047	3.259	3.4178		3.8147	3.5652	3.603	3.0284	1.6446	2.6919	3.3573	3.4178	3.4972	2.6276
SD	1.7173	2.0402	1.6738	2.077	2.0987	1.8333	2.5097	1.5409		1.0999	1.2927	1.2267	1.8053	1.8487		1.9531	1.8882	1.8982	1.7402	1.2824	1.6407	1.8323	1.8487	1.8701	1.621

Climatic and Environmental Requirements	Power Requirements	Heat Dissipation	Acceptance of the System / Project: By Owner (Operating Organization)	By Project Management Team (PMT)	End User	By Government	By Public	Permits: Equipment Importation Permits	Land Use Permit	Vendor Support: Warranties	On-Site Maintenance	Consulting	Documentation	Hot-Line Support	User Training	Waivers	Time To Implement	Safety Rating	Compliance: Owner's Standards	International Standards	ITU	
3	3	3	5	3	3	2	4	4	2	6	3	3	5	4	4	7	5	7	7	4	5	
5	6	5	8	8	8	8	1	7	9	7	9	6	8	7	8	8	8	8	7	7	7	
5	5	5	7	7	7	6	7	7	6	7	5	4	5	4	8	7	5	5	9	8	7	
5	3	3	9	8	5	1	1	9	9	3	3	5	7	5	3	7	7	9	7	6	5	
9	7	2	7	8	7	2	9	8	9	5	6	3	5	3	6	7	6	8	9	8	8	
5	3	3	8	9	8	8	9	8	9	9	9	8	9	8	9	7	8	9	7	7	7	
4	3	2	9	5	9	4	5	7	7	3	3	3	3	3	3	4	7	7	7	3	3	
4	2	4	5	7	5	8	9	9	9	4	5	5	7	6	4	8	9	9	5	5	5	
3	4	9	9	6	9	5	5	9	9	9	9	9	9	7	8	7	8	6	9	9	9	
5	4	5	9	4	2	2	3	3	2	9	9	8	8	7	6	5	4	3	2	8	7	
7	5	4	5	6	3	2	4	4	4	5	8	6	8	4	7	5	4	7	6	8	8	
9	5	9	9	8	6	1	7	5	7	9	5	8	8	4	9	5	7	9	8	6	6	
7	8	4	8	6	7	7	9	9	9	9	5	5	5	2	5	5	9	8	7	9	9	
3	5	7	8	6	3	9	7	4	7	6	2	1	1	2	7	7	5	9	9	5	5	
9	4	3	9	7	1	9	9	7	7	8	9	3	7	3	1	7	9	7	9	9	9	
7	9	9	8	9	9	7	7	3	1	6	7	6	5	7	8	6	5	5	6	5	6	
4	4	4	7	6	5	3	7	1	1	5	4	6	7	3	6	5	6	9	6	5	9	
8	7	7	7	7	7	1	6	5	7	7	5	4	9	5	5	5	7	7	7	7	7	
3	4	4	9	7	6	7	7	1	5	7	7	7	7	2	9	7	7	7	7	7	7	
8	4	4	8	7	8	1	5	3	7	8	9	3	9	3	8	5	7	7	7	9	9	
3	4	4	7	7	9	1	7	4	8	6	4	4	7	3	7	4	5	8	6	5	9	
4	7	4	9	6	8	2	2	7	1	5	2	6	5	2	8	3	7	9	6	6	8	
3	4	7	6	6	7	3	3	7	2	4	9	7	5	6	8	9	5	7	7	6	7	
123.0	110.0	111.0	176.0	153.0	142.0	99.0	133.0	131.0	137.0	147.0	137.0	120.0	149.0	100.0	147.0	140.0	150.0	170.0	160.0	152.0	162.0	Total
5.3478	4.7826	4.8261	7.6522	6.6522	6.1739	4.3043	5.7826	5.6957	5.9565	6.3913	5.9565	5.2174	6.4783	4.3478	6.3913	6.087	6.5217	7.3913	6.9565	6.6087	7.0435	Mean
4.4877	3.0397	4.4045	1.7921	1.966	5.535	8.4726	6.344	6.2117	8.7372	3.6295	6.1285	4.0832	4.0756	3.5312	4.673	2.1664	2.3365	2.3251	2.3894	2.8469	2.6503	Varia.
2.1184	1.7435	2.0987	1.3387	1.4021	2.3527	2.9108	2.5187	2.4923	2.9559	1.9051	2.4756	2.0207	2.0188	1.8791	2.1617	1.4719	1.5286	1.5248	1.5458	1.6873	1.628	SD

