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Short Communication

Efficient Evaluation of Production Measures Based on Logistical Models

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Abstract

In the course of globalization, producing companies are confronted with new challenges to optimize their logistics performance based on logistical measures. In order to be able to create a quantifiable basis for the selection of optimal measures, a management tool was developed at the Institute for Production Systems and Logistics. The developed tool is based on logistical and transfer models for logistically and monetarily evaluating logistical measures. Based on implemented logistical measures, this paper focuses on the evaluation of improved logistics performance and its impact on sales.

Keywords: Production management, routing, scheduling, supply chain

JEL Classification code: M110

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With the aid of selected logistical measures in production, producing companies are in a position to counter the high competitive pressures to which they are subjected. Therefore, companies require a suitable management tool to provide a substantiated basis for the monetary and logistical assessment of measures in production. In this way, companies would be provided with support when reaching decisions on taking logistical measures and on making the consequential logistical and monetary effects on turnover measurable.

At the Institute of Production Systems and Logistics (IFA), numerous research projects have shown that the logistics performance of a company can already be significantly improved through logistical measures with low investment costs (Nyhuis & Wiendahl, 2009; Lödding, 2013; Hon, 2005; Schoensleben, 2012). For instance, through harmonization of the content work, the variation of the throughput time can be reduced, and the schedule adherence increased for downstream processes or the customer (Nyhuis & Wiendahl, 2009). However, up until now, there is nothing in national or international literature offering an approach which permits a comprehensive, generally valid, and quantitative assessment of logistical measures. In the literature, it is only possible to find approaches which permit the cost assessment of measures (Grigutsch, Becker, & Nyhuis, 2014; Nyhuis, Busse, & Wriggers, 2008).

Within the scope of the recently finalized Transfer Project T07 "Assessment of Measures in Production" from the Collaborate Research Centre 489 (SFB489), a universal Logistics Information System (LIS) was developed. This management and decision-making tool is based on Microsoft Excel©, it allows users to assess selected logistical measures based on monetary (e.g., increase in turnover) and logistical objectives (e.g., reduction in lead time). The developed LIS is based on a decision logic which realizes a link between the logistical models and the so-called Economic Value Added or Residual Gain (RG) driver tree (Grigutsch et al., 2014; Grigutsch, Kennemann, & Nyhuis, 2011; Fernández, 2002). This permits the simultaneous assessment of logistical measures in production with regard to monetary (e.g., increase in turnover, reduction in process costs) and logistical aspects (e.g., reduction in lead time). The basic LIS concept is conducted through a comparison between actual values and set values (e.g., RG) and therefore facilitates the assessment of the efficiency and potential of the selected logistical measures. Users are thus capable of estimating the measure-induced profit and cost changes within the company. The basis of this decision's logic is the link between a driver tree for determination of the RG, the logistic operating curves, and the transfer functions. For example, the so-called sales-delivery performance function permits an assessment of the improvement in sales respectively turnover by an increase of logistics performance capability (Grigutsch et al., 2014; Nyhuis & Busse, 2008). This allows the user to conduct a holistic analysis of the profit and costs development through the implementation of a logistical measure. Within the scope of this publication, the modelling of the sales-delivery performance function is presented in order to estimate the effect of an improved logistics performance on company sales (Nyhuis, Grigutsch, & Keil, 2013).

Literature Review

Up to now, no suitable approach can be found in the literature which depicts a quantitative assessment of the relationship between logistics performance and sales, respectively. The approaches discussed in the literature are subject to purely qualitative descriptions (Windt & Wittekindt, 2003; Wildemann, 2004; Simon & Fassnacht, 2009).

Basically, two different approaches can be found which provide differing descriptions of the sales-delivery performance function (or transfer function) progression. A common approach in the literature is the S-shaped progression of the sales-delivery performance function (Simon & Fassnacht, 2009; Lambert & Burduroglu, 2000; Kennemann, Wriggers, & Nyhuis, 2009; Ballou, 2004). This function is defined through the asymptotic progression of the marginal utility, whereby a further increase in logistics performance does not cause a further increase in sales. The limit sales are therefore directly coupled with the maximum available market volume which the company can activate. The progression of the function is shown on the left in Figure 1.

