Minimizing total completion time in large-sized pharmaceutical quality control scheduling

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Abstract: This paper proposes an algorithm for the effective scheduling of analytical chemistry tests in the context of quality control for pharmaceutical manufacturing. The problem is formulated as an extension of a dual resource constrained flexible job shop scheduling problem for the allocation of both machines and analysts resources for analytical laboratory work of real dimensions. The formulation is novel and custom made to fit real quality control laboratory. The novelty comes from allowing multiple analyst interventions for each machine allocation while minimising the total completion time, formulated as a mixed integer linear programming model. A three-level dynamic heuristic is proposed to solve the problem efficiently for instances representative of real world schedules. The CPLEX solver and a Tabu Search algorithm are used for comparison. Results show that the heuristic is competitive with the other strategies for medium-sized instances while outperforming them for large-sized instances. The dynamic heuristic runs in a very short amount of time, making it suitable for real world environments. This work is valuable for the development of laboratory management solutions for quality control as it presents a way to provide automatic scheduling of resources.

Keywords: Scheduling, Heuristics, Dual resource constrained scheduling, Quality control laboratory