ABSTRACT

In today's borderless competitive world, organisations must clearly define their manufacturing strategy which is compatible with the marketing strategy. Past experience shows that manufacturing strategy assumes a significant importance and calls for serious research attention. Group Technology (GT) / Cellular Manufacturing Systems (CMS) is one of the important strategies that help to reorganise the manufacturing systems, which is recognised by the industrial world to have a competitive edge.

Among several problems related to design of GT/CMS, this thesis addresses the problem of design of cellular systems using Product Ownership (POW) measure. This is evolved based on the concept of owning vs sharing of resources, which is a deviation from the traditional approaches to the design of CMS. The problem is modeled with an objective of maximisation of overall POW by considering product-component-machine relationship explicitly. In view of the model complexity, an SA algorithm has been developed and employed to solve three industrial case studies. The results obtained are encouraging. However, the results show that the achievement of higher POW requires higher level of duplication of resources which is economically infeasible. In view of practical limitations in achieving 100% ownership, CMS with a remainder cell known as Fractional Cell Formation (FCF) has been proposed as an alternative.

The fractional cell formation problem has been addressed using input data in the form of binary, ordinal and alternate process plan with multiple copies of machine type. A suitable mathematical model has been proposed
with differential weights for inter cell and remainder cell moves. A Hybrid Heuristic Approach (HHA) is proposed and the same is used to solve small and large problems selected from literature. The objectives include minimisation of inter cell moves, total moves and weighted moves. The performance of the proposed heuristic is evaluated using binary and ordinal level data. The proposed heuristic produces significantly better results than the existing algorithms. Further, the fractional cell formation problem has been studied with variable input data such as well and ill structured matrices, ordinal data with multiple copies of machine type, alternate process plans for parts and multiple copies of machine type by modifying the hybrid heuristic. The results obtained are encouraging.