The second basic approach describes the stepped progression of the sales-delivery performance function (Wolff, 1995). This approach is subject to the assumption that the function progression is compiled of plateaus. These plateaus describe tolerance ranges in which an improvement of the logistics performance does not directly cause an improvement in sales. From a certain tolerance threshold, however, a jump in sales can be observed with a significant increase in the logistics performance. An exemplary situation of this is price negotiations with potential customers over a specific product which is produced within the scope of contract manufacture. In order to convince the potential customer of their product, and thus to develop further sales potential, the company must offer a substantially improved logistics performance in the form of lead time or schedule adherence in comparison to their rivals. Only after a substantially better logistics performance has been offered in comparison to the competition, the customer can be won over.

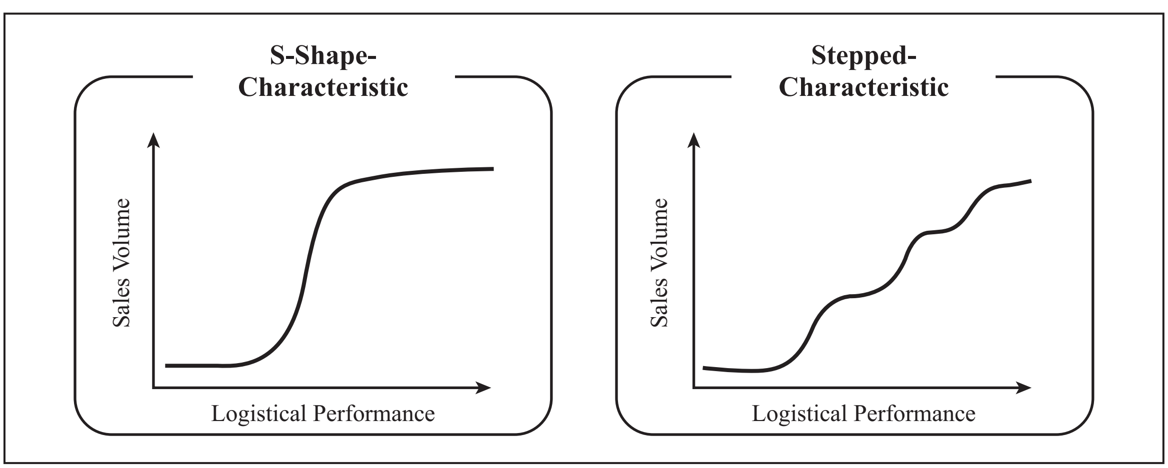


Figure 1. Possible function characteristics between the lead time and sales.

In the introduced approaches, mainly the relationship between the sales and the lead time are modelled. Further influence parameters on the sales—such as the unit price of the product, which can also be increased as the logistics performance increases, and therefore has a significant effect on sales—is not considered in these approaches (Simon & Fassnacht, 2009).

Approach for Modelling a Sales-Logistics Performance Function Area

In order to develop an approach for determining the relationship between the sales and the logistics performance further influence parameters, the first step in the Transfer Project was to investigate the influence parameters on the sales quantity of the company. Figure 2 shows a selection of the fundamental influence parameters which indicate a relationship with the sales quantity.

