BUILD-TO-ORDER PRINCIPLE OF CUSTOMIZED PRODUCTION IN THE FIELD OF AUTOMOTIVE

Ing. Andrea Lešková, PhD.
Technical University of Košice, Faculty of Mechanical Engineering
DTuM, Mäsiarska 74, 040 01 Košice
e-mail: andrea.leskova@tuke.sk

Abstract
The presented article focuses on characteristics of customized products creating in the automotive industry. There are some actual trends in automotive supply chain based on flexibility of parts delivery to OEMs. Most manufacturers of customized cars produce them under business models called “build to order”, ”assemble to order”, “configure to order” or “engineer to order” and this strategy is considered as a competitive advantage in global scale. The theoretical part provides an overview of manufacturing principles in automotive based on BTO approach. Next part presented the example of model to car production by customized requirements supported with some ICT tools.

Key words: mass customization; automotive production; modularity; build to order principle.

INTRODUCTION

The complexity of customized models and variants is on the increase, especially with regard to how individual vehicles are equipped. Traditional car segments are fragmenting variety more and more into niches. The derivations of vehicles models are growing (such as hatchbacks, sedans, vans, and pick-up to minivans, cross- over coupes, roadsters, two-seaters vehicles, SUV, MPV etc.). More product variety is causing escalating costs and complexity in the automotive manufacturing system.

For example, in this context can be note one of research projects of the Seventh Framework Programme, financed from the EU founds, is “Sustainable Mass Customization – Mass Customization for Sustainability” (S-MC-S). The S-MC-S project aims at supporting European manufacturing to adapt to global competitive pressures by developing methods and innovative enabling technologies towards a customer oriented and eco-efficient manufacturing. To this end, S-MC-S vision is to define and research a new production paradigm, Sustainable Mass-Customization, while also presenting Customization as one of the main driving forces behind the future success of Sustainability. [9]

CUSTOMIZATION IN THE PRODUCTION

Toyota started with the conception of manufacturing of a product to the buyer’s specifications in the 1960’s. The process of creating customized product is known as build-to-order (BTO) or make-to-order. Customer driving manufacturing is an integrated business methodology designed around the customer, producer and sales. At present, mass customization principles are preferred in manufacturing approach in adapted form. Some interpretations of mass customization (MC) term are:

- Mass customization is a process [7] that enables the production of customized products to users’ specification. It is an approach to organizing a manufacturing business so the customer can be seamlessly connected to the enterprise.
- MC [11] is about producing an end product on demand (and, only after receipt of an order) based on a customer’s requirements that are derived from previously articulated and modularized set of features and options all the while producing that end-product with the same efficiency as a mass-produced product.
- MC is usually done with the use of flexible manufacturing (computer-aided, robotics), which permits the production of large quantities (mass), at a fast speed and at a low unit cost; mass customization is usually done as an assembly process of standard components. [5]
- MC allows a manufacturer to produce unique customer configurations from a pre-determined set of choices with the same efficiency that it would take to produce a similar, mass produced product. [2]
- MC is accomplished by proactively developing product families around a modular product architecture, implementing a flow manufacturing to achieve one-batch-size capability, establishing a spontaneous supply chain around standard materials, creating agile systems to order process based on product configuration and building parametric CAD templates with automatic CAD/CAM linkages to CNC equipment. [8]

Using the principles of mass customization implies a radical revision of the company’s overall business model. Mass customization strategy is characterized by [13]:

- a focused market strategy – strategy for which customers should be serviced with which product;
sales and development of manufacturing specifications for customized products that utilize product configuration systems;

- a product range based on modules, so a customized product is assembled by selecting, possibility adapting a set of standard modules;

- mass production of standard modules and customer – initiated assembly of customized product based on the use of modules;

- after - sales service of product based on installation and replacement of modules.

At fig. 1 is presented process of demand driven production where a product is scheduled and build in response to a confirmed order received for it from a final customer.

**Fig.1 Mass customization management principles in production. Source: [13]**

Key elements of MC production [13] are:

- modular bill of material structure and configuration rules;

- configurator application that support: quotations, forecasting, order submission, electronic product “catalogue” with specifications.

Mass customization can be realized in manufacturing practice by [5]:

1. The concept of build-to-order (BTO) - means that a firm starts to make a product only after an order for it is placed. It is also known as demand-driven manufacturing (DDM), customization, and pull technology [1]. This changes not only production planning and control but also the entire supply chain and payment cycle; BTO necessarily involves the outsourcing of different components.

