ABSTRACT

Manufacturing companies are to manage increasing product complexities, shorter time to market, newer technologies, threats of global competition and rapidly changing environment. To cope with the manufacturing competition, flexible manufacturing system (FMS) is established. FMS is an integrated manufacturing system that consists of multi-functional numerically controlled machine tools connected with an automated material handling system. The objective of FMS is flexibility in production without compromising quality of products. The FMS flexibility depends on the flexibility of CNC machines, automated material handling devices and control software’s.

There are a number of problems faced during the life cycle of an FMS. These problems are classified into design, planning, scheduling and control problems. During the implementation and operation phase of the FMS, the user requires adjusting and fine-tuning of the FMS to the best operating conditions. Researchers are continuously putting efforts to solve design and operational problems of FMS. The dynamic planning of FMS operation needs attention.

The traditional techniques are limited in application and yield a local optimal solution. The use of metaheuristics to solve scheduling problems of FMS needs attention. These techniques are population based and yield a global optimal solution. In this research, metaheuristics such as
genetic algorithm, simulated annealing algorithm, ant colony optimization algorithm and particle swarm optimization algorithm have been proposed and developed to solve the FMS scheduling problems.

Job and tool flows are the two key factors in the operation of FMS. The work centre of FMS can process a group of jobs. The usage of common tool magazine is in practice for FMS facilities in order to reduce tool inventory. Some metaheuristic techniques are proposed and developed for job and tool scheduling problem in FMS and validated with benchmark problems. Further, proper routing and dispatching of the material handling system should be carried out in a FMS to enhance the efficiency of job and tool scheduling.

Automated Guided Vehicles (AGVs) are widely used for material handling in a FMS. As one of the enabling technologies, routing and dispatching of AGVs have attracted considerable attention. The FMS completes a task by performing a series of operations through the workstations and the parts are transported between the workstations by the AGV’s. The problem of task scheduling in an FMS can be stated as finding a schedule for the AGV’s among the workstations such that the tasks can be completed in the shortest time. Some metaheuristic techniques are proposed and developed for routing, dispatching and task scheduling problem of AGV in FMS and are exemplified with illustrations. Suitable production planning for the enhancement of FMM needs attention. Job descriptions are known in advance and processing time for each job is independent of its position in the job sequence. Hence, single machine scheduling problem is addressed.
Single machine scheduling is a central task in production planning of FMM. Some metaheuristics have been proposed and developed for single machine scheduling with an objective to minimize the total weighted tardiness. The objective of the total weighted tardiness problem is to find a processing order of all the jobs; this order is a schedule that minimizes the sum of the weighted tardiness of all jobs. The proposed metaheuristics are validated with benchmark problems. To improve the productivity of FMS, sequencing and scheduling of material handling system needs attention.

The effects of production and Material Handling System (MHS) scheduling decisions on the FMS performance are investigated. In this research, the importance of production schedule and MHS schedule in FMS is focused. The Giffler and Thompson algorithm with different PDRs is developed to minimize the makespan in the FMS production schedule. Its output is used for MHS scheduling where the distance traveled and the number of backtrackings of the AGV are minimized using metaheuristics technique. The proposed metaheuristics are validated with benchmark problems.