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Table of Contents

Impact of influence factors on logistics planning in the Automotive Industry

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Abstract

Logistics planning in the Automotive Industry has a variety of tasks with a strong impact on the resulting cost of a car. Especially during the vehicle development phase before the start of production (SOP), the logistics planning determines the resulting costs and the flexibility of the logistics system in the production phase (after SOP).

Influence factors on the logistics system are constantly changing not only during planning but also in the production phase. The paper examines the nature of these influence factors and the impact of changes on the logistics system during the planning and the production phase.

It can be noticed, that some influence factors and changes are neglected during production phase what can lead to a non-optimized logistics system with higher costs than necessary. Therefore a new holistic planning model is introduced.

Keywords:

Logistics planning, automotive industry, integrated planning

1 INTRODUCTION

The effective planning of logistic systems is an undisputed success factor in any given company. In the automobile industry in particular, planning quality is a massively cost relevant factor. In the modern automobile production, logistics account for about 10% of the costs entailed in the product price – the majority of these costs are specified within the product development process before the Start of Production (SOP).[1]

The planning process and with that the determination of planning objects begins up to 60 months before serial start, depending on planning complexity and manufacturer.[2] This lead time to the actual serial production is followed by a period between five to seven years of production during which the logistics system is maintained unaltered for the most part, bringing the total time frame of the logistics system to up to10 years.

Changes in the logistics system and of the framework conditions can be divided into internal, external and global factors of the two main processes in automotive industry – the product development process and the production process.

Main purpose of this paper is to look at changes and influence factors of the logistics system of automotive manufacturers (OEM) during the planning and product lifecycle, identify a possible impact on the logistics system to find an answer if the planning aim – to minimize logistics costs – is still fulfilled.

2 AIMS OF LOGISTICS PLANNING AND INFLUENCE FACTORS DURING PLANNING STAGE

Logistic planning §involves the development, evaluation and selection of concept alternatives for the future design and optimization of logistic systems and logistic processes."[3]

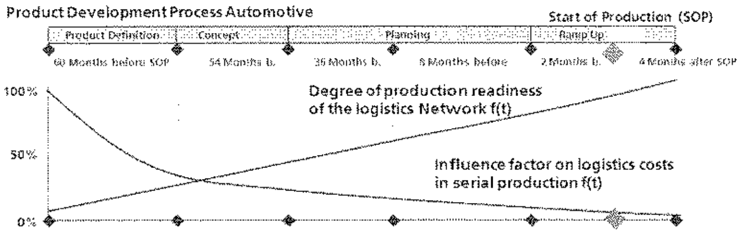

Figure 1: Connection between production readiness of the logistics system and possibility to influence logistics costs

The aim of a logistic planning process is primarily geared to maximizing logistic performance, while simultaneously minimizing logistic costs.[4] The fundamental goal setting is thus the economic planning of logistics systems, that explicitly includes the influence on the product from a logistic perspective.[5] Thus, the logistics planning must kick-off at an early planning stage, where the possibility to influence costs is highest. On the other hand, these are moments in which the maturity of the product, the logistical network and processes are however minimal [6] (Figure 1).

Multiple run-through's of the steps involved in the planning process are mandatory, due to assumptions, which have to be made at the beginning of the planning process and are altered or modified in the course of the planning process. Given the complexity of an automotive network that includes suppliers, service providers and manufacturers, a complete methodical support across departmental and company borders is a prerequisite for securing quality in the planning process. Most especially due to the high number of planning partners comprising of suppliers, external service providers, transportation planners, structural or resource planners, all with individual targets. As an example the supplier regards his own production container as optimal, since he has not to change it for the OEM. From a transport perspective the container that optimizes the corresponding dimensions of truck capacity is optimal. From a handling perspective within an OEM manufacturing plant, the largest possible available container contributing to effort reduction and from an assembly perspective as the smallest available container contributing to minimizing the capital tied up and optimizing the bundled utilized buffer space.

The logistics planning process must therefore while taking account of the interdependence of influence factors, implement and align the company objectives within the logistics system. The result of a logistics planning process can therefore only be a total optimum within the system limits. For sub-systems no specific optimum will be targeted, if this does not lead to an optimum for the entire system as a result.[7]

For multiple-staged, multiple-structured logistic systems, such as in the automobile industry, with different companies and associated companies goals and as such with a large number of independent decision makers, interest balancing and cooperative solutions have priority. The optimization process starts with the function optimization of the individual subsystems and then on to the entire system. This requires continuous feedback with the performance of all stakeholders in the logistic chain, which includes suppliers, manufacturers, external logistics service provider all the way to the customer.[7]

The dynamics during the whole planning phase by the three factors of influence (internal, external and global, see Figure 2) is therefore usually high. But the planning process has to take alterations into consideration and until the end of the planning process the planning result aims to a global optimum integrating these changes. Assuming that the result of the planning process is optimal, the logistics system can be considered as optimal at the end of the planning process.