APPENDIX B

Program Codes Listing

```
Option Base 1
Dim arrayn() As Variant
Dim xl As Object
Dim xR As Integer
Dim GI As Integer
Dim mChrt As Chart
Dim ARRAYM() As Variant
Dim Marray() As Double
Dim VARNAME() As Variant
Dim Y As Double
Dim x As Integer
Dim X10 As Integer
Dim T1 As Integer
Dim TotalCr As Integer
Dim NoOfCriteria As Integer
Dim NoOfAlternative As Integer
Dim AMatrix() As Double
Dim R As Integer
Dim C As Integer
Dim g0 As Long
Dim s0 As Long
Dim G As Long
Dim S As Long
Dim s1 As Long
Dim s2 As Long
Dim s3 As Long
Dim g1 As Long
Dim g2 As Long
Dim g3 As Long
Dim Cr As Long
Dim Al As Long
Dim Grpname As Variant
Dim inptval As String
Dim inptval00 As Integer
Dim inptval000 As Integer
Dim inptval0 As String
Dim inptval11 As String
Dim Sgrname As String
Dim Pok As Boolean
Dim ncr0 As String
Dim db As Database
Dim rsGroup As Recordset
Dim rsSub As Recordset
Dim rsCrt As Recordset
Dim rsAlt As Recordset
Dim rsCnm As Recordset
Dim rsAnm As Recordset
Dim rsRnd As Recordset
Dim rsSynthesis As Recordset
Dim rsTEMP As Recordset
Dim rsC As Recordset
Dim rsMC As Recordset
Dim rssC1 As Recordset
Dim ARRAY19() As Variant
 Sub AddGroup()
 Dim G As Integer
 Dim S As Integer
 Set db = OpenDatabase(App.Path & "\" & "AlirEzaM.mdb")
 Set rsGroup = db.OpenRecordset("Groups")
 TSQ1 = "DELETE FROM GROUPS WHERE   LEN(GROUPS.NAME)=0 OR ISNULL(GROUPS.[GROUP ID])"
db.Execute TSQ1, dbFailOnError
Set rsTEMP = db.OpenRecordset("Select Max(Groups.[Group ID]) as Gmax From Groups;")
If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
```

```
    G = 1
  Else
    G = rsTEMP("Gmax") + 1
  End If
  Set rsTEMP = Nothing
  Set rsTEMP = db.OpenRecordset("Select Max(Groups.[SubGroupID]) as Smax from Groups;")
  If IsNull(rsTEMP!smax) Or Len(rsTEMP!smax) = 0 Then
    S = 1
  Else
    S = rsTEMP("smax") + 1

  End If

  rsGroup.AddNew
  rsGroup("Group ID") = G
  rsGroup("SubGroupID") = S
  rsGroup("Name") = Grpname
  rsGroup.Update

  db.Close


End Sub

Sub AddSubGroup()
  'On Error Resume Next

  Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
  Set rsSub = db.OpenRecordset("SubGroup")
   Tsql = "Delete from Groups where len(Groups.Name)=0 or isnull(Groups.[Group ID])"
  db.Execute Tsql, dbFailOnError

  Set rsTEMP = db.OpenRecordset("Select Max(Groups.[Group ID]) as Gmax From Groups;")
   G = rsTEMP!Gmax
  Set rsTEMP = Nothing
  Set rsTEMP = db.OpenRecordset("Select Max(Groups.[SubGroupID]) as Smax from Groups;")
   S = rsTEMP("smax")
  Set rsTEMP = Nothing
  Set rsTEMP = db.OpenRecordset("Select Max(SubGroup.[CID]) as Cmax From SubGroup;")
  If IsNull(rsTEMP!cmax) Then
    Cr = 1
  Else
    Cr = rsTEMP!cmax + 1
  End If
  Set rsTEMP = Nothing
   Set rsTEMP = db.OpenRecordset("Select Max(SubGroup.[AID]) as Amax From SubGroup;")
  If IsNull(rsTEMP!Amax) Then
    Al = 1
  Else
    Al = rsTEMP!Amax + 1
  End If

  rsSub.AddNew
  rsSub("GID") = G
  rsSub("SID") = S
  rsSub("No_Of_Criteria") = NoOfCriteria
  'rsSub("No_Of_Alternative") = NoOfAlternative
  rsSub("CID") = Cr
  rsSub("AID") = Al

  rsSub("Name") = Sgrname
   'If IsNull(Sgrname) Then
  If rsSub("Name") = "" Then
' MsgBox "Enter Decision Maker Name"
```

```
    rsSub("Name") = "NO - Name"
    End If
    rsSub.Update

    db.Close
'   If rsSub("Name") = "" Then
'    MsgBox "Enter Decision Maker Name"
'    End If
End Sub

Sub AltAnormal()

    Dim Value As Double, Temp As Double
    ReDim AMatrix(NoOfAlternative)
    Dim x As Integer, C As Integer, R As Integer
    grdAnormal.Rows = NoOfAlternative + 1
    x = 1
    For C = 1 To NoOfAlternative

      Value = 0#
      For R = 1 To NoOfAlternative

        grdAnormal.Row = R
        grdAnormal.Col = C
        Temp = CDbl(grdAnormal.Text)
        Value = Value + Temp    'Val(grdAnormal.Text)
      Next R

      AMatrix(C) = Value
    Next C
    For C = 1 To NoOfAlternative

      For R = 1 To NoOfAlternative

        grdAnormal.Col = C
        grdAnormal.Row = R
        grdAnormal.Text = Format(Val(grdAnormal.Text) / AMatrix(C), "##0.0000")
      Next R

    Next C


End Sub
Sub AltComparision()

    On Error GoTo GEtOUT

    Dim value1 As Double
    Dim value2 As Double
    Dim value3 As Double
    Dim x As Integer
    Dim C As Integer
    Dim R As Integer
    NoOfAlternative = txtNoOfAlternatives.Text
    x = 0

    For C = 1 To NoOfAlternative
      x = x + 1
      For R = x To NoOfAlternative
        grdAlter.Row = C
        grdAlter.Col = C
        value1 = Format(grdAlter.Text, "#0.00")
        grdAlter.Row = C
        grdAlter.Col = R
```

```
            value2 = Format(grdAlter.Text, "#0.00")
            grdAlter.Row = R
            grdAlter.Col = C
            value3 = value1 / value2
            grdAlter.Text = value3
          Next R
        Next C

        AltFillGrids
        AltAnormal
        AltWeight
        AltWeight1
        AltConsistency
        Exit Sub
GEtOUT:
        MsgBox "Check The Pair Values In The Grid.", vbCritical, "PairWise Calculation"
        Exit Sub

    End Sub
    Sub AltConsistency()

      Dim R As Integer
      Dim C As Integer
      Dim Value As Double
      Dim Temp As Double
      Value = 0#

      For R = 1 To NoOfAlternative

        For C = 1 To NoOfAlternative

          grdAlter.Row = R
          grdAlter.Col = C
          grdAweight1.Row = C
          grdAweight1.Col = 1
          Temp = (grdAlter.Text * grdAweight1.Text)
          Value = Value + Temp
        Next C
        grdAcons.Row = 1
        grdAcons.Col = R
        grdAcons.Text = Value
        Value = 0#
      Next R

    End Sub


    Sub AltFillGrids()

      Dim C As Integer
      Dim R As Integer

      For C = 1 To NoOfAlternative
        grdAlter.Col = C
        grdAnormal.Col = C
        grdAltBak.Col = C

        For R = 1 To NoOfAlternative
          grdAlter.Row = R
          grdAnormal.Row = R
          grdAltBak.Row = R
          grdAnormal.Text = grdAlter.Text
          grdAltBak.Text = grdAlter.Text
        Next R
```

```
    Next C

End Sub


Sub AltWeight()

    Dim R As Integer
    Dim C As Integer
    ReDim AMatrix(NoOfAlternative)
    Dim Value As Double, Temp As Double
    Dim x As Integer
    Value = 0#


    For R = 1 To NoOfAlternative

        For C = 1 To NoOfAlternative
            grdAnormal.Row = R
            grdAnormal.Col = C
            Temp = Format(grdAnormal.Text, "#0.0000")
            Value = Format((Value + Temp), "#0.0000")
        Next C

        AMatrix(R) = Value
        Value = 0#

    Next R

    For R = 1 To NoOfAlternative

        grdAweight.Col = nLindex + 1
        grdAweight.Row = R
        grdAweight.Text = Format(AMatrix(R), "#0.0000") / NoOfAlternative

    Next R


End Sub

Sub Anormal()

    Dim Value As Double
    ReDim MATRIX(NoOfCriteria)
    Dim x As Integer, C As Integer, R As Integer
    grdpnormal.Rows = NoOfCriteria + 1
    x = 1
    For C = 1 To NoOfCriteria

        Value = 0#
        For R = 1 To NoOfCriteria

            grdpnormal.Row = R
            grdpnormal.Col = C
            Value = Value + Val(grdpnormal.Text)
        Next R

        MATRIX(C) = Value
    Next C
    For C = 1 To NoOfCriteria

        For R = 1 To NoOfCriteria

            grdpnormal.Col = C
```

```
        grdpnormal.Row = R
        grdpnormal.Text = Format(Val(grdpnormal.Text) / MATRIX(C), "#0.0000")
      Next R

    Next C

End Sub

Sub ConsIndex()
  'On Error GoTo GEtOUT
On Error Resume Next
'-------------------------------------------------------------
  Dim R As Integer
  Dim C As Integer
  Dim Value As Double, Temp As Double
  Dim RI As Double
  Dim Msg As String
  Value = 0#
  Temp = 0#

  'For R = 1 To NoOfCriteria

     grdpweight.Col = 1
     grdpcons.Row = 1
    For C = 1 To NoOfCriteria

      grdpweight.Row = C
      grdpcons.Col = C
      Temp = grdpcons.Text / grdpweight.Text
      Value = Value + Temp

    Next C

  'Next R
  Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
  Set rsRnd = db.OpenRecordset("RandomIndex")
  rsRnd.Index = "RID"
  rsRnd.Seek "=", NoOfCriteria
  RI = rsRnd("Rindex")

  Msg = ""
  Value = Value / NoOfCriteria
  Temp = (Value - NoOfCriteria) / (NoOfCriteria - 1)
  Label10 = Temp / RI
  '-----------

  Msg = Msg & Chr(13) & "Lambda Max =  " & Format(Value, "###0.0000")
  Msg = Msg & Chr(13) & "Consistency Index =  " & Format(Temp, "###0.0000")

  Msg = Msg & Chr(13) & "Random Index= " & RI
  Msg = Msg & Chr(13) & "CI/RI   =  " & Format((Temp / RI), "###0.0000")

  If (Temp / RI) < 0.1 Then
    Msg = Msg & Chr(13) & "Degree of Consistency Is Satisfactory"
  Else
    Msg = Msg & Chr(13) & "Degree of Consistency Is  Not Satisfactory"
  End If

  inptval11 = MsgBox(Msg, vbOKCancel)
  'Text1 = Temp / RI

'RETVALUE = MsgBox(" Do you require any further Calculations", vbYesNo)
```

```
If inptval11 = vbOK Then

FileSave1
 'X10 = X10 + 1
 'L = L + 1

End If

If inptval11 = vbCancel Then

MsgBox "Repeat Your Calculation"

Exit Sub
End If


End Sub

Sub Consistency()

  Dim R As Integer
  Dim C As Integer
  Dim Value As Double
  Dim Temp As Double
  Value = 0#

  For R = 1 To NoOfCriteria

    For C = 1 To NoOfCriteria

      grdpair.Row = R
      grdpair.Col = C
      grdpweight.Row = C
      grdpweight.Col = 1
      Temp = (grdpair.Text * grdpweight.Text)
      Value = Value + Temp
    Next C
    grdpcons.Row = 1
    grdpcons.Col = R
    grdpcons.Text = Value
    Value = 0#
  Next R

End Sub


Sub FillGrids()
  Dim C As Integer
  Dim R As Integer

  For C = 1 To NoOfCriteria
    grdpair.Col = C
    grdpnormal.Col = C
    grdPairBak.Col = C

    For R = 1 To NoOfCriteria
      grdpair.Row = R
      grdpnormal.Row = R
      grdPairBak.Row = R
      grdpnormal.Text = grdpair.Text
      grdPairBak.Text = grdpair.Text
    Next R
  Next C
```

```
End Sub

Sub PairWiseComparision()
On Error GoTo GEtOUT


   Dim value1 As Double
   Dim value2 As Double
   Dim value3 As Double
   Dim x As Integer
   Dim C As Integer
   Dim R As Integer
   NoOfCriteria = txtNoOfCriteria.Text
   x = 0

   For C = 1 To NoOfCriteria
      x = x + 1
      For R = x To NoOfCriteria
         grdpair.Row = C
         grdpair.Col = C
         value1 = Format(grdpair.Text, "#.0000")
         grdpair.Row = C
         grdpair.Col = R
         value2 = Format(grdpair.Text, "#.0000")
         grdpair.Row = R
         grdpair.Col = C
         value3 = value1 / value2
         grdpair.Text = value3
      Next R
   Next C

   FillGrids
   Anormal
   Weight
   Consistency
   Exit Sub
GEtOUT:
   MsgBox "Check The Pair Values In The Grid.", vbCritical, "PairWise Calculation"
   Exit Sub

End Sub
Sub Synthesis()
   'NoOfCrAlt = NoOfCrAlt.Text
   Dim TOT() As Double
   ReDim TOT(NoOfAlternative) As Double
   Dim NoCA As Integer
   Dim NoAl As Integer
   Dim R As Integer
   Dim C As Integer
   Dim value1 As Double
   Dim value2 As Double
   Dim v As Double
   Dim x As String
'-------------------------------------------------------
   NoCA = NoOfCrAlt
   NoAl = NoOfAlternative
   For R = 1 To NoAl
      v = 0#
      value1 = 0#
      value2 = 0#
      TOT(R) = 0#
      For C = 1 To NoCA
'-------------------------------------------------------
```

```
        Grid2.Col = R
        Grid2.Row = C
         value1 = Grid2.Text
'-------------------------------------------------------------

        TOT(R) = value1 + TOT(R)
      Next C
    Next R

    grdSynthesis.Cols = NoOfAlternative + 1

    For C = 1 To NoOfAlternative

      grdSynthesis.Row = 1
      grdSynthesis.Col = C
      grdSynthesis.Text = TOT(C)
    Next C
    value1 = TOT(1)
    For C = 1 To NoOfAlternative

      If value1 > TOT(C) Then
      Else
        value1 = TOT(C)
        R = C
      End If
    Next C
    lblsynthesis.Caption = "Choose Alternative  No : " & R
    Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

    Set rsSynthesis = db.OpenRecordset("Synthesis")

For R = 1 To NoAl
rsSynthesis.AddNew
rsSynthesis("GID") = G
rsSynthesis("SID") = S
lstAlternatives.ListIndex = R - 1
rsSynthesis("Alternatives") = lstAlternatives.Text
grdSynthesis.Row = 1
grdSynthesis.Col = C
rsSynthesis("Final Result") = grdSynthesis.Text
rsSynthesis("Result") = value1
rsSynthesis("Message") = lblsynthesis.Caption
rsSynthesis.Update
Next R

db.Close

End Sub

Sub Weight()

  Dim R As Integer
  Dim C As Integer
  ReDim MATRIX(NoOfCriteria)
  ReDim MATRIX1(NoOfCriteria)
  Dim Value As Double, Temp As Double
  Dim x As Integer
  Dim Y As Double
  Value = 0#

  x = 1

  For R = 1 To NoOfCriteria
```

```
        For C = 1 To NoOfCriteria
            grdpnormal.Row = R
            grdpnormal.Col = C
           ' Temp = Format(grdpnormal.Text, "fixed ")
           ' Value = Format((Value + Temp), "fixed ")
           Temp = Format(grdpnormal.Text, "#0.0000 ")
           Value = Format((Value + Temp), "#0.0000")
        Next C

        MATRIX(R) = Value
       ' MATRIX1(R) = value * Y
        Value = 0#
        x = x + 1
    Next R

    For R = 1 To NoOfCriteria

      grdpweight.Col = 1
      grdpweight.Row = R
      grdpweight.Text = Format(MATRIX(R), "#0.0000") / NoOfCriteria

    Next R

End Sub

Private Sub AboutDeciMaker_Click()

Frmabout9.Show

End Sub

Private Sub ADDCAL_Click()
Dim I As Integer
   Dim frm As Object

   Set frm = New frmdecsion

   cp = InputBox("Caption")

   frm.Caption = cp


   frm.Show
End Sub


Private Sub ALtList_KeyPress(KeyAscii As Integer)
' KeyAscii = Asc(UCase(Chr(KeyAscii)))
   If KeyAscii = 13 Then
      If Len(Trim(ALtList.Text)) > 0 Then

''     'lstcriteria.AddItem UCase(txtCriterias.Text)
       lstcritriabak.AddItem UCase(ALtList.Text)
    ALtList.Text = " "
     End If
   End If
End Sub


Private Sub ALtList_LostFocus()
Dim I As Integer
Dim CHARCTER As String
For I = 1 To Len(ALtList.Text)
If (CHARCTER < "A" Or CHARCTER > "Z") And (CHARCTER < "0" Or CHARCTER > "9") Then
```

```
Beep
ALtList.SetFocus
Exit For
End If
Next I

End Sub

Private Sub Alternatives_Change()
SSCommand2.Visible = True
GrdInAltDat1.Visible = False
End Sub

Private Sub Alternatives_KeyPress(KeyAscii As Integer)
 If KeyAscii = 13 Then
       If Len(Trim(Alternatives.Text)) > 0 Then
         AlternativesList.AddItem UCase(Alternatives.Text)

        Alternatives.Text = ""

       End If
    End If

End Sub


Private Sub AlternativesList_DblClick()
AlternativesList.Clear
End Sub

Private Sub AltPWCalculation_Click()
 'cmdAlternative.TOOLTIPTEXT = SSS
   Dim a As Integer
   Dim x As Integer

GrdInAltDat1.Col = 4
For I = 1 To NoOfAlternative
 For R = 1 To NoOfAlternative

grdAlter.Col = R
grdAlter.Row = I
grdAlter.Text = GrdInAltDat1.Text
GrdInAltDat1.Col = 4 + R
 Next R
 GrdInAltDat1.Row = GrdInAltDat1.Row + 1
Next I

   If Not IsNumeric(txtNoOfLevels.Text) Then
       MsgBox "Please Enter Numebr of Levels"
       txtNoOfLevels = 3
   End If

  a = txtNoOfLevels

  grdAlter.Col = 0
  grdAlter.Row = 0
  If IsNull(grdAlter.Text) Or Len(Trim(grdAlter.Text)) = 0 Then
     MsgBox "Select Criteria for This Alternative.", vbCritical, "Alternative"
     Exit Sub
  End If
  'If nCriteria = 0 Then
     sCriteria = lstcritriabak.Text
    'sCriteria = Label1(10).Caption
     nCriteria = nCriteria + 1
```

```
    x = lstcritriabak.ListIndex
    ' x = Label1(10).Caption
    nLindex = x + 1 + nLindex
'     lstcritriabak.RemoveItem x
  'End If

  AltComparision
  AltConsisIndex

  PlotAltData


End Sub

Private Sub chartdisplay_Click()

 ReloadData
 CreatChart
 xl.Application.Quit
 Set xl = Nothing
 Exit Sub

End Sub


Private Sub cmdAGridHead_Click()
  Dim x As Integer
 x = lstAlternatives.ListCount
 If x <> NoOfAlternative Then
  MsgBox "No. Of Alternatives Does Not Match The Alternative Count. ", vbCritical, "Test Project"
  Exit Sub
 End If

 For I = 0 To x - 1
    grdAlter.Row = I + 1
    grdAlter.Col = 0
    grdAnormal.Row = I + 1
    grdAnormal.Col = 0
    grdAltBak.Row = I + 1
    grdAltBak.Col = 0
    lstAlternatives.ListIndex = I
    grdAlter.Text = lstAlternatives.Text
    grdAnormal.Text = lstAlternatives.Text
    grdAltBak.Text = lstAlternatives.Text
 Next
 For I = 0 To x - 1
    grdAlter.Col = I + 1
    grdAlter.Row = 0
    grdAnormal.Col = I + 1
    grdAnormal.Row = 0
    grdAltBak.Col = I + 1
    grdAltBak.Row = 0
    lstAlternatives.ListIndex = I
    grdAlter.Text = lstAlternatives.Text
    grdAnormal.Text = lstAlternatives.Text
    grdAltBak.Text = lstAlternatives.Text
 Next
 For I = 0 To x - 1
    grdAweight.Row = I + 1
    grdAweight.Col = 0
     lstAlternatives.ListIndex = I
    grdAweight.Text = lstAlternatives.Text
 Next I
 For I = 0 To x - 1
```

```
        grdAcons.Row = 0
        grdAcons.Col = I + 1
        lstAlternatives.ListIndex = I
        grdAcons.Text = lstAlternatives.Text
    Next I

End Sub

Private Sub cmdAltAdd_Click()

    If NoOfCrAlt = 0 Or IsNull(NoOfCrAlt) Then Exit Sub
    AddAlternatives
End Sub

Private Sub Cmbtype2_Click()
Dim sel2  As String
sel2 = Cmbtype2.Text
Select Case sel2

Case "2D-Bar"
Graph2.GraphType = gphBar2D

Case "2D-Pie"
Graph2.GraphType = gphPie2D

Case "3D-Bar"
Graph2.GraphType = gphBar3D

Case "3D-Pie"
Graph2.GraphType = gphPie3D

Case "Area"
Graph2.GraphType = gphArea

Case "Gantt"
Graph2.GraphType = gphGantt

Case "HLC"
Graph2.GraphType = gphHLC

Case "Line"
Graph2.GraphType = gphLine

Case "Polar"
Graph2.GraphType = gphPolar

Case "SCATTER"
Graph2.GraphType = gphScatter
Case Else
Graph2.GraphType = gphLine
End Select
Graph2.DrawMode = 2
Cmbtype2.Visible = False
End Sub

Private Sub Cmbtype_Click()
Dim sel  As String
sel = Cmbtype.Text
Select Case sel
Case "3D-Bar"
Graph1.GraphType = gphBar3D
Case "2D-Bar"
Graph1.GraphType = gphBar2D
Case "2D-Pie"
```

```
 Graph1.GraphType = gphPie2D
 Case "3D-Pie"
 Graph1.GraphType = gphPie3D
 Case "Line"
 Graph1.GraphType = gphLine
 Case "Area"
 Graph1.GraphType = gphArea
 Case "Gantt"
 Graph1.GraphType = gphGantt
' Case "Log/Lin"
' Graph1.GraphType = gphlog / Lin
 Case "Polar"
 Graph1.GraphType = gphPolar
 Case "HLC"
 Graph1.GraphType = gphHLC
 Case "SCATTER"
 Graph1.GraphType = gphScatter
  Case Else
  Graph1.GraphType = gphLine
 End Select
 Graph1.DrawMode = 2
 Cmbtype.Visible = False
End Sub


Private Sub Cmbtype3_Click()
Dim sel3  As String
 sel3 = Cmbtype3.Text
 Select Case sel3
  Case "2D-Bar"
 Graph3.GraphType = gphBar2D

 Case "2D-Pie"
 Graph3.GraphType = gphPie2D

 Case "3D-Bar"
 Graph3.GraphType = gphBar3D

 Case "3D-Pie"
 Graph3.GraphType = gphPie3D

 Case "Area"
 Graph3.GraphType = gphArea

 Case "Gantt"
 Graph3.GraphType = gphGantt

 Case "HLC"
 Graph3.GraphType = gphHLC

 Case "Line"
 Graph3.GraphType = gphLine

 Case "Polar"
 Graph3.GraphType = gphPolar

 Case "SCATTER"
 Graph3.GraphType = gphScatter
 Case Else
 Graph3.GraphType = gphLine
 End Select

Graph3.DrawMode = 2
Cmbtype3.Visible = False
```

```
End Sub

Private Sub cmdAlternative_Click()
  'cmdAlternative.TOOLTIPTEXT = SSS
   Dim a As Integer
   Dim x As Integer

GrdInAltDat1.Col = 4
For I = 1 To NoOfAlternative
 For R = 1 To NoOfAlternative

grdAlter.Col = R
grdAlter.Row = I
grdAlter.Text = GrdInAltDat1.Text
GrdInAltDat1.Col = 4 + R
 Next R
 GrdInAltDat1.Row = GrdInAltDat1.Row + 1
Next I

   If Not IsNumeric(txtNoOfLevels.Text) Then
       MsgBox "Please Enter Numebr of Levels"
       txtNoOfLevels = 3
   End If

  a = txtNoOfLevels

  grdAlter.Col = 0
  grdAlter.Row = 0
   If IsNull(grdAlter.Text) Or Len(Trim(grdAlter.Text)) = 0 Then
      MsgBox "Select Criteria for This Alternative.", vbCritical, "Alternative"
      Exit Sub
   End If
   'If nCriteria = 0 Then
      sCriteria = lstcritriabak.Text
     'sCriteria = Label1(10).Caption
      nCriteria = nCriteria + 1
      x = lstcritriabak.ListIndex
     ' x = Label1(10).Caption
      nLindex = x + 1 + nLindex
'     lstcritriabak.RemoveItem x
   'End If

   AltComparision
   AltConsisIndex
  ' If NoOfCrAlt = 0 Or IsNull(NoOfCrAlt) Then Exit Sub
   'AddAlternatives

   PlotAltData


End Sub

Private Sub cmdExit_Click()
   Unload Me
End Sub

Private Sub Command2_Click()
 If MSFlexGrid1.GridLinesFixed < 3 Then
MSFlexGrid1.GridLinesFixed = MSFlexGrid1.GridLines + 1
Else
MSFlexGrid1.GridLinesFixed = 0
End If
End Sub
```

```
Private Sub Command1_Click()
If MSFlexGrid1.GridLines < 3 Then
MSFlexGrid1.GridLines = MSFlexGrid1.GridLines + 1
Else
MSFlexGrid1.GridLines = 0
End If
End Sub


Sub Command44_Click()
Dim I As Integer
Dim NOcr As Integer

 NOcr = 4 'NoOfCriteria.Text
 Dim sngInew(4) As Single
Graph1.GraphTitle = "Criteria Weights"

Graph1.NumPoints = 4
Graph1.ThisPoint = 1
Graph1.AutoInc = 1
For I = 1 To 4
sngInew(4) = Rnd(1) * I + 1
grdpweight.Col = 1
grdpweight.Row = I

Graph1.GraphData = grdpweight.Text

'lstcriteria.ListIndex = i - 1
'Graph1.LabelText = lstcriteria
Next I
For I = 1 To 4
sngInew(4) = Rnd(1) * I + 1
grdpweight.Col = 0
grdpweight.Row = I


Graph1.LabelText = grdpweight.Text

Graph1.DrawMode = 2

Next I

End Sub

Private Sub CrInData_Click()

Dim DM As Variant
Dim MO As Variant
Dim DM1 As Variant
Dim MO1 As Variant

 On Error Resume Next

'--------
GridInputData.Visible = True
GrdInAltDat1.Visible = True


'-------------
DecisonMakerName.Text = ""
MainObjective.Text = ""
txtNoOfLevels.Text = ""
NoOfCrNode.Text = ""
```

```
lstcriteria.Clear
list1.Clear
ListCRALT.Clear
text2.Text = ""
Text4.Text = ""
LstCrNodes.Clear
LstLevels.Clear
NofCrList.Clear
AlternativesList.Clear
ListCRALT.Clear
NoOfCrAlt.Text = ""
txtCriteriaAlt.Text = ""
'-------------

'-------

'SSCommand3.Visible = False
