AUTOMOTIVE SUPPLY CHAIN OUTLINE

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Summary: The presented article focuses on characteristics of automotive supply chain. The theoretical part provides an overview of component suppliers' structure. Next part is relating to supply chain base in Slovakia. There are also some actual trends in automotive and supply industry based on flexibility and agility principles. This factor is known as a competitive advantage in global automotive benchmark. The example of application build-to-order supply management is presented in condition of automotive plant with directly customers purchase impulses. At the close part of the paper is reason for the need of using support information technologies tools to flexible and efficient design of suppliers' production and logistics processes.

Key words: automotive industry, supply chain management, flexibility.

INTRODUCTION

The OEMs (original equipment manufacturer) operates in an environment with strong global competition, market is more turbulent, complex and uncertain. The automotive industry offers rapid increases in the number of models and model variants that are available on the global market to customers. Traditional car segments such as hatchbacks, sedans, vans, and pick-up are fragmenting variety more and more into niches. Derivative car segments, such as minivans, cross- over coupes, roadsters, two-seaters vehicles, SUV coupes and sport vans, are growing. This fragmentation and segmentation of vehicles results in a more complex supply chain that needs to be managed flexible. Key trend in the automotive industry is standardisation of components and modules of construction to common platforms. This means that models can be adjusted to the individual requirements of customers and delivery schedules enable to OEMs produced multiple models (based on varying platforms), at the same manufacturing facility.

OEMs are continually pushing supply-chain pressures on their tiered suppliers to reduce costs, increase output, increase quality, and provide more frequent deliveries. Suppliers, in position as strategic partners of automobile producers, must be able to quickly respond to changing demands in the market because OEMs are abdicating responsibilities in the areas of development, sourcing and planning and vehicle component makers must demonstrate that they can deliver the required design, quality, service and price.

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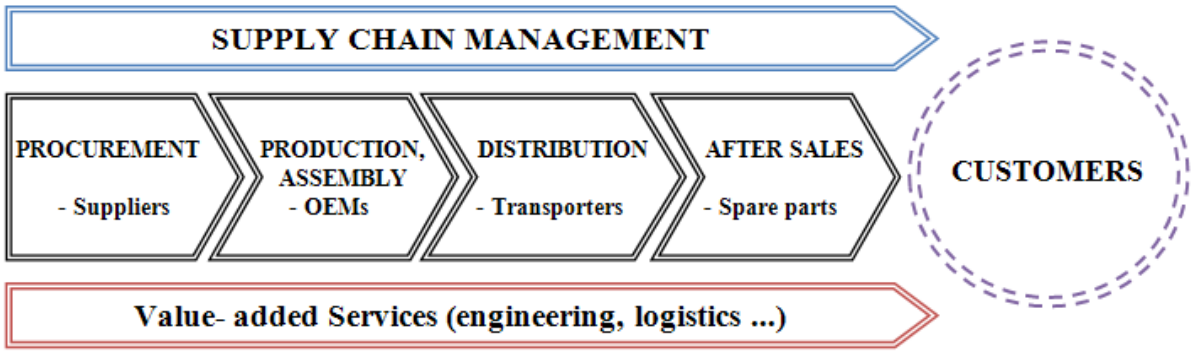
Today competitiveness of OEMs is influenced by dramatic rise in flexibility and responsiveness across supply chain partners. The supply chain requires integrated capabilities and flexible tools based on real-time information to address this increasing complexity.

1. OVERVIEW OF AUTOMOTIVE SUPPLY CHAIN MANAGEMENT

1.1 Automotive supply chain standard structure

A supply chain includes all activities, functions and facilities (directly or indirectly) in the flow and transformation of goods and services from the raw materials stage to the finished products and deliver them to end user - customer towards the market (1). The term "supply chain" means related managing business activities within organizations and encompasses the web of interconnected relationships between the sales channel, distribution, warehousing, manufacturing, transportation, and suppliers (see Figure 1).



