6.0 GENERAL CONCLUSIONS

The aim of the present research work is to apply the analytic hierarchy process (AHP) technique in various Industrial Engineering (IE) related multi-criteria decision-making (MCDM) problems and also to develop a user-friendly application software to implement this AHP technique. Different modules of the present work show that how effectively and successfully the AHP technique can be used in the field of multi-criteria decision-making problems having conflicting objectives. The AHP technique starts with the identification of the predominant criteria, sub-criteria and alternatives relevant to a given problem and a hierarchical structure is then constructed based on their interrelationships. The weightage or priority values of different criteria and sub-criteria are calculated using the pairwise comparison matrices. Finally, the preference values of the alternative decision options are determined so as to rank those alternatives.

The AHP based vendor selection methodology is based on knowledge and pairwise comparison matrices for solving this multi-criteria decision-making problem. The results clearly favor the preceding methodology and the developed approach is found to be better than the other simple scoring techniques because it will consider all the important performance criteria and sub-criteria of the related problem and the decision maker will not have to be concerned about the bias in the judgments and quantitative weights of each of the criteria for selecting the most suitable vendor. The real time case study results also strongly support the proposed AHP based approach of vendor selection and performance appraisal.

Based on the analytic hierarchy process (AHP) technique, an approach is developed to select the optimal maintenance policy for a specific manufacturing environment. Three alternative maintenance polices are considered and it is observed that the preventive maintenance is the most preferred policy having the highest preference value and ‘Maintainability’ is the most important criteria for this problem.

The proposed analytic hierarchy process (AHP) based ABC analysis model works successfully and yields acceptable results as well as makes accurate decisions. The results obtained are congruent with those of the classical ABC analysis technique. It is simple to note from this model that ‘Value analysis’ is the most critical criteria showing the desired dominance in the ABC analysis. The developed approach surely eases the decision maker’s task of choosing the quantitative weights and making further calculations and thereby renders the decision maker less susceptible to human error. Moreover, this approach does not require the decision maker to have any in-depth knowledge regarding various inventory items available in the organization.

The design of the material handling equipment selection model is based on knowledge and pairwise comparison matrices for solving this multi-criteria decision-making problem. The
results clearly show that the AHP technique can be suitably implemented to select the optimal material handling equipment under a given organizational environment. Based on this technique, it is observed that the conveying systems are the most preferred material handling equipment having the highest preference value and ‘Material’ is the most important criteria. But the results of sensitivity analyses reveal that ‘Methods’ is the most robust criteria and ‘Move’ is the most critical criteria while selecting the optimal material handling equipment.

Using the analytic hierarchy process (AHP) technique, it is found that the perpetual review policy is the best choice for controlling the inventory items of an organization and ‘Order quantity’ is the most important criteria. The results of sensitivity analyses show that ‘Order quantity’, ‘Relevant cost’ and ‘Demand forecasting’ are the most robust criteria and ‘Safety stock’ is the most critical criteria in controlling the inventory items.

The AHP-based approach for optimal replacement policy selection problem reveals that the unit or age replacement is the optimal policy having the maximum preference value and ‘Technological’ is the most important criteria.

It is also noticed that the developed approach using the AHP technique in order to prioritize the alternative facility layout designs is quite accurate and flexible. It basically considers the linear distance between various departments of the organization and is able to estimate the relative performance of the alternative layouts in a consistent way. The criteria priority values help in identifying the relative importance of different criteria influencing this selection process. In the distributed and idealized modes, as the exact absolute values are used while comparing the alternative layouts, the judgments become perfectly consistent. This proposed approach enables the decision maker to take into account both the qualitative and quantitative factors affecting the decision-making problem. By structuring the hierarchy, the interrelationships between various criteria can be defined and analyzed and the optimal or best facility layout design can be obtained quite easily.

The proposed approach for selecting the most suitable measuring instrument is observed to be quite accurate under a given situation as it considers all the relevant criteria and sub-criteria of the present decision-making problem. The AHP technique is used to derive the preference values of the alternative measuring instruments. The main advantage of the AHP is that it provides consistent decisions. The approach seems to be favorable believing in the fact that it is a tool to develop quality instruments, refine the hierarchy, modify the judgments and generate a new set of priority values to cope up with the always dynamically changing customer needs.

While selecting the optimal facility location amongst a set of alternatives, it is observed that ‘Technical’ criterion has immense importance while selecting the optimal facility location due to fast changing technology in the manufacturing processes. Other criteria, such as environmental, social factors also affect this decision-making problem to some extent.
A methodology is also proposed that objectively rates various projects in the area of multi-criteria decision-making problems. The AHP technique is identified as the most suitable tool in selecting the best project using the available data and knowledge. It also helps in identifying the most important criteria and sub-criteria affecting the selection of the best project among a set of alternatives. Social and environmental factors have less importance, whereas technical is the most important criteria.

It is observed that the developed application software reduces the computational time for solution of the AHP-related problems and eliminates the errors associated with human interventions. The graphical user interface (GUI) allows the user to define the problem title along with different criteria, sub-criteria and alternatives and also compute the priority values of those elements. Using those priority values of the criteria, sub-criteria and alternatives, the optimal alternative can be selected. The developed software is user-friendly and the test results are satisfactory to prove that it can be implemented for real-time commercial applications.