tabDecision.TabEnabled(0) = True
tabDecision.TabEnabled(3) = True
tabDecision.TabEnabled(4) = True
tabDecision.TabEnabled(5) = True

'-----------------------------
Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rsAltIn = db.OpenRecordset("AlternativesInput")

Set rsLCANo = db.OpenRecordset("LevCrAltNo")
FN = InputBox("File Name?")

rsLCANo.Index = "FileName"
rsLCANo.Seek "=", FN

If rsLCANo.NoMatch = True Then

MsgBox "File Does Not Exist "
'End

Else


RetrlevCRALTNO
CRDataRetrieve
AltDataRetrieve

End If

End Sub

Private Sub CrNodeName_Change()
SSCommand3.Visible = True
 GridInputData.Visible = False
 lstcriteria.Clear
list1.Clear
 ListCRALT.Clear

End Sub

Private Sub CrNodeName1_KeyPress(KeyAscii As Integer)
    If KeyAscii = 13 Then
    If Len(Trim(CrNodeName1.Text)) > 0 Then
    LstCrNodes.AddItem UCase(CrNodeName1.Text)

     CrNodeName1.Text = ""
```

```
    End If
  End If


End Sub

Private Sub CrNodeName1_LostFocus()
  CrNodeName1 = CrNodeName1.Text
End Sub

Private Sub CrNodeName1_GotFocus()
CrNodeName1.Text = ""
End Sub


Private Sub CrNodeName_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
      If Len(Trim(CrNodeName.Text)) > 0 Then
       LstCrNodes.AddItem UCase(CrNodeName.Text)
        ' ListCRALT.AddItem UCase(txtCriteriaAlt.Text)
        CrNodeName.Text = ""

      End If
   End If
End Sub

Private Sub DecisonMakerName_KeyPress(KeyAscii As Integer)

Sgrname = DecisonMakerName.Text
If KeyAscii = 13 Then
 SendKeys "{TAB}", True
End If


End Sub

Private Sub DISPLAYOTHERTBS_Click()
tabDecision.TabEnabled(1) = True
tabDecision.TabEnabled(2) = True
tabDecision.TabEnabled(4) = True
tabDecision.TabEnabled(5) = True
End Sub

Private Sub Filenew_Click()

Dim I As Integer
Dim frm As Object

Set frm = New frmdecsion
cp = InputBox("Caption")
frm.Caption = cp
frm.Show

End Sub

Private Sub filexit_Click()
 Unload Me
End Sub

Private Sub Form_Load()

tabDecision.TabEnabled(0) = False
 tabDecision.TabEnabled(1) = True
```

```
tabDecision.TabEnabled(2) = True

tabDecision.TabEnabled(3) = False
tabDecision.TabEnabled(4) = False
tabDecision.TabEnabled(5) = False

GrdHeadInDat

Graph1.Visible = False
Graph2.Visible = False
Graph3.Visible = False

GrdInAltDat1.Visible = False
GridInputData.Visible = False

'_______

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsGroup = db.OpenRecordset("Groups")
Set rsSub = db.OpenRecordset("SubGroup")
Set rsMC = db.OpenRecordset("MAINCR")
Set rSsc2 = db.OpenRecordset("SubCr2")
Set rsSC3 = db.OpenRecordset("SubCr3")
Set rsSC4 = db.OpenRecordset("SubCr4")
Set rsACW2 = db.OpenRecordset("AltCrWeight2")
Set rsACW3 = db.OpenRecordset("AltCrWeight3")
Set rsACW4 = db.OpenRecordset("AltCrWeight4")
Set rsACW5 = db.OpenRecordset("AltCrWeight5")
Set rsSynthesis = db.OpenRecordset("Synthesis")


Do Until rsGroup.EOF

  rsGroup.Delete
  rsGroup.MoveNext
Loop

Do Until rsSub.EOF
 rsSub.Delete
 rsSub.MoveNext
Loop

Do Until rsMC.EOF

 rsMC.Delete
 rsMC.MoveNext
Loop

Do Until rSsc2.EOF
 rSsc2.Delete
 rSsc2.MoveNext
Loop

Do Until rsSC3.EOF

 rsSC3.Delete
 rsSC3.MoveNext
Loop

Do Until rsSC4.EOF
 rsSC4.Delete
 rsSC4.MoveNext
Loop
```

```
Do Until rsACW2.EOF

  rsACW2.Delete

  rsACW2.MoveNext
Loop

Do Until rsACW3.EOF
 rsACW3.Delete
 rsACW3.MoveNext
Loop

Do Until rsACW4.EOF
 rsACW4.Delete
 rsACW4.MoveNext
Loop


Do Until rsACW5.EOF

  rsACW5.Delete

  rsACW5.MoveNext
 Loop


Do Until rsSynthesis.EOF

rsSynthesis.Delete
rsSynthesis.MoveNext

Loop

End Sub

Private Sub formprint_Click()

 PrintForm

End Sub


Private Sub grdAlter_KeyDown(KeyCode As Integer, Shift As Integer)
For I = grdAlter.SelStartCol To grdAlter.SelEndCol

      grdAlter.ColWidth(I) = 600

Next I
End Sub

Private Sub grdAlter_KeyPress(KeyAscii As Integer)

   If KeyAscii = 13 Then
     grdAlter.Text = Format(grdAlter.Text, "#.0")
     SendKeys "{RIGHT}", True
     Exit Sub
   End If
   If KeyAscii = 8 Then
     If Len(Trim(grdAlter.Text)) > 0 Then
        grdAlter.Text = Mid(grdAlter.Text, 1, Len(grdAlter.Text) - 1)
     End If
```

```
    Exit Sub
  End If

  grdAlter.Text = grdAlter.Text & Chr(KeyAscii)

End Sub

Private Sub grdAweight1_DblClick()
grdAweight1.Col = 1
grdAweight1.Row = 0
grdAweight1.Text = "ALTERNATIVES WEIGHT"


For I = grdAweight1.SelStartCol To grdAweight1.SelEndCol

      grdAweight1.ColWidth(I) = 4000

Next I
End Sub


Private Sub GrdInAltDat1_DblClick()

 On Error Resume Next
'On Error GoTo GEtOUT


GrdInAltDat1.Col = 1
grdAlter.Col = 0
grdAlter.Row = 0
grdAlter.Text = UCase(GrdInAltDat1.Text)
txtCriteriaAlt.Text = UCase(GrdInAltDat1.Text)
Label1(10).Caption = UCase(grdAlter.Text)
grdAweight1.Col = 0
grdAweight1.Row = 0

grdAweight1.Text = UCase(GrdInAltDat1.Text)

'-----------------------------------
GrdInAltDat1.Col = 2

txtNoOfAlternatives = GrdInAltDat1.Text


  If IsNull(txtNoOfAlternatives.Text) = True Or Len(Trim(txtNoOfAlternatives.Text)) = 0 Then
  Else
    grdAlter.Cols = txtNoOfAlternatives.Text + 1
    grdAlter.Rows = txtNoOfAlternatives.Text + 1
    grdAweight1.Rows = txtNoOfAlternatives + 1
    grdAweight1.Cols = txtNoOfAlternatives + 1
    grdAnormal.Cols = txtNoOfAlternatives.Text + 1
    grdAnormal.Rows = txtNoOfAlternatives.Text + 1
    grdAltBak.Cols = txtNoOfAlternatives.Text + 1
    grdAltBak.Rows = txtNoOfAlternatives.Text + 1
    grdAweight.Rows = txtNoOfAlternatives + 1

     grdAweight.Cols = NoOfCrAlt + 1
    grdAcons.Cols = txtNoOfAlternatives + 1


    NoOfAlternative = txtNoOfAlternatives.Text
  End If
  nCriteria = 0
```

```
For R = 1 To NoOfAlternative
GrdInAltDat1.Col = 3
'GrdInAltDat1.Row = 1
grdAlter.Col = 0
grdAlter.Row = R

grdAlter.Text = UCase(GrdInAltDat1.Text)
grdAweight1.Col = 0
grdAweight1.Row = R

grdAweight1.Text = UCase(grdAlter.Text) ' UCase(grdAlter.Text)
'GridAltData.Row = 2
grdAweight.Col = 0
grdAweight.Row = R
grdAweight.Text = UCase(grdAweight1.Text)
'txtalternatives = GridAltData.Text
grdAlter.Row = 0
grdAlter.Col = R
grdAlter.Text = UCase(grdAweight.Text)

'-----------------------------------------------------------
GrdInAltDat1.Col = 3 + R
GrdInAltDat1.Row = GrdInAltDat1.Row - R
GrdInAltDat1.Text = UCase(grdAlter.Text)


GrdInAltDat1.Row = GrdInAltDat1.Row + R
GrdInAltDat1.Row = GrdInAltDat1.Row + 1

'-----------------------------------------------------------

Next R

I = 1
        For I = GrdInAltDat1.SelStartCol To GrdInAltDat1.SelEndCol

       GrdInAltDat1.ColWidth(I) = 600

        Next I

  GrdInAltDat1.Visible = True

End Sub


Private Sub GrdInAltDat1_KeyPress(KeyAscii As Integer)
Dim I As Integer

If KeyAscii = 13 Then
    GrdInAltDat1.Text = Format(GrdInAltDat1.Text, "#.00000")
      SendKeys "{RIGHT}", True
      Exit Sub
  End If
  If KeyAscii = 8 Then
     If Len(Trim(GrdInAltDat1.Text)) > 0 Then
      GrdInAltDat1.Text = Mid(GrdInAltDat1.Text, 1, Len(GrdInAltDat1.Text) - 1)
     End If
     Exit Sub
  End If
'-----------------------------------------------------------
      I = 1
       For I = GrdInAltDat1.SelStartCol To GrdInAltDat1.SelEndCol

      GrdInAltDat1.ColWidth(I) = 800
```

```
        Next I
'-------------------------------------------------------

  GrdInAltDat1.Text = GrdInAltDat1.Text & Chr(KeyAscii)
End Sub


Private Sub grdpair_KeyDown(KeyCode As Integer, Shift As Integer)
For I = grdpair.SelStartCol To grdpair.SelEndCol

        grdpair.ColWidth(I) = 600

Next I

End Sub

Private Sub grdPair_KeyPress(KeyAscii As Integer)

   If KeyAscii = 13 Then
      grdpair.Text = Format(grdpair.Text, "#0.0")
      SendKeys "{RIGHT}", True
      Exit Sub
   End If
   If KeyAscii = 8 Then
      If Len(Trim(grdpair.Text)) > 0 Then
         grdpair.Text = Mid(grdpair.Text, 1, Len(grdpair.Text) - 1)
      End If
      Exit Sub
   End If

   grdpair.Text = grdpair.Text & Chr(KeyAscii)

End Sub


Private Sub grdpweight_DblClick()
grdpweight.Col = 1
grdpweight.Row = 0
grdpweight.Text = "CRITERIA WEIGHT"


For I = grdpweight.SelStartCol To grdpweight.SelEndCol

        grdpweight.ColWidth(I) = 4000

Next I
End Sub


Private Sub Grid4_Click()
For I = GridInputData.SelStartCol To GridInputData.SelEndCol

        GridInputData.ColWidth(I) = 830

Next I
End Sub

Private Sub Grid4_DblClick()
Dim R As Integer
GridAltData.Row = 1
GridAltData.Col = 1
```

```
grdAlter.Col = 0
grdAlter.Row = 0
grdAlter.Text = GridAltData.Text
GridAltData.Row = 2
 GridAltData.Col = 1

      lstcritriabak.ListIndex = R - 1
      lstcritriabak.AddItem UCase(GridAltData.Text)
      ListCRALT.AddItem UCase(GridAltData.Text)

GridAltData.Col = 3
GridAltData.Row = 1
txtNoOfAlternatives = GridAltData.Text
GridAltData.Col = 3
GridAltData.Row = 2
txtalternatives = GridAltData.Text
'-------------------------------------------------------

 If IsNull(txtNoOfAlternatives.Text) = True Or Len(Trim(txtNoOfAlternatives.Text)) = 0 Then
   Else
      grdAlter.Cols = txtNoOfAlternatives.Text + 1
      grdAlter.Rows = txtNoOfAlternatives.Text + 1
      grdAnormal.Cols = txtNoOfAlternatives.Text + 1
      grdAnormal.Rows = txtNoOfAlternatives.Text + 1
      grdAltBak.Cols = txtNoOfAlternatives.Text + 1
      grdAltBak.Rows = txtNoOfAlternatives.Text + 1
      grdAweight.Rows = txtNoOfAlternatives + 1
      'grdAweight.Cols = txtNoOfCriteria + 1
       grdAweight.Cols = NoOfCrAlt + 1
      grdAcons.Cols = txtNoOfAlternatives + 1
      lstAlternatives.Clear
      'lstcritriabak.Clear' THIS PROGRAMMING CODE IS FROM EFORE

      NoOfAlternative = txtNoOfAlternatives.Text
   End If
   nCriteria = 0

End Sub

Private Sub Grid4_KeyPress(KeyAscii As Integer)
Dim I As Integer

 If KeyAscii = 13 Then
     GridInputData.Text = Format(GridInputData.Text, "#.00000")
       SendKeys "{RIGHT}", True
      Exit Sub
   End If
   If KeyAscii = 8 Then
      If Len(Trim(GridInputData.Text)) > 0 Then
        GridInputData.Text = Mid(GridInputData.Text, 1, Len(GridInputData.Text) - 1)
      End If
      Exit Sub
   End If
'-------------------------------------------------------
       I = 1
        For I = GridInputData.SelStartCol To GridInputData.SelEndCol

        GridInputData.ColWidth(I) = 830

        Next I

'-------------------------------------------------------

  GridInputData.Text = GridInputData.Text & Chr(KeyAscii)
```

```
End Sub

Private Sub Grid3_DblClick()
GrdInAltDat1.Col = 1
grdAlter.Col = 0
grdAlter.Row = 0
grdAlter.Text = UCase(GrdInAltDat1.Text)
txtCriteriaAlt.Text = UCase(GrdInAltDat1.Text)
Label1(10).Caption = UCase(grdAlter.Text)
grdAweight1.Col = 0
grdAweight1.Row = 0

grdAweight1.Text = UCase(GrdInAltDat1.Text)

ListCRALT.AddItem UCase(grdAlter.Text)
txtCriteriaAlt.Text = ""

'-------------------------------

GrdInAltDat1.Col = 2
'GridAltData.Row = 1
txtNoOfAlternatives = GrdInAltDat1.Text

'-------------------------------

If IsNull(txtNoOfAlternatives.Text) = True Or Len(Trim(txtNoOfAlternatives.Text)) = 0 Then
Else
        grdAlter.Cols = txtNoOfAlternatives.Text + 1
        grdAlter.Rows = txtNoOfAlternatives.Text + 1
        grdAweight1.Rows = txtNoOfAlternatives + 1
        grdAweight1.Cols = txtNoOfAlternatives + 1
        grdAnormal.Cols = txtNoOfAlternatives.Text + 1
        grdAnormal.Rows = txtNoOfAlternatives.Text + 1
        grdAltBak.Cols = txtNoOfAlternatives.Text + 1
        grdAltBak.Rows = txtNoOfAlternatives.Text + 1
        grdAweight.Rows = txtNoOfAlternatives + 1

        grdAweight.Cols = NoOfCrAlt + 1
        grdAcons.Cols = txtNoOfAlternatives + 1
        lstAlternatives.Clear
        'lstcritriabak.Clear' THIS PROGRAMMING CODE IS FROM EFORE

        NoOfAlternative = txtNoOfAlternatives.Text
 End If
    nCriteria = 0

  For R = 1 To NoOfAlternative
  GrdInAltDat1.Col = 3
  'GrdInAltDat1.Row = 1
  grdAlter.Col = 0
  grdAlter.Row = R
  grdAweight1.Col = 0
  grdAweight1.Row = R

  grdAlter.Text = UCase(GrdInAltDat1.Text)
  grdAweight1.Text = UCase(grdAlter.Text)
  'GridAltData.Row = 2
  grdAweight.Col = 0
  grdAweight.Row = R
  grdAweight.Text = UCase(grdAweight1.Text)
  'txtalternatives = GridAltData.Text
  grdAlter.Row = 0
  grdAlter.Col = R
  grdAlter.Text = UCase(GrdInAltDat1.Text)
```

```
'-------------------------------------------------------------
GrdInAltDat1.Col = 3 + R
GrdInAltDat1.Row = GrdInAltDat1.Row - R
GrdInAltDat1.Text = UCase(grdAlter.Text) 'lstcriteria.Text


GrdInAltDat1.Row = GrdInAltDat1.Row + R
GrdInAltDat1.Row = GrdInAltDat1.Row + 1
'GrdInAltDat1.Row = R
'-------------------------------------------------------------

Next R

I = 1
        For I = GrdInAltDat1.SelStartCol To GrdInAltDat1.SelEndCol

       GrdInAltDat1.ColWidth(I) = 1000

        Next I
End Sub


Private Sub grdSynthesis_DblClick()
For I = grdSynthesis.SelStartCol To grdSynthesis.SelEndCol

      grdSynthesis.ColWidth(I) = 2000
Next I
End Sub



Private Sub GridInputData_DblClick()
Dim R As Integer

 On Error Resume Next

GridInputData.Col = 1

grdpair.Col = 0
grdpair.Row = 0
GridInputData.Text = UCase(GridInputData.Text)
grdpair.Text = GridInputData.Text
grdpweight.Col = 0
grdpweight.Row = 0
grdpweight.Text = GridInputData.Text
Label4(0).Caption = GridInputData.Text

 Grpname = grdpair.Text
 GridInputData.Col = 3
 txtNoOfCriteria = GridInputData.Text

If IsNull(txtNoOfCriteria.Text) = True Or Len(Trim(txtNoOfCriteria.Text)) = 0 Then
   Else
      grdpair.Cols = txtNoOfCriteria.Text + 1
      grdpair.Rows = txtNoOfCriteria.Text + 1
      grdpnormal.Cols = txtNoOfCriteria.Text + 1
      grdpnormal.Rows = txtNoOfCriteria.Text + 1
      grdPairBak.Cols = txtNoOfCriteria.Text + 1
      grdPairBak.Rows = txtNoOfCriteria.Text + 1
      grdpweight.Rows = txtNoOfCriteria + 1
      grdpcons.Cols = txtNoOfCriteria + 1
     "" lstcriteria.Clear
```

```
    NoOfCriteria = txtNoOfCriteria.Text
End If
'-------------------------------------------------------
GridInputData.Col = 2
lablevel(1).Caption = GridInputData.Text
lablevel(2).Caption = lablevel(1).Caption + 1

 For R = 1 To NoOfCriteria


GridInputData.Col = 4

grdpair.Col = 0
grdpair.Row = R
grdpweight.Row = R
grdpweight.Col = 0
GridInputData.Text = UCase(GridInputData.Text)
grdpair.Text = GridInputData.Text
grdpweight.Text = grdpair.Text
"lstcriteria.AddItem UCase(grdpair.Text)
grdpair.Row = 0
grdpair.Col = R
grdpair.Text = GridInputData.Text

'-------------------------'
GridInputData.Col = 4 + R
GridInputData.Row = GridInputData.Row - R
GridInputData.Text = UCase(grdpair.Text) 'lstcriteria.Text
GridInputData.Row = GridInputData.Row + R
GridInputData.Row = GridInputData.Row + 1

Next R

GridInputData.Visible = True
SSCommand3.Visible = False
End Sub


Private Sub GridInputData_KeyPress(KeyAscii As Integer)
Dim I As Integer

If KeyAscii = 13 Then
    GridInputData.Text = Format(GridInputData.Text, "#0.00000")
     SendKeys "{RIGHT}", True
    Exit Sub
  End If
  If KeyAscii = 8 Then
    If Len(Trim(GridInputData.Text)) > 0 Then
      GridInputData.Text = Mid(GridInputData.Text, 1, Len(GridInputData.Text) - 1)
    End If
    Exit Sub
  End If
'-------------------------------------------------------
      I = 1
       For I = GridInputData.SelStartCol To GridInputData.SelEndCol

       GridInputData.ColWidth(I) = 800

       Next I

'-------------------------------------------------------

  GridInputData.Text = GridInputData.Text & Chr(KeyAscii)
```

```
End Sub


Private Sub LevelNo_Change()
SSCommand3.Visible = True
 GridInputData.Visible = False
End Sub

Private Sub LevelNo_KeyPress(KeyAscii As Integer)
 LevelNo = LevelNo.Text

   If KeyAscii = 13 Then
      If Len(Trim(LevelNo.Text)) > 0 Then
       LstLevels.AddItem UCase(LevelNo.Text)
       ' ListCRALT.AddItem UCase(txtCriteriaAlt.Text)
        LevelNo.Text = ""

      End If
   End If

End Sub


Private Sub LevelNo_LostFocus()
velNo = LevelNo.Text
If Not IsNumeric(LevelNo.Text) Then
       MsgBox "Please Enter a Level  Numebr"
        LevelNo = LevelNo.Text
   End If
End Sub

Private Sub list1_DblClick()
list1.Clear
End Sub

Private Sub ListCRALT_DblClick()
 ListCRALT.Clear
End Sub

Private Sub lstcriteria_DblClick()
lstcriteria.Clear
list1.Clear
ListCRALT.Clear
End Sub

Private Sub lstcritriabak_Click()

    Label1(10).Caption = lstcritriabak.Text
'   Label1(10).Caption = ALtLis.Text
End Sub

Private Sub LstCrNodes_DblClick()
LstCrNodes.Clear
End Sub

Private Sub LstLevels_DblClick()
LstLevels.Clear
End Sub

Private Sub MainObjective_KeyPress(KeyAscii As Integer)

If KeyAscii = 13 Then
 SendKeys "{TAB}", True
End If
```

```
 inptval = MainObjective.Text

If Len(inptval) = 0 Then
MsgBox "Try Again"


End If
End Sub


Private Sub NoCrNodes_KeyPress(KeyAscii As Integer)
 If KeyAscii = 13 Then

      SendKeys "{TAB}", True
   End If
End Sub


Private Sub NoCrNodes_LostFocus()
If IsNull(NoCrNodes.Text) = True Or Len(Trim(NoCrNodes.Text)) = 0 Then
    Else


    NoCrNodes = NoCrNodes.Text

   End If
End Sub


Private Sub NofCrList_DblClick()
NofCrList.Clear
End Sub


Private Sub NoOfCrAlt_Change()
SSCommand2.Visible = True
GrdInAltDat1.Visible = False
End Sub



Private Sub NoOfCrNode_Change()
 SSCommand3.Visible = True
 GridInputData.Visible = False
 lstcriteria.Clear
list1.Clear
ListCRALT.Clear

End Sub

Private Sub NoOfCrNode_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then

      SendKeys "{TAB}", True
   End If
   NoOfCrNode = NoOfCrNode.Text
End Sub


Private Sub NoOfCrNode_LostFocus()


If Not IsNumeric(NoOfCrNode.Text) Then
```

```
        MsgBox "Please Enter  Numebr of Criteria Nodes"
         NoOfCrNode = 0
    End If

If (NoOfCrNode.Text) = 0 Then
        MsgBox "Please Enter  Numebr of Criteria Nodes"
       ' NoOfCrNode = 1
    End If


If IsNull(NoOfCrNode.Text) = True Or Len(Trim(NoOfCrNode.Text)) = 0 Then

    Else
    '
        LstCrNodes.Clear
      ' ListCRALT.Clear
      NoOfCrNode = NoOfCrNode.Text
    End If
End Sub


Private Sub PairWC_Click()

  'GREADHEAD1
Dim x As Integer
Dim L As Integer
Dim R As Integer

'--------ENTER DATA FOR COL 5+ ----------

GridInputData.Col = 5

For R = 1 To NoOfCriteria

 For I = 1 To NoOfCriteria
'
grdpair.Row = R
grdpair.Col = I
grdpair.Text = GridInputData.Text
GridInputData.Col = I + 5 'GridInputData.Col + 1
Next I
GridInputData.Row = GridInputData.Row + 1

Next R

'-----END OF ENETERING DATA-------------------------


If NoOfCriteria = 0 Or IsNull(NoOfCriteria) Then Exit Sub
    PairWiseComparision
    ConsIndex
    PlotData


End Sub


Private Sub PAIRWISECOMP_Click()

  'GREADHEAD1
Dim x As Integer
Dim L As Integer
Dim R As Integer
```

```
'-------ENTER DATA FOR COL 5+ ---------

GridInputData.Col = 5

For R = 1 To NoOfCriteria

 For I = 1 To NoOfCriteria
'
grdpair.Row = R
grdpair.Col = I
grdpair.Text = GridInputData.Text
GridInputData.Col = I + 5 'GridInputData.Col + 1
Next I
GridInputData.Row = GridInputData.Row + 1

Next R

'-----END OF ENETERING DATA----------------------


If NoOfCriteria = 0 Or IsNull(NoOfCriteria) Then Exit Sub
   PairWiseComparision
   ConsIndex
   PlotData

End Sub

Private Sub SaveIn_Click()
' SaveIn.Enabled = False
 SaveCrInput
  SaveAltInput
 SaveCrAltNodeLeNo

End Sub


Private Sub SSCmdSynthesis_Click()
 On Error Resume Next


 SynthesisF

  Data2.Refresh
 PlotDataSyntheis
  Graph3.Visible = True
   DispDatInExcel.Enabled = True
End Sub

Private Sub Text3_Change()
If KeyAscii = 13 Then
      'lstcriteria.Clear
     lstcritriabak.Clear
      SendKeys "{TAB}", True
   End If
End Sub

Private Sub SSCommand4_Click()
Dim I As Integer
GrdInAltDat1.Col = 3
For I = 1 To NoOfAlternative
 For R = 1 To NoOfAlternative

grdAlter.Col = R
grdAlter.Row = I
```

```
grdAlter.Text = GrdInAltDat1.Text
GrdInAltDat1.Col = 3 + R
 Next R
 GrdInAltDat1.Row = GrdInAltDat1.Row + 1
Next I
End Sub

Private Sub SSCommand111_Click()
 If KeyAscii = 13 Then
     If Len(Trim(txtCriterias.Text)) > 0 Then
      lstcriteria.AddItem UCase(txtCriterias.Text)
       list1.AddItem UCase(txtCriterias.Text)
       ListCRALT.AddItem UCase(txtCriterias.Text)


      txtCriterias.Text = ""

     End If

   End If
 tabDecision.TabEnabled(0) = True

tabDecision.TabEnabled(3) = True
tabDecision.TabEnabled(4) = True
tabDecision.TabEnabled(5) = True
End Sub

Private Sub SSCommand2_Click()
Dim DD As String
Dim YY As Integer
Dim R2 As Integer
Dim F1 As Integer
On Error GoTo GEtOUT
GrdInAltDat1.Visible = True

Text4.Text = NoOfAlternative

SaveIn.Enabled = True
For R = 1 To 30
 For R1 = 1 To 999
  GrdInAltDat1.Col = R
  GrdInAltDat1.Row = R1
   GrdInAltDat1.Text = ""
 Next R1
Next R

F1 = 1
GrdInAltDat1.Col = 1
 GrdInAltDat1.Row = 1

 R = 1

 ListCRALT.ListIndex = R - 1
 GrdInAltDat1.Text = ListCRALT.Text
'GrdInAltDat1.Text =

For I = 1 To NoOfCrAlt - 1
'F1 = (NoOfAlternative + 1) + F1
F1 = (NoOfAlternative + 2) + F1
GrdInAltDat1.Row = F1

'GrdInAltDat1.Row = (NoOfAlternative * I) + (2 * I) + 1
ListCRALT.ListIndex = I '- 1
 GrdInAltDat1.Text = ListCRALT.Text
```

```
Next I

GrdInAltDat1.Col = 2
GrdInAltDat1.Row = 1

GrdInAltDat1.Text = txtNoOfAlternatives
For I = 1 To NoOfCrAlt - 1

'F1 = (NoOfAlternative + 2) + F1
'GrdInAltDat1.Row = F1

GrdInAltDat1.Row = (NoOfAlternative * I) + (2 * I) + 1

GrdInAltDat1.Text = txtNoOfAlternatives
Next I

GrdInAltDat1.Col = 3


  For R = 1 To NoOfAlternative
    GrdInAltDat1.Row = R
    AlternativesList.ListIndex = R - 1
    GrdInAltDat1.Text = AlternativesList.Text
  Next R


  For R = 1 To NoOfCrAlt - 1
   C = R * NoOfAlternative + (2 * R)

    For R1 = 1 To NoOfAlternative
      GrdInAltDat1.Row = C + R1 '- 1
      AlternativesList.ListIndex = R1 - 1

      GrdInAltDat1.Text = AlternativesList.Text