Source: Author´s adaptation

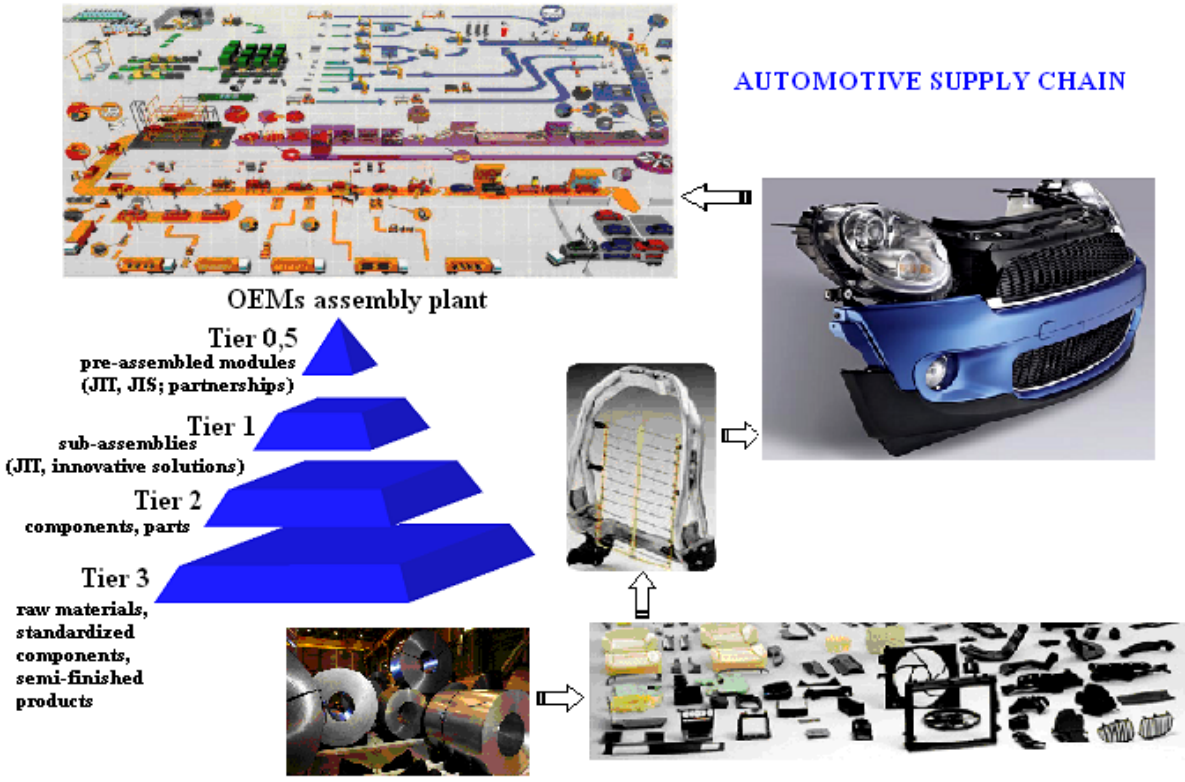
Fig. 1 - The key areas of supply chain

Business activities that results from key supply and logistics processes are: procurement, customer service, distribution, transportation, inventory control with information systems, sales, planning, order entry, receiving, shipping, inspection, purchasing, production scheduling, master scheduling, warehouse management, and supplier management. The point is in assuring the collaboration between suppliers.

A typical supply chain in automotive may include components or modules suppliers (Tier 1 - 3), OEMs (car manufacturers), distributors, dealers (retailers) and customers. The model of automotive supply chain is presented at Figure 2.

- *First tier suppliers* - mainly global world players - with own production or assembly capacities establish near to OEM (operating processes in condition of JIT delivery specifications) - are incorporated into the production development projects and innovation process; this means that they make their own engineering and designing decisions with establishing local engineering or development centre.
- Tier 1 suppliers have their own *2nd tier suppliers* who procured parts for these modules (assembly units) – they are the companies with own production or assembly plants establish near to 1-Tier suppliers (global or regional players).

- *Tier 3 suppliers* are local home companies (manufacturing capacities for small simple automotive parts, components - e.g. plastic parts, metal parts, aluminium parts, raw material suppliers), which fulfil mainly quality and volume conditions of 2-Tier suppliers, some supplies for 1-Tier suppliers.



Source: Author´s adaptation

Fig. 2 - Automotive supply chain structure

Each member of the supply chain is connected to other parts of the supply chain by the flow of materials in one direction, the flow of orders and money in the other direction, and the flow of information in both directions. Supply chain coordination is focused on the control of material flow and information flow among suppliers, manufacturers and customers through the processes of information sharing, communications and transmission. A change in any link of the chain usually creates waves of influence that propagate throughout the supply system. These waves of influence are demonstrated in prices (for raw materials, labour, parts, and finished product), flow of materials and product (within a single facility or between facilities within the supply chain), and inventories (of parts, labour capacity, and finished product). How these influences propagate through the complex system determines the "dynamics" of the supply chain. The supply chains are becoming demand-driven rather than forecast-driven in order to effectively respond in real-time car manufacturer demand.

