2 Review of Literature

Some work has already been done in this field. A brief overview of some selected studies is given in this section.

Zadeh and Bellman (1970) investigated that most of the decision making in the real world takes place in an environment in which the goals, the constraints, and the consequences of possible actions are not known precisely.” Management often makes decisions based on incomplete, vague, or uncertain information. Several decision tools have been studied with the hope that managers could make better decisions, even though the environment is uncertain. Zadeh and Bellman question the assumption in decision theory that precision can be equated with randomness.

Thome (1996) presented a new approach for the task of feed-forward type neural network training process based on a multi-criterion efficiency measurement and proposed a novel hybrid neuro-genetic algorithm that tries to optimize a three dimension criterion vector composed by speed, accuracy, and percentage of convergence, which measures the overall stability of the training algorithm to converge to good minimal. The proposed approach takes the speed advantage of the conventional algorithms as well as the accuracy and percentage of convergence advantages of the genetic algorithms. The empirical results obtained up to now shows the strength and potentiality of the method.

Pomerol (1997) reviewed some experiences with multi-criteria decision support systems (MCDSSs). It is also proved that MCDSSs have been able to deal with to the ‘choice’
phase of decision rather than with tasks involved in developing criteria and alternatives. This strongly limits the use of MCDSSs within organizations. Designers should focus their efforts on alternatives. This weakness of MCDSSs in dealing with alternatives can be alleviated by emphasizing the cooperation between the decision maker and the system. And also stress was given on the interest of modeling cooperation, explanation and context to improve MCDSSs acceptance. Beyond MCDSSs some organizational lessons extend to other DSSs.

Chung-Hsing (1997) presented a new algorithm for solving the general fuzzy multi-criteria decision making (MCDM) problems involving fuzzy data expressed by means of linguisting terms. A fuzzy performance matrix representing the overall assessment of alternatives with respect to each criteria is obtained by using interval arithmetic. The algorithm developed is simple and comprehensible with easy computation which facilitates its use in a decision support system for the general fuzzy MCDM problems.

Rommelfanger (1998), constituted a new method for solving multi criteria decision problems. Similar to the analytic hierarchy process or the utility value analysis the goals and sub goals are ordered in a hierarchical structure. The goals on the lowest level are evaluated by means of linguistic variables based on cardinal or ordinal scales which are proposed by experts. The evaluation of the sub goals are aggregated by using expert rules and fuzzy inference.

Roy (2000) proposed a fuzzy logic based computational approach as an alternative way to determine the management control quality of projects’ development processes from measures of customer satisfaction and process performance. Its focal point takes
advantage of the fuzzy logic capabilities to the analysis and design of systems whose behavior is based on experts’ skills and knowledge in project management. Its main goals are centralized to: provide quantitative management with visibility into the projects’ process performance; supply feedback information to stakeholders about the projects’ management control quality; and minimize the human task in evaluating the overall quality of organizations’ management control. To enforce the proposed approach he provided set of criteria used to its design as well as it’s qualitative and quantitative analysis to conclude, he applied the overall approach to a set of data originated from projects of telecommunication management networks.

Henry (2002) emphasized that establishment of common, shared goals and efficient allocation of resources are among the most important issues with the implementation and administration of resource allocation programs. Oftentimes such programs are multicriterion in nature and articulated in fuzzy terms. For example criterion 1 is more important than criterion 2 and so on. Unfortunately, even the best of normative plans requires a formal process for selecting the ‘best’ possible course of action in the face of multiple goals and objectives that may be inherently incompatible. In this paper, a new technique of Genetic Algorithms (GA s) provide a very efficient way to solve such problems. This process is a multi-criterion decision-making mechanism based on finding a ‘satisfying’ solution using simulation and ‘front-end processing’.

Peneva (2002) investigation was directed towards summarizing and researching of models for decision making support in multi criteria problems under uncertainties from fuzzy type. The models simulate (approximate) human decision making by means of applying of the fuzzy sets theory. Multi criteria fuzzy decision making problems will be
considered in cases of fuzziness present in initial information and the stages of problem’s solutions, as well.

Wikil (2003) reviewed that there are major shortcomings in the mathematical models in the existing human resource allocation models for a CPA firm. First, linear programming models cannot handle multiple objective human resource allocation problems for a CPA firm. Second, goal programming or multiple objective linear programming (MOLP) cannot deal with the organizational differentiation problems. To reduce the complexity in computing the trade-offs among multiple objectives, this paper adopts a fuzzy set approach to solve human resource allocation problems. A solution procedure is proposed to systematically identify a satisfying selection of possible staffing solutions that can reach the best compromise value for the multiple objectives and multiple constraint levels. The fuzzy solution can help the CPA firm make a realistic decision regarding its human resource allocation problems as well as the firm’s overall strategic resource management when environmental factors are uncertain.