    Next R1

  Next R


      GEtOUT:

  Msg = Msg & Chr(13) & "Are you Sure  Your Data is Correc"


  DD = MsgBox(Msg, vbOKCancel)
If DD <> vbOK Then
MsgBox "Try Again"
End If

SSCommand2.Visible = False



End Sub

Private Sub SSCommand3_Click()
Dim YY, YY1, SS As String
Dim DD As Boolean
Dim S As Integer

On Error Resume Next
SSCommand3.Visible = False
```

```
GridInputData.Visible = True
For R = 1 To 30

 For R1 = 1 To 100
  GridInputData.Col = R
 GridInputData.Row = R1
 GridInputData.Text = ""
 Next R1
Next R


'----------Criteria Input----------
 T1 = 0
 x = 1
 C = 1
 C4 = 1
R1 = 1
For R = 1 To NoOfCrNode
GridInputData.Col = 1


 GridInputData.Row = C
LstCrNodes.ListIndex = R - 1
GridInputData.Text = LstCrNodes.Text
 GridInputData.Col = 2
 LstLevels.ListIndex = R - 1
 GridInputData.Text = LstLevels.Text

 GridInputData.Col = 3
 NofCrList.ListIndex = R - 1
 GridInputData.Text = NofCrList.Text
 NoOfCriteria = NofCrList.Text


 C = NoOfCriteria + 1 + C

 T1 = T1 + NoOfCriteria
 TotalCr = T1
Next R

'----------end of input 1----------
 D = 1
 Y0 = 1
  Y = 0
DD = 0
 For D = 1 To NoOfCrNode
GridInputData.Col = 4

 NofCrList.ListIndex = D - 1

 Y = Y + NofCrList.Text
 For D1 = Y0 To Y

 GridInputData.Row = D + D1 + DD - 1
lstcriteria.ListIndex = D1 - 1

GridInputData.Text = lstcriteria.Text

 Next D1
Y0 = Y + 1

Next D
```

```
'-------------------------------------------
w = 0
S = 0
For R1 = 1 To NoOfCrNode '- 1
 LstCrNodes.ListIndex = R1 - 1
  For R = w To TotalCr
   ListCRALT.ListIndex = R '- 1
    If ListCRALT.Text = LstCrNodes.Text Then 'YY Then
    ListCRALT.RemoveItem R '- 1
    S = S + 1
   End If
   Next R
Next R1


NoOfCrAlt = TotalCr - S
'-----------------
text2.Text = TotalCr

End Sub



Private Sub tabDecision_DblClick()
Cmbtype3.Visible = False
Cmbtype2.Visible = False
Cmbtype.Visible = False

End Sub


Private Sub TxtLvelOfHeirachy_Click()

If IsNull(TxtLvelOfHeirachy.Text) = True Or Len(Trim(TxtLvelOfHeirachy.Text)) = 0 Then

 inptval0 = TxtLvelOfHeirachy.Text
 End If
 End Sub

 Private Sub txtalternatives_GotFocus()

    txtalternatives.Text = ""
 End Sub

 Private Sub txtalternatives_KeyPress(KeyAscii As Integer)

   If KeyAscii = 13 Then
      If Len(Trim(txtalternatives.Text)) > 0 Then
       lstAlternatives.AddItem UCase(txtalternatives.Text)
       txtalternatives.Text = ""

      GridheadAlt
      End If
   End If

End Sub

Private Sub txtCriterias_Change()
SSCommand3.Visible = True
GridInputData.Visible = False
End Sub
```

```
Private Sub txtCriterias_GotFocus()
txtCriterias.Text = ""

End Sub


Private Sub txtCriterias_KeyPress(KeyAscii As Integer)

  If KeyAscii = 13 Then
     If Len(Trim(txtCriterias.Text)) > 0 Then
      lstcriteria.AddItem UCase(txtCriterias.Text)
       list1.AddItem UCase(txtCriterias.Text)
       ListCRALT.AddItem UCase(txtCriterias.Text)


      txtCriterias.Text = ""

      End If

  End If
 tabDecision.TabEnabled(0) = True

tabDecision.TabEnabled(3) = True
tabDecision.TabEnabled(4) = True
tabDecision.TabEnabled(5) = True

End Sub


Private Sub txtLevels_GotFocus()
txtLevels.Text = ""
End Sub


Private Sub txtLevels_KeyPress(KeyAscii As Integer)
If KeyAscii = 13 Then
      If Len(Trim(txtLevels.Text)) > 0 Then
     LstLevels.AddItem UCase(txtLevels.Text)

       txtLevels.Text = ""

      End If
   End If

End Sub


Private Sub txtNoOfAlternatives_Change()
SSCommand2.Visible = True
GrdInAltDat1.Visible = False
End Sub

Private Sub txtNoOfAlternatives_KeyPress(KeyAscii As Integer)

  If KeyAscii = 13 Then

     SendKeys "{TAB}", True
  End If

End Sub


Private Sub txtNoOfAlternatives_LostFocus()
```

```
If Not IsNumeric(txtNoOfAlternatives.Text) Then
      MsgBox "Please Enter a Numebr"
       txtNoOfAlternatives.Text = ""
  End If

  If IsNull(txtNoOfAlternatives.Text) = True Or Len(Trim(txtNoOfAlternatives.Text)) = 0 Then
  Else


    NoOfAlternative = txtNoOfAlternatives.Text
  End If
  nCriteria = 0

  If NoOfAlternative < 2 Then
  MsgBox " Are You Sure You Have Less Than Two Alternatives"
  End If
End Sub


Private Sub txtNoOfCriteria_Change()
SSCommand3.Visible = True
 GridInputData.Visible = False
' lstcriteria.Clear
'list1.Clear
' ListCRALT.Clear

End Sub

Private Sub txtNoOfCriteria_KeyPress(KeyAscii As Integer)

  '
 If KeyAscii = 13 Then
    If Len(Trim(txtNoOfCriteria)) > 0 Then
     NofCrList.AddItem UCase(txtNoOfCriteria.Text)

     txtNoOfCriteria.Text = ""

    End If
  End If

  ' NoOfCriteria = txtNoOfCriteria.Text
End Sub

Public Sub AddMCweight1()
Dim I As Integer

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

Set rsMC = db.OpenRecordset("MainCr")


  For R = 1 To NoOfCriteria

    rsMC.AddNew
   ' rsMC("MCID") = g1
    rsMC("GID") = G
    rsMC("SID") = S

    grdpweight.Col = 1
    grdpweight.Row = R

    rsMC("NAME") = Grpname
    rsMC("MCValue") = grdpweight.Text
'-------------------------------------------------------------
```

```
    GridInputData.Col = 4
    GridInputData.Row = R
    rsMC("MCName") = GridInputData.Text

    rsMC.Update

  Next R

  db.Close

  End Sub


Public Sub ADDSCWEIGHT4()

Dim V2 As Double
Dim V3 As Double
Dim V4 As Double
Dim Z As Variant
Dim v5 As Variant

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

Set rsSC4 = db.OpenRecordset("SubCr4")

Set rsSC3 = db.OpenRecordset("SubCr3")


  For R = 1 To NoOfCriteria

    rsSC4.AddNew

    rsSC4("GID") = G
    rsSC4("SID") = S

    grdpweight.Col = 1
    grdpweight.Row = R
   ' Grpname = GOAL
    rsSC4("NAME") = Grpname
    rsSC4("SC4Value") = grdpweight.Text
'-----------------------------New Operation Here----------------

   J = 1
    Do Until rsSC3.EOF

     If rsSC4("NAME") = rsSC3("SC3NAME") Then
      'v1 = RSSC2("sC2VALUE")

      V2 = rsSC3("SC3Value")
      Z = rsSC3("MCName")
      V3 = rsSC3("MCValue")
      V4 = rsSC3("GVALUE")
      v5 = rsSC3("Name")
      'Text4.Text = v5
      'Text2.Text = Z
      J = 1 + J
     End If
    rsSC3.MoveNext
    Loop
'-------------------End Of Instruction for that Operation---------
    rsSC4("Gvalue") = V2
```

```
'-------------------------------------------------------------
    grdpair.Col = 0
    grdpair.Row = R
    rsSC4("SC4Name") = grdpair.Text
'-------------------------------------------------------------
    'lstcriteria.ListIndex = R - 1
    'rsSC4("SC4Name") = lstcriteria.Text
    rsSC4("SC2NAME") = v5 'Text4.Text
    rsSC4("SC2Value") = V4
    rsSC4("MCName") = Z 'Text2.Text
    rsSC4("MCValue") = V3
    rsSC4("COValue") = rsSC4("MCValue") * rsSC4("SC2Value") * rsSC4("GVALUE") * rsSC4("SC4VALUE")
    rsSC4.Update

  Next R

  db.Close
End Sub


Public Sub ADDSCWEIGHT2()
Dim I As Integer

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

Set rSsc2 = db.OpenRecordset("SubCr2")

Set rsMC = db.OpenRecordset("MAINCR")


  For R = 1 To NoOfCriteria

    rSsc2.AddNew

    rSsc2("GID") = G
    rSsc2("SID") = S

    grdpweight.Col = 1
    grdpweight.Row = R
    rSsc2("NAME") = Grpname
    rSsc2("SC2Value") = grdpweight.Text

'--Here The Program Will Retrieve The Weight For The Criteria Group Head--------
    J = 1
    Do Until rsMC.EOF

     If rSsc2("NAME") = rsMC("MCNAME") Then
      'v1 = RSSC2("sC2VALUE")
      V2 = rsMC("MCVALUE")
      J = 1 + J
     End If
    rsMC.MoveNext
    Loop
'-------------------End Of Instruction for that Operation---------
    rSsc2("GVALUE") = V2
    rSsc2("COVALUE") = rSsc2("GVALUE") * rSsc2("SC2VALUE")

'-------------------------------------------------------------

    grdpair.Col = 0
    grdpair.Row = R
    rSsc2("SC2Name") = grdpair.Text
```

```
    rSsc2.Update

  Next R

  db.Close
End Sub


Public Sub ADDSCWEIGHT3()

Dim V3 As Double
Dim Z As Variant
Dim V2 As Double
Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

Set rsSC3 = db.OpenRecordset("SubCr3")

Set rSsc2 = db.OpenRecordset("SubCr2")


  For R = 1 To NoOfCriteria

    rsSC3.AddNew

    rsSC3("GID") = G
    rsSC3("SID") = S

    grdpweight.Col = 1
    grdpweight.Row = R

    rsSC3("NAME") = Grpname
    rsSC3("SC3Value") = grdpweight.Text
'-------------------NEW Opertion Here-------------------
    J = 1
    Do Until rSsc2.EOF

     If rsSC3("NAME") = rSsc2("sc2name") Then
      'v1 = RSSC2("sC2VALUE")
      V2 = rSsc2("SC2VALUE")
      Z = rSsc2("NAME")
      V3 = rSsc2("GVALUE")
      J = 1 + J
     End If
    rSsc2.MoveNext
    Loop
'-----------------End Of Instruction for that Operation---------
    rsSC3("GVALUE") = V2

    rsSC3("MCname") = Z
    rsSC3("MCValue") = V3
'-------------------------------------------------------
    grdpair.Col = 0
    grdpair.Row = R
    rsSC3("SC3Name") = grdpair.Text
    rsSC3("COValue") = rsSC3("GVALUE") * rsSC3("SC3VALUE") * rsSC3("MCValue")
'-------------------------------------------------------

    'lstcriteria.ListIndex = R - 1
    'rsSC3("SC3Name") = lstcriteria.Text

    rsSC3.Update

  Next R
```

```
    db.Close
End Sub


Sub FileSave1()
Dim CTR As Integer
Dim Y As Double
Dim Y1 As Double
Dim Y2 As Double
Dim MATRIX1() As Double
Dim I As Integer

inptval0 = lablevel(1).Caption
CTR = 1


   Do While IsNull(inptval0) Or Len(Trim(inptval0)) = 0
    If CTR = 3 Then End
     MsgBox "Try Again", 48
inptval0 = InputBox("Which Level of The Hierarchy Is This, Please Indicate 1 For The Main Criteria Level1, 2 For SuBcriteria at
Level 2 and So On.")
     CTR = CTR + 1
    Loop

ncr0 = inptval0

AddGroup
AddSubGroup

If ncr0 = 1 Then
  AddMCweight1

ElseIf ncr0 = 2 Then

  ADDSCWEIGHT2
ElseIf ncr0 = 3 Then
 ADDSCWEIGHT3
ElseIf ncr0 = 4 Then
   ADDSCWEIGHT4
ElseIf ncr0 = 5 Then
  ' ADDSCWEIGHT5
ElseIf ncr0 = 6 Then
  ' ADDSCWEIGHT6
ElseIf ncr0 = 7 Then
  ' ADDSCWEIGHT7
ElseIf ncr0 = 8 Then
  ' ADDSCWEIGHT8
End If

If ncr0 > 8 Then
    MsgBox " This exceeds the limitation of the program", vbCritical

End If

If (ncr0 <= 0) Then
    MsgBox " You Have Entered Wrong Information ", vbCritical

End If

End Sub

Public Sub filenew1()
```

```
Dim ncr0 As Integer

CTR = 1
   Sgrname = InputBox("Enter Decision Maker Name :", "Analysis")
   Do While IsNull(Sgrname) Or Len(Trim(Sgrname)) = 0
      If CTR = 3 Then End
      Sgrname = InputBox("Enter Decision Maker Name :", "Analysis")
      CTR = CTR + 1
   Loop


CTR = 1

 inptval = InputBox("Enter The Main Objective")

   Do While IsNull(inptval) Or Len(Trim(inptval)) = 0
      If CTR = 3 Then End
       inptval = InputBox("Enter  The Criteria Group Name :", "Analysis")
      CTR = CTR + 1
   Loop

'ReDim inptval1(0 To nCr) As Variant

If Len(inptval) = 0 Then
MsgBox "Try Again"


End If

'Loop
End Sub



Public Sub GREADHEAD1()
 Dim x As Integer
  x = lstcriteria.ListCount


  For I = 0 To x - 1
     grdpair.Row = I + 1
     grdpair.Col = 0
     grdpnormal.Row = I + 1
     grdpnormal.Col = 0
     grdPairBak.Row = I + 1
     grdPairBak.Col = 0
     lstcriteria.ListIndex = I
     grdpair.Text = lstcriteria.Text
     grdpnormal.Text = lstcriteria.Text
     grdPairBak.Text = lstcriteria.Text
  Next
  For I = 0 To x - 1
     grdpair.Col = I + 1
     grdpair.Row = 0
      grdpnormal.Col = I + 1
     grdpnormal.Row = 0
      grdPairBak.Col = I + 1
     grdPairBak.Row = 0
     lstcriteria.ListIndex = I
     grdpair.Text = lstcriteria.Text
      grdpnormal.Text = lstcriteria.Text
       grdPairBak.Text = lstcriteria.Text
  Next
  For I = 0 To x - 1
```

```
      grdpweight.Row = I + 1
      grdpweight.Col = 0
       lstcriteria.ListIndex = I
      grdpweight.Text = lstcriteria.Text
    Next I
    For I = 0 To x - 1
      grdpcons.Row = 0
      grdpcons.Col = I + 1
       lstcriteria.ListIndex = I
      grdpcons.Text = lstcriteria.Text
    Next I
End Sub

Public Sub GridheadAlt()
Dim x As Integer


  For I = 0 To x - 1
     grdAlter.Row = I + 1
     grdAlter.Col = 0
     grdAnormal.Row = I + 1
     grdAnormal.Col = 0
     grdAltBak.Row = I + 1
     grdAltBak.Col = 0
     lstAlternatives.ListIndex = I
     grdAlter.Text = lstAlternatives.Text
     grdAnormal.Text = lstAlternatives.Text
     grdAltBak.Text = lstAlternatives.Text
  Next
  For I = 0 To x - 1
     grdAlter.Col = I + 1
     grdAlter.Row = 0
     grdAnormal.Col = I + 1
     grdAnormal.Row = 0
     grdAltBak.Col = I + 1
     grdAltBak.Row = 0
     lstAlternatives.ListIndex = I
     grdAlter.Text = lstAlternatives.Text
     grdAnormal.Text = lstAlternatives.Text
     grdAltBak.Text = lstAlternatives.Text
  Next
  For I = 0 To x - 1
     grdAweight.Row = I + 1
     grdAweight.Col = 0
      lstAlternatives.ListIndex = I
     grdAweight.Text = lstAlternatives.Text
  Next I
   For I = 0 To x - 1
     grdAcons.Row = 0
     grdAcons.Col = I + 1
      lstAlternatives.ListIndex = I
     grdAcons.Text = lstAlternatives.Text
  Next I


End Sub

Public Sub AltWeight1()
Dim R As Integer
   Dim C As Integer
   ReDim AMatrix(NoOfAlternative)
   Dim Value As Double, Temp As Double
   Dim x As Integer
   Value = 0#
```

```
  For R = 1 To NoOfAlternative

    For C = 1 To NoOfAlternative
        grdAnormal.Row = R
        grdAnormal.Col = C
        Temp = Format(grdAnormal.Text, "#0.0000")
        Value = Format((Value + Temp), "#0.0000")
    Next C

    AMatrix(R) = Value
    Value = 0#

  Next R

  For R = 1 To NoOfAlternative

    grdAweight1.Col = 1
    grdAweight1.Row = R
    grdAweight1.Text = Format(AMatrix(R), "#0.0000") / NoOfAlternative

  Next R

End Sub

Public Sub AltAdd2()
Dim g2 As Integer
Dim Y As Double
Dim x As Double
Dim Z As Variant
Dim FF As String

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rSsc2 = db.OpenRecordset("SubCr2")

Set rsMC = db.OpenRecordset("MAINCR")
Set rsACW2 = db.OpenRecordset("AltCrWeight2")
'--------- The next programming code add the LD No. for the main Criteria.


  Tsql = "Delete from AltCrWeight2 where len(AltCrWeight2.CrName)=0 or isnull(AltCrWeight2.[AltID])"
  db.Execute Tsql, dbFailOnError


  Set rsTEMP = db.OpenRecordset("Select Max(AltCrWeight2.[AltID]) as Gmax From AltCrWeight2;")

  If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
    g2 = 1
  Else
    g2 = rsTEMP("Gmax") + 1

  End If


  For R = 1 To NoOfAlternative

    rsACW2.AddNew

    rsACW2("AltID") = g2

    rsACW2("CrName") = Label1(10).Caption

    grdAlter.Col = R
```

```
      grdAlter.Row = 0
      rsACW2("AltName") = grdAlter.Text
      grdAweight1.Col = 1
      grdAweight1.Row = R
      rsACW2("AltValue") = grdAweight1.Text

'--Here The Program Will Retrieve The Weight For The Criteria Group Head---------


     J = 1
      Do Until rsMC.EOF

       If rsACW2("CrName") = rsMC("MCNAME") Then

         Y = rsMC("MCVALUE")
         FF = rsMC("MCNAME")

         J = 1 + J
       End If
      rsMC.MoveNext
      Loop


         GRIDTEST.Col = 1
         GRIDTEST.Row = R
         GRIDTEST.Text = rsACW2("CrName")

         GRIDTEST.Col = 2
         GRIDTEST.Row = R
         GRIDTEST.Text = FF


         GRIDTEST.Col = 3
         GRIDTEST.Row = R
         GRIDTEST.Text = Y
'-------------------End Of Instruction for that Operation---------
      rsACW2("CrValue") = Y
     ' rsACw2("L1CrName") = z
      rsACW2("TValue") = rsACW2("CrValue") * rsACW2("AltValue")
     ' rsACw2("L1CrVal") = x
      rsACW2.Update

   Next R

   db.Close
End Sub


Private Sub txtNoOfCriteria_LostFocus()

If Not IsNumeric(txtNoOfCriteria.Text) Then
       MsgBox "Please Enter  Numebr of  Sub-Criteria"
        txtNoOfCriteria = 0
   End If
   If IsNull(txtNoOfCriteria.Text) = True Or Len(Trim(txtNoOfCriteria.Text)) = 0 Then
   Else


     NoOfCriteria = txtNoOfCriteria.Text
   End If
End Sub

Private Sub txtNoOfLevels_KeyPress(KeyAscii As Integer)
```

```
If KeyAscii = 13 Then

    SendKeys "{TAB}", True
  End If

  txtNoOfLevels = txtNoOfLevels.Text

End Sub



Private Sub txtNoOfLevels_LostFocus()

  If IsNull(txtNoOfLevels.Text) = True Or Len(Trim(txtNoOfLevels.Text)) = 0 Then
  Else

     txtNoOfLevels = txtNoOfLevels.Text
   End If

  If Not IsNumeric(txtNoOfLevels.Text) Then
      MsgBox "Please Enter Numebr of Levels"
      txtNoOfLevels = 3
  End If

    If (txtNoOfLevels > 6) Or (txtNoOfLevels < 3) Then
    MsgBox " You Have Entered Wrong Information ", vbCritical
      'MsgBox " This exceeds the limitation of the program", vbCritical
    txtNoOfLevels.Text = 3
      End If

End Sub



Public Sub AltAdd3()
Dim g2 As Integer
Dim Y As Double
Dim x As Double
Dim Z As Variant

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rSsc2 = db.OpenRecordset("SubCr2")

Set rsMC = db.OpenRecordset("MAINCR")
Set rsACW3 = db.OpenRecordset("AltCrWeight3")
Dim K1, K2, K3 As Boolean
Dim Y2 As Variant

'---------- The next programming code add the I.D No. for the main Criteria.


  Tsql = "Delete from AltCrWeight3 where len(AltCrWeight3.CrName)=0 or isnull(AltCrWeight3.[AltID])"
  db.Execute Tsql, dbFailOnError


  Set rsTEMP = db.OpenRecordset("Select Max(AltCrWeight3.[AltID]) as Gmax From AltCrWeight3;")

  If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
    g2 = 1
```

```
Else
  g2 = rsTEMP("Gmax") + 1

End If


For R = 1 To NoOfAlternative

  rsACW3.AddNew
  rsACW3("AltID") = g2
  rsACW3("CrName") = Label1(10).Caption

  grdAlter.Col = R
  grdAlter.Row = 0
  rsACW3("AltName") = grdAlter.Text

  grdAweight1.Col = 1
  grdAweight1.Row = R
  rsACW3("AltValue") = grdAweight1.Text


 J = 1
  Do Until rsMC.EOF

   If rsACW3("CrName") = rsMC("MCNAME") Then
    'v1 = RSSC2("sC2VALUE")
    Y = rsMC("MCVALUE")
    Z = rsMC("MCNAME")
    K1 = True
    J = 1 + J
   End If
  rsMC.MoveNext
  Loop
'---------

  If K1 = True Then

   rsACW3("L1CrName") = Z
   rsACW3("L1CrVal") = Y
   rsACW3("CrValue") = Y
   rsACW3("TValue") = rsACW3("L1CrVal") * rsACW3("AltValue")

  End If

'-----------

  J = 1
  Do Until rSsc2.EOF

   If rsACW3("CrName") = rSsc2("SC2NAME") Then
    'v1 = RSSC2("sC2VALUE")
    Y = rSsc2("SC2VALUE")
    Z = rSsc2("NAME")
    x = rSsc2("GVALUE")

    Y2 = rSsc2("SC2Name")
    K2 = True


    J = 1 + J
   End If
  rSsc2.MoveNext
  Loop
'----------------End Of Instruction for that Operation---------
```

```
    If K2 = True Then
     ' rsACW5("CrValue") = Y
      'rsACW3("L2CrVal") = Y
      rsACW3("CrValue") = Y
       rsACW3("CrName") = Y2
      'rsACW3("L2CrName") = Y2
      rsACW3("L1CrName") = Z
      rsACW3("L1CrVal") = x
      rsACW3("TValue") = rsACW3("L1CrVal") * rsACW3("CrValue") * rsACW3("AltValue")
    End If

     rsACW3.Update

  Next R

  db.Close
End Sub

Public Sub AltAdd4()
Dim g2 As Integer
Dim Y As Double
Dim x As Double
Dim Z As Variant
Dim X1 As Double
Dim z1 As Variant
Dim K1, K2, K3, K4 As Boolean
Dim Y2, Y3 As Variant

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rSsc2 = db.OpenRecordset("SubCr2")
Set rsSC3 = db.OpenRecordset("SubCr3")
Set rsMC = db.OpenRecordset("MAINCR")
Set rsACW4 = db.OpenRecordset("AltCrWeight4")
'---------- The next programming code add the I.D No. for the main Criteria.


  Tsql = "Delete from AltCrWeight4 where len(AltCrWeight4.CrName)=0 or isnull(AltCrWeight4.[AltID])"
  db.Execute Tsql, dbFailOnError


  Set rsTEMP = db.OpenRecordset("Select Max(AltCrWeight4.[AltID]) as Gmax From AltCrWeight4;")

  If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
    g2 = 1
  Else
    g2 = rsTEMP("Gmax") + 1

  End If


  For R = 1 To NoOfAlternative

    rsACW4.AddNew

    rsACW4("AltID") = g2


    rsACW4("CrName") = Label1(10).Caption
    ' lstAlternatives.ListIndex = R - 1
    'rsACw4("AltName") = lstAlternatives.Text
    grdAlter.Col = R
    grdAlter.Row = 0
    rsACW4("AltName") = grdAlter.Text
```

```
    grdAweight1.Col = 1
    grdAweight1.Row = R
    rsACW4("AltValue") = grdAweight1.Text

'--Here The Program Will Retrieve The Weight For The Criteria Group Head--------


   J = 1
    Do Until rsMC.EOF

     If rsACW4("CrName") = rsMC("MCNAME") Then
      'v1 = RSSC2("sC2VALUE")
      Y = rsMC("MCVALUE")
      Z = rsMC("MCNAME")
      K1 = True
      J = 1 + J
     End If
    rsMC.MoveNext
    Loop
'-------------------------------------------------------------
    If K1 = True Then

    rsACW4("L1CrName") = Z
    rsACW4("L1CrVal") = Y
    rsACW4("CrValue") = Y
    rsACW4("TValue") = rsACW4("L1CrVal") * rsACW4("AltValue")

   End If
'-------------------------------------------------------------
    J = 1
    Do Until rSsc2.EOF

     If rsACW4("CrName") = rSsc2("SC2NAME") Then
      'v1 = RSSC2("sC2VALUE")
      Y = rSsc2("SC2VALUE")
      Y2 = rSsc2("SC2Name")
      Z = rSsc2("NAME")
      x = rSsc2("GVALUE")
      K2 = True
      J = 1 + J
     End If
    rSsc2.MoveNext
    Loop
'-----------------End Of Instruction for that Operation--------

   If K2 = True Then
    ' rsACW5("CrValue") = Y
    rsACW4("L2CrVal") = Y
    rsACW4("CrValue") = Y
    rsACW4("L2CrName") = Y2
    rsACW4("L1CrName") = Z
    rsACW4("L1CrVal") = x
    rsACW4("TValue") = rsACW4("L1CrVal") * rsACW4("L2CrVal") * rsACW4("AltValue")
   End If

'-------------------------------------------------------------
    J = 1
    Do Until rsSC3.EOF

     If rsACW4("CrName") = rsSC3("SC3NAME") Then
      'v1 = RSSC2("sC2VALUE")
      Y = rsSC3("SC3VALUE")
      Y3 = rsSC3("SC3NAME")
      Z = rsSC3("NAME")
```

```
                    x = rsSC3("GVALUE")
                    z1 = rsSC3("MCNAME")
                    X1 = rsSC3("MCVALUE")
                    K3 = True
                    J = 1 + J
                   End If
                  rsSC3.MoveNext
                  Loop
               '----------------End Of Instruction for that Operation--------