Priority of supply chain and OEMs network integration is reduced order-to-deliver time for the consumer with a higher degree of personalization by allowing higher efficiency and flexibility at the final assembly plant.

1.2 Mapping the automotive supply chain structure in Slovakia

The three reputable car producers are located in Slovakia - Volkswagen Slovakia, PSA Peugeot Citroën Slovakia, Kia Motors Slovakia - represent a different cultures of manufacturing and management approach. These companies created specifics supplier chain structure, which is located near to OEM plants. In Slovakia they were created through natural growth of the three strong regional clusters of automobile industry (see fig. 3). Slovakia has an advantage of good geographic location. Important for the further development of suppliers' network is the proximity to other car manufacturers' factory in Central Europe region and strong connection to Western European car producers and subcontractors. All automotive car producers and suppliers in Slovakia present the progressive technologies, high-tech production methods and close cooperation.

Structure of supply chain in Slovakia was adapted to meet conditions and requirements of three different cultures of car producers (German, French and Korean). Various focusing suppliers generate a synergistic effect. Structure is composed by suppliers 1-Tier, 2-Tier, 3-Tier and cooperation is complemented with other small and medium enterprises, service providers and institutes. The supply chain locations are unevenly distributed. Most component manufacturers are concentrated in the territory: Bratislava, Trnava, region Považie a Žilina.

Source: Author´s adaptation according to IPDAP data (3)

Fig. 3 - Regional arrangement of supply chain in Slovakia

It is possible to specify: (2)

- *Kia Slovakia* - Žilina supply system: The structure of suppliers and subcontractors for Kia Motors is about 50 suppliers of parts and modules. Parts must be supplied in the required quality and at the right time and price; they seek directly to the assembly line. Suppliers are divided into local (that means European suppliers), and those who supply them with components from countries outside Europe (Korea, Japan and USA). Local contractors make up 75% of total delivery, of which the Slovak suppliers accounts for about 55%. Supplying the most important parts for Kia is provided from certified and traditional

suppliers (e.g. Dong Won Metal, Johnson Controls, Hanlla Climate, Hyundai Mobis, Hyundai Hysco, Dong Hee etc.).

- *Volkswagen Slovakia* - Bratislava supply system: Suppliers must be able to provide the required quality and to fulfil orders on JIT principles. Share of JIT supply logistics is 27% of the material delivered per vehicle. They emphasize the precise processing of logistics concepts. VW SK cooperates with more than 3,500 supplier companies of which most of the delivery comes from Slovakia, followed by Germany. The most important suppliers for VW: Bosch, Brose, Tower Automotive, Faurecia, Hella, Johnson Controls, TRW, Delphi, Magna, HPBO, SE Bordnetze, SAS Automotive etc.
- *PSA Slovakia* - Trnava supply system: When selecting suppliers for PSA Peugeot Citroen Slovakia does not decide their nationality, but the quality, flexibility and ability to supply exactly the parts they need on time. All at the lowest possible price. The advantage is proximity to suppliers to assembly plant, which allows them to be flexible and spend less on logistics. Examples of suppliers: Lear, Konsberg, Visteon, Valeo, Tower Automotive, Faurecia.

Published forecasts indicate that this year, car production in Slovakia will reach 780 000 units (4) and suppliers participates in this issue. Automotive suppliers in Slovakia are an important part of the whole structure of the automotive industry. The aim is to get the largest share of automotive components were subcontracted from Slovak producers.

2. SUPPLY CHAIN MANAGEMENT IN FLEXIBLE AUTOMOTIVE PRODUCTION

Ericsson (6) define flexibility in supply chains as: the possibility to respond to short term changes in demand or supply situations of other external disruptions together with the adjustment to strategic and structural shifts in the environment of the supply chain. Flexibility thus combines agility and adaptability. In the automotive industry are five categorical dimensions of flexibility regarded as critical for OEMs and suppliers, as show in table 1.

