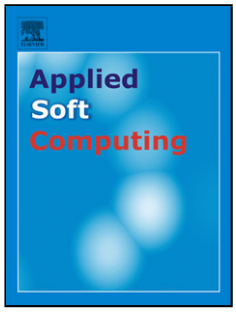

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Concurrent cell formation and layout design based on hybrid approaches

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Highlights

- Proposing a linear model for concurrent cell formation and layout design.
- Considering many specific attributes for designing cellular manufacturing systems.
- This model generates lower total cost and higher machine utilization rate.
- Proposing two hybrid approaches combining metaheuristics and exact approach.
- Hybrid approaches outperforms an exact approach and pure metaheuristics.

Abstract: Considering the interaction between the cell formation and cell layout problems when designing cellular manufacturing systems (CMSs), this paper investigates the integrated cell formation and layout problem (ICFLP). A comprehensive mixed-integer linear programming model is developed. This model features the simultaneous incorporation of some specific design attributes of CMSs, such as unequal machine dimensions, duplicate machines, alternative process routings, coexistence of alternative process routings, lot splitting, and production planning. Given the computational difficulty of the model, two hybrid approaches, one combining a genetic algorithm and linear programming (GALP) and the other combining simulated annealing and linear programming (SALP), are proposed to efficiently solve real-sized problems. The results of an illustrative example reveal that lower production cost and higher machine utilization rate can be generated by the concurrent cell formation and layout design, and the incorporation of relevant attributes. Comparison experiments show that the GALP and SALP outperform a previous metaheuristic and an existing heuristic for solving a simplified ICFLP model. They also excel pure GA, pure SA and CPLEX on solving the proposed model.

Keywords: cell formation; cell layout; genetic algorithm; simulated annealing; hybrid approach