                  If K3 = True Then

                  rsACW4("CrValue") = Y
                  'rsACW4("L3CrVal") = Y
                  'rsACW4("L3CrName") = Y3
                  rsACW4("CrName") = Y3
                  rsACW4("L2CrName") = Z
                  rsACW4("L2CrVal") = x
                  rsACW4("L1CrName") = z1
                  rsACW4("L1CrVal") = X1
                  rsACW4("TValue") = rsACW4("L1CrVal") * rsACW4("L2CrVal") * rsACW4("CrValue") *
rsACW4("AltValue")
                End If

                '-------------------------------

                  rsACW4.Update

               Next R

               db.Close
            End Sub

            Public Sub AltAdd5()
            Dim g2 As Integer
            Dim Y As Double
            Dim x As Double
            Dim Z As Variant
            Dim X1 As Double
            Dim z1 As Variant

            Dim K1, K2, K3, K4 As Boolean
            Dim Y2, Y3, y4 As Variant

            Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
            Set rSsc2 = db.OpenRecordset("SubCr2")
            Set rsSC3 = db.OpenRecordset("SubCr3")
            Set rsSC4 = db.OpenRecordset("SubCr4")
            Set rsMC = db.OpenRecordset("MAINCR")
            Set rsACW5 = db.OpenRecordset("AltCrWeight5")
            '---------- The next programming code add the I.D No. for the main Criteria.


            Tsql = "Delete from AltCrWeight5 where len(AltCrWeight5.CrName)=0 or isnull(AltCrWeight5.[AltID])"
            db.Execute Tsql, dbFailOnError


            Set rsTEMP = db.OpenRecordset("Select Max(AltCrWeight5.[AltID]) as Gmax From AltCrWeight5;")

              If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
                g2 = 1
              Else
```

```
    g2 = rsTEMP("Gmax") + 1

  End If


'-----------------------
  For R = 1 To NoOfAlternative

    rsACW5.AddNew

    rsACW5("AltID") = g2


    rsACW5("CrName") = Label1(10).Caption
   ' lstAlternatives.ListIndex = R - 1
   ' rsACw5("AltName") = lstAlternatives.Text
   grdAlter.Col = R
    grdAlter.Row = 0
    rsACW5("AltName") = grdAlter.Text


    ' rsACw("GID") = g
   'rsSc2("SID") = s
   ' rsSc2("SC2Row") = R
   ' rsSc2("SC2Col") = 1
    grdAweight1.Col = 1
    grdAweight1.Row = R
    rsACW5("AltValue") = grdAweight1.Text

'--Here The Program Will Retrieve The Weight For The Criteria Group Head----------


    J = 1
    Do Until rsMC.EOF

     If rsACW5("CrName") = rsMC("MCNAME") Then
       'v1 = RSSC2("sC2VALUE")
       Y = rsMC("MCVALUE")
       Z = rsMC("MCNAME") """"
    ' Else
    '   Y = 1
       K1 = True
       J = 1 + J
     End If
    rsMC.MoveNext
    Loop
'-------------------------------------------------------------
   If K1 = True Then

    rsACW5("L1CrName") = Z
    rsACW5("L1CrVal") = Y
    rsACW5("CrValue") = Y
    rsACW5("TValue") = rsACW5("L1CrVal") * rsACW5("AltValue")

   End If
'-------------------------------------------------------------
    J = 1
    Do Until rSsc2.EOF

     If rsACW5("CrName") = rSsc2("SC2NAME") Then
       'v1 = RSSC2("sC2VALUE")
       Y = rSsc2("SC2VALUE")
```

```
                    Y2 = rSsc2("SC2Name")
                    Z = rSsc2("NAME")
                    x = rSsc2("GVALUE")
                    K2 = True
                    J = 1 + J
                   End If
                  rSsc2.MoveNext
                  Loop
          '----------------End Of Instruction for that Operation---------
                  If K2 = True Then
                   ' rsACW5("CrValue") = Y
                    rsACW5("L2CrVal") = Y
                    rsACW5("CrValue") = Y
                    rsACW5("L2CrName") = Y2
                    rsACW5("L1CrName") = Z
                    rsACW5("L1CrVal") = x
                    rsACW5("TValue") = rsACW5("L1CrVal") * rsACW5("L2CrVal") * rsACW5("AltValue")
                  End If

          '-------------------------------------------------------------
                   J = 1
                  Do Until rsSC3.EOF

                   If rsACW5("CrName") = rsSC3("SC3NAME") Then
                    'v1 = RSSC2("sC2VALUE")
                    Y = rsSC3("SC3VALUE")
                    Y3 = rsSC3("SC3NAME")
                    Z = rsSC3("NAME")
                    x = rsSC3("GVALUE")
                    z1 = rsSC3("MCNAME")
                    X1 = rsSC3("MCVALUE")
                    K3 = True
                    J = 1 + J
                   End If
                  rsSC3.MoveNext
                  Loop
          '----------------End Of Instruction for that Operation---------
                 If K3 = True Then

                  'rsACW5("CrValue") = Y
                  rsACW5("CrValue") = Y
                  rsACW5("L3CrVal") = Y
                  rsACW5("L3CrName") = Y3
                  rsACW5("L2CrName") = Z
                  rsACW5("L2CrVal") = x
                  rsACW5("L1CrName") = z1
                  rsACW5("L1CrVal") = X1
                  rsACW5("TValue") = rsACW5("L1CrVal") * rsACW5("L2CrVal") * rsACW5("L3CrVal") *
rsACW5("AltValue")
                 End If
          '-------------------------------------------------------------

                J = 1
                 Do Until rsSC4.EOF

                  If rsACW5("CrName") = rsSC4("SC4NAME") Then
                   'v1 = RSSC2("sC2VALUE")
                   Y = rsSC4("SC4VALUE")
                   Z = rsSC4("NAME")
                   x = rsSC4("GVALUE")
                   z1 = rsSC4("MCNAME")
                   X1 = rsSC4("MCVALUE")

                   z2 = rsSC4("SC2NAME")
```

```
                    X2 = rsSC4("SC2VALUE")
                    K4 = True
                    J = 1 + J
                   End If
                  rsSC4.MoveNext
                  Loop
          '----------------End Of Instruction for that Operation---------
                 If K4 = True Then

                  rsACW5("CrValue") = Y
                  rsACW5("CrValue") = Y
                  rsACW5("L3CrName") = Z
                   rsACW5("L3CrVal") = x
                   rsACW5("L1CrName") = z1
                   rsACW5("L1CrVal") = X1

                   rsACW5("L2CrName") = z2
                   rsACW5("L2CrVal") = X2
    rsACW5("TValue") = rsACW5("L1CrVal") * rsACW5("L2CrVal") * rsACW5("L3CrVal") * rsACW5("CrValue") *
rsACW5("AltValue")
                 End If
                  rsACW5.Update

                Next R

                db.Close
              End Sub

              Public Sub ReteriData()
              Dim X1 As Excel.Application
              Dim a As Integer
              Dim R As Integer
              Dim C As Integer
              Dim S As Integer
              Dim NOcr As Integer
              Dim ARRAY19() As Variant
              Dim ARRAY29() As Double
              Dim ARRAY39() As Variant
              Dim ARRAY49() As Double
              Dim ARRAY59() As Variant
              Dim ARRAY69() As Double
              Dim ARRAY79() As Variant
              Dim ARRAY89() As Double
              Dim ARRAY99() As Variant
              Dim ARRAY109() As Double
              Dim ARRAY209() As Double

              Dim g2 As Integer

              Dim x As Double
              Dim Z As Variant
              Dim v As Double
              Dim Y As Variant

              a = txtNoOfLevels

              Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
              Set rsACW2 = db.OpenRecordset("AltCrWeight2")
              Set rsACW3 = db.OpenRecordset("AltCrWeight3")
              Set rsACW4 = db.OpenRecordset("AltCrWeight4")
              Set rsACW5 = db.OpenRecordset("AltCrWeight5")

              Set rsGroup = db.OpenRecordset("Groups")
```

```
NOcr = 100 ' NoOfCrAlt * NoOfAlternative

ReDim ARRAY19(NOcr, 1) As Variant
ReDim ARRAY29(NOcr, 1) As Double
ReDim ARRAY39(NOcr, 1) As Variant
ReDim ARRAY49(NOcr, 1) As Double
ReDim ARRAY59(NOcr, 1) As Variant
ReDim ARRAY69(NOcr, 1) As Double
ReDim ARRAY79(NOcr, 1) As Variant
ReDim ARRAY89(NOcr, 1) As Double
ReDim ARRAY99(NOcr, 1) As Variant
ReDim ARRAY109(NOcr, 1) As Double
ReDim ARRAY209(NOcr, 1) As Double

'-------------------------
C = 1
R = 1
If a = 3 Then
  Do Until rsACW2.EOF
    Grid1.Col = 1
    Grid1.Row = C
   If Grid1.Text = rsACW2("CrName") Then
    Y = rsACW2("CrValue")
    ARRAY19(R, 1) = Grid1.Text
    ARRAY29(R, 1) = Y
    ARRAY39(R, 1) = rsACW2("AltName")
    ARRAY49(R, 1) = rsACW2("AltValue")
    ARRAY209(R, 1) = rsACW2("TValue")
    R = R + 1
    S = S + 1
   End If
   If S > NoAl Then
   S = 1
   C = C + 1
   End If


    rsACW2.MoveNext
  Loop
 ' RetriDataLeV3
End If

I = 1

  If a = 3 Then
    Do Until rsACW2.EOF

      If rsACW2("AltId") > 0 Then
       ARRAY19(I, 1) = rsACW2("CrName")
       ARRAY29(I, 1) = rsACW2("CrValue")
       ARRAY39(I, 1) = rsACW2("AltName")
       ARRAY49(I, 1) = rsACW2("AltValue")

       ARRAY209(I, 1) = rsACW2("TValue")

     I = I + 1
     End If
     rsACW2.MoveNext

Loop

End If

  I = 1
```

```
If a = 4 Then
  Do Until rsACW3.EOF
  '
     If rsACW3("AltId") > 0 Then
      ARRAY19(I, 1) = rsACW3("L1CrName")
      ARRAY29(I, 1) = rsACW3("L1CrVal")
      ARRAY39(I, 1) = rsACW3("CrName")
      ARRAY49(I, 1) = rsACW3("CrValue")
      ARRAY59(I, 1) = rsACW3("AltName")
      ARRAY69(I, 1) = rsACW3("AltValue")
      ARRAY209(I, 1) = rsACW3("TValue")

     I = I + 1
     End If


 rsACW3.MoveNext

Loop

End If


   If a = 5 Then

     Do Until rsACW4.EOF
  '
      If rsACW4("AltId") > 0 Then
       ARRAY19(I, 1) = rsACW4("L1CrName")
       ARRAY29(I, 1) = rsACW4("L1CrVal")
       ARRAY39(I, 1) = rsACW4("L2CrName")
       ARRAY49(I, 1) = rsACW4("L2CrVal")
       ARRAY59(I, 1) = rsACW4("CrName")
       ARRAY69(I, 1) = rsACW4("CrValue")
       ARRAY79(I, 1) = rsACW4("AltName")
       ARRAY89(I, 1) = rsACW4("AltValue")
       ARRAY209(I, 1) = rsACW4("TValue")

     I = I + 1

     End If

   rsACW4.MoveNext
  Loop

  End If
If a = 6 Then

 Do Until rsACW5.EOF
  '
      If rsACW5("AltId") > 0 Then
       ARRAY19(I, 1) = rsACW5("L1CrName")
       ARRAY29(I, 1) = rsACW5("L1CrVal")
       ARRAY39(I, 1) = rsACW5("L2CrName")
       ARRAY49(I, 1) = rsACW5("L2CrVal")
       ARRAY59(I, 1) = rsACW5("L3CrName")
       ARRAY69(I, 1) = rsACW5("L3CrVal")
       ARRAY79(I, 1) = rsACW5("CrName")
       ARRAY89(I, 1) = rsACW5("CrValUE")
       ARRAY99(I, 1) = rsACW5("AltName")
       ARRAY109(I, 1) = rsACW5("AltValue")
       ARRAY209(I, 1) = rsACW5("TValue")
```

```
        I = I + 1
        End If
rsACW5.MoveNext


Loop

End If

End Sub


Public Sub SynthesisF()
Dim ARRAYM() As Variant
Dim ARRAYM1() As Double
Dim ARRAYTV() As Double
Dim x As Double
Dim Y As Double
Dim NoAl As Integer
Dim NoCA As Integer
Dim C As Integer
Dim R, R1 As Integer
Dim Y1 As Double
Dim Y2 As Double
Dim J As Integer
Dim a As Integer
Dim F As Integer


Dim ARRAY19() As Variant
Dim ARRAY29() As Double
Dim ARRAY39() As Variant
Dim ARRAY49() As Double
Dim ARRAY59() As Variant
Dim ARRAY69() As Double
Dim ARRAY79() As Variant
Dim ARRAY89() As Double
Dim ARRAY99() As Variant
Dim ARRAY109() As Double
Dim ARRAY209() As Double



Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rSsc2 = db.OpenRecordset("SubCr2")

Set rsMC = db.OpenRecordset("MAINCR")
Set rsACW2 = db.OpenRecordset("AltCrWeight2")
Set rsACW3 = db.OpenRecordset("AltCrWeight3")
Set rsACW4 = db.OpenRecordset("AltCrWeight4")
Set rsACW5 = db.OpenRecordset("AltCrWeight5")
Set rsSynthesis = db.OpenRecordset("synthesis")
NoAl = NoOfAlternative
NoCA = NoOfCrAlt.Text
a = txtNoOfLevels.Text

F = 1


ReDim ARRAYM(NoCA, 1) As Variant
ReDim ARRAYM1(NoAl, NoCA) As Double
ReDim ARRAYTV(NoAl) As Double
```

```
GrdInAltDat1.Row = 1

For R = 1 To NoCA
GrdInAltDat1.Col = 1
ARRAYM(R, 1) = GrdInAltDat1.Text
Grid1.Col = 1
Grid1.Row = R
Grid1.Text = ARRAYM(R, 1)
F = (NoOfAlternative + 2) + F

'GrdInAltDat1.Row = R + (R * NoOfAlternative) + 1
GrdInAltDat1.Row = F
Next R

 NOcr = NoOfCrAlt * NoOfAlternative

ReDim ARRAY19(NOcr, 1) As Variant
ReDim ARRAY29(NOcr, 1) As Double
ReDim ARRAY39(NOcr, 1) As Variant
ReDim ARRAY49(NOcr, 1) As Double
ReDim ARRAY59(NOcr, 1) As Variant
ReDim ARRAY69(NOcr, 1) As Double
ReDim ARRAY79(NOcr, 1) As Variant
ReDim ARRAY89(NOcr, 1) As Double
ReDim ARRAY99(NOcr, 1) As Variant
ReDim ARRAY109(NOcr, 1) As Double
ReDim ARRAY209(NOcr, 1) As Double


 R1 = 1
 C = 1
 R = 1

'-------------------------------------------------
If a = 3 Then
   Do Until rsACW2.EOF
     Grid1.Col = 1
     Grid1.Row = C
    If Grid1.Text = rsACW2("CrName") Then
     Y = rsACW2("TValue")
     Grid2.Col = C
     Grid2.Row = R
     Grid2.Text = Y


     Grid100.Row = R1

     Grid100.Col = 1
     Grid100.Text = rsACW2("CrName")


     Grid100.Col = 2
     Grid100.Text = rsACW2("CrValue")

     Grid100.Col = 3
     Grid100.Text = rsACW2("AltName")


     Grid100.Col = 4
     Grid100.Text = rsACW2("AltValue")


     Grid100.Col = 5
     Grid100.Text = rsACW2("TValue")
```

```
      R1 = R1 + 1
      R = R + 1
     End If
     If R > NoAl Then
      R = 1
      C = C + 1
     End If
     rsACW2.MoveNext
    Loop
  End If
'-------------------------------------------------------
   If a = 4 Then
    Do Until rsACW3.EOF
      Grid1.Col = 1
      Grid1.Row = C
     If Grid1.Text = rsACW3("CrName") Then
      Y = rsACW3("TValue")

      Grid2.Col = C
      Grid2.Row = R
      Grid2.Text = Y
      R = R + 1
      End If
      If R > NoAl Then
       R = 1
       C = C + 1
      End If
      rsACW3.MoveNext
     Loop
  End If

'-----------------------------------------
 If a = 5 Then
    Do Until rsACW4.EOF
      Grid1.Col = 1
      Grid1.Row = C
     If Grid1.Text = rsACW4("CrName") Then
      Y = rsACW4("TValue")

      Grid2.Col = C
      Grid2.Row = R
      Grid2.Text = Y
      R = R + 1
     End If
      If R > NoAl Then
       R = 1
       C = C + 1
      End If
     rsACW4.MoveNext
    Loop
  End If


'-----------------------------------------
  If a = 6 Then
    Do Until rsACW5.EOF
      Grid1.Col = 1
      Grid1.Row = C
     If Grid1.Text = rsACW5("CrName") Then
      Y = rsACW5("TValue")

     Grid2.Col = C
```

```
    Grid2.Row = R
    Grid2.Text = Y
    R = R + 1
   End If
   If R > NoAl Then
    R = 1
    C = C + 1
   End If
   rsACW5.MoveNext
  Loop
End If



For R = 1 To NoAl

 Y1 = 0
 Y2 = 0

 For C = 1 To NoCA
  Grid2.Col = C
  Grid2.Row = R
  Y1 = Grid2.Text
  Y2 = Y1 + Y2
  ARRAYTV(R) = Y2
 Next C

Next R

 grdSynthesis.Cols = NoAl + 1

   For R = 1 To NoOfAlternative
     grdAweight1.Col = 0
     grdAweight1.Row = R
     grdSynthesis.Col = R
     grdSynthesis.Row = 0
     grdSynthesis.Text = grdAweight1.Text
   Next R

 For C = 1 To NoAl

    grdSynthesis.Row = 1
    grdSynthesis.Col = C
    grdSynthesis.Text = ARRAYTV(C)
 Next C
'-------------------------------------------------------------
 Y2 = ARRAYTV(1)

 For C = 1 To NoAl

   If Y2 > ARRAYTV(C) Then
   Else
     Y2 = ARRAYTV(C)
     R = C
   End If
Next C
lblsynthesis.Caption = "Choose Alternative  No : " & R
Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")

Set rsSynthesis = db.OpenRecordset("Synthesis")

For R = 1 To NoAl
rsSynthesis.AddNew
```

```
    ' rsSynthesis("GID") = G
    ' rsSynthesis("SID") = S
     grdAweight1.Col = 0
     grdAweight1.Row = R
     rsSynthesis("Decision-Maker") = DecisonMakerName
     rsSynthesis("Alternatives") = grdAweight1.Text
     'lstAlternatives.ListIndex = R - 1
    ' rsSynthesis("Alternatives") = lstAlternatives.Text

     rsSynthesis("Final Result") = ARRAYTV(R)
    ' rsSynthesis("Result") = Y2
    ' rsSynthesis("Message") = lblsynthesis.Caption
     rsSynthesis.Update
     Next R

     db.Close


End Sub

Public Sub PlotData()
Dim I As Integer
Dim NOcr As Integer
Dim sngInew(10) As Double
On Error Resume Next

NoOfCriteria = txtNoOfCriteria.Text

Graph1.GraphTitle = "Criteria Weights"

Graph1.NumPoints = NoOfCriteria
Graph1.ThisPoint = 1
Graph1.AutoInc = 1
For I = 1 To NoOfCriteria
sngInew(NoOfCriteria) = Rnd(1) * I + 1
grdpweight.Col = 1
grdpweight.Row = I

Graph1.GraphData = grdpweight.Text

Next I
For I = 1 To NoOfCriteria
sngInew(NoOfCriteria) = Rnd(1) * I + 1
grdpweight.Col = 0
grdpweight.Row = I


Graph1.LabelText = grdpweight.Text

Graph1.DrawMode = 2

Next I

Graph1.Visible = True

End Sub

Public Sub START()
Dim L As Integer, I As Integer, R As Integer, C As Integer, X10 As Integer, x3 As Integer

lstcriteria.Clear

  R = 1 + NoOfCriteria
```

```
'-------------------
' x = x + 1
' L = L + 1

' R = NoOfCriteria + 1
 GridInputData.Col = C
 GridInputData.Row = R
'-------------------
C = 1
GridInputData.Col = C
GridInputData.Row = R
CrNodeName = " "
CrNodeName = GridInputData.Text
C = 2
GridInputData.Col = C
GridInputData.Row = R
LevelNo = " "
LevelNo = GridInputData.Text
C = 3
txtNoOfCriteria = " "
'-------------------------------------
GridInputData.Col = C
GridInputData.Row = R

txtNoOfCriteria = GridInputData.Text
If IsNull(txtNoOfCriteria.Text) = True Or Len(Trim(txtNoOfCriteria.Text)) = 0 Then
   Else
      grdpair.Cols = txtNoOfCriteria.Text + 1
      grdpair.Rows = txtNoOfCriteria.Text + 1
      grdpnormal.Cols = txtNoOfCriteria.Text + 1
      grdpnormal.Rows = txtNoOfCriteria.Text + 1
      grdPairBak.Cols = txtNoOfCriteria.Text + 1
      grdPairBak.Rows = txtNoOfCriteria.Text + 1
      grdpweight.Rows = txtNoOfCriteria + 1
      grdpcons.Cols = txtNoOfCriteria + 1
      lstcriteria.Clear
     ' lstcritriabak.Clear

      NoOfCriteria = txtNoOfCriteria.Text
   End If

'-------------------------------------

C = 4

'-----------------------------------------
For R = R To (NoOfCriteria + R - 1)
GridInputData.Col = C
GridInputData.Row = R
'If KeyAscii = 13 Then
'     If Len(Trim(txtCriterias.Text)) > 0 Then
      lstcriteria.AddItem UCase(GridInputData.Text)

'      txtCriterias.Text = ""

    ' End If
Next R
'-----------------------------


  x3 = lstcriteria.ListCount
 ' If X <> NoOfCriteria Then
 '  MsgBox "No. Of criteria Does Not Match The Criteria ", vbCritical, "Test Project"
 '  Exit Sub
```

```
' End If

 For I = 0 To x3 - 1
    grdpair.Row = I + 1
    grdpair.Col = 0
    grdpnormal.Row = I + 1
    grdpnormal.Col = 0
    grdPairBak.Row = I + 1
    grdPairBak.Col = 0
    lstcriteria.ListIndex = I
    grdpair.Text = lstcriteria.Text
    grdpnormal.Text = lstcriteria.Text
    grdPairBak.Text = lstcriteria.Text
 Next
 For I = 0 To x3 - 1
    grdpair.Col = I + 1
    grdpair.Row = 0
     grdpnormal.Col = I + 1
    grdpnormal.Row = 0
     grdPairBak.Col = I + 1
    grdPairBak.Row = 0
    lstcriteria.ListIndex = I
    grdpair.Text = lstcriteria.Text
     grdpnormal.Text = lstcriteria.Text
      grdPairBak.Text = lstcriteria.Text
 Next
 For I = 0 To x3 - 1
    grdpweight.Row = I + 1
    grdpweight.Col = 0
     lstcriteria.ListIndex = I
    grdpweight.Text = lstcriteria.Text
 Next I
  For I = 0 To x3 - 1
    grdpcons.Row = 0
    grdpcons.Col = I + 1
     lstcriteria.ListIndex = I
    grdpcons.Text = lstcriteria.Text
 Next I
'-------------------------------
 If L <= NoCrNodes Then 'And L <= NoCrNodes Then X10 = X10 + 1
  R = NoOfCriteria + 1
  L = L + 1

 End If

X10 = X10 + 1
End Sub


Public Sub GrdHeadInDat()
Dim R As Integer, I As Integer
'-----------------

'----------THIS IS FOR THE OTHER GRID-- ALTTERNATIVE GRID------
" GrdInAltDat1.Col = 1
"GrdInAltDat1.Row = 0
 "GrdInAltDat1.Text = "NoOfCr.-Alt.""
 GrdInAltDat1.Col = 1
GrdInAltDat1.Row = 0
'GridAltData.Text = "No Of Alt./Cr."
'GridAltData.Col = 1
 GrdInAltDat1.Text = "Alt.Cr."
'GridAltData.Row = 1
```

```
GrdIn.AltDat1.Row = 0
GrdIn.AltDat1.Col = 2
GrdIn.AltDat1.Text = "NoOf.Alt."
GrdIn.AltDat1.Col = 3
GrdIn.AltDat1.Text = "Alt."

For R = 1 To 999
GrdIn.AltDat1.Col = 0
GrdIn.AltDat1.Row = R
GrdIn.AltDat1.Text = R
Next R

For I = GrdIn.AltDat1.SelStartCol To GrdIn.AltDat1.SelEndCol

    GrdIn.AltDat1.ColWidth(I) = 880

Next I


'-----------------
GridInputData.Col = 1
GridInputData.Row = 0
GridInputData.Text = "Cr.Node "

GridInputData.Col = 2
GridInputData.Row = 0
GridInputData.Text = "Level.No."

GridInputData.Col = 3
GridInputData.Row = 0
GridInputData.Text = "NoOfCr."

GridInputData.Col = 4
GridInputData.Row = 0
GridInputData.Text = "CrName "
'GridInputData.Col = 5
'GridInputData.Row = 0
'GridInputData.Text = "Cr. Name "
For R = 1 To 999
GridInputData.Col = 0
GridInputData.Row = R
GridInputData.Text = R
Next R
'For R = 1 To 6

'   GridInputData.Col.Alignment(i) = 3
' Next R
'---------------

If KeyAscii = 13 Then
    lstcriteria.Clear
   ' lstcritriabak.Clear
    SendKeys "{TAB}", True
  End if

'-------------------------------------
For I = GridInputData.SelStartCol To GridInputData.SelEndCol

    GridInputData.ColWidth(I) = 880

Next I
```

```
For I = grd.Aweight.SelStartCol To grd.Aweight.SelEndCol

    grd.Aweight.ColWidth(I) = 880


Next I

End Sub


Public Sub Plot.AltData()
Dim I As Integer
Dim NOcr As Integer
On Error Resume Next

 Dim sngInew(10) As Double
' NoOfCriteria = txtNoOfCriteria.Text
'
Graph2.GraphTitle = "Alternatives Weights"

Graph2.NumPoints = NoOf.Alternative
Graph2.ThisPoint = 1
Graph2..AutoInc = 1
For I = 1 To NoOf.Alternative
sngInew(NoOf.Alternative) = Rnd(1) * I - 1
grd.Aweight1.Col = 1
grd.Aweight1.Row = I

Graph2.GraphData = grd.Aweight1.Text

Next I

For I = 1 To NoOf.Alternative
sngInew(NoOf.Alternative) = Rnd(1) * I - 1
grd.Aweight1.Col = 0
grd.Aweight1.Row = I


Graph2.LabelText = grd.Aweight1.Text

Graph2.DrawMode = 2

Next I

Graph2.Visible = True
End Sub