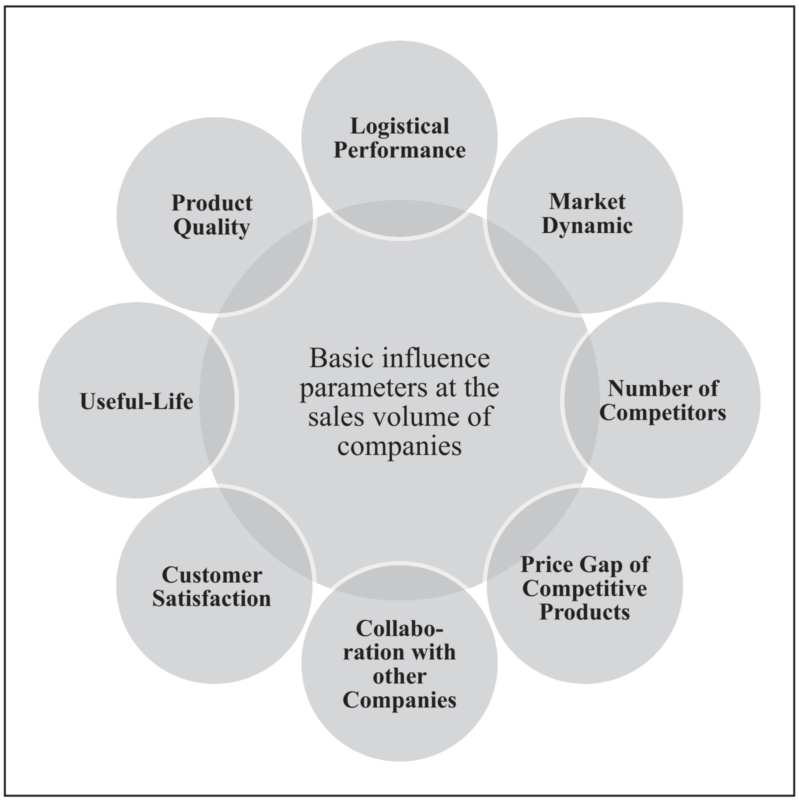
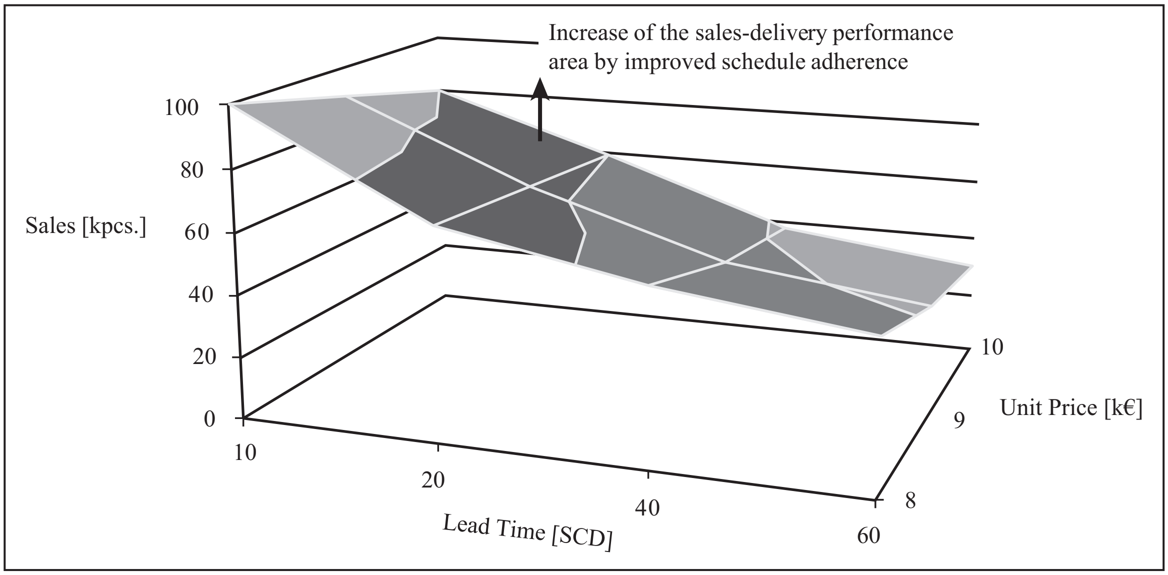


Figure 2. Selection of fundamental influence parameters.

For example, the market dynamic is a decisive influence parameter. Dynamic markets (e.g., the bulk commodities industry) are characterized by their high elasticity in which minor changes have far-reaching consequences on the sales quantity. Static markets, on the other hand, feature far less elasticity and are far more stable with regard to logistical changes. In collaboration with the product management of the company, all relevant influence parameters must be determined through various market research methods, such as the Conjoint Analysis or the Delphi Method (Baier, 2009; Luce & Tukey, 1964; Linstone, 1975; Rauch & Wersig, 1978).

After the analysis of the basic influence parameters, a new sales-delivery performance function is modelled on the basis of the approach developed in the SFB489 (Grigutsch et al., 2014). In addition to the classic approach of modelling the relationship between the sales and the lead time, other influence parameters are integrated into the model. Within the research project, the model was extended by the influence parameter unit price. For example, the company is able—with an improved lead time—to sell its products at higher prices on the market, which in turn has a direct effect on the sales and turnover for the company. By integrating the price as a further dimension, the transfer function can now be presented through a so-called sales-delivery performance area function (see Figure 3).



