The Implementation of the

Shifting Bottleneck Heuristic in Job Shops

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Scheduling algorithms were formulated for the first time in the mid fifties. Since then there has been a growing interest in scheduling. During the seventies, computer scientists discovered scheduling as a tool for improving the performance of computer systems. Furthermore, scheduling problems have been investigated and classified with respect to their computational complexity. During the last years new and interesting scheduling problems have been formulated in connection with flexible manufacturing.

Scheduling problems can be understood in general as the problems of allocating resources over time to perform a set of tasks being parts of some processes, among which computational and manufacturing ones are most important. Tasks individually compete for resources which can be of a very different nature, e.g. manpower, money, processors (machines), energy, tools. The same is true for task characteristics, e.g. ready times, due dates, relative urgency weights, functions describing task processing in relation to allotted resources.

Moreover, a structure of a set of tasks, reflecting relations among them, can be defined in different ways. In addition, different criteria which measure the quality of the performance of a set of tasks can be taken into account. It is easy to imagine that scheduling problems understood so generally appear almost everywhere in real-world situations. Of course, there are many aspects concerning approaches for modeling and solving these problems which are of general methodological importance.

In the presented thesis the focus is over applications from industry and service operation management. A constraint taken into account is that only deterministic scheduling problems are considered, in which a set of resources always contains machines. The focus is over job shop problems.

Job shops are prevalent in industries where each customer order is unique and has its own parameters. Wafer fabs in the semiconductor industry often function as job shops; an order usually implies a batch of certain type of item and the batch has to go through the facility following a certain route with given processing times. Another classical example of a job shop is a hospital. The patients in a hospital are the jobs. Each patient has to follow a given route and has to be treated at a number of different stations while he/she goes through the system.

Getting deeper into it, this diploma project consists mainly of an application - an extension to a Production Planning Simulator by introducing scheduling algorithms in order to minimize the makespan.
Since it has turned out very hard to solve job shop problems with large numbers of jobs to optimality, many heuristic procedures have been designed. One of the most successful procedures for minimizing the makespan in a job shop, which is used in the present application also, is the Shifting Bottleneck heuristic.