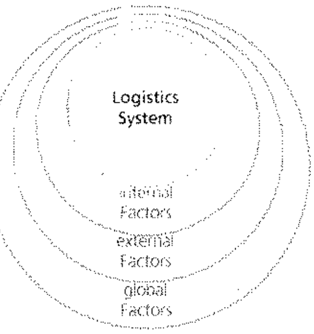

Figure 2: Influencing Factors on the Logistics System

3 DYNAMICS WITHIN THE LOGISTICS NETWORK AND OTHER EXTERNAL OR GLOBAL FACTORS

The structure of logistics networks in the automobile industry is to a large extent a reflection of the complexity of the cars produced. The most diverse companies are networked with one another through several overlapping and in themselves interpenetrating enterprise networks. Sydow describes company networks in the automobile industry as complex polycentric systems, that are regulated over several hierarchically structured control centers [8]. Each supplier has in addition a supplier network, which as a rule increases in complexity with each corresponding higher level in the value creation chain.

Each of the companies is however embeded in the networks of other companies and the automobile industry can thus be understood as a network of networks. The supplied parts are mostly specifically designed to the needs of the purchasers and can therefore usually not be alternatively used, this specificity increases downstream in the value creation chain.[9]

These complex networks not only have a great dynamism but also a great impact on the logistics system. Changes such as in the delivery location of a supplier have major implications for the time schedule and the corresponding delivery form (Warehousing, Just-in-time supply or direct delivery), the transport chain, the inventory level within the manufacturing plant etc.

Other external influence factors have to be searched for within the market. Here are notably: competition, changes in client needs and demand fluctuations, that from logistical perspective result in quantity alterations of purchased and delivered parts or of finished cars for distribution. In particular in the procurement process quantities of parts are highly relevant planning parameters, which also substantially influence planning related outcomes.

So influence factors on a structural level (supplier location as source) as well as on parameter level (quantities) are critical for the costs of a logistics system.

A further area addresses the factors of influence that Gudehus categorizes under "environment" and "law".[10] Changes in this area have varying effects on the logistics system. The general introduction of a truck-toll (Vignette) generally has a cost increasing effect, without however having an influence on the outcome of the planning process. The introduction of distance dependent transport costs would on the contrary alter the planning process outcome to favour less remotely located suppliers.

An also very extensive area is within the field of "technological progress". This can refer to technological changes within the field of logistics (IT systems for tracking and tracing, ordering, RFID systems for material flow tracking), technological changes within the product field (battery packages for Hybrid motor units), or even the availability of newer planning systems within logistic planning process itself (digital factory models). In practice, these changes, as far as they must not be rapidly implemented due to legal reasons, are in most cases curtailed for the next planning cycle.

So it can be noticed that some external or global influence factors have no, others a general impact (cost increasing for the whole system but not result changing) and others a specific influence with result changing character. In practice the latter means, that higher logistic costs then necessary incur, when the logistics system experiences no adjustments.

4 DYNAMICS WITHIN THE LOGISTICS NETWORK AND OTHER EXTERNAL OR GLOBAL FACTORS

Gudehus divides the internal influence factors on the planning process into product, process and production, structure and area, employees as well as business strategy.[10] With a direct connection between product and the logistics planning process. The production is the customer of procurement logistics and each product alteration also simultaneously brings about an adaptation in logistics process. Here processes of phase in and phase out of parts in serial operation are established and also the parallel product development and logistics planning process during the product development process generates a direct connection with a mutual influence. However, this feedback only curtails for physical product changes. Deviations to the planning assumptions such as those involving part variants have from logistical perspective a significant impact. The decision on sequenced delivery of parts, depends greatly on the number of variants of the respective part.[11]

There is a similarly close connection between the production process and the logistics system to another - a change in the order of production or in the position of the assembly of a part on the assembly line, inevitably brings about a re-planning of the logistics system because the position of line-side presentation of the part at the assembly line changes.

Nevertheless, as mentioned before, the number of units produced per unit time unit is also logistically massively relevant to the planning process – here however there are often no adjustments made to the logistics system. Reason for this absence of adaptation can be found in the lack of knowledge at what specific quantity other forms of supply are more cost effective than the existent one.

Structures and areas are undergoing permanent alterations in assembly plants. In particular in manufacturing plants in which several different models are parallel produced, not only new or dis-continued models but also current serial production is modified due to the re-planning process.

Employees naturally have a considerable high degree of dynamism not only within companies in general as a resource but also in logistics planning process with their experience and knowledge. In the long term the performance potential of the company is determined by the regulation of staff capacity in the various areas of the company.[12] There may be adjustments such as in the shift models, which usually also lead to re-planning the logistics system. The planning knowledge in the logistics planning process is mostly documented in planners specification guide, where results of the planning in the form of service concepts or within the planning system are also documented. Some studies in the recent past focus on improving planning outcomes through appropriate planning knowledge management systems in order to achieve a sustainable improvement in planning quality and to anchor the know-how of planners within the company.