Note. pcs. = pieces; SCD = shop calendar days; € = Euro.

Figure 3. Sales-delivery performance area function (Nyhuis et al., 2013).

Based on the generated function, every lead time-price relationship can now be assigned to a defined sales volume. The function is represented through Formula (1), whereby the function based on the parameter *lead time, average unit price* and *schedule adherence* defines the sales volume:

$$f\,(lt, up, sr) \rightarrow sv, \tag{1}$$

where:

lt = Lead time (Shop Calendar Days),

up = Average unit price [€],

sr = Schedule adherence [%],

sv = Sales volume [pcs.].

As a further influence parameter, the order schedule adherence as a measure of customer satisfaction is taken into account within the model. Within the modelling, an improvement of the schedule adherence for the entire delivery performance area is displaced in a positive y-direction, so that a larger sales potential through increased customer satisfaction results (Figure 3).

The Sales-Delivery Performance Area Function Embedded in the LIS

On application of the LIS, the existing company-specific monetary parameters (among other things, the material, manufacture, and WIP costs) are entered into the system in the initial step. After the entry of these parameters, the feedback data from production is recorded within the tool. The feedback data from production is related to the input and output data, the order times and monetarily-weighted schedule deviation distributions on defined feedback items in order to generate further logistical operating curves developed on the IFA in addition to the realization of the production operating curve (Nyhuis & Wiendahl, 2009; Nyhuis et al., 2013; Schmidt, Bertsch, & Nyhuis, 2013).

The Structure of LIS

In addition to the generation of logistical operating curves for the analysis of individual processes, the parameterization of the sales-delivery performance area function must be undertaken in a subsequent step. A procedural model is applied in this research project in order to derive the sales-price logistics performance relations specific to the company and for the product to be considered. During the progression of the determination of the relationships, several standardized steps for the derivation of the function area must be conducted. In an initial step, the market environment is analysed based on the product or product group to be considered (a stable market environment, or a product with large market growth). After characterization of the market environment, the actual situation with regard to logistical parameters (schedule adherence and lead time), unit costs (capital commitment costs and process costs), and the market share (sales volume and price) of the analysed product spectrum must be investigated in collaboration between the Development, Sales and Production Departments. In addition, further influence parameters, such as strategic partnerships between the company and suppliers, must be integrated into considerations during the actual analysis. The question must always be clarified here, as to whether a market penetration with the respective product is possible at all due to existing strategic partnerships between rivals. After determination of the actual situation, potential fields are to be derived in a subsequent step with regard to the market penetration of the product by the respective specialist divisions, mainly Sales and Development. Potential fields describe the chances of realizing an improvement in price or sales volume on increasing the logistical performance capability. During derivation of the potential fields, standard tools such as the Conjoint Analysis (see above) must be used. Once the potential fields are defined, the departments involved can now dedicate themselves to the determination of the so-called sales-delivery performance area. To do this, the individually determined logistics-price relationships are linked to the sales to be realized. The area determined from the coordinates is then linked to the realized schedule adherence scenarios. For example, improved schedule adherence increases the sales-delivery performance area (Figure 3).

Application of the Developed LIS

Figure 4 shows the exemplary application of the LIS with the contained logistical operating curves on the left and the so-called cockpit with the most important key performance indicator (KPI) on the right. A company featuring small and medium-sized series production has been selected for this example, in which a continuous logistical analysis has been conducted on the basis of the management tool. With the exemplary implementation of work content harmonization in the supply processes, the lead time and the schedule adherence could be increased at the end of the supply chain (see Figure 4 on the right).