Public Sub AltConsisIndex()
 Dim R As Integer
   Dim C As Integer
   Dim Value As Double, Temp As Double
   Dim RI As Double
   Dim Msg As String


  On Error Resume Next
  Value = 0#
  Temp = 0#

  'For R = 1 To NoOfAlternative

    grd.Aweight1.Col = 1
     grd.Acons.Row = 1
```

```
    For C = 1 To NoOfAlternative

      grdAweight1.Row = C
      grdAcons.Col = C
      Temp = grdAcons.Text   grdAweight1.Text
       Value = Value - Temp

    Next C

  Next R
  Set db = OpenDatabase(App.Path & " " & "Alirezam.mdb")
  Set rsRnd = db.OpenRecordset("RandomIndex")
  rsRnd.Index = "RID"
  rsRnd.Seek "=", NoOfAlternative
  RI = rsRnd("Rindex")

  Msg = ""
  Value = Value   NoOfAlternative
  Temp = (Value - NoOfAlternative)   (NoOfAlternative - 1)
 Label.AltCons = Temp   RI

  Msg = Msg & Chr(13) & "Lambda Max = " & Format(Value, "===0.0000")
  Msg = Msg & Chr(13) & "Consistency Index = " & Format(Temp, "===0.0000")

  Msg = Msg & Chr(13) & "Random Index= " & RI
  Msg = Msg & Chr(13) & "CI RI  = " & Format((Temp   RI), "===0.0000")

  If (Temp   RI)   0.1 Then
    Msg = Msg & Chr(13) & "Degree of Consistency Is Satisfactory"
  Else
    Msg = Msg & Chr(13) & "Degree of Consistency Is  Not Satisfactory"
  End If

  inptval11   MsgBox(Msg, vbOKCancel)

If inptval11   vbOK Then

filesave11

End If

If inptval11 = vbCancel Then

MsgBox "Repeat Your Calculation"

Exit Sub
End If

End Sub

Public Sub filesave11()
Dim a As Integer
a = txtNoOfLevels
' If NoOfCrNode = 0 Or IsNull(NoOfCrNode) Then Exit Sub
  If a = 3 Then

  AltAdd2
  ElseIf a = 4 Then
  AltAdd3
  ElseIf a = 5 Then
  AltAdd4
  ElseIf a = 6 Then
  AltAdd5
' ElseIf a = 7 Then
```

```
'  AltAdd6
'  ElseIf a = 8 Then
'  AltAdd7
   End If


End Sub

Public Sub StoreInputData()

Dim xl As Object


Dim a As Integer
Dim NOcr1 As Integer
Dim NOcr2 As Integer
Dim ARRAY1() As Variant
Dim ARRAY2() As Double
Dim g2 As Integer
Dim NOcr As Integer
Dim x As Double
Dim Z As Variant
Dim v As Double
Dim Y As Variant
Dim J As Integer
'Dim nocr2 As Integer
NoAl = NoOfAlternative

'a = txtNoOfLevels


'NOcr = NoOfCrAlt * NoOfAlternative
 NOcr1 = 60
 ReDim ARRAY11(NOcr1, 1) As Variant
 ReDim ARRAY21(NOcr1, 1) As Variant
 ReDim ARRAY31(NOcr1, 1) As Variant
 ReDim ARRAY41(NOcr1, 1) As Variant
 ReDim ARRAY51(NOcr1, 1) As Variant
 ReDim ARRAY61(NOcr1, 1) As Variant
 ReDim ARRAY71(NOcr1, 1) As Variant
 ReDim ARRAY81(NOcr1, 1) As Variant
 ReDim ARRAY91(NOcr1, 1) As Variant
 ReDim ARRAY101(NOcr1, 1) As Variant
 ReDim ARRAY111(NOcr1, 1) As Variant
 ReDim ARRAY121(NOcr1, 1) As Variant
 ReDim ARRAY131(NOcr1, 1) As Variant
 ReDim ARRAY141(NOcr1, 1) As Variant

 ReDim ARRAY151(NOcr1, 1) As Variant
 ReDim ARRAY161(NOcr1, 1) As Variant
 ReDim ARRAY171(NOcr1, 1) As Variant
 ReDim ARRAY181(NOcr1, 1) As Variant
 ReDim ARRAY191(NOcr1, 1) As Variant
 ReDim ARRAY200(NOcr1, 1) As Variant
 ReDim ARRAY201(NOcr1, 1) As Variant
 ReDim ARRAY202(NOcr1, 1) As Variant
 ReDim ARRAY203(NOcr1, 1) As Variant
 ReDim ARRAY204(NOcr1, 1) As Variant
 ReDim ARRAY205(NOcr1, 1) As Variant
 ReDim ARRAY206(NOcr1, 1) As Variant
 ReDim ARRAY207(NOcr1, 1) As Variant

'-------OUTPUT DATA-----------------------------------------------
```

```
Dim R As Integer
Dim C As Integer
Dim S As Integer
'Dim NOCR As Integer
Dim ARRAY19() As Variant
Dim ARRAY29() As Double
Dim ARRAY39() As Variant
Dim ARRAY49() As Double
Dim ARRAY59() As Variant
Dim ARRAY69() As Double
Dim ARRAY79() As Variant
Dim ARRAY89() As Double
Dim ARRAY99() As Variant
Dim ARRAY109() As Double
Dim ARRAY209() As Double



a = txtNoOfLevels

Set db = OpenDatabase(App.Path & " " & "Alirezam.mdb")
Set rsACW2 = db.OpenRecordset("AltCrWeight2")
Set rsACW3 = db.OpenRecordset("AltCrWeight3")
Set rsACW4 = db.OpenRecordset("AltCrWeight4")
Set rsACW5 = db.OpenRecordset("AltCrWeight5")

Set rsGroup = db.OpenRecordset("Groups")



NOcr2 = NoOfCr.Alt * NoOf.Alternative

NOcr = 60 ' NoOfCr.Alt * NoOf.Alternative

ReDim ARRAY19(NOcr2, 1) As Variant
ReDim ARRAY29(NOcr2, 1) As Double
ReDim ARRAY39(NOcr2, 1) As Variant
ReDim ARRAY49(NOcr2, 1) As Double
ReDim ARRAY59(NOcr2, 1) As Variant
ReDim ARRAY69(NOcr2, 1) As Double
ReDim ARRAY79(NOcr2, 1) As Variant
ReDim ARRAY89(NOcr2, 1) As Double
ReDim ARRAY99(NOcr2, 1) As Variant
ReDim ARRAY109(NOcr2, 1) As Double
ReDim ARRAY209(NOcr2, 1) As Double
ReDim ARRAYM(NoOfAlternative, 1) As Variant
'---------------------------------

'On Error GoTo OLE_ERROR



C = 1
R = 1

If a = 3 Then

   For R = 1 To NOcr2
```

```
    Grid100.Row = R

    Grid100.Col = 1

    ARRAY19(R, 1) = Grid100.Text

    Grid100.Col = 2

    ARRAY29(R, 1) = Grid100.Text

    Grid100.Col = 3

    ARRAY39(R, 1) = Grid100.Text

    Grid100.Col = 4

    ARRAY49(R, 1) = Grid100.Text

    Grid100.Col = 5

    ARRAY209(R, 1) = Grid100.Text
'

   Next R

.
End If
'----------------------END OF OUTPUT DATA FOR 3 LEVEL HEIRARCHY----
'

  'I = 1

   For I = 1 To NOcrl

       GridInputData.Col = 1
       GridInputData.Row = I
       ARRAY11(I, 1) = GridInputData.Text

       GridInputData.Col = 2
       GridInputData.Row = I
       ARRAY21(I, 1) = GridInputData.Text

       GridInputData.Col = 3
       GridInputData.Row = I
       ARRAY31(I, 1) = GridInputData.Text

       GridInputData.Col = 4
       GridInputData.Row = I
       ARRAY41(I, 1) = GridInputData.Text

       GridInputData.Col = 5
       GridInputData.Row = I - 1
       ARRAY51(I, 1) = GridInputData.Text



       GridInputData.Col = 6
       GridInputData.Row = I - 1
       ARRAY61(I, 1) = GridInputData.Text

       GridInputData.Col = 7
```

```
GridInputData.Row = I '- 1
ARRAY71(I, 1) = GridInputData.Text


GridInputData.Col = 8
GridInputData.Row = I '- 1
ARRAY81(I, 1) = GridInputData.Text

GridInputData.Col = 9
GridInputData.Row = I '- 1
ARRAY91(I, 1) = GridInputData.Text


GridInputData.Col = 10
GridInputData.Row = I '- 1
ARRAY101(I, 1) = GridInputData.Text


GridInputData.Col = 11
GridInputData.Row = I '- 1
ARRAY111(I, 1) = GridInputData.Text

GridInputData.Col = 12
GridInputData.Row = I '- 1
ARRAY121(I, 1) = GridInputData.Text

GridInputData.Col = 13
GridInputData.Row = I '- 1
ARRAY131(I, 1) = GridInputData.Text

GridInputData.Col = 14
GridInputData.Row = I '- 1
ARRAY141(I, 1) = GridInputData.Text


GrdIn.AltDat1.Col = 1
GrdIn.AltDat1.Row = I '- 1
ARRAY151(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 2
GrdIn.AltDat1.Row = I '- 1
ARRAY161(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 3
GrdIn.AltDat1.Row = I '- 1
ARRAY171(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 4
GrdIn.AltDat1.Row = I '- 1
ARRAY181(I, 1) = GrdIn.AltDat1.Text

GrdIn.AltDat1.Col = 5
GrdIn.AltDat1.Row = I '- 1
ARRAY191(I, 1) = GrdIn.AltDat1.Text
```

```
GrdIn.AltDat1.Col = 6
GrdIn.AltDat1.Row = I - 1
ARRAY200(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 7
GrdIn.AltDat1.Row = I - 1
ARRAY201(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 8
GrdIn.AltDat1.Row = I - 1
ARRAY202(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 9
GrdIn.AltDat1.Row = I - 1
ARRAY203(I, 1) = GrdIn.AltDat1.Text


GrdIn.AltDat1.Col = 10
GrdIn.AltDat1.Row = I - 1
ARRAY204(I, 1) = GrdIn.AltDat1.Text

GrdIn.AltDat1.Col = 11
GrdIn.AltDat1.Row = I - 1
ARRAY205(I, 1) = GrdIn.AltDat1.Text

GrdIn.AltDat1.Col = 12
GrdIn.AltDat1.Row = I - 1
ARRAY206(I, 1) = GrdIn.AltDat1.Text

GrdIn.AltDat1.Col = 13
GrdIn.AltDat1.Row = I - 1
ARRAY207(I, 1) = GrdIn.AltDat1.Text


Next I


Load frmdecsion

End Sub

Public Sub PlotDataSyntheis()
Dim I As Integer
Dim NOcr As Integer


Dim sngInew(10) As Double

Graph3.GraphTitle = "Synthesis"

Graph3.NumPoints = NoOfAlternative
Graph3.ThisPoint = 1
Graph3.AutoInc = 1

For I = 1 To NoOfAlternative
sngInew(NoOfAlternative) = Rnd(1) * I + 1
grdSynthesis.Col = I
grdSynthesis.Row = 1
```

```
'grd.Aweight1.Col = 0
'grd.Aweight1.Row = R
Graph3.GraphData = grdSynthesis.Text
'Graph3.LabelText = grd.Aweight1.Text
Next I

 For I = 1 To NoOf.Alternative
 sngInew(NoOf.Alternative) = Rnd(1) * I + 1
 grdSynthesis.Col = I
 grdSynthesis.Row = 0


 Graph3.LabelText = grdSynthesis.Text

Graph3.DrawMode = 2

 Next I

Graph3.Visible = True
End Sub


Public Sub SaveCrInput()
Dim xl As Object

Dim DM As Variant
Dim MO As Variant
Dim TOTALCR1 As Integer
Dim a As Integer
Dim NOcr1 As Integer
Dim NOcr2 As Integer
Dim ARRAY1() As Variant
Dim ARRAY2() As Double
Dim g2 As Integer
Dim NOcr As Integer
Dim x As Double
Dim Z As Variant
Dim v As Double
Dim Y As Variant
Dim J As Integer

Set db = OpenDatabase(App.Path & " " & "Mirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rs.AltIn   db.OpenRecordset("AlternativesInput")

Set rsLC.ANo = db.OpenRecordset("LevCr.AltNo")


Set rsGroup = db.OpenRecordset("Groups")
'--------------------------------

 Tsql = "Delete from CriteriaInput where len(CriteriaInput.CrName)=0 or isnull(CriteriaInput.[GID])"
    db.Execute Tsql, dbFailOnError


   Set rsTEMP = db.OpenRecordset("Select Max(CriteriaInput.[GID]) as Gmax From CriteriaInput;")

   If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
      g2 = 1
   Else
      g2 = rsTEMP("Gmax") + 1

   End If
'--------------------------------
```

```
TOTALCR1 = text2.Text
DM = DecisonMakerName
MO = MainObjective
NOcr1 = TOTALCR1 - NoOfCrNode - 1
No.Al = NoOfAlternative
NoCA = NoOfCrAlt
NLev = txtNoOfLevels
    For I = 1 To NOcr1

        rsCrIn.AddNew
        rsCrIn("GID") = g2
        rsCrIn("Decision-Maker") = DM
        rsCrIn("Objective") = MO

        GridInputData.Col = 1
        GridInputData.Row = I
        rsCrIn("Cr-Node") = GridInputData.Text

        GridInputData.Col = 2
        GridInputData.Row = I
        rsCrIn("LevelNo") = GridInputData.Text

        GridInputData.Col = 3
        GridInputData.Row = I
        rsCrIn("No-Of-Cr") = GridInputData.Text

        GridInputData.Col = 4
        GridInputData.Row = I
        rsCrIn("CrName") = GridInputData.Text

        GridInputData.Col = 5
        GridInputData.Row = I
        rsCrIn("1") = GridInputData.Text

        GridInputData.Col = 6
        GridInputData.Row = I
        rsCrIn("2") = GridInputData.Text

        GridInputData.Col = 7
        GridInputData.Row = I
        rsCrIn("3") = GridInputData.Text

        GridInputData.Col = 8
        GridInputData.Row = I
        rsCrIn("4") = GridInputData.Text

        GridInputData.Col = 9
        GridInputData.Row = I
        rsCrIn("5") = GridInputData.Text


        GridInputData.Col = 10
        GridInputData.Row = I
        rsCrIn("6") = GridInputData.Text

        GridInputData.Col = 11
        GridInputData.Row = I
        rsCrIn("7") = GridInputData.Text

        GridInputData.Col = 12
        GridInputData.Row = I
        rsCrIn("8") = GridInputData.Text

        GridInputData.Col = 13
```

```
        GridInputData.Row = I
        rsCrIn("9") = GridInputData.Text

        GridInputData.Col = 14
        GridInputData.Row = I
        rsCrIn("10") = GridInputData.Text

        rsCrIn.Update

      Next I

      db.Close

.


End Sub

Public Sub CRDataRetrieve()

Dim xl As Object
Dim DM1 As Variant
Dim MO1 As Variant
Dim DM As Variant
Dim MO As Variant
Dim a As Integer
Dim NOcr1 As Integer
Dim NOcr2 As Integer
Dim ARRAY1() As Variant
Dim ARRAY2() As Double
Dim g2 As Integer
Dim NOcr As Integer
Dim x As Double
'Dim xR As Double
Dim Z As Variant
Dim v As Double
Dim Y As Variant
Dim J As Integer
Dim YY As Variant

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rsAltIn = db.OpenRecordset("AlternativesInput")
Set rsLCANo = db.OpenRecordset("LevCrAltNo")

Set rsGroup = db.OpenRecordset("Groups")
'--------------------------------
GridInputData.Visible = True


For R = 1 To 30

 For R1 = 1 To 998
  GridInputData.Col = R
 GridInputData.Row = R1
 GridInputData.Text = ""
 Next R1
Next R

'xR = rsLCANo("GID")
 ' NO = InputBox("Enter YOUR ID")
  NO = xR
'Text2.Text = NO
I = 1
```

```
rsCrIn.Index = "GID"
  rsCrIn.Seek "=", NO
   If rsCrIn.NoMatch = False Then
    NO = rsCrIn("GID")


End If

 Do Until rsCrIn.EOF
'
'  If rsCrIn.NoMatch = False Then

 If rsCrIn("GID") = NO Then
'


 GridInputData.Col = 1
 GridInputData.Row = I
 YY = rsCrIn("Cr-Node")
 GridInputData.Text = YY

 GridInputData.Col = 2
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("LevelNo")

 GridInputData.Col = 3
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("No-Of-Cr")
'
 GridInputData.Col = 4
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("CrName")

 GridInputData.Col = 5
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("1")

 GridInputData.Col = 6
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("2")

 GridInputData.Col = 7
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("3")

 GridInputData.Col = 8
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("4")

 GridInputData.Col = 9
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("5")


 GridInputData.Col = 10
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("6")

 GridInputData.Col = 11
 GridInputData.Row = I
 GridInputData.Text = rsCrIn("7")
```

```
        GridInputData.Col = 12
        GridInputData.Row = I
        GridInputData.Text = rsCrIn("8")

        GridInputData.Col = 13
        GridInputData.Row = I
        GridInputData.Text = rsCrIn("9")

        GridInputData.Col = 14
        GridInputData.Row = I
        GridInputData.Text = rsCrIn("10")

    ' End If
     End If

  ' End If
   I = I - 1
   rsCrIn.MoveNext
   Loop

' End If


End Sub

Public Sub LevCrAltInput()
Dim xl As Object

Dim DM As Variant
Dim MO As Variant
Dim a As Integer
Dim NOcr1 As Integer
Dim NOcr2 As Integer
Dim ARR.AY1() As Variant
Dim ARR.AY2() As Double
Dim g2 As Integer
Dim NOcr As Integer
Dim x As Double
Dim Z As Variant
Dim v As Double
Dim Y As Variant
Dim J As Integer

Set db = OpenDatabase(App.Path & "" & "Alirezam.mdb")
Set rsLC.No = db.OpenRecordset("LevCrAltNo")

DM = DecisonMakerName
MO = MainObjective
NOcr1 = TotalCr - NoOfCrNode - 1
NoAl = NoOfAlternative


  For I = 1 To NOcr1

     rsCrIn.AddNew

     rsCrIn("Decision-Maker") = DM
     rsCrIn("Objective") = MO


     rsCrIn.Update
```

```
    Next I

    db.Close



End Sub

Public Sub RetrlevCR.ALTNO()


Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rs.AltIn = db.OpenRecordset("AlternativesInput")

Set rsLC.ANo = db.OpenRecordset("LevCr.AltNo")
 FN = InputBox("File Name:")



      rsLC.ANo.Index = "FileName"
      rsLC.ANo.Seek "=", FN

.
      If rsLC.ANo.NoMatch = False Then
      NLev = rsLC.ANo("NoOfLevels")
      txtNoOfLevels.Text = NLev
      NoC.A = rsLC.ANo("Cr-Alt-Nodes")
      NoOfCr.Alt.Text = NoC.A

      DecisonMakerName.Text = rsLC.ANo("Decision-Maker")
      MainObjective = rsLC.ANo("Objective")
      frmdecsion.Caption = rsLC.ANo("FileName")

      NoOfCrNode.Text = rsLC.ANo("NOfCrNode")
      text2.Text = rsLC.ANo("TotalCr")
      Text4.Text = rsLC.ANo("No-Of-Alt")
      xR = rsLC.ANo("GID")
.
      End If

   I = I


    GI = xR

End Sub

Public Sub AltDataRetrieve()
Dim DM As Variant
Dim MO As Variant
Dim DM1 As Variant
Dim MO1 As Variant
Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rs.AltIn = db.OpenRecordset("AlternativesInput")
Set rsLC.ANo = db.OpenRecordset("LevCr.AltNo")
Set rsGroup = db.OpenRecordset("Groups")
'-------------------------.Alternatives Input----------------------
 GrdIn.AltDat1.Visible = True
```

```
For R = 1 To 30
For R1 = 1 To 999
 GrdIn.AltDat1.Col = R
 GrdIn.AltDat1.Row = R1
  GrdIn.AltDat1.Text = ""
Next R1
Next R
GI = xR
       rs.AltIn.Index = "GID"
       rs.AltIn.Seek "=", GI
      If rs.AltIn.NoMatch = False Then

     GI = rs.AltIn("GID")
     End If
    I = 1

    Do Until rs.AltIn.EOF

     ' If rs.AltIn.NoMatch = False Then
      If rs.AltIn("GID") = GI Then


    .
    .
    .
       GrdIn.AltDat1.Col = 1
       GrdIn.AltDat1.Row = I
       GrdIn.AltDat1.Text = rs.AltIn("Cr-Alt-Node")


       ' ListCR.ALT.ListIndex = I - 1
       '  ListCR.ALT.Text = rs.AltIn("Cr-Alt-Node")


       GrdIn.AltDat1.Col = 2
       GrdIn.AltDat1.Row = I
       GrdIn.AltDat1.Text = rs.AltIn("No-Of-Alt")
    .
       GrdIn.AltDat1.Col = 3
       GrdIn.AltDat1.Row = I
       GrdIn.AltDat1.Text = rs.AltIn("Alternative")
    .
       GrdIn.AltDat1.Col = 4
       GrdIn.AltDat1.Row = I
       GrdIn.AltDat1.Text = rs.AltIn("1")
    .
    .
      GrdIn.AltDat1.Col = 5
      GrdIn.AltDat1.Row = I
      GrdIn.AltDat1.Text = rs.AltIn("2")
    .
    .
    .
      GrdIn.AltDat1.Col = 6
      GrdIn.AltDat1.Row = I
      GrdIn.AltDat1.Text = rs.AltIn("3")
    .
      GrdIn.AltDat1.Col = 7
      GrdIn.AltDat1.Row = I
      GrdIn.AltDat1.Text = rs.AltIn("4")
    .
      GrdIn.AltDat1.Col = 8
```

```
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("5")

        GrdIn.AltDat1.Col = 9
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("6")

      .
        GrdIn.AltDat1.Col = 10
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("7")
      .
        GrdIn.AltDat1.Col = 11
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("8")
      .
        GrdIn.AltDat1.Col = 12
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("9")
      .
        GrdIn.AltDat1.Col = 13
        GrdIn.AltDat1.Row = I
        GrdIn.AltDat1.Text = rs.AltIn("10")

    End If
    I = I + 1

    rs.AltIn.MoveNext

  Loop

End Sub

Public Sub SaveCr.AltNodeLeNo()

Dim TCr As Integer
Dim No.Alt As Integer

Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rs.AltIn = db.OpenRecordset("AlternativesInput")

Set rsLCANo = db.OpenRecordset("LevCr.AltNo")
'-----------------------Level no. cr-alt nodes number-----------------
 Tsql = "Delete from LevCr.AltNo where len(LevCr.AltNo.FileName)=0 or isnull(LevCr.AltNo.[GID])"
    db.Execute Tsql, dbFailOnError


   Set rsTEMP = db.OpenRecordset("Select Max(LevCr.AltNo.[GID]) as Gmax From LevCr.AltNo;")

   If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
     g2 = 1
   Else
     g2 = rsTEMP("Gmax") + 1

   End If

'-------------------------------------------------------------------------
DM = DecisonMakerName
MO = MainObjective
TCr = text2.Text
No.Alt = Text4.Text
NOcr1 = TCr + NoOfCrNode - 1
No.Al = NoOf.Alternative
```

```
NoCA = NoOfCrAlt
NLev = txtNoOfLevels


FName = InputBox("Save File As")

Do Until rsLCANo.EOF
   If FName = rsLCANo("FileName") Then
    MsgBox "File Exists, Try To Save File Under A Diffrent Name"
   'rsLCANo("FileName") = ""
   FName = InputBox("Save File As")
  End If

rsLCANo.MoveNext

Loop
frmdecsion.Caption = FName

   'For I = 1 To NOcr1

        rsLCANo.AddNew
        rsLCANo("GID") = g2
        rsLCANo("FileName") = FName
        rsLCANo("Decision-Maker") = DM
        rsLCANo("Objective") = MO
        rsLCANo("NoOfLevels") = NLev
        rsLCANo("Cr-Alt-Nodes") = NoCA
        rsLCANo("NOfCrNode") = NoOfCrNode
        rsLCANo("TotalCr") = TCr
        rsLCANo("No-Of-Alt") = No.Alt
        rsLCANo.Update

    ' Next I

      db.Close
End Sub

Public Sub SaveAltInput()

Dim DM As Variant
Dim MO As Variant

Dim NOcr1 As Integer
Dim NOcr2 As Integer

Dim g2 As Integer
Dim NOcr As Integer


Set db = OpenDatabase(App.Path & "\" & "Alirezam.mdb")
Set rsCrIn = db.OpenRecordset("CriteriaInput")
Set rs.AltIn = db.OpenRecordset("AlternativesInput")


DM = DecisonMakerName
MO = MainObjective
'NOcr1 = TotalCr - NoOfCrNode - 1
No.Al = Text4.Text
'No.Al = NoOfAlternative
NoCA = NoOfCrAlt
NLev = txtNoOfLevels
Tsql = "Delete from AlternativesInput where len(AlternativesInput.Alternative)=0 or isnull(AlternativesInput.[GID])"
    db.Execute Tsql, dbFailOnError
```

```
Set rsTEMP = db.OpenRecordset("Select Max(AlternativesInput.[GID]) as Gmax From AlternativesInput;")

If IsNull(rsTEMP!Gmax) Or Len(rsTEMP!Gmax) = 0 Then
  g2 = 1
Else
  g2 = rsTEMP("Gmax") + 1

End If
'----------.Alternatives Input----------
NOcr2 = NoAl * NoCA + 2 * NoCA

      For I = 1 To NOcr2
       rsAltIn.AddNew
       rsAltIn("Decision-Maker") = DecisonMakerName
       rsAltIn("Objective") = MainObjective
    .
    .
       rsAltIn("GID") = g2
       GrdInAltDat1.Col = 1
       GrdInAltDat1.Row = I
       rsAltIn("Cr-Alt-Node") = GrdInAltDat1.Text
    .
       GrdInAltDat1.Col = 2
       GrdInAltDat1.Row = I
       rsAltIn("No-Of-Alt") = GrdInAltDat1.Text
    .
       GrdInAltDat1.Col = 3
       GrdInAltDat1.Row = I
       rsAltIn("Alternative") = GrdInAltDat1.Text
    .
       GrdInAltDat1.Col = 4
       GrdInAltDat1.Row = I
       rsAltIn("1") = GrdInAltDat1.Text
    .
    .
      GrdInAltDat1.Col = 5
      GrdInAltDat1.Row = I
      rsAltIn("2") = GrdInAltDat1.Text
    .
    .
    .
      GrdInAltDat1.Col = 6
      GrdInAltDat1.Row = I
      rsAltIn("3") = GrdInAltDat1.Text
    .
      GrdInAltDat1.Col = 7
      GrdInAltDat1.Row = I
      rsAltIn("4") = GrdInAltDat1.Text
    .
      GrdInAltDat1.Col = 8
      GrdInAltDat1.Row = I
      rsAltIn("5") = GrdInAltDat1.Text

      GrdInAltDat1.Col = 9
      GrdInAltDat1.Row = I
      rsAltIn("6") = GrdInAltDat1.Text
    .
      GrdInAltDat1.Col = 10
      GrdInAltDat1.Row = I
      rsAltIn("7") = GrdInAltDat1.Text
```

```
        .
            GrdIn.AltDat1.Col = 11
            GrdIn.AltDat1.Row = I
            rs.AltIn("8") = GrdIn.AltDat1.Text
        .
            GrdIn.AltDat1.Col = 12
            GrdIn.AltDat1.Row = I
            rs.AltIn("9") = GrdIn.AltDat1.Text
        .
            GrdIn.AltDat1.Col = 13
            GrdIn.AltDat1.Row = I
            rs.AltIn("10") = GrdIn.AltDat1.Text
    rs.AltIn.Update
    Next I
    db.Close
End Sub
```

