NETWORKS AND TOOLS FOR SUPPLY CHAIN OPTIMIZATION IN AUTOMOTIVE INDUSTRY

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Abstract

The car manufacturers worldwide are under the roughest business environment. Its sales are affected by a financial crisis that mutes a customer's ability to buy new cars. Due to those unfavorable conditions it is important to take all available tools in order to mitigate crisis effects. The paper basically describes Supply Chain Management including some types of networks its weaknesses as well as optimization models in automotive industry. As a result of globalization, more and more supply chains originate in low-cost countries, primarily in Asia and Eastern Europe, while largely continuing to terminate in North America and Western Europe. As a result, traditional organizational structures and business practices are being challenged. Next, some suggestions for optimization of the procurement, production, transport and warehouse management is described in the paper.

Keywords: Automotive industry, procurement management, warehouse, production management

1. INTRODUCTION

As the automotive industry shifts from a traditional local business model to a global one, OEMs and suppliers are among those experiencing the most disruption.

Major automotive players are in various stages of transformation from a localized "buy / make / sell" model to a global "buy / move / make / move / sell anywhere" model. This transition is being undertaken in order to achieve greater scale and cost efficiencies while capitalizing on rapidly expanding markets. Companies must maintain or enhance supply chain flexibility and customer responsiveness despite these major shifts in the automotive industry [1].

During the last 15 years Supply Chain Management (SCM) has developed from a veritable procurement strategy to an important part of integrated business models. By the use of SCM in some subareas distinctive improvements have been achieved, but the potential is by far not utilized. The accelerated globalization of economy, the increasing customer requirements, the short product life cycles and new information technologies are new challenges for SCM and inter-corporational networks. Especially in Automotive Industry, where they have to deal with a wide range of products and product variability, high customer requirements and many suppliers SCM is one of the most important factors to stay competitive [1], [2].

This article will now focus on Supply Chain optimization, an inter-corporational orientation of operative and strategic business processes to satisfy customer requirements along the whole Supply Chain. Due to the companies focus on their core competences many complex production-networks were established. To ensure the competitiveness of the involved companies, Supply Chain Optimization focuses on the optimal planning and control of all material, information and financial flows. Mathematical models and software tools support the cooperation between the consumers and suppliers and afford a smoothly and optimized flow of business processes [2], [3], [4].

2. TYPES OF NETWORKS IN AUTOMOTIVE INDUSTRY AND THEIR WEAKNESSES

In automotive industry production networks, those connect geographical separated production plants of one or more companies are reality for many years. The networks consist of the Original Equipment Manufacturer's (OEM) production plants and of his worldwide suppliers. The objective of the networks is to optimize material and information flows between the plants. Due to the worldwide partners in a production network the legal frameworks are totally different and it is often a hard challenge to conclude contracts. [1]

In **Figure 1** you can see a simplified description of a production network between an OEM and his suppliers.

