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## A hybrid metaheuristic algorithm to optimise a real-world robotic cell

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### Abstract

In this paper, a real-world robotic cell is investigated by transforming it into a special job shop with a set of stationary robots for manufacturing the parts of a product (i.e., operations of a job) at multiple operational stages. In addition, this robotic cell contains a particular mobile robot to transport the parts among stationary robots inside the cell as well as a depot (for initialising the production) and a stockpile (for stocking the complete products) outside the cell. Thus, a new scheduling problem called *Blocking Job Shop Scheduling problem with Robotic Transportation (BJSSRT)* is proposed. A numerical example is presented to illustrate the characteristics and complexity of *BJSSRT*. According to the problem properties, four types of robotic movements are defined for a mobile robot in an operation's execution: processing-purpose, depot-purpose, return-purpose and stocking-purpose. By satisfying complex feasibility conditions, an innovative graph-based constructive algorithm is developed to produce a good feasible *BJSSRT* schedule. Embedded with the constructive algorithm, a hybrid Tabu Search and Threshold Accepting metaheuristic algorithm is developed to find a near-optimal solution in an efficient way. The proposed *BJSSRT* methodology has practical benefits in modelling the automated production system using stationary and mobile robots, especially in manufacturing and mining industries.

### Keywords

Robotic Cell; Stationary Robot; Mobile Robot; Job Shop Scheduling; Robotic Transportation; Metaheuristics

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