APPENDIX C

Input Data Files

GID	FileName	Decision-Maker	Objective	NoOfLevels	Cr-Alt-Nodes	NOfCrNode	TotalCr	NofAlt
1	BMRS	ALIREDA	BMRS	5	49	15	63	3

INITIAL INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS	BMRS	1	3	PROJ	1	0.5	0.5							
1	ALIREDA	BMRS				SYST		1	1							
1	ALIREDA	BMRS				VEND			1							
1	ALIREDA	BMRS					COST	T&M	P&A	ACCE						
1	ALIREDA	BMRS	PROJ	2	4	COST	1	1	0.5	0.5						
1	ALIREDA	BMRS				T&M		1	0.2	1						
1	ALIREDA	BMRS				P&A			1	1						
1	ALIREDA	BMRS				ACCE				11						
1	ALIREDA	BMRS					OPER	MC	COMPL	L&T						
1	ALIREDA	BMRS	SYST	2	4	OPER	1	4	1	1						
1	ALIREDA	BMRS				MC		1	0.143	0.143						
1	ALIREDA	BMRS				COMPL			1	1						
1	ALIREDA	BMRS				L&T				1						

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS					VR	VSDI	VSAC							
1	ALIREDA	BMRS	VEND	2	3	VR	1	0.5	0.5							
1	ALIREDA	BMRS				VSDI		1	1							
1	ALIREDA	BMRS				VSAC			1							
1	ALIREDA	BMRS					INIC	O&MC	SUC	A&RC	LEAC	DECC				
1	ALIREDA	BMRS	COST	3	6	INIC	1	0.5	2	2	2	4				
1	ALIREDA	BMRS				O&MC		1	2	1	2	4				
1	ALIREDA	BMRS				SUC			1	0.5	1	6				
1	ALIREDA	BMRS				A&RC				1	2	3				
1	ALIREDA	BMRS				LEAC					1	2				
1	ALIREDA	BMRS				DECC						1				
1	ALIREDA	BMRS					TIME	O&C	LOCA							
1	ALIREDA	BMRS	T&M	3	3	TIME	1	0.333	2							

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS				O&C		1	4							
1	ALIREDA	BMRS				LOCA			1							
1	ALIREDA	BMRS					LP	EP	WAIV							
1	ALIREDA	BMRS	P&A	3	3	LP	1	1	2							
1	ALIREDA	BMRS				EP		1	2							
1	ALIREDA	BMRS				WAIV			1							
1	ALIREDA	BMRS					GOVA	PMTA	OWNA	EUA	PUBA					
1	ALIREDA	BMRS	ACCE	3	5	GOVA	1	2	2	2	2					
1	ALIREDA	BMRS				PMTA		1	0.5	0.333	0.333					
1	ALIREDA	BMRS				OWNA			1	0.333	0.25					
1	ALIREDA	BMRS				EUA				1	0.5					
1	ALIREDA	BMRS				PUBA					1					
1	ALIREDA	BMRS					RELI	AVAI	PROT	HEAT	POWE	CLIM	SECU			

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS	OPER	3	7	RELI	1	1	2	4	5	4	1			
1	ALIREDA	BMRS				AVAI		1	2	2	2	4	1			
1	ALIREDA	BMRS				PROT			1	2	2	3	1			
1	ALIREDA	BMRS				HEAT				1	1	1	1			
1	ALIREDA	BMRS				POWE					1	1	1			
1	ALIREDA	BMRS				CLIM						1	1			
1	ALIREDA	BMRS				SECU							1			
1	ALIREDA	BMRS					DIME	PC	WEIG							
1	ALIREDA	BMRS	MC	3	3	DIME	1	1	1							
1	ALIREDA	BMRS				PC		1	1							
1	ALIREDA	BMRS				WEIG			1							
1	ALIREDA	BMRS					ISTA	OSTA	IS	COMPA	MF	OF				
1	ALIREDA	BMRS	COMPL	3	6	ISTA	1	0.25	0.25	0.2	0.5	1				

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS				OSTA		1	1	1	1	2				
1	ALIREDA	BMRS				IS			1	1	1	4				
1	ALIREDA	BMRS				COMPA				1	1	2				
1	ALIREDA	BMRS				MF					1	2				
1	ALIREDA	BMRS				OF						1				
1	ALIREDA	BMRS					SMA	TECS	EL	WL	TL					
1	ALIREDA	BMRS	L&T	3	5	SMA	1	1	0.333	0.25	1					
1	ALIREDA	BMRS				TECS		1	1	1	1					
1	ALIREDA	BMRS				EL			1	2	1					
1	ALIREDA	BMRS				WL				1	1					
1	ALIREDA	BMRS				TL					1					
1	ALIREDA	BMRS					AOTL	RTC	CONS							
1	ALIREDA	BMRS	VR	3	3	AOTL	1	0.25	0.333							

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision-Maker	Objective	Cr-Node	LevelNo	No-Of-Cr	CrName	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS				RTC		1	1							
1	ALIREDA	BMRS				CONS			1							
1	ALIREDA	BMRS					AOTE	QOEW	OSSFI	WARR	OSM					
1	ALIREDA	BMRS	VSDI	3	5	AOTE	1	0.5	0.5	1	0.2					
1	ALIREDA	BMRS				QOEW		1	1	2	2					
1	ALIREDA	BMRS				OSSFI			1	2	1					
1	ALIREDA	BMRS				WARR				1	0.333					
1	ALIREDA	BMRS				OSM					1					
1	ALIREDA	BMRS					DOCU	HLS	UT							
1	ALIREDA	BMRS	VSAC	3	3	DOCU	1	0.2	0.333							
1	ALIREDA	BMRS				HLS		1	1							
1	ALIREDA	BMRS				UT			1							

CRITERIA PAIRWISE COMPARISONS INPUT DATA

GID	Decision Maker	Objective	Criteria	No. Of Alt	Alternative	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS	INIC	3	ALT1	1	0.25	0.333							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	O&MC	3	ALT1	1	0.333	0.333							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	SUC	3	ALT1	1	0.5	0.167							
1	ALIREDA	BMRS			ALT2		1	0.143							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	A&RC	3	ALT1	1	0.5	0.2							
1	ALIREDA	BMRS			ALT2		1	0.2							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	LEAC	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	DECC	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	TIME	3	ALT1	1	1	4							
1	ALIREDA	BMRS			ALT2		2	4							
1	ALIREDA	BMRS			ALT3			1							

Alternatives Input Data

GRO	Project Name	Group	Activity	No Of Alt	Alternative	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	O&C	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	LOCA	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	LP	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	EP	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	WAIV	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	GOVA	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							

Alternatives Input Data

BID	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	ALIREDA	BMRS	PMTA	3	ALT1	1	2	4							
1	ALIREDA	BMRS			ALT2		1	4							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	OWNA	3	ALT1	1	2	4							
1	ALIREDA	BMRS			ALT2		1	4							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	EUA	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	PUBA	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	RELI	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.2							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	AVAI	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	PROT	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.2							
1	ALIREDA	BMRS			ALT3			1							

Alternatives Input Data

GID	Decision Maker	Objective	Criteria	No. Of Alt	Alternative	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	HEAT	3	ALT1	1	1	0.333							
1	ALIREDA	BMRS			ALT2		1	0.333							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	POWE	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	CLIM	3	ALT1	1	0.333	0.2							
1	ALIREDA	BMRS			ALT2		1	0.25							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	SECU	3	ALT1	1	0.5	0.5							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	DIME	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.25							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	PC	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.2							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	WEIG	3	ALT1	1	1	1							

Alternatives Input Data

OID	[illegible]	[illegible]	[illegible]	[illegible]	Alternative	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	ISTA	3	ALT1	1	0.167	0.143							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	OSTA	3	ALT1	1	0.5	0.143							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	IS	3	ALT1	1	4	4							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	COMPA	3	ALT1	1	0.2	0.2							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	MF	3	ALT1	1	1	0.333							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	OF	3	ALT1	1	0.5	0.333							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													

Alternatives Input Data

1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	SMA	3	ALT1	1	0.5	0.5
1	ALIREDA	BMRS			ALT2		1	1
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	TECS	3	ALT1	1	2	4
1	ALIREDA	BMRS			ALT2		1	2
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	EL	3	ALT1	1	0.333	0.25
1	ALIREDA	BMRS			ALT2		1	0.5
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	WL	3	ALT1	1	0.5	0.333
1	ALIREDA	BMRS			ALT2		1	0.5
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	TL	3	ALT1	1	0.333	0.25
1	ALIREDA	BMRS			ALT2		1	0.5
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	AOTL	3	ALT1	1	2	2
1	ALIREDA	BMRS			ALT2		1	1
1	ALIREDA	BMRS			ALT3			1
1	ALIREDA	BMRS						
1	ALIREDA	BMRS				ALT1	ALT2	ALT3
1	ALIREDA	BMRS	RTC	3	ALT1	1	2	1
1	ALIREDA	BMRS			ALT2		1	0.5

Alternatives Input Data

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	CONS	3	ALT1	1	2	1							
1	ALIREDA	BMRS			ALT2		1	0.333							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	AOTE	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.25							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	QOEW	3	ALT1	1	2	1							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	OSSFI	3	ALT1	1	1	0.2							
1	ALIREDA	BMRS			ALT2		1	0.25							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	WARR	3	ALT1	1	1	0.25							
1	ALIREDA	BMRS			ALT2		1	0.5							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	OSM	3	ALT1	1	0.5	0.333							
1	ALIREDA	BMRS			ALT2		1	0.333							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							

Alternatives Input Data

Obs	Decision Maker	Choice	Evaluator	No. of Alt	Alternative	1	2	3	4	5	6	7	8	9	10
1	ALIREDA	BMRS	DOCU	3	ALT1	1	4	4							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	HLS	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS				ALT1	ALT2	ALT3							
1	ALIREDA	BMRS	UT	3	ALT1	1	1	1							
1	ALIREDA	BMRS			ALT2		1	1							
1	ALIREDA	BMRS			ALT3			1							
1	ALIREDA	BMRS													
1	ALIREDA	BMRS													

Alternatives Input Data

APPENDIX D

Output Data Files

CRITERIA	STD	NAME	SYNONYME	MCVALUE
1	1	BMRS	PROJ	0.2
1	1	BMRS	SYST	0.4
1	1	BMRS	VEND	0.4

MAIN CRITERIA WEIGHTS

GID	SID	Name	SVALUE	SCNAME	SCVALUE	FCVALUE
2	2	PROJ	0.2	COST	0.1550	0.0310
2	2	PROJ	0.2	T&M	0.1629	0.0326
2	2	PROJ	0.2	P&A	0.4036	0.0807
2	2	PROJ	0.2	ACCE	0.2786	0.0557
3	3	SYST	0.4	OPER	0.2887	0.1155
3	3	SYST	0.4	MC	0.0552	0.0221
3	3	SYST	0.4	COMPL	0.3281	0.1312
3	3	SYST	0.4	L&T	0.3281	0.1312
4	4	VEND	0.4	VR	0.2000	0.0800
4	4	VEND	0.4	VSDI	0.4000	0.1600
4	4	VEND	0.4	VSAC	0.4000	0.1600

SUB-CRITERIA (LEVEL II) WEIGHTS

SID	SID	MCName	MCValue	Name	GValue	SCNAME	SCVALUE	SCGValue
5	5	PROJ	0.2	COST	0.15495	INIC	0.2332	0.0072
5	5	PROJ	0.2	COST	0.15495	O&MC	0.2593	0.0080
5	5	PROJ	0.2	COST	0.15495	SUC	0.1454	0.0045
5	5	PROJ	0.2	COST	0.15495	A&RC	0.1983	0.0061
5	5	PROJ	0.2	COST	0.15495	LEAC	0.1121	0.0035
5	5	PROJ	0.2	COST	0.15495	DECC	0.0518	0.0016
6	6	PROJ	0.2	T&M	0.162875	TIME	0.2394	0.0078
6	6	PROJ	0.2	T&M	0.162875	O&C	0.6233	0.0203
6	6	PROJ	0.2	T&M	0.162875	LOCA	0.1373	0.0045
7	7	PROJ	0.2	P&A	0.4036	LP	0.4000	0.0323
7	7	PROJ	0.2	P&A	0.4036	EP	0.4000	0.0323
7	7	PROJ	0.2	P&A	0.4036	WAIV	0.2000	0.0161
8	8	PROJ	0.2	ACCE	0.2786	GOVA	0.3096	0.0173
8	8	PROJ	0.2	ACCE	0.2786	PMTA	0.0891	0.0050
8	8	PROJ	0.2	ACCE	0.2786	OWNA	0.1127	0.0063
8	8	PROJ	0.2	ACCE	0.2786	EUA	0.2049	0.0114
8	8	PROJ	0.2	ACCE	0.2786	PUBA	0.2837	0.0158
9	9	SYST	0.4	OPER	0.2887	RELI	0.2641	0.0305
9	9	SYST	0.4	OPER	0.2887	AVAI	0.2073	0.0239
9	9	SYST	0.4	OPER	0.2887	PROT	0.1463	0.0169
9	9	SYST	0.4	OPER	0.2887	HEAT	0.0861	0.0099
9	9	SYST	0.4	OPER	0.2887	POWE	0.0844	0.0097
9	9	SYST	0.4	OPER	0.2887	CLIM	0.0753	0.0087
9	9	SYST	0.4	OPER	0.2887	SECU	0.1364	0.0158
10	10	SYST	0.4	MC	0.05515	DIME	0.3333	0.0074

