Section 1
Introduction

The situation of automotive companies can be characterized by low and fluctuating demands for final products. Too often, components supply as well as production systems and networks are optimized for the operation at high degrees of utilization without explicitly supporting flexibility.

Therefore the financial downturn in late 2008 has serious impacts on the automotive industries, concerning especially sales caused by dramatically decreased market demands and the pressure on OEMs and suppliers. The missing flexibility and reactivity of the supply network as well as restricted collaboration and communication between the partners in the network lead to dramatic planning unconsistencies and at least causing material shortages with high emergency logistic costs or production line breakdowns.

Additionally the cost pressure of the European Automotive Industry is growing. Automotive companies in emerging industry countries like China or India did there homework and try faster and faster to catch up to the world leading automotive standards here in Europe, but delivering and selling cars at lower costs.

Even more the customers are more ambitious causing higher number of variants, reduced demand predictability, leadning to even higher capacities or demanding more flexible and lean production systems. The suppliers delivering the crucial system relevant parts to the OEM must have the right tools at hand to face this challenges. Therfore the ability to operate a supply chain network becomes a decisive role for suppliers.

What has to be done

Goal-oriented strategies to strengthen the European Car Industry are firstly branding & differentiation to deal with the increasing individuality, the needed flexibility and the call for a high-class image. Secondly, the reduction of delivery times resulting in fast responses of a highly flexible overall production system and low working capital. Thirdly the number of variants have to be reduced through standardized or software configured late customized components. All other not reducable variants must be managed using intelligent supply network management systems. Traditional approaches of supply network planning like actual implementation of collaboration processes and the princinples of increased cost pressures upstream in the supply-chain should be questioned.

What answeres offers this book

The following chapters introduce how the European funded project 5-Days-Car-AC/DC (Advanced Chassis Development for 5-Days Cars) will implement these needed strategies to face future automotive market challenges.

The arising new challenges for the automotive industries and especially the suppliers are effecting not only each partner seperatly in the supply grid. To be competitive and increase the competetive advantages of European leading industrial area, there must be more collaboration in the supply network and the industry should think about the implementation of better and less restrictive collaboration approaches.

1.1 The AC/DC-Project

The vision behind AC/DC is the development of a vehicle production & supply system to deliver a customer ordered vehicle in 5 days using the experience of leading companies in the European Automotive industry. This vision not only targets short order-to-delivery times and low stocks, but the overall flexibility of the automotive production grid. The approach to reach this vision is a dynamic supply network system for the automotive supplier industry that fully supports the "3 H's", i.e. to be "Highly reactive", "Highly reliable" and "Highly flexible". Enabler for this new supply network system is the Customized-To-Order (CtO) principle, which is based on the late customization of components and products by means of mechatronics. The generation of variants by means of software instead of mechanics additionally decreases investment costs for new machines and tools, thereby tackling the financial pressure on automotive companies.

New Mechatronic Technolgies

From a technical point-of-view, the developed highly mechatronic automotive chassis modules support a late customization of order-neutral modules towards costumer-specific requirements. Derived from this novel automotive chassis technology there is plenty of potential for even new drive trains, electrical propulsion, and new wheel systems. The technologies tackled enhance existing safety functions and increase driving comfort options. Technical progress in intelligent software and sensor-actuator technology combined in customer-neutral mechatronic chassis modules pave the way to the next generation of automotive chassis,

which needs to be taken into account by new automotive production processes. Chapter 2 introduces those technologies.

New Supply Network Collaboration principles

AC/DC develops the approach "dynamic supply chain collaboration concept" – the Dynamic Supply Loops (DSL) – that promotes the conventional automotive terms of delivery to a highly reactive "5-Day-capable" system that cuts down inventories in the supply network. Importantly, AC/DC maintains the 100 % guarantee of delivery as an uncompromised constraint. It leaves hierarchic production concepts behind by building on multiple planning loops. This dynamic supply network management is an ideal test case for the integration of both: the high-tech modular technology and the appropriate process configuration features. Chapter 3 introduces the developed concepts.

More Production Flexibility

To implement a reliable and fast supply network management approach available production capacity flexibility potentials at each partner of the supply chain must allocated. Flexibiliy enables the definition of robust planning and operational control processes dealing with habd foreseeable events and reacting fast without causing higher costs. Chapter 4 introduces techniques and tools for identification and implemention of more flexibility in automotive production systems.

1.2 Definition of BtO and CtO

Traditional approaches, i.e. the production of goods for their storage based on forecasts can be summarized as Build-to-Forecast (BtF). BtO and CtO are both advancements of this traditional approach towards customer-oriented production concepts. The advancements, however, are done in different manners. While in the case of BtO the production of parts and components is triggered and "pulled" by orders, in CtO components are produced in accordance to plans and lately customized by flashing software and/or parameters.

Product components considered by BtO are typically components with substantial influence on the production costs. The reason for this is that implementation and operation of a BtO supply chain implies more complex and consequently costlier processes and tuning efforts than traditional approaches for BtF. As a result of the high flexibility of a BtO supply chain, additional attributes for components that are suitable for BtO are their variety and fluctuating demands.

In contrast, the application of CtO is appropriate for components, for which the variety can be realized by means of software as well as parameterization and is not a result of their "physical shape". This means, the respective variant-building feature is not directly "visible" for the end-customer, in opposite to e.g. fabrication of a seat cover or the haptics of a control element.

