Heuristic algorithms for lotsize scheduling with application in the tobacco industry

Marcus Pattloch[a], Günter Schmidt[b,1,*], Mikhail Y. Kovalyov[c,1]

[a]*DFN-Verein, Anhalter Str. 1, 10963 Berlin, Germany*
[b]*Universität des Saarlandes, Im Stadtwald, Gebäude 15, 66041 Saarbrücken, Germany*
[c]*Institute of Engineering Cybernetics, National Academy of Sciences of Belarus, Surganova 6, 220012 Minsk, Belarus*

Abstract

We investigate a production planning problem which appears in many industries. We present an example from the tobacco industry. The basic question is how tasks of different types can be scheduled on machines in lots such that the number of changeovers is minimized. These changeovers occur if two tasks of different types are scheduled in sequence on a machine. We analyze the problem in detail and present heuristics for the single and multiple machine case. We evaluate these heuristics and give recommendations for their application to serial production systems. © 2001 Elsevier Science Ltd. All rights reserved.

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1. The industrial problem

The problem we investigate exists in many industries. Let us concentrate on an application we found in a company of the tobacco industry. The company produces different types of cigarettes according to the process whose description is shown in Fig. 1.

The process starts with the production of the filter tips and the preparation of the tobacco. To produce the filter tips acetate, filter paper and tip paper are needed. Tobacco preparation requires raw tobacco and generates cut tobacco. Filter tips and cut tobacco are merged with cigarette paper to produce a cigarette. The cigarettes are wrapped and packed over several stages and are sent to the customers. The production of cigarettes is carried out on production lines.

* Corresponding author. Fax: +49-681-302-4565.

 E-mail address: gs@itm.uni-sb.de (G. Schmidt).

Acetate, Filter Paper, Tip Paper   Raw Tobacco   Cigarette Paper

Filter Tips   Cut Tobacco
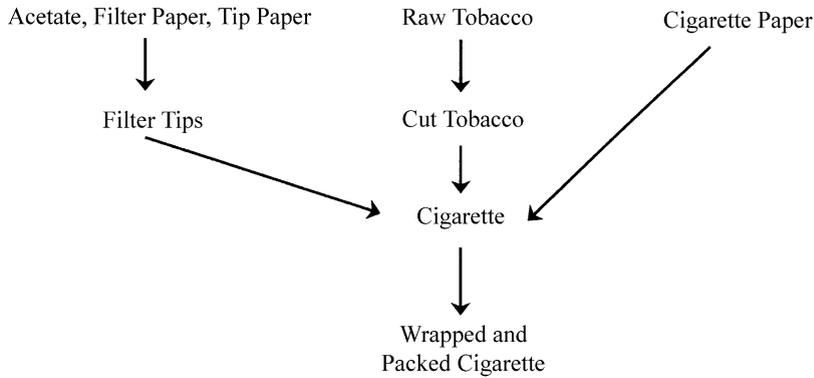
Cigarette

Wrapped and
Packed Cigarette

Fig. 1. Process of cigarette production.

The company we investigate currently produces about 20 cigarette types regularly with several production lines belonging to different shops. When a line changes production from one cigarette type to another a changeover activity has to be carried out.

Cigarette production is currently organized on three levels. There are two planning levels and a physical one. The planning levels are mid term and short term. For the mid term level production data is provided by a sales forecast system. On the short term level a MRP II system generates production schedules for the different shops. On the physical level several parallel and identical production lines are producing the cigarettes.

Mid term decisions relate to the determination of production orders. A production order defines which type of cigarette should be produced in which quantity until which deadline within the next mid term period. These decisions are based on data on expected sales.

On the short term level the MRP II system provides data to generate production schedules for the shops from the production orders. A production schedule is defined by the cigarette type it relates to, the
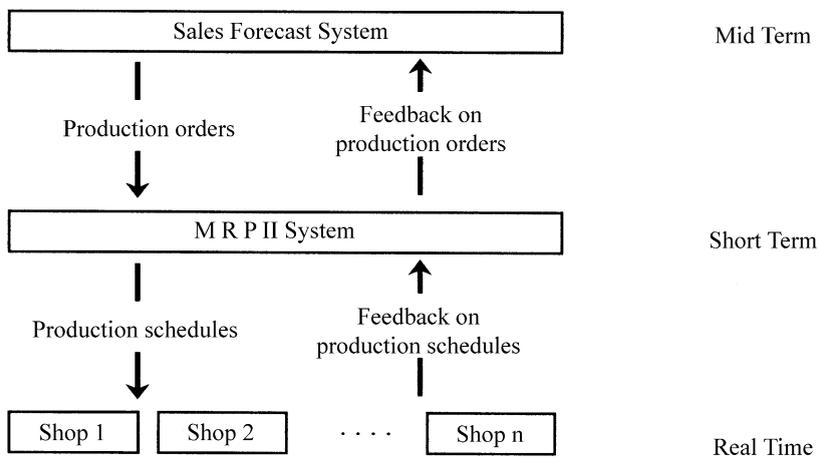
| Sales Forecast System | Mid Term |

Production orders   Feedback on
production orders

| M R P II System | Short Term |

Production schedules   Feedback on
production schedules

| Shop 1 | Shop 2 | · · · · | Shop n | Real Time |

Fig. 2. Production planning system.