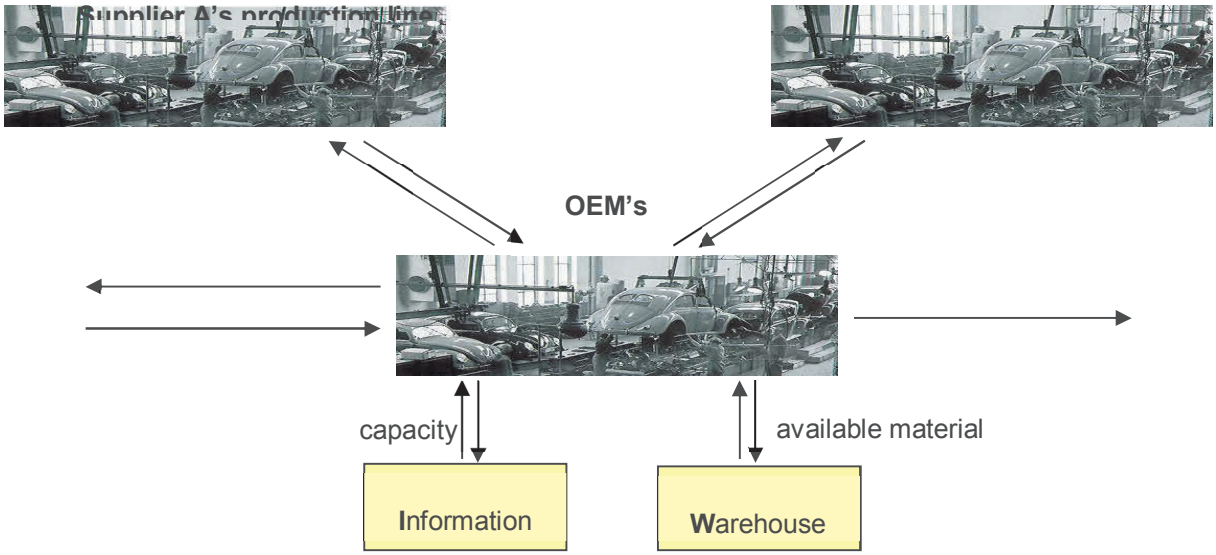

Figure 1 Simplified production network

Contrary to production networks a distribution network has a totally different scope of duties. The point of view of these networks is focused on the optimization of the distribution structure and organization. It is common that independent companies act as a partner of the OEM and distribute in many regional stores the products to the customer [5], [6].

The following figure shows a simplified distribution network of a French OEM.

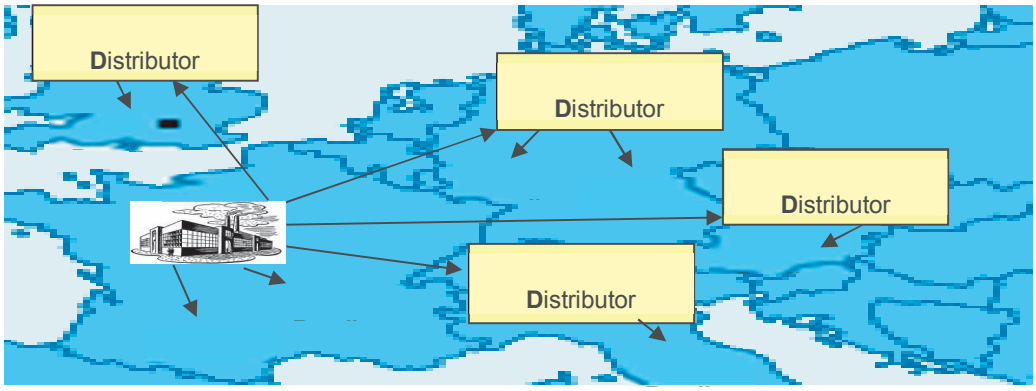

Figure 2 Distribution network

The third common combination of networks concerns the procurement. OEMs like VW or BMW use procurement networks to optimize procurement processes, to gain economies of scale and scope and to create market power. In automotive industry procurement networks are usually closely connected with production networks. [7]

Figure 3 shows the procurement process of a factory and some different transport structures that are discussed at the point transport management.

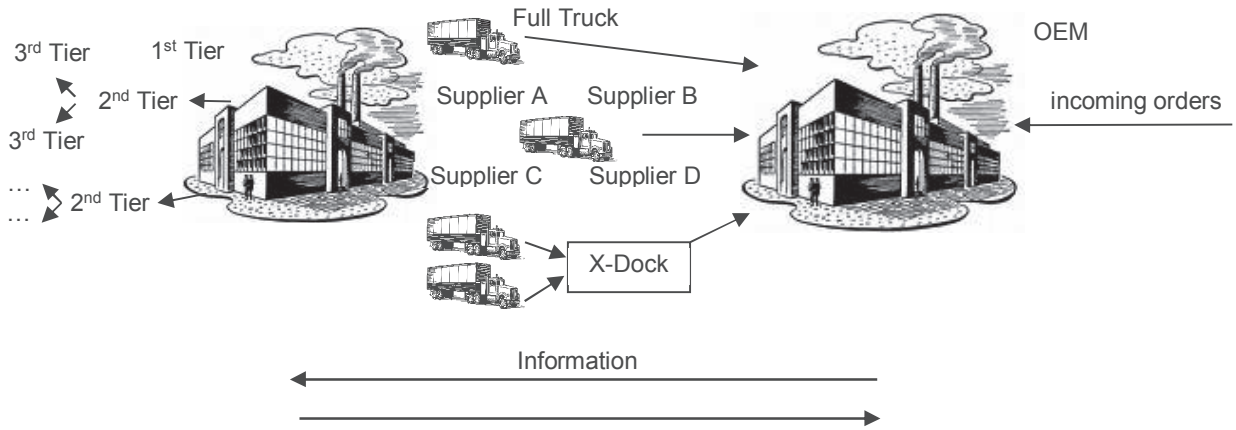

Figure 3 Procurement network and transport systems

Weaknesses in automotive industry networks frequently occur of the high number of process partners in the supply chain. In general a coordinating department with detailed information about processes does not exist and a continuous responsibility for the whole process is also missing. The absence implementation of process standards is a further barrier for global network management. Non-integrated information systems, missing capacity adjustments and complicated accounting systems complete the problem list. [6]