Heggset (2003) analyzed a strategy for prioritizing a power company’s different types of maintenance projects. Qualitative criteria such as for instance safety for personal and effect on the environment, together with a economic figures, form the decision framework. The approach described in this paper is based on using the AHP method (Analytic Hierarchy Process) when dealing with the qualitative evaluation of projects and emphasized that the MCDM method can not make the decision for the decision maker. However, it is a useful tool to help and establish a better basis for complex decisions.
Huang (2004) explained the appointment of managers in enterprises through fuzzy neural network, to construct a new model for evaluation of managerial talent, and accordingly to develop a decision support system in human resource selection. Therefore, the research methods of reviewing literature, in-depth interview, questionnaire survey, and fuzzy neural network are used in the study. The fuzzy neural network is used to train the concrete database, based on 191 questionnaires from experts, for getting the best network model in different training conditions.

Saghaian (2005), proposed a modified fuzzy technique for order performance by similarity to ideal solution (modified fuzzy TOPSIS) for the Multi-criteria decision making (MCDM) problem when there is a group of decision makers. Regarding the value of the truth that a fuzzy number is greater than or equal to another fuzzy number, a new distance measure was found.

Monireh (2005) proposed a solution for multi criteria group decision making problems where the preference are stated by fuzzy numbers. Fuzzy model has been applied to rank the possible alternatives of the problem. The criteria of decision making problem are usually dependent on each other. By considering the dependency of the criteria three relations have been used: conflicting, cooperative and irrelevant relations. In this implementation the conflicting degree and the cooperative degree between any two criteria is first formulated. Relationship between criteria are identified based upon their conflicting and cooperative degree and a new fuzzy method for multi criteria decision making problems is proposed based on relationship analysis between criteria. Here in the ordered list of alternative is provided in four steps: calculating conflicting and cooperative degree for each pair of criteria, dividing criteria into two classes using an
algorithm, calculating criteria satisfaction of each class for each alternative and finally, the ordered list of alternatives is provided by using ranking method.

Kapoor (2005) in his paper taken the problem of Robot selection is of great relevance in the present times of automation. Traditionally such problems were addressed using conventional techniques of Multi Criteria Decision Making such as The Analytic Hierarchy Process (AHP) and The Multi Attribute Utility Theory (MAUT). Author proposed a methodology for solving common Robot Selection problems using a modification of the conventional AHP by incorporating ‘Fuzzy Linguistic Variables’ in place of numbers. The methodology encapsulates creation of Fuzzy Interface for conversion of input and output variables into suitable linguistic variables.

Further, employing the fuzzification process by assigning the linguistic variables to numerical values of the membership functions and formulating suitable decision rules, the procedure culminates into the defuzzification process for converting fuzzy output into crisp value and obtaining the result in the form of Fuzzy Score. The proposed model is explained using a numerical example. The paper also presents a validation of the proposed methodology over real world problems and provides directions for future research towards the end.

Wang (2006) identified that Fuzzy VIKOR is not only appropriate for decision based in communication, negotiations, interaction and conflict, but also to deal with a contingency or emergency in group decision. In order to avoid wasting cost in making mistakes and errors when human face an important decision, the development and innovation of Multi-
Criteria Decision making (MCDM) can be applied to the most important issues in human life.

Noothong (2006) investigated that the Bayesian networks support resource allocation in software project and also help in analyzing trade-offs among resources, as more than half of software development projects according to a survey are over budget, behind schedule, or deliver fewer features than originally specified. The paper proposes extending the Bayesian network into the decision networks to optimize an organizational target and to handle the multi-criteria environment of software project management. Specifically, the decision networks are used to find an optimal set of software activities under constraints of software cost and quality.

Wang (2006) highlighted that the family of Ordered Weighted Averaging (OWA) operators, as introduced by Yager, appears to be very useful in multi-criteria decision-making (MCDM). In his paper, extended a family of parameterized OWA operators to fuzzy MCDM based on vague set theory, where the characteristics of the alternatives are presented by vague sets. These families are specified by a few parameters to aggregate vague values instead of the intersection and union operators proposed by Chen. The proposed method provides a “soft” and expansive way to help the decision maker to make his decisions.

Cheong (2006) developed a web-based decision making tool, which utilizes fuzzy analytic hierarchy process (AHP) methodology to solve daily complicated decision making problems. Fuzzy concepts are used to enhance the traditional AHP, which is mainly applied in crisps decision environment. Fuzzy linguistic term approach is applied
to capture the fuzziness and subjectiveness of decision makers’ judgements. Due to simplicity and effectiveness, we selected triangular fuzzy numbers as a reference to indicate the influence strength of each element in the hierarchy structure. \( \alpha \)-cut-based method has been utilized to prevent the controversial of fuzzy number ranking process. The confidence level and the optimistic level of decision maker are captured by using \( \alpha \)-cut-based fuzzy number results. A numerical example is demonstrated to illustrate the fuzzy approach. The fuzzy approach exhibits a more appropriate and flexible result compared to the traditional approach.