Tab. 1 - Flexibility indicated in automotive production

Flexibility pattern	***Explanatory***
Production flexibility	Ability to manufacture a product in different value-creation systems on reconfigurable production base.
Product flexibility	Ability to make more than one product in the same system (e.g. different models of car on one assembly line).
Variant flexibility	Ability to produce multiple variants (is similar to product flexibility).
Volume flexibility	Ability to manufacture different quantities of a product, without substantially changing the unit costs.
Location flexibility/mobility	Ability to produce and deliver quickly from other locations in terms of globalisation.

Source: Author´s adaptation according to (6)

In this context can be refer to example R&D project, funded in part by the European Commission, "MyCar - Flexible assembly processes for the car of the third millennium". The overall objective of the project is to increase the competitiveness of European vehicle manufacturers by improving flexibility in assembly plants. The goal is also to network assembly plant through enhanced supply chain communication flows to enable real time decisions. Solutions inclusive (5):

- Simulation tool to test the feasibility of changing the specification of vehicles within the lock in period;
- Low cost, universal RFID (radio frequency identification systems) technology to enable the real time, IT-independent visibility of components in the supply chain and the automatic population of data in the simulation tool;
- 2-way IT communication flows within the supply chain to nth tier to increase the level of supply chain information available to support decision making via the simulation tool;
- Use of buyer behaviour modelling to assist with decision-making.

The basic idea to improve flexibility in supply chain is to hold inventory in some generic or modular form and only complete the final assembly or configuration when the precise customer order is received from OEMs.

2.1 Demonstration of supply flexibility in build-to-order way

The supply chain and logistic process in automotive environment starts from the costumer and ends with the customer.

Strategy of OEMs manufacturing principles, relates to suppliers parts delivers in assembly plant, can be explained by various ways: make-to-stock, build-to-forecast, build-to-order: engineer-to-order, assembly-to-order, configure-to-order (customize-to-order).

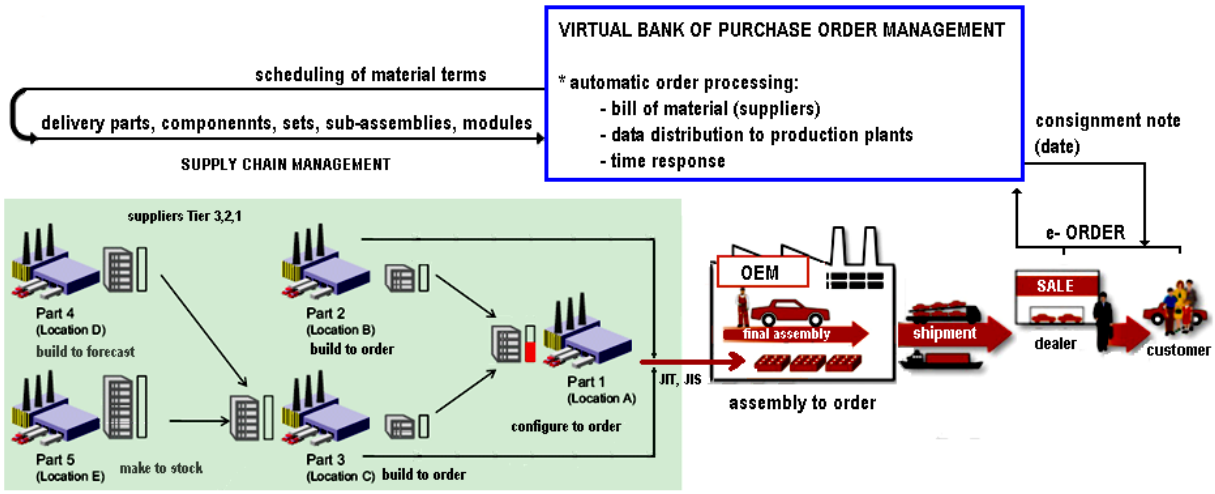
The management fundamentals of car production by "build to order" (BTO) explained simplified in this section of article (with scheme at fig. 4). In this context can be noted that VW BA uses BTO methodology for the production of vehicle models (VW Touareg and Audi Q7).

Customer makes their request through the dealers and specification is then communicated to carmaker. Orders delivered via phone, fax, or other paper-based order methods can be processed as those received electronically.

The information is captured in a central database and bill allocation is done to determine cost of production and deciding place where the car will be manufactured - is stated the nearest location of customers vehicle model production plant. All parts are supplied, imported and received by logistics ways. Just in time (JIT) or Just in sequence (JIS) supply principles ensure that certain part of the vehicle (the right component) arrive to the right point on the assembly line and at the right time has to be ready for installation on the respective body (to be inserted to the particular vehicle they are made for). Based on a fixed production sequence planned several days in advance (or on the order in which vehicle bodies leave the paint shop), OEMs ask suppliers to deliver components to match the production sequence.