The company strategy and the company goals play a great role in the general design of the logistics systems since the logistics objectives are derived from the company objectives. Thus, a change in the aims of the company also leads to a corresponding alteration of the logistics objectives and -systems. The changes are not in reference to for individual elements of the logistics system but rather in reference to long-term changes in the product, production program or sourcing strategies.[12]

5 CONCLUSIONS

In conclusion it can be said, that the dynamism of the factors of influence during the planning period and the process of serial production is very high. These changes are systematically included in the system design during planning phase in the vehicle development process. During production process only specific relevant changes lead to changes in the logistics system. Other relevant changes are neglected in operative practice. Adjustments are in particular made, where the physical material flow is changed and as such makes re-planning an inevitable necessity. Otherwise in the operative practice, a worst-case scenario is formed and this determines the interpretation of the logistics system. It sets the maximum number of produced cars per time unit, the theoretically possible number of variants per part, the maximum space requirements. This inevitably results in a sub-optimal condition with respect to the cost objectives of the logistics system.

In the analysis of the scientific literature on the logistics planning for serial production it is noticeable that a holistic view on the whole lifecycle from planning over start of production to production process until end of production is not used very often. Schneider is stating, that the logistic planning process in the product development process significantly less space, as the planning in serial operation.[13] Scheuchl [11] empirically examines how various factors influence the planning process, the dependence of the quality of planning on planning triggers and factors of influence and introduces a planning environment, which makes it possible to make scenarios to forecast some effects, the feedback of influences in the production phase to the logistics system is however not explicitly envisaged.

Dürrschmidt [14] suggests a model, in which the scenarios for influence criteria in the planning stage are defined in terms of variants, quantity flows or logistics performance metrics and pre-planned. During the operational phase options of choice between different predefined logistics systems can be made. If not pre-planned, parts or the whole system must be re-planned. He as such combines planning and operational phases in a holistic adaptive model. This model is however very general and is not based on the logistics planning process of the automobile industry.

That is why it can be said that existing methods of the logistics planning process in the automobile industry only inadequate curtail for the dynamics of the factors of influence during the planning and the serial operation.

The present paper shows on the one hand the necessity and relevance of methodical logistic planning in the automobile industry over the entire life cycle of a vehicle and on the other hand the deficits entailed in the known models. A holistic integrated planning must have the following features:

- ability to provide methodical support from the commencement of planning before SOP to the end of production (EOP),

- ability to take into account the dynamics within the environment and adaptively react to changing factors in planning processes before SOP as well as during serial process.

Thus the following model for integrated adaptive logistics planning shall be introduced (see Figure 4):

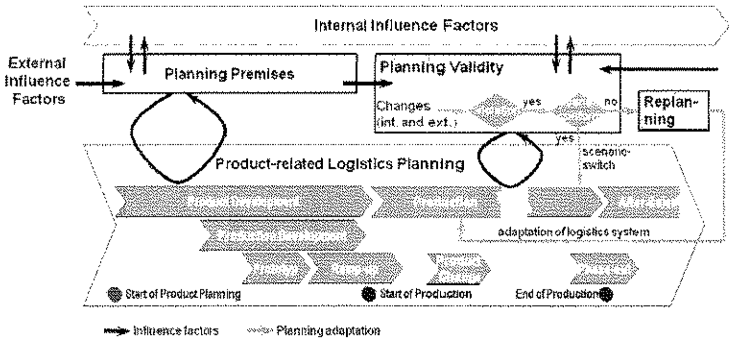

Figure 3: Integrated Logistics Planning

The product related logistics planning spans from start of product planning over the start of production to the end of production and includes the planning of after sales parts and structures after the production cycle of the car. It contents not only planning activities in the product and production development phase but also in the prototyping (ex. provision of prototypes) and ramp-up-phase (ex. adjustments in the logistics system as result of the try-out production). During the product development phase, a repository with all planning premises, methods, processes and data is held and constantly updated due to changes internally and externally. The planning phase reacts adaptively to the internal and external influence factors.

During the planning, several states in the lifecycle of the production process in terms of production quantities, variants and significant changes in structure of the plant or plants are pre-planned (ex. introduction of a new derivate or model in the plant with impact on space, material flow or structure). Each scenario has not only a planning result but also a validity concerning the main parameters of the planning (ex. part geometry, number of parts, number of variants, supplier etc.). This validity is transferred to a repository for the production phase.

During production this main figures are monitored. In cases of a deviation, either a switch in an appropriate pre-planned scenario is executed or a replanning initiated. This leads to an integrated adaptive logistics planning which fulfills all above mentioned demands.

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