Zhang(2007) suggested that organizational decisions are often made in groups where group members may be distributed geographically in different locations. Furthermore, a decision-making process, in practice, frequently involves various uncertain factors including linguistic expressions of decision makers’ preferences and opinions. The study first proposes a rational-political group decision-making model which identifies three uncertain factors involved in a group decision-making process: decision makers’ roles in a group reaching a satisfactory solution, preferences for alternatives and judgments for assessment-criteria. Based on the model, a linguistic term oriented multi-criteria group decision-making method is developed. The method uses general fuzzy number to deal with the three uncertain factors described by linguistic terms and aggregates these factors into a group satisfactory decision that is in a most acceptable degree of the group. Moreover, this study implements the method by developing a web-based group decision support system. This system allows decision makers to participate a group decision-making through the web, and manages the group decision-making process as a whole, from criteria generation, alternative evaluation, opinions interaction to decision
aggregation. Finally, an application of the system is presented to illustrate the web-based group decision support system.

Vasant (2008) conducted a study and found that the decision support systems (DSS) usually and analyze managerial decisions in unstructured or semi-unstructured situations. They are also defined as computer-based information systems used to support decision-making activities in situations where it is not possible or not desirable to have an automated system perform the entire decision process. This chapter aims to delineate measurement of level-of-satisfaction during decision making under an intelligent fuzzy environment. Before proceeding with the multi-criteria decision making model (MCDM), authors try to build a co-relation among DSS, decision theories, and fuzziness of information. The co-relation shows the necessity of incorporating decision makers’ level-of-satisfaction in MCDM models. Later, the authors introduce an MCDM model incorporating different cost factor components and the said level-of-satisfaction parameter. In a later chapter, the authors elucidate an application as well as validation of the devised model. The strength of the proposed MCDM methodology lies in combining both cardinal and ordinal information to get eclectic results from a complex, multi-person and multi-period problem hierarchically.

Panagiotis (2009) through his research on Fuzzy multicriteria decision-making methodology for selection of human resources in a Greek private bank which was based on methodology of order preference by similarity to ideal solution (TOPSIS) multicriteria decision tool. The findings and the applicability of the methodology was discussed using real data from a major Greek bank. As a result, it was considered necessary to consider criteria, criteria weights, and the distances from both the ideal and the anti-ideal solution.
in order to select the more appropriate candidate. The method can help human resources managers reach better decisions by selecting employees through a process that takes into account organizational objectives as well as employees' qualities. Moreover, selection of human resources can be seen as part of an integrated career management system in the organization.

The research implications on modern approaches recognize that selection of human resources is a complex process that involves a significant amount of vagueness and subjectivity, and serious consideration for candidate's uncertainties of career life.

Yee (2009) described that Performance appraisal of employee is important in managing the human resource of an organization. With the change towards knowledge-based capitalism, maintaining talented knowledge workers is critical. However, management classification of “outstanding”, “poor” and “average” performance may not be an easy decision. Besides that, superior might also tend to judge the work performance of their subordinates informally and arbitrarily especially without the existence of a system of appraisal. In this paper, we propose a performance appraisal system using multifactorial evaluation model in dealing with appraisal grades which are often express vaguely in linguistic terms. The proposed model is for evaluating staff performance based on specific performance appraisal criteria. The project was in collaboration with one of the Information and Communication Technology Company in Malaysia with reference to its performance appraisal process.

Kar (2009) investigated that the Electronic procurement is frequently defined as the sourcing of goods or services via electronic means, usually through the internet. A major
process in the e-procurement decision making is that of supplier selection process. In the real world, the criteria and constraints for such a process are subjective in nature. In this study, the criteria for supplier selection, which already have been established empirically, has been adopted and no new criteria for the same has been proposed. These criteria and constraints have been modeled using fuzzy logic into constraints, which further has been modeled as a multi-objective decision making process, by combining neural networks and analytic hierarchy process. Then the suppliers have been classified into suitable suppliers and unsuitable suppliers, from the viewpoint of the firm.

Chen (2009) This study is intended to improve the lack of recruitment processes as well as reduce individual senses of supervisory level by fuzzy logic and Analytic Hierarchy Process methods. This study tries to identify appropriate personality traits and key professional skills through the information statistics and analysis of Analytic Hierarchy Process in order to expect the recruitment process be more reasonable based on the fuzzy multiple criteria decision making model to achieve the goal of merit-based selection.

The results showed that the fuzzy multiple criteria model constructed in this study could indeed solve the shortcomings in existing enterprises’ recruitment, and provide more information for decision-making reference