

A report on the PhD thesis

Scheduling in Manufacturing Systems

which has been submitted at the Faculty of Electrical Engineering
of the Czech Technical University in Prague, by

Jan Kelbel

Reviewer: Prof. RNDr Petr Jančar, CSc.
Faculty of Electrical Engineering and Computer Science,
VŠB - Technical University of Ostrava

Overview of the thesis

The submitted thesis is written in English and has around 70 pages, divided into three main chapters (Chapter 2,3,4), besides Introduction and Conclusion.

Chapter 2 recalls two problems from scheduling, the job-shop scheduling problem, with earliness/tardiness penalties, and a more specific lacquer production scheduling problem. Such optimization problems are NP-hard, and the challenge is to suggest specific (heuristic) algorithms to handle reasonable problem instances. The author recalls the general constraint programming solvers, and suggests specific algorithms for improving the results in the studied cases. The improving is confirmed by experiments on random instances.

Chapter 3 deals with an optimization problem in an assembly process where components are to be distributed to the multiple machines at the assembly line. The author gives a detailed introduction into the area, with an overview of the approaches in the literature. Then he describes the combination of standard approaches and of the original ideas, used for developing an algorithm applied to a concrete case of an SMT assembly line; the problem is to (safely) modify an existing solution, which adds other constraints. It is reported that the algorithm decreased the assembly time by 10 percent; the experiments were performed also for random instances.

Chapter 4 deals with another scheduling problem categorized as a permutation flow-shop problem with blocking. After an overview of approaches in the literature, an algorithm is suggested, again as a specific combination of standard deterministic procedures. As the author admits, for larger problem instances the results were surpassed by the tabu search reported in the literature.

Evaluation

- a/ The topic surely belongs to a current live research area, heavily motivated by real industrial problems in scheduling.
- b/ The goal was to contribute to solving combinatorial optimization problems which are present in the domain of manufacturing systems. The goal has been satisfied at a solid

level; the main parts have been published also in a quality journal.

c/ The chosen methods are appropriate.

d/ The results have been already mentioned.

e/ The thesis shows some practical industrial problems whose solution can be improved by applying the mathematical (optimization) methods, and demonstrates that the area of problem-specific approaches is far from having been fully explored.

f/ The author has shown the ability to perform a solid scientific, practically oriented, work; this is also testified by several quality publications, including one in the international Journal of Intelligent Manufacturing.

Conclusion I surely recommend the thesis for a defence.

Some comments/questions which can be addressed at the defence:

- The definitions are sometimes incomplete, and there are also other unclear places. E.g., in 2.2.1. the role of resources is not clear, by -the result of the scheduling problem- you probably mean -a solution- ... I did not find G6 in Fig. 2.1., and I have found the figure unclear as well. Have you meant your thesis as a self-contained text, or you have assumed familiarity with the area ?

- You also mention, e.g., genetic algorithms. Are you aware about other meta-approaches which seem to have been also successfully applied to combinatorial optimization ? (Can you say a few words, e.g., about the differential evolution?)

- On p.59 you mention that you have used only first five instances from the benchmark set by Taillard. Why have you not used all of them? Do you find the Table 4.1. to be a sufficient way to compare the algorithms?

Ostrava, 21 June 2012