3. INSTRUMENTS FOR NETWORK OPTIMIZATION

According to the objectives of networks, network management has to deal with different requirements. To optimize networks the management has to provide appropriate instruments. At the beginning analyses should be enforced to show existing dependency and cooperation models between the factories and suppliers in a structured way. In automotive industry the procedure is as follows. Analyses record all incoming material volume and logistic costs related to the different production plants, car series, procurement region and groups of parts. These analyses also show management ratios like transport and handling time as well as costs, the turnover volume, available capacity, stock amounts and capital lockup. In contrast to these standard logistic analyses supplier based analyses show the outgoing material volumes and costs of each car series. Analyses related to the groups of part record all supplier, transport and handling costs, while procurement analyses show the procurement volume and amount for each production plant and car series. After the recording and structuring of all analyses and information, decisions about network optimization can be reached by the use of simulations. In general improvements are the result of modified standard processes and parts allocation, of optimized network elements and intensified supplier integration. [7]

Another essential instrument for network optimization is process management that plans, controls and executes logistic processes. The objective of process management is to organize the company's intern process chains, from the processing to the waste disposal department, in an optimized and efficient way. Other instruments for a successful network optimization and smoothly material and information flow are consolidated planning and controlling systems, capacity databases to coordinate lead times and utilization, coordinated management information systems and workflow systems [7], [8].

Figure 4 shows a short summarization of possible optimization instruments.

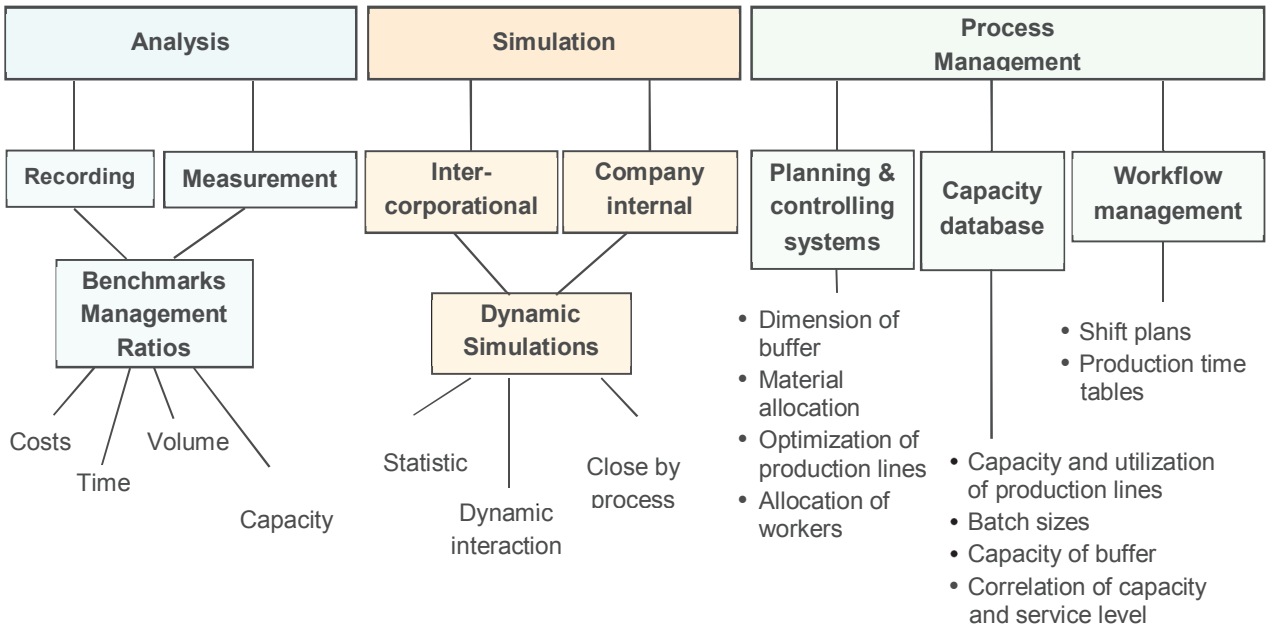

Figure 4 Optimization instruments

4. SUGGESTIONS FOR OPTIMIZATION MODELS IN AUTOMOTIVE INDUSTRY

The following part of this article will give some suggestions for optimization of the procurement, warehouse, production and transport management in automotive industry.