Suppliers can ensure this OEMs requirement of sequence delivery to continue producing components in batch, them they are warehoused, usually at a location in close

proximity to the final assembly plant. When sequence orders come from OEMs to the supplier, components at the warehouse are simply repackaged (often aided by information-based tools) in the right sequence and quickly delivered. Once car is assembled, it is transported to the dealers ready for the customer.



Source: Author´s adaptation

Fig. 4 - Build - to - order processes in automotive

Just - in - Sequence is a further key issue of modern automotive production. To optimally fulfil individual customer wishes, the precise identification of each individual component is crucial.

The information technology plays an increasingly important role. The requirement for producing highly customized vehicles imposes the need for reconsidering the organizational structures and supporting them with advanced information technology. The underlying IT network plays a critical role by enabling the integration of various endpoints (for example, RFID sensors, bar-code readers, handhelds, and laptops), communication technologies (fixed-line, wireless), IT- assets (servers, databases). Late change in production schedule creates increased complexity in managing transportation.

2.2 Supply chain flexibility support techniques

Logistics planning, in a flexible environment, requires an integrated and dynamic planning tool to dynamically control the supply network. Best in class automotive companies used support information technologies tools e.g. mySAP Automotive to monitor production status in real time. This software (6) helps to reduce order-to delivery time, strengthens supply chain activities in the areas of demand planning and tracking and tracing of material deliveries, and improves inventory accuracy across plant – enabling significant reduction time-to-customer. It also receives custom-configured manufacturing orders from OEM's planning system and those include all the parts required to build each car. OEM sends the long-horizon forecasts and short-horizon JIT delivery schedules to its suppliers and e.g. larger 1-tier suppliers receive the information via electronic data interchange (so-called EDI order). Other suppliers access the mySAP automotive supplier portal, where OEM posts the requirements to provide up-to-date information on delivery needs. Using only an Internet

browser, suppliers can view all information in real time, including release schedules, purchasing documents, invoices, and engineering documents. When they ship parts, the suppliers send OEM advance shipping notifications (ASNs) to provide the car manufacturer with exact information on parts counts and delivery dates. Parts arriving at the OEM dock are then received and transferred directly to the assembly line. OEM do not hold inventory because cars are made in sequence as the orders are placed using advanced technology network which communicates demand planning across the actors of the supply chain. Production sequencing is especially important for car manufacturing companies where multiple products are being built from the same base platform. In these operations, production schedules can dictate the sequential build of different car models to meet specific customer orders and demand trends.

For the flexible and efficient design of OEM production and logistics processes they applied e.g. special solutions on the basis of innovative radio frequency identification systems (RFID) in combination with Industrial Wireless Communication (IWLAN). This technology helping to collect accurate and reliable data and therefore enables the producers to have a supply chain with higher transparency. Additional benefits in the automotive supply chain are e.g.: local supply chain process control, asset management, reduced counterfeits, reduced delivery time of spare parts, improved vehicle end-of-life management and after sales and service.

Supplier delivery excellence begins with having up-to-the-minute customer demand visible to the all areas of the organization for planning and execution of downstream operational activities, including manufacturing planning, vendor scheduling, production, shipping, and warehousing.

The build-to-order system has made automotive business more profitable by giving to OEMs the flexibility and agility to produce and ship components in the right quality at the right time and in the right sequence from a distant low cost location.

CONCLUSION

Supply chains in the automotive industry become increasingly complex. The modern automotive manufacturing methods aim to “pull” components through production based on demand requirements. OEMs typically rates suppliers according to price, quality, delivery reliability, and operational performance. The goal for “best-in-class” suppliers is to produce the right parts in the right quantity at the right price, delivered to the right place at the right time. Effective management of relationships between OEMs and supply chain companies becomes more and more important.

Suppliers must either pre-build the parts and keep the inventory on their shelves, or move to flexible and sequenced manufacturing so they can produce and deliver the production parts as they are needed.

The automotive manufacturers - OEMs and Tier 1 suppliers have adopting many of new manufacturing practices, e.g. lean production, Just-In-Time (JIT) inventory. These practices

are being driven down to Tier 2 and 3 suppliers and address important manufacturing goals of shorter lead times, improved production flow and faster cycle times.

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