Abstract

Layout planning is a very important factor of organizational productivity and efficiency. The allocation of various departments to different locations, which falls under the process layout category and the allocation of the work elements involved in the assembly of a product, to different work stations, without violating a set of precedence and cycle time constraints, which falls under the product layout category, are two thoroughly researched areas. In this dissertation, the quadratic assignment problem formulation of the facilities layout problem with departments of equal area and the single-model, stochastic assembly line balancing problem have been selected as the problem areas.

Many exact and heuristic methods are available for the solution of the above two problems. Exact methods give optimal solutions, but the computational effort required is tremendous. Literature suggests that there are limitations on the problem sizes that could be solved using exact methods. Heuristic approaches give non-optimal solutions rather quickly. They sacrifice solution quality for gains in computational efforts. The drawbacks of the above methods led to the development and use of random search methods, which could solve large problems at a moderate computational effort and still provide near-optimal solutions. Genetic algorithms and simulated annealing are two such methods and have been applied for the solution of a variety of combinatorial optimization problems.

An attempt has been made in this thesis to apply both genetic algorithms and simulated annealing to the two problem areas mentioned above. In the case of the quadratic assignment problem formulation of the facilities layout problem, single- and multi-objective type problems are solved and comparisons are made with some of the existing heuristic solutions. In the case of the assembly line balancing problem, comparisons are made with two of the existing methodologies. The results in all the cases are found to compare well with these heuristic solutions. Comparisons are also made with some applications of random search methods that exist in the case of single-objective facilities layout problems. A hybrid algorithm, which is a combination of a genetic algorithm and simulated annealing is also presented for the case of the facilities layout problem. The results in this case are found to be the best solutions of this study.

Key words: Genetic algorithms, simulated annealing, facilities layout, assembly line balancing, hybrid algorithm