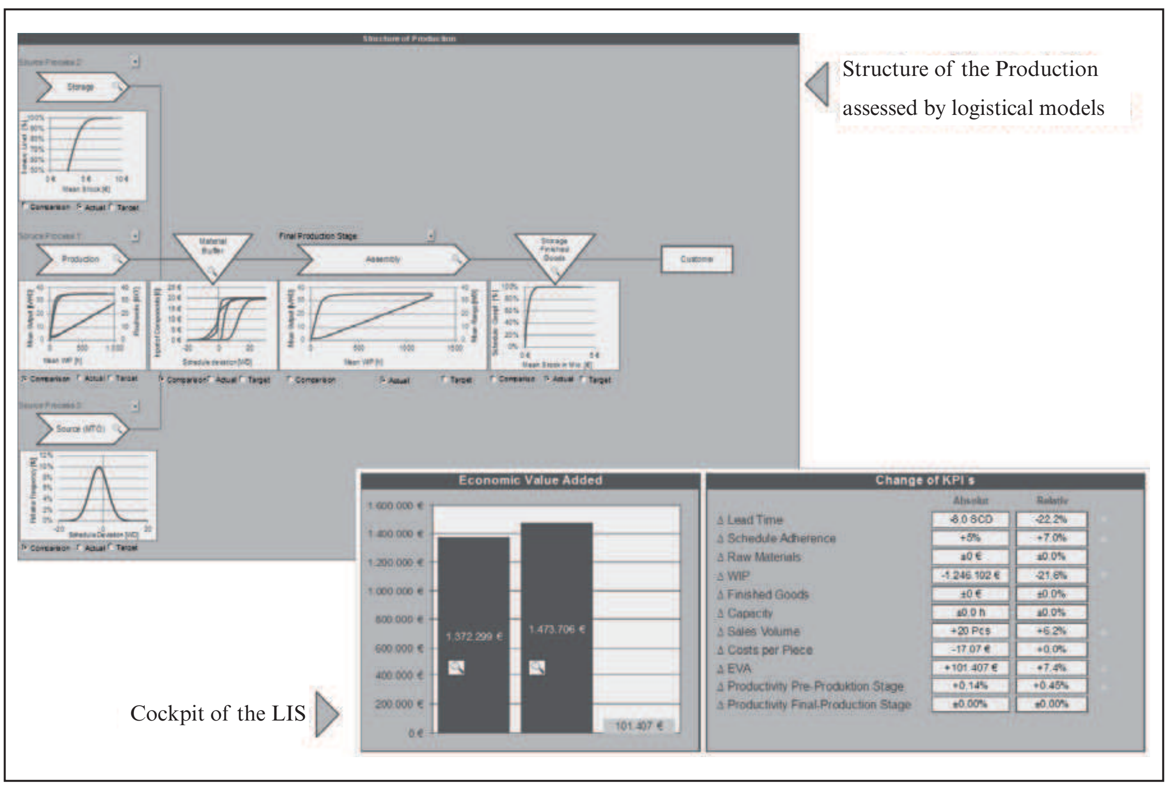


Figure 4. Application of the LIS (Grigutsch et al., 2014).

The result of this logistical measure was, in addition to the reduction in unit costs, an increase in the quantities sold. Due to the increased logistics performance capability, the product can achieve a higher price on the market. With the aid of the sales-delivery performance area function, the company can decide how much they wish to steer the sales by fixing a unit price. Here, the unit price can contribute towards the stabilization of the sales if capacities are already fully utilized. In addition to the Figure 4 showing the logistical measure order time harmonization, it is possible for the user to analyze further measures based on a database. The user is also in a position to analyze the effects of a pure price change on the sales, and thus on the RG. With the aid of the sales-delivery performance area function, for instance, the company can identify price-sensitive plateaus, and steer sales through clever fixing of prices.

Conclusion

Based on the approach presented here, it is possible to depict the complex relationships between the sales of a company and its logistics performance capability. The approach is based on the requirement that an upstream market analysis is conducted by the respective product management of the company for a previously-defined product spectrum. Then, the modelling of the sales-delivery performance area function can be conducted using the obtained data record. Afterwards, the user is enabled to evaluate the impact on logistical measures to the sales volume of the company.

The introduced approach is integrated into a decision-making support system LIS which is developed within this research project. The result is presented by a software tool which can be used cross-branch and, therefore, for different product categories (individual, series, and bulk manufacture). In the end, it should be possible for every company to assess selected measures in production logistically and monetarily as well as, for example, to reach strategic decisions with regard to the fixing of product prices for market penetration. Ultimately, any enterprise should be using this model to reach well-founded investment decisions and to increase the value of the company, as well as the role within markets.

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