2. Assemble-to-order (ATO) - refers to a manufacturing strategy in which products are not final assembled until customer order arrives.

3. Configure-to-order (CTO) - is special case of assemble-to-order, the components are classified into subsets, from which customers select the required components.

Mass customization implies that the customers can select order and receive a specially configured product to satisfy their specific requirements.

**BUILD-TO-ORDER APPROACH IN THE AUTOMOTIVE PRODUCTION**

The model diversity is an important sales argument and order-to-delivery time is the key factor to the automotive market and manufacturing process. A potential alternative to manage the variety-induced complexity in automotive is to implement a platform strategy.

Key trend in the automotive production is standardization of modules of car’s construction to common platforms. [6] Customized vehicle structure is put together by selecting, combining and possibility adapting a set of standard modules.

This means that vehicles can be adjusted to the individual requirements of customers and delivery schedules enable OEMs (Original Equipment Manufacturer) to produce multiple models (based on varying platforms), at the same manufacturing facility in assembly plant.

A platform can be described as [4] a basic common module that can be used in several variants of a product family. Platforms enable OEM companies to cope with the conflict between customization and efficiency.

For example, as illustrate fig. 2, Volkswagen will introduce a new chassis this year 2012 - codenamed the MQB (it's short for Modularer Querbaukasten - translating to "Modular Transverse Matrix"). It represents a big change in the design and production of cars with transverse-mounted engines - this is the set up that the vast majority of modern front-wheel drive cars have.

The fact it's a modular platform means that models that use it can be built together - even if they're difference brands. This means that in theory models as diverse as the Volkswagen Polo, Audi A3 and SEAT Alhambra could be built at the same plant.

This new modular platform will form the basis of a huge number of new models from Volkswagen, Audi, SEAT and Škoda. [12]

Platform strategy and commonality may lead to a drastic reduction of the supplier base. Suppliers do not deliver single components, but entire modules. Product modularity can impact the supply chain in that modules are outsourced to first-tier suppliers within the scope of modular sourcing. Modularity is the strategy with the greatest potential to reduce lead times - the OEM companies together with the module suppliers can work on developing innovative solutions. [6]
Organizing of customized car production

The management fundamentals of customized car production by build to order principle is explained simplified in this section of paper (see scheme at fig. 3). Assemble-to-order OEM’s supply chain is a system consisting of push and a pull parts. In the push part, undifferentiated components and subassemblies are manufactured to forecasts whereas in the pull part, end products are assembled according to customer specifications. This latter part is customer driven and largely determines how long customers wait between order placement and delivery of final products. Customers generally accept this delay because they highly value customized products, which naturally require a specific time for assembly and shipment after order placement. [11]

Due to the nature of build-to-order automotive supply chains, before receiving the customer order, it is impossible to determine what end products should be assembled. The advances realized in information technology and especially the Internet has enabled companies to operate a direct business to consumer model by eliminating retail. The Internet facilitates e-procurement across the auto industry. The low cost and high speed of this communication method is necessary for the mass customization strategy to be economically feasible and to tell the automakers what customers want them to build. Companies from the automotive industry use product configuration systems in order to make it possible for customers to configure customized products over the Internet. These software systems mainly assist customers in the selection of components and only allow the configuration of consistent product variants that can actually be produced on the main assembly line. Whereas product configuration systems are implemented at the interface between the OEM and its customers, other types of information systems are necessary in order to enable the coordination of operations with the network of suppliers, e.g. Enterprise Resource Planning; Vendor-Managed Inventory; Electronic Data Interchange; Radio Frequency Identification. [4]

Processes of customized vehicle production are presented at fig. 3 in simplified form. As shown in the schematic picture, 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. Manufacturing or assembly starts only after an order is received in OEM’s information system. 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. JIT (just in time) or JIS (just in sequence) 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. [2]

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.

CONCLUSION

Actually, the minority of vehicles in the world is exclusively built to customer specifications, and large stocks of finished vehicles are held at dealerships to enable a certain degree of choice for customers.

To ensure an effective use of production resources, a BTO approach is to frequently offer both standard and customized products. Companies with highly-configurable products need to combine the technical superiority of their products with operational excellence.

In automotive industry, one way used to build products to order is to draw parts from forecasted inventory and assemble to order modular products. The factory, supplier or distributor must carry large inventors and be good at forecasting the assembler’s demand. In automotive production, with close cooperation of supply chain members, after receiving an order, reactive OEM companies place purchase orders for all the materials, parts, subsystems and wait for all of them to arrive and then assemble them into a vehicle.

References


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