ABSTRACT

Manufacturing industries play a vital role in defining the growth and development of a nation. More often than not, the health of manufacturing industries is a direct reflection on the economic health and prosperity of a nation. The viability and profitability of any industry depends on how easily and quickly the industry adapts itself to changes basing on the demand. An industry must be lean, flexible and should be capable of utilizing the existing resources to the optimum level, in order to adapt itself to the changes quickly. Flexible Manufacturing System working on small batches, having low set-up times characterized by several degrees of freedom in decision making process, provides the industry with adaptability to change according to the demands and consumer needs.

A Flexible Manufacturing System is a group of numerically-controlled machine tools, interconnected by a central control system. The various machine cells are interconnected with loading and unloading stations by an automated transport system. Operational flexibility is enhanced by the ability to execute all the manufacturing tasks on various product designs in small quantities with faster delivery.

Even in the case of Flexible Manufacturing System, its benefits can be maximized only if the available resources are utilized in an optimized manner. Optimum utilization of resources can only be possible, if there is a proper scheduling system in place. Scheduling can be defined as, “The allocation of resources over a period of time to perform a collection of tasks”. Yet another definition of scheduling is that “It is a function to determine an actual (optimal or feasible) implementation plan as to the time schedule for all the jobs to be executed; that is when, with which machine, and who does the operation”. Sequencing and scheduling are very old and well-known optimization problems. These problems exist whenever a decision is needed to arrange a number of tasks to be performed by a number of resources. Recent advances in computing technology, especially in artificial intelligence, have alleviated this problem by intelligently restricting the search space considered, thus opening the possibility of obtaining better results. Numerous studies have been used for various techniques that were developed under the general rubric of artificial intelligence to solve job shop scheduling problems. With a rapid progress in computer
technology, it has become even more important to find practically acceptable solutions by “approximation methods” especially for large-scale problems within a limited period of time. Metaheuristics yield near-optimal or optimal solutions for problems of large sizes in a considerably shorter period of time.

In this research work, an automated tool is designed for optimization of scheduling in FMS system with primary emphasis on Metaheuristic approaches. The Metaheuristic approaches are considered for the optimization which includes Bacterial Foraging Optimization Algorithm (BFOA), Genetic Algorithm (GA) and Differential Evolution (DE). The scheduling problem is modeled in the form of a combined objective function which takes into consideration, idleness of machines and total penalty along with the rewards for a particular sequence if a job is completed within a stipulated time. Two different case problems from industry and literature are considered in this research work to validate the results of the proposed approach.

In this particular work, it can be concluded that the results point to the fact that optimization using BFOA is found better in comparison to both priority rules like SPT, LPT, EDD, LBS, SBS and HPS used in this work in most of the cases and other Metaheuristic methods considered such as GA and DE. The results also emphasize the fact that the inclusion of reward points has improved the results across the spectrum and also the results presented for the Metaheuristic approaches such as GA, DE and BFOA are the best, returned by algorithms for a number of runs.

In order to impress upon the industry management to take proper decisions about the significance of the proposed changes, the best setup and schedule as suggested by BFOA have been modeled by using the Promodel software. From the results presented, it can be clearly observed that the simulation results conform to the results suggested by BFOA and give a direction in accepting the modification of schedule as suggested by the designed scheduling system. In order to deliver the fruits of this research as a tool to the user, a Graphical User Interface (GUI), which can be seamlessly integrated with the process aiding in easy decision making is also designed by using MATLAB.