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A DISCRETE EVENT SIMULATION TO FACILITATE HYBRID PRODUCTION PLANNING IN A PAPER PRODUCTION PLANT

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ABSTRACT

This study investigates a paper production facility that markets its products in Europe and its producing strategy is purely make-to-order (MTO). The effects of deploying a make-to-stock (MTS) production strategy for specific end products is analyzed on a scenario building basis via a discrete event simulation model. Initially, the current situation where the production strategy is purely MTO was simulated and validated. Afterwards, end products were evaluated if they can be produced as MTS. Products that are qualified to be produced as MTS had their simulated production schedule developed on a spreadsheet-based model. Forecasting for the new production schedule was based on four time series forecasting methods. Results of various simulation runs highlight that due to postponement, the MTS production strategy for the qualified final products leads to a leaner warehouse flow

1 INTRODUCTION

The paper reel production industry is characterized by fluctuating demand due to promotionally driven customer orders. Due to global market competition, high customer service levels and economized production machinery utilization are perceived as a necessity rather than a competitive advantage in the paper reel production industry (Borges et al. 2014). Additionally, production runs are characterized by a cyclical pattern in order to minimize machine idle times and waste (Bouchriha et al. 2007). Due to this complexity, simulation modelling is a promising tool to assist decisions a production facility has to take on a short-term basis in its corresponding supply chain.

2 METHODOLOGY

To understand the effects the new production strategy imposes, the connection between the production and warehousing facilities was modelled in a first step. The discrete event simulation model describes the flow of goods in the warehouse by matching the production and customer orders based on a predefined key code, initially from the empirical input and, afterwards, from the new Master Production Schedule (MPS). After matching the production and customer orders, those goods wait in a queue until the corresponding transportation unit with a predefined destination arrives for pickup. The outbound processing time in the warehouse and truck arrival times are represented as the varying parameters during the simulation runs. In Figure 1, the key parts of the implemented concept are described, where empirical data collected from the production plant was used as input. The MPS takes input from a forecasting model which uses four time-series forecasting methods from the forecast package in R (Hyndman 2020). The alternative production strategy is based on a framework that identifies the potential end products that can be produced as MTS.

Such a framework is motivated by the work of Garn and Aitken (2015), Perona, Saccani, and Zanoni (2009) and Rafiei and Rabbani (2009).

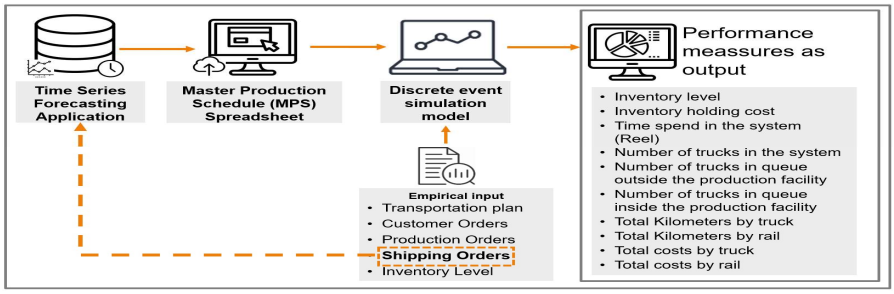

Figure 1: Key parts of the implementation concept.

3 RESULTS AND DISCUSSION

The framework identified two end products out of more than 1,000 as promising to be produced as MTS. These two products were responsible for more than 11% of the total turnover. As visualized in Figure 2, when the effect of producing these two products as MTS was analyzed on the total flow with the developed simulation, results highlight that a reduction of 9.2% in average inventory in the warehouse is possible.

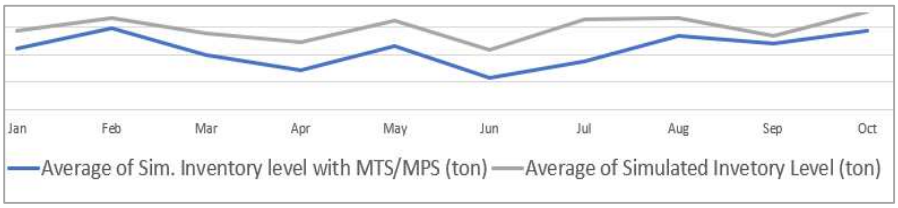

Figure 2: Simulated inventory level.

These savings result from postponement, which can lead to a reduced inventory level (Bienert 2018). Additionally, the simulation model can further support various related decisions. With the right process measurement, CO_2 tracking can be integrated. As the paper reel industry is characterized by a high cyclicality opportunity due to the products nature (Berends and Romme 2001), further developments of this work can path in that direction.

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