SUB-CRITERIA (LEVEL III) WEIGHTS

FID	STD	MCName	MCValue	Name	GValue	SCNAME	SCVALUE	COValue
10	10	SYST	0.4	MC	0.05515	PC	0.3333	0.0074
10	10	SYST	0.4	MC	0.05515	WEIG	0.3333	0.0074
11	11	SYST	0.4	COMPL	0.3281	ISTA	0.0655	0.0086
11	11	SYST	0.4	COMPL	0.3281	OSTA	0.2079	0.0273
11	11	SYST	0.4	COMPL	0.3281	IS	0.2357	0.0309
11	11	SYST	0.4	COMPL	0.3281	COMPA	0.2177	0.0286
11	11	SYST	0.4	COMPL	0.3281	MF	0.1883	0.0247
11	11	SYST	0.4	COMPL	0.3281	OF	0.0849	0.0111
12	12	SYST	0.4	L&T	0.3281	SMA	0.1269	0.0167
12	12	SYST	0.4	L&T	0.3281	TECS	0.1903	0.0250
12	12	SYST	0.4	L&T	0.3281	EL	0.2684	0.0352
12	12	SYST	0.4	L&T	0.3281	WL	0.2242	0.0294
12	12	SYST	0.4	L&T	0.3281	TL	0.1903	0.0250
13	13	VEND	0.4	VR	0.2	AOTL	0.1263	0.0101
13	13	VEND	0.4	VR	0.2	RTC	0.4576	0.0366
13	13	VEND	0.4	VR	0.2	CONS	0.4161	0.0333
14	14	VEND	0.4	VSDI	0.4	AOTE	0.1028	0.0164
14	14	VEND	0.4	VSDI	0.4	QOEW	0.2762	0.0442
14	14	VEND	0.4	VSDI	0.4	OSSFI	0.2320	0.0371
14	14	VEND	0.4	VSDI	0.4	WARR	0.1087	0.0174
14	14	VEND	0.4	VSDI	0.4	OSM	0.2803	0.0449
15	15	VEND	0.4	VSAC	0.4	DOCU	0.1149	0.0184
15	15	VEND	0.4	VSAC	0.4	HLS	0.4795	0.0767
15	15	VEND	0.4	VSAC	0.4	UT	0.4056	0.0649

SUB-CRITERIA (LEVEL III) WEIGHTS

AltID	L1CrtName	L1Crival	L2CrtName	L2Crival	CrtName	CrValue	AltName	AltValue	TValue
1	PROJ	0.2	COST	0.1550	INIC	0.2332	ALT1	0.1261	0.0009
1	PROJ	0.2	COST	0.1550	INIC	0.2332	ALT2	0.4570	0.0033
1	PROJ	0.2	COST	0.1550	INIC	0.2332	ALT3	0.4168	0.0030
2	PROJ	0.2	COST	0.1550	O&MC	0.2593	ALT1	0.1423	0.0011
2	PROJ	0.2	COST	0.1550	O&MC	0.2593	ALT2	0.4288	0.0034
2	PROJ	0.2	COST	0.1550	O&MC	0.2593	ALT3	0.4288	0.0034
3	PROJ	0.2	COST	0.1550	SUC	0.1454	ALT1	0.0993	0.0004
3	PROJ	0.2	COST	0.1550	SUC	0.1454	ALT2	0.1500	0.0007
3	PROJ	0.2	COST	0.1550	SUC	0.1454	ALT3	0.7507	0.0034
4	PROJ	0.2	COST	0.1550	A&RC	0.1983	ALT1	0.1149	0.0007
4	PROJ	0.2	COST	0.1550	A&RC	0.1983	ALT2	0.1822	0.0011
4	PROJ	0.2	COST	0.1550	A&RC	0.1983	ALT3	0.7028	0.0043
5	PROJ	0.2	COST	0.1550	LEAC	0.1121	ALT1	0.3333	0.0012
5	PROJ	0.2	COST	0.1550	LEAC	0.1121	ALT2	0.3333	0.0012
5	PROJ	0.2	COST	0.1550	LEAC	0.1121	ALT3	0.3333	0.0012
6	PROJ	0.2	COST	0.1550	DECC	0.0518	ALT1	0.3333	0.0005
6	PROJ	0.2	COST	0.1550	DECC	0.0518	ALT2	0.3333	0.0005
6	PROJ	0.2	COST	0.1550	DECC	0.0518	ALT3	0.3333	0.0005
7	PROJ	0.2	T&M	0.1629	TIME	0.2394	ALT1	0.4444	0.0035
7	PROJ	0.2	T&M	0.1629	TIME	0.2394	ALT2	0.4444	0.0035
7	PROJ	0.2	T&M	0.1629	TIME	0.2394	ALT3	0.1111	0.0009
8	PROJ	0.2	T&M	0.1629	O&C	0.6233	ALT1	0.3333	0.0068
8	PROJ	0.2	T&M	0.1629	O&C	0.6233	ALT2	0.3333	0.0068
8	PROJ	0.2	T&M	0.1629	O&C	0.6233	ALT3	0.3333	0.0068
9	PROJ	0.2	T&M	0.1629	LOCA	0.1373	ALT1	0.3333	0.0015
9	PROJ	0.2	T&M	0.1629	LOCA	0.1373	ALT2	0.3333	0.0015
9	PROJ	0.2	T&M	0.1629	LOCA	0.1373	ALT3	0.3333	0.0015

Output Data -- Weights of Alternatives with respect to Criteria

AltID	L1CrtNam	L1CrtVal	L2CrtNam	L2CrtVal	CrtNam	CrtVal	AltNam	AltVal	TVal
10	PROJ	0.2	P&A	0.4036	LP	0.4000	ALT1	0.3333	0.0108
10	PROJ	0.2	P&A	0.4036	LP	0.4000	ALT2	0.3333	0.0108
10	PROJ	0.2	P&A	0.4036	LP	0.4000	ALT3	0.3333	0.0108
11	PROJ	0.2	P&A	0.4036	EP	0.4000	ALT1	0.3333	0.0108
11	PROJ	0.2	P&A	0.4036	EP	0.4000	ALT2	0.3333	0.0108
11	PROJ	0.2	P&A	0.4036	EP	0.4000	ALT3	0.3333	0.0108
12	PROJ	0.2	P&A	0.4036	WAIV	0.2000	ALT1	0.3333	0.0054
12	PROJ	0.2	P&A	0.4036	WAIV	0.2000	ALT2	0.3333	0.0054
12	PROJ	0.2	P&A	0.4036	WAIV	0.2000	ALT3	0.3333	0.0054
13	PROJ	0.2	ACCE	0.2786	GOVA	0.3096	ALT1	0.3333	0.0058
13	PROJ	0.2	ACCE	0.2786	GOVA	0.3096	ALT2	0.3333	0.0058
13	PROJ	0.2	ACCE	0.2786	GOVA	0.3096	ALT3	0.3333	0.0058
14	PROJ	0.2	ACCE	0.2786	PMTA	0.0891	ALT1	0.5437	0.0027
14	PROJ	0.2	ACCE	0.2786	PMTA	0.0891	ALT2	0.3459	0.0017
14	PROJ	0.2	ACCE	0.2786	PMTA	0.0891	ALT3	0.1103	0.0005
15	PROJ	0.2	ACCE	0.2786	OWNA	0.1127	ALT1	0.5437	0.0034
15	PROJ	0.2	ACCE	0.2786	OWNA	0.1127	ALT2	0.3459	0.0022
15	PROJ	0.2	ACCE	0.2786	OWNA	0.1127	ALT3	0.1103	0.0007
16	PROJ	0.2	ACCE	0.2786	EUA	0.2049	ALT1	0.3333	0.0038
16	PROJ	0.2	ACCE	0.2786	EUA	0.2049	ALT2	0.3333	0.0038
16	PROJ	0.2	ACCE	0.2786	EUA	0.2049	ALT3	0.3333	0.0038
17	PROJ	0.2	ACCE	0.2786	PUBA	0.2837	ALT1	0.3333	0.0053
17	PROJ	0.2	ACCE	0.2786	PUBA	0.2837	ALT2	0.3333	0.0053
17	PROJ	0.2	ACCE	0.2786	PUBA	0.2837	ALT3	0.3333	0.0053
18	SYST	0.4	OPER	0.2887	RELI	0.2641	ALT1	0.1429	0.0044
18	SYST	0.4	OPER	0.2887	RELI	0.2641	ALT2	0.1429	0.0044
18	SYST	0.4	OPER	0.2887	RELI	0.2641	ALT3	0.7143	0.0218

Output Data -- Weights of Alternatives with respect to Criteria

AltID	L1CrName	L1CrVal	L2CrName	L2CrVal	CrName	CrValue	AltName	AltValue	TValue
19	SYST	0.4	OPER	0.2887	AVAI	0.2073	ALT1	0.3333	0.0080
19	SYST	0.4	OPER	0.2887	AVAI	0.2073	ALT2	0.3333	0.0080
19	SYST	0.4	OPER	0.2887	AVAI	0.2073	ALT3	0.3333	0.0080
20	SYST	0.4	OPER	0.2887	PROT	0.1463	ALT1	0.1429	0.0024
20	SYST	0.4	OPER	0.2887	PROT	0.1463	ALT2	0.1429	0.0024
20	SYST	0.4	OPER	0.2887	PROT	0.1463	ALT3	0.7143	0.0121
21	SYST	0.4	OPER	0.2887	HEAT	0.0861	ALT1	0.1992	0.0020
21	SYST	0.4	OPER	0.2887	HEAT	0.0861	ALT2	0.1992	0.0020
21	SYST	0.4	OPER	0.2887	HEAT	0.0861	ALT3	0.6017	0.0060
22	SYST	0.4	OPER	0.2887	POWE	0.0844	ALT1	0.3333	0.0032
22	SYST	0.4	OPER	0.2887	POWE	0.0844	ALT2	0.3333	0.0032
22	SYST	0.4	OPER	0.2887	POWE	0.0844	ALT3	0.3333	0.0032
23	SYST	0.4	OPER	0.2887	CLIM	0.0753	ALT1	0.1037	0.0009
23	SYST	0.4	OPER	0.2887	CLIM	0.0753	ALT2	0.2318	0.0020
23	SYST	0.4	OPER	0.2887	CLIM	0.0753	ALT3	0.6645	0.0058
24	SYST	0.4	OPER	0.2887	SECU	0.1364	ALT1	0.2000	0.0032
24	SYST	0.4	OPER	0.2887	SECU	0.1364	ALT2	0.4000	0.0063
24	SYST	0.4	OPER	0.2887	SECU	0.1364	ALT3	0.4000	0.0063
25	SYST	0.4	MC	0.0552	DIME	0.3333	ALT1	0.1492	0.0011
25	SYST	0.4	MC	0.0552	DIME	0.3333	ALT2	0.1607	0.0012
25	SYST	0.4	MC	0.0552	DIME	0.3333	ALT3	0.6902	0.0051
26	SYST	0.4	MC	0.0552	PC	0.3333	ALT1	0.1429	0.0011
26	SYST	0.4	MC	0.0552	PC	0.3333	ALT2	0.1429	0.0011
26	SYST	0.4	MC	0.0552	PC	0.3333	ALT3	0.7143	0.0053
27	SYST	0.4	MC	0.0552	WEIG	0.3333	ALT1	0.3333	0.0025
27	SYST	0.4	MC	0.0552	WEIG	0.3333	ALT2	0.3333	0.0025
27	SYST	0.4	MC	0.0552	WEIG	0.3333	ALT3	0.3333	0.0025

Output Data -- Weights of Alternatives with respect to Criteria

AltID	L1CrName	L1CrVal	L2CrName	L2CrVal	CrName	CrValue	AltName	AltValue	TValue
28	SYST	0.4	COMPL	0.3281	ISTA	0.0655	ALT1	0.0703	0.0006
28	SYST	0.4	COMPL	0.3281	ISTA	0.0655	ALT2	0.3465	0.0030
28	SYST	0.4	COMPL	0.3281	ISTA	0.0655	ALT3	0.5831	0.0050
29	SYST	0.4	COMPL	0.3281	OSTA	0.2079	ALT1	0.1095	0.0030
29	SYST	0.4	COMPL	0.3281	OSTA	0.2079	ALT2	0.2624	0.0072
29	SYST	0.4	COMPL	0.3281	OSTA	0.2079	ALT3	0.6281	0.0171
30	SYST	0.4	COMPL	0.3281	IS	0.2357	ALT1	0.6667	0.0206
30	SYST	0.4	COMPL	0.3281	IS	0.2357	ALT2	0.1667	0.0052
30	SYST	0.4	COMPL	0.3281	IS	0.2357	ALT3	0.1667	0.0052
31	SYST	0.4	COMPL	0.3281	COMPA	0.2177	ALT1	0.0903	0.0026
31	SYST	0.4	COMPL	0.3281	COMPA	0.2177	ALT2	0.3537	0.0101
31	SYST	0.4	COMPL	0.3281	COMPA	0.2177	ALT3	0.5559	0.0159
32	SYST	0.4	COMPL	0.3281	MF	0.1883	ALT1	0.2102	0.0052
32	SYST	0.4	COMPL	0.3281	MF	0.1883	ALT2	0.2405	0.0059
32	SYST	0.4	COMPL	0.3281	MF	0.1883	ALT3	0.5493	0.0136
33	SYST	0.4	COMPL	0.3281	OF	0.0849	ALT1	0.1635	0.0018
33	SYST	0.4	COMPL	0.3281	OF	0.0849	ALT2	0.2967	0.0033
33	SYST	0.4	COMPL	0.3281	OF	0.0849	ALT3	0.5398	0.0060
34	SYST	0.4	L&T	0.3281	SMA	0.1269	ALT1	0.2000	0.0033
34	SYST	0.4	L&T	0.3281	SMA	0.1269	ALT2	0.4000	0.0067
34	SYST	0.4	L&T	0.3281	SMA	0.1269	ALT3	0.4000	0.0067
35	SYST	0.4	L&T	0.3281	TECS	0.1903	ALT1	0.5714	0.0143
35	SYST	0.4	L&T	0.3281	TECS	0.1903	ALT2	0.2857	0.0071
35	SYST	0.4	L&T	0.3281	TECS	0.1903	ALT3	0.1429	0.0036
36	SYST	0.4	L&T	0.3281	EL	0.2684	ALT1	0.1224	0.0043
36	SYST	0.4	L&T	0.3281	EL	0.2684	ALT2	0.3210	0.0113
36	SYST	0.4	L&T	0.3281	EL	0.2684	ALT3	0.5565	0.0196

Output Data -- Weights of Alternatives with respect to Criteria

AltID	L1CrName	L1CrVal	L2CrName	L2CrVal	CrName	CrValue	AltName	AltValue	TValue
37	SYST	0.4	L&T	0.3281	WL	0.2242	ALT1	0.1635	0.0048
37	SYST	0.4	L&T	0.3281	WL	0.2242	ALT2	0.2967	0.0087
37	SYST	0.4	L&T	0.3281	WL	0.2242	ALT3	0.5398	0.0159
38	SYST	0.4	L&T	0.3281	TL	0.1903	ALT1	0.1224	0.0031
38	SYST	0.4	L&T	0.3281	TL	0.1903	ALT2	0.3210	0.0080
38	SYST	0.4	L&T	0.3281	TL	0.1903	ALT3	0.5565	0.0139
39	VEND	0.4	VR	0.2000	AOTL	0.1263	ALT1	0.5000	0.0051
39	VEND	0.4	VR	0.2000	AOTL	0.1263	ALT2	0.2500	0.0025
39	VEND	0.4	VR	0.2000	AOTL	0.1263	ALT3	0.2500	0.0025
40	VEND	0.4	VR	0.2000	RTC	0.4576	ALT1	0.4000	0.0146
40	VEND	0.4	VR	0.2000	RTC	0.4576	ALT2	0.2000	0.0073
40	VEND	0.4	VR	0.2000	RTC	0.4576	ALT3	0.4000	0.0146
41	VEND	0.4	VR	0.2000	CONS	0.4161	ALT1	0.3868	0.0129
41	VEND	0.4	VR	0.2000	CONS	0.4161	ALT2	0.1695	0.0056
41	VEND	0.4	VR	0.2000	CONS	0.4161	ALT3	0.4437	0.0148
42	VEND	0.4	VSDI	0.4000	AOTE	0.1028	ALT1	0.1492	0.0025
42	VEND	0.4	VSDI	0.4000	AOTE	0.1028	ALT2	0.1607	0.0026
42	VEND	0.4	VSDI	0.4000	AOTE	0.1028	ALT3	0.6902	0.0114
43	VEND	0.4	VSDI	0.4000	QOEW	0.2762	ALT1	0.4000	0.0177
43	VEND	0.4	VSDI	0.4000	QOEW	0.2762	ALT2	0.2000	0.0088
43	VEND	0.4	VSDI	0.4000	QOEW	0.2762	ALT3	0.4000	0.0177
44	VEND	0.4	VSDI	0.4000	OSSFI	0.2320	ALT1	0.1492	0.0055
44	VEND	0.4	VSDI	0.4000	OSSFI	0.2320	ALT2	0.1607	0.0060
44	VEND	0.4	VSDI	0.4000	OSSFI	0.2320	ALT3	0.6902	0.0256
45	VEND	0.4	VSDI	0.4000	WARR	0.1087	ALT1	0.1865	0.0032
45	VEND	0.4	VSDI	0.4000	WARR	0.1087	ALT2	0.2341	0.0041
45	VEND	0.4	VSDI	0.4000	WARR	0.1087	ALT3	0.5794	0.0101

Output Data -- Weights of Alternatives with respect to Criteria

AltID	L1CrName	L1CrVal	L2CrName	L2CrVal	CrName	CrValue	AltName	AltValue	TValue
46	VEND	0.4	VSDI	0.4000	OSM	0.2803	ALT1	0.1587	0.0071
46	VEND	0.4	VSDI	0.4000	OSM	0.2803	ALT2	0.2508	0.0112
46	VEND	0.4	VSDI	0.4000	OSM	0.2803	ALT3	0.5905	0.0265
47	VEND	0.4	VSAC	0.4000	DOCU	0.1149	ALT1	0.6667	0.0123
47	VEND	0.4	VSAC	0.4000	DOCU	0.1149	ALT2	0.1667	0.0031
47	VEND	0.4	VSAC	0.4000	DOCU	0.1149	ALT3	0.1667	0.0031
48	VEND	0.4	VSAC	0.4000	HLS	0.4795	ALT1	0.3333	0.0256
48	VEND	0.4	VSAC	0.4000	HLS	0.4795	ALT2	0.3333	0.0256
48	VEND	0.4	VSAC	0.4000	HLS	0.4795	ALT3	0.3333	0.0256
49	VEND	0.4	VSAC	0.4000	UT	0.4056	ALT1	0.3333	0.0216
49	VEND	0.4	VSAC	0.4000	UT	0.4056	ALT2	0.3333	0.0216
49	VEND	0.4	VSAC	0.4000	UT	0.4056	ALT3	0.3333	0.0216

Output Data -- Weights of Alternatives with respect to Criteria

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IMAGE EVALUATION
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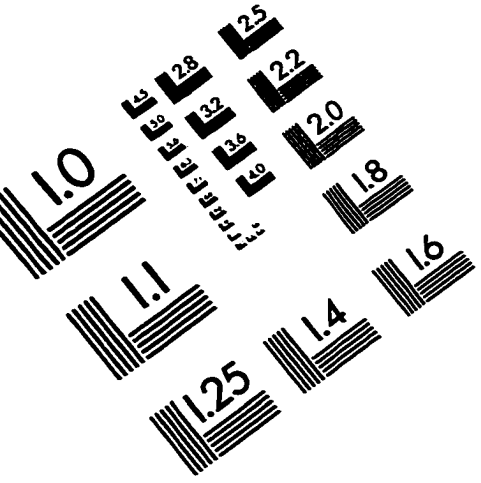

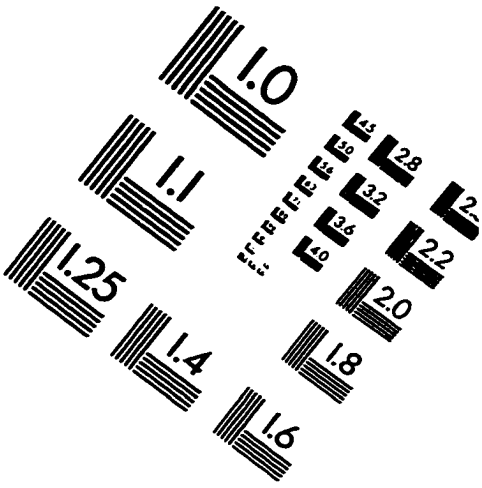

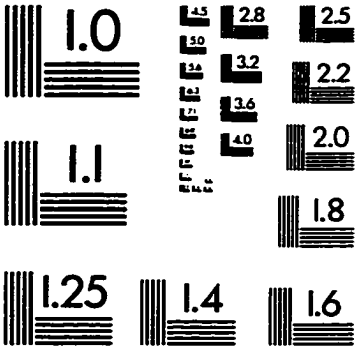

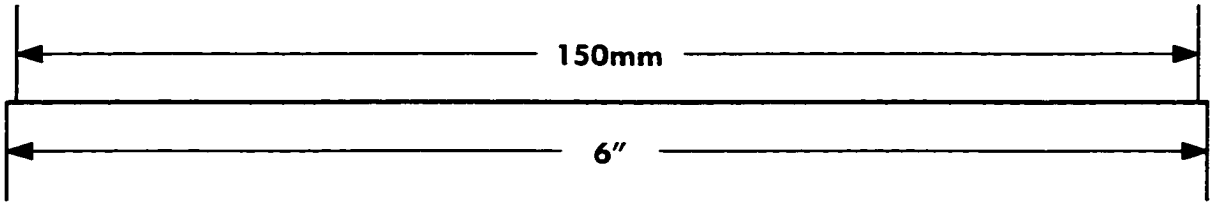

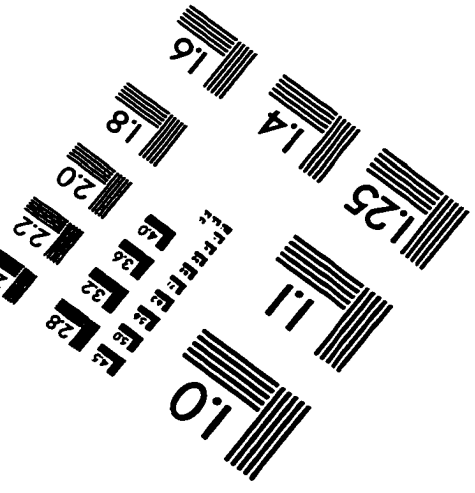

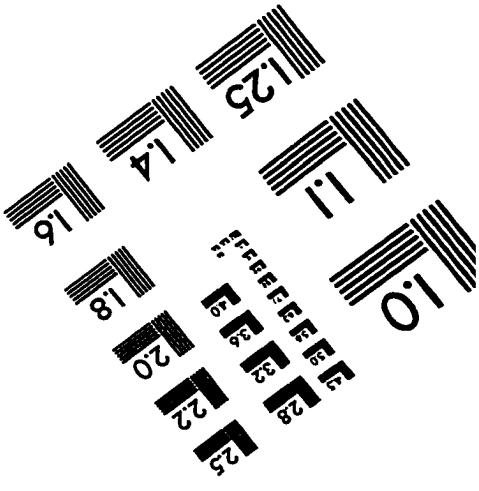

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