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Margaretha Gansterer

www.elsevier.com/locate/ijpe

PII: S0925-5273(15)00207-8
DOI: http://dx.doi.org/10.1016/j.ijpe.2015.06.001
Reference: PROECO6105

To appear in: *Int. J. Production Economics*

Received date: 20 March 2014
Accepted date: 1 June 2015

Cite this article as: Margaretha Gansterer, Aggregate planning and forecasting in make-to-order production systems, *Int. J. Production Economics,* http://dx.doi.org/10.1016/j.ijpe.2015.06.001

Aggregate Planning and Forecasting in Make-to-Order Production Systems

Margaretha Gansterer[1]

Department of Business Administration, University of Vienna,
A-1090 Vienna, Austria

Abstract

In hierarchical production planning (HPP) systems, aggregate production planning (APP) is meant to balance capacity requirements and production quantities for medium term planning horizons. Aggregate plans provide the basic input for further planning steps. In recent years researchers came up with comprehensive models and sophisticated solution methods for this kind of high level planning. However, some practitioners claim that the aggregate planning concept is rarely applied in industry.

We present a comprehensive HPP framework, which we use to investigate the impact of aggregate planning in a make-to-order (MTO) environment. The basic inputs for aggregate plans are market forecasts. Thus, we conduct experiments assuming different forecasting techniques. The planning problem is formulated as a linear mathematical model and solved to optimality by a standard optimization engine. A discrete-event simulation model is used to perform lower level planning steps and to mimic the shop floor where stochastic and nonlinear dependencies are considered. The performance of the system is evaluated based on service- and inventory levels. Real world data coming from the automotive supplier industry is used to define four demand scenarios. For each of them we compare the performance of the system with and without the inclusion of aggregate plans. If aggregate plans are used we assess the impact of different forecasting techniques. We analyse the results and give managerial recommendations. Our experiments show, for example, that in a setting of low capacity utilization, aggregate plans are rather unprofitable. Moreover, we observe that APP using time series forecasting techniques seems to be a good strategy if demand is highly volatile or resources are scarce.

Keywords: Hierarchical production planning, aggregate planning, make-to-order.

[1] margaretha.gansterer@univie.ac.at
Phone: +43 1 4277 37915