4.1. Procurement Management

Due to the increasing horizontal and vertical product range in automotive industry and the thereby occurring rising number of parts, suppliers, complexity and costs, procurement management plays a very important role in staying competitive. As a result of the rapid grow in total revenue many OEMs focus on the implementation of a strategic procurement process. In this case the primary objective is to optimize the worldwide processes.

To achieve that it is advisable to analyse the whole procurement volume, the suppliers and the different material groups. After the interpretation of the results and the identification of the strategic procurement processes decisions concerning product development and supplier management processes, cost optimization models or Make-or-Buy decisions could be made. Cross-functional teams can be introduced to analyse the interfaces inside the company but also between the supplier and the OEM. [9]

To assure an optimized and increased process quality it is reasonable to introduce some supplier management software to simplify the procurement process. The Mercedes Car Group introduced a Supplier Management Base (SMB) that is aimed to make capacities, stocks, demands and supplier data transparent to provide the supplier's production processes with actual information. This system makes it much easier to prevent bottlenecks and bullwhip effects and is also reducing the reaction time in case of an existing bottleneck by an automated reclamation process. [10]

Other instruments for procurement process optimization could be the introduction of Quality Gates to increase the process stability or Process-Owners that are responsible for a smoothly process flow.

4.2. Production Management

For years simulation is an important tool in production planning. Depending on the production structure analytical models are an alternative or an extension for simulation application. By the use of simulation software it is possible to model complex structures in a few days or even in a few hours. After analysing the simulation results, the responsible persons for the process can start to optimize the process by changing batch sizes, free and blocked floats and other parameters [10].

One example for software that is used in automotive industry is RFID software for Complex Event Processing from TIBCO Software Inc. With this software it is possible to integrate all relevant information of RFID in the existing supply chain data flow to track the products during the entire supply chain. So it is possible to synchronise and optimize the production process or to use Just-in-Time and Just-in-Sequence models.

Another instrument to reduce the complexity of production programs is the introduction of some Assemble-to-Order or Build-to-Order concepts. These concepts are characterised by the capability to quickly build standard or mass-customized products upon receipt of spontaneous orders without purchasing delays, forecasts or inventory. [12]

One very simple but very effective optimization tool, which is used since the seventies in Japanese automotive industry, is the KANBAN system. This system is based on the pull-strategy and is exclusively orientated on the demand of a consumptive production area. Autonomous control cycles on workflow-level are the core element of this flexible production control system. The KANBAN system can reduce stocks and lead times and an improvement of material availability, production efficiency and delivery reliability can be reached. [13]

4.3. Transport Management

One of the major problems in transport is the long delivery stop during the loading process. The challenge is to organise the loading process in a physical way that minimize the delivery stops and loading times. Material supply in some base frames or optimized handling equipment for direct loading could be helpful.

For an effective transport optimization it is also necessary to integrate a standardized production planning and control system (PPC-System) or an intranet platform to generate all data concerning material flows between suppliers and the OEM [14], [15]. This tool provides a transparent database and helps to review all important information. To optimize transport it is also necessary to divide the delivery volume in a classical ABC-classification. For A-goods a direct delivery are appropriate while for B-goods milkruns or the disposal of the whole delivery volume to an area forwarder are possible opportunities. C-goods are normally distributed via Cross-Docking-Platforms [16].

4.4. Warehouse Management

To optimize costs and long required waiting time for stocks, the implementation of a Warehouse Management System (WMS) is advisable. Such systems control the transport flows in warehouses between the different areas.

Another suggestion to optimize warehouse processes is the generation and optimization of picking orders. Product and demand analyses should find out for which products chaotic and for which products regulated picking systems are efficient [17].

To optimize warehouse processes it is also recommended to divide the products in an ABC-classification. After the classification it is possible to find appropriate warehouse systems for each product groups [18].

CONCLUSION

Due to the increasing product variety, customer requirements, suppliers and costs the network building of autonomous companies and the optimization of business process is of upmost importance to stay competitive. The cooperation in production and supplier networks leads to a quality improvement and risk minimization because of know how bundling. Networks are also an appropriate instrument to stay or improve competiveness. For example, time advantages can be reached by reducing lead and processing or increased reaction times. Economies of scale and scope can be achieved by improved market entry and market penetration. Technical specialisation and synergy effects, that can cause cost reduction, are also much easier to realize in networks than for one company alone.

To reach all the advantages of network building it is top priority to coordinate all material and information flows between the different operating areas and the company's interfaces. This leads to new challenges and responsibilities for logistics that can be countered by the development of precise network management. According to the permanent improvement of optimization systems and models the optimization potential for an efficient coordination of a company's processes is not utilized by a long time.

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