

## Chapter 21

# Production Lots as Determinant of Paper Production Lead Time Performance

**Pekka Koskinen**

*Confidea Business Consulting, Finland*

**Olli-Pekka Hilmola**

*Lappeenranta University of Technology, Finland*

### ABSTRACT

*In this research work we are interested about connection between lead time performance, and production order size as well as in how many production lots this order was eventually produced. Based on the system dynamics simulation model, the authors got a priori assumption that production lots have in multiproduct environment better explanation power. Our empirical findings give support for this – number of production lots explain in production environment manufacturing lead time much better than production order size. Further support is gained from supply chain phases, which are analyzed similarly, but as surprise explanation power of production lots decreases, and seems to be significantly lower in more distant markets. It is interesting to note that currently used IT applications of analyzed global case company do not give real time snapshot regarding to the development of overall supply chain lead time.*

### INTRODUCTION

Lead time performance of entire production operations, but also the whole supply chain is widely discussed issue in the contemporary supply chain research. After Just-in-Time (JIT) revolution during 80's, most of the researchers were thinking that lead time is not major research interest subject, after companies have implemented new methods in production and supplier network related opera-

tions (e.g. Mistry, 2005; Chen et al., 2005; Kros et al., 2006). However, ever larger corporations in manufacturing, larger factories, offshore outsourcing opportunities, new emerging markets, and larger markets overall to be served by each factory has resulted into the situation that lead time performance is still an issue – for example, in paper production number of mills at European soil has decreased during the last two decades by more than 25%, but production volume has doubled (CEPI, 2007). As purchasing and manufacturing altogether take major proportion from total costs

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incurred, but surprisingly lead time of transportation and warehousing takes most from the lead time of supply chain (Lowson, 2001; Rubesch & Banomyong, 2005; Kumar & Arbi, 2008). In this research work we are interested to know, how manufacturing related decision, namely scale in production batches and amount of production lots, affects into lead time performance of paper production line, and what kind of connections it has on supply chain lead time performance.

Paper industry has long traditions in Northern Europe, and particularly in Finland, but making academic research concerning the supply chain behavior has not been frequent (recently dealt only within Koskinen & Hilmola, 2008). Very rarely real-life case studies, and especially larger quantitative datasets accompanied with qualitative interviews, have been published. In this research work we use two paper mills, operating in Finland, as empirical basis of our research work. Distribution network of these factories differs in a manner that A mill uses mostly Eastern Finnish sea port (exceptions for products shipped to North America), while B mill favours another sea port located in West coast. A mill could be categorized as a medium sized paper mill as measured with production capacity, and B mill belongs class of large production outlet, having annual production of approx. 0.9 million tons. Both paper mills have several paper machines (PM), but for the further analysis of our research work, only one paper machine per mill was selected. The motivation for selecting these paper machines was that both of the paper machines were producing their own type of paper qualities for the same markets; UK and USA as market representatives were selected, because customers on both of the markets play an important logistics role for the case company and the supply chains to these markets were considered to be representative for other market areas as well.

The supply chain management organization in the case company is divided principally in three different organizational units: the mill, the company's central logistics organization and the

logistics organization in abroad. This is in line with modern management theory, which suggests that decentralizing is an effective way of managing large organizations. Each of the supply chain partners has its own decision rights and acts like a single decision maker in order to optimize its own profits and resources (Yu et al., 2001). With effective information sharing, the decentralized supply chain can achieve the optimal performance under centralized control. The paper mill is doing the production planning based on the orders coming from the sales network. After the actual production process of a paper, respective mill is responsible for the domestic logistics. This includes dispatch planning, booking of transport capacity (trucks and railway wagons), loading of transport units at the mill, supervision of the transports to the port of loading, and daily operational contacts to the local port operators. Logistics control of the mill ends, when the orders have been discharged from arriving wagon or truck to the port. Mill should have an overall picture of the logistics movements of the shipped orders from the mill to the ship's cargo decks, where the orders are stowed. Mill's logistics responsibility also includes providing necessary logistics documentation.

The central logistics organization has a strategic role in the supply chain development and an operative role in the daily supply chain management. The central logistics organization makes the annual contracts with the railway and trucking companies in Finland, with the port operators in Finland and with the shipping lines. The central logistics organization has in the case company a daily operative role, which starts when the orders are waiting in the terminal of the loading port, and the operative responsibility ends, when the vessel arrives to the discharging port.

The lead time and production data used in this research work was decided to be used from year 2003 as this year was considered to be a normal year without any strikes in the production or in the loading or in the discharging ports. Another reason supporting the selection of year 2003 was

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