As a consequence of the characterisation above, the portfolio shown in the following figure can be derived. It consists of the two axes

visibility and *variety*. *Visibility* refers to the aforementioned direct physical perceptibility of the variant-building feature by the end-customer that can not be generated by means of software or parameterisation. *Variety* indicates the overall amount of variants of the part or component. In the four quadrants, we located the respective production strategies Build-to-Forecast, Build-to-Order and Customize-to-Order.

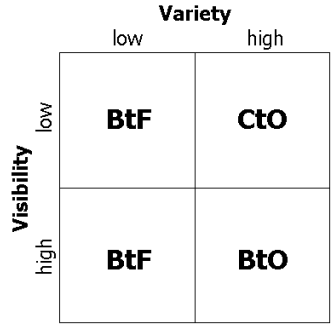

Fig. 1: Production strategy portfolio

The traditional BtF approach is simple to apply in industrial enterprises but tend to result in large stocks of finished and unfinished goods (work-in-progress). This effect increases if BtF is applied to parts and components with a large variety. Considering the costs for stocks as a consequence, traditional approaches are suitable if the demand is constant or well-predictable, the direct costs for the components are low, or the variety of the parts and components is small. This takes into account the multiplication of costs for inventory with the number of variants.

As mentioned above, BtO is especially suitable for parts and components that exist in a large variety, that are visible to the end-customer, and those are cost-intensive. BtO requires the fulfillment of demand with mass production efficiency, but in very short times which leads to fractioned production and probably to inefficient production schedules.

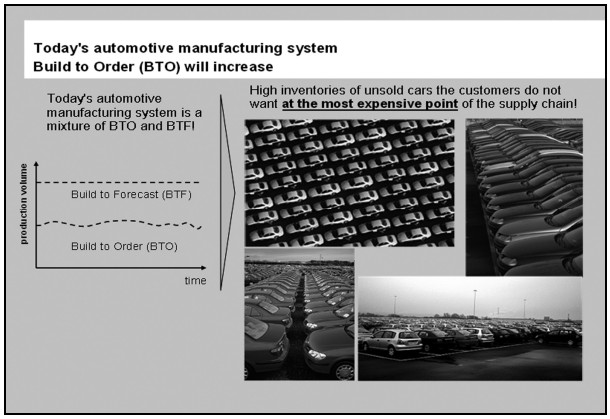

Fig. 2: Hybrid production strategy along the supply chain

In contrast, CtO-based approaches are well suited for parts and components that exist in a large variety, while the variety can be achieved by means of software or parameterization – and is therefore not "visible."

Consequently, we suggest the hybrid strategy shown in the following figure. BtF, BtO, and CtO may be applied at the suppliers as appropriate for the respective components produced, while the different components are "Assembled-to-Order" (AtO) at the OEM.

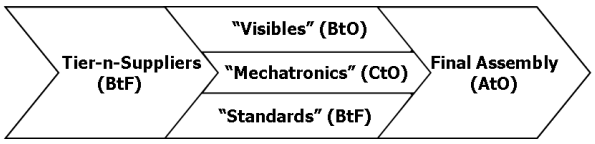

Fig. 3: Hybrid production strategy along the supply chain

1.3 Benefits of CtO

To implement BtO, companies have to redesign their internal technical and organizational processes [1]. Furthermore, they have to adjust product distribution channels and possibly customer service procedures. Staff must be trained to handle the new procedures. That is why the efforts are very high to achieve a BtO supply chain in traditional companies. In contrast, technical processes in CtO-based systems are comparable to traditional BtF-based systems, except for the need for late software flashing. Regarding the organization, companies have to radically change the approaches for planning towards Dynamic Supply Loops (DSL, see chapter 3) to achieve CtO, resulting in substantial implementation efforts. As the CtO approach is more an incremental innovation of the traditional system than BtO, the efforts for change management and training to implement CtO are noticeable lower as for BtO.

Despite of its great scope for improving organizational competitiveness in a global market, operation efforts in BtO are higher than in traditional approaches as the partners in the supply chain are coupled tighter and internal orders are pulled for each final product sold. These "overheads" for building and operation of a "virtual enterprise"-like network and for the generation, fulfillment, and monitoring of a large amount of network-internal orders tend to result in disadvantages of BtO in comparison to CtO. CtO results in efforts nearly comparable to those in the traditional BtF approach. Because of the importance of the components considered to be suitable for CtO, e.g. the chassis, additional efforts are made to properly plan, coordinate, and monitor the supply net, realized in AC/DC by means of DSL. For CtO, extra efforts result from the additional information flows to and from the on-site flashing stations.

In summary, essential advantages of the CtO approach and its realization by means of Dynamic Supply Loops are

- Small physical variety of components;
- *Stable* production to forecasts;
- low stocks needed;

and

- Low efforts for the management of the production of costumer-specific components and systems.

1.4 Reader´s Guide

This book introduces the implementation of new strategies like CtO by means of innovative technical and organizational approaches as developed by the European-funded project 5DayCar AC/DC (Advanced Chassis Development for 5-Days Cars).

The approaches and methods described are valid for the automotive industry but may be applied to costumer-oriented series production of complex products in general, too; they enhance adaptivity and flexibility of production systems. In particular, they support the shift from traditional cars to hybrids and electric vehicles.

This book is a practical reference guide with links to the AC/DC website for descriptions in detail – it is not intended to be a scientific textbook. When you have just 5 minutes time to read, proceed directly to the methods of interest for yourself in the following chapters. When

you invest more time, you obtain a wider comprehension of the new approaches. You can expect helpful solutions for issues that could arise in your business.

1.5 References

[1] A. Gunasekaran, E. W. T. Ngai: Build-to-order supply chain management: a literature review and framework for further development. Journal of Operations Management 23, 423-451, 2005

[2]