On Scheduling Reworks for Jobs on Parallel Machines under Steel Bar Manufacturing Process

Lin-Kuei Huang

Department of Industrial and Information Management (Executive Master)

National Cheng Kung University

China’s steel mills have been a major player in the market because it follows a high-volume-low-variety strategy. This strategy involves selling large quantities but just a few types of steel in order to maximize production efficiency, which keeps prices low. High efficiency and low prices are China's primary advantages in the market. Even though the economic scale of Taiwan’s steel mills is smaller than China’s, Taiwan’s technology and quality of the steel are still competitive in the market. Hence, Taiwan’ s production model has changed to a make-to-order strategy, meaning Taiwan produces a large number of customized steel products but low volumes of each type. In order to satisfy the customized specifications by different clients, steel mills have to fulfill different requirements on steel quality, deadlines, and zero stock. Because each customized steel product usually requires its own manufacturing process, defective products are common. Steel mills have to fix defects and rework their manufacturing process in order to meet deadlines of orders. Therefore, the reworking process may affect manufacturing schedules, which will in turn delay manufacturing of other orders.

This thesis discusses issues of rescheduling jobs on parallel machines under steel bar manufacturing process. Due-dates, setup times, and production limitations of parallel machines can be used to determine individual work in a certain order for parallel machine scheduling. Furthermore, assuming that the rate of defective products of each parallel machine are known, one can reorganize tasks in a certain order to optimize the output of using parallel machines. In order to efficiently calculate good manufacturing schedules, we propose greedy algorithms based on two rules: ARI (All Reworks Insertion Rule) and SRI (Single Rework Insertion Rule). Once the original orders and the new order are known, these data can be used to calculate good local optimal solutions, which can then be further improved. We also give a tabu search method to solve our problem. By our proposed solution methods, steel mills could increase more production with shorter completion time of parallel machines.

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Thesis advisor: *I-Lin Wang,* ilinwang@mail.ncku.edu.tw
http://ilin.iim.ncku.edu.tw
***Lin-Kuei Huang* entered the executive master’s program of IIM at NCKU in 2010, graduated in 2013.**

Our computational experiments indicate SRI performs better than ARI. However, the performance of ARI could be much improved when it integrates with the Tabu search mechanism. Both SRI and ARI are useful for making better schedules for manufacturing

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