1st Conference on Production Systems and Logistics

Assessing product portfolios from a production logistics perspective

Tim Kämpfer[1], Torben Lucht[1], Philipp Schäfers[1], Peter Nyhuis[1]

[1] *Leibniz University Hannover, Institute of Production Systems and Logistics, Germany*

Abstract

The increasing individualization and the growing customer demand for product variety leads to a constant shortening of product life cycles and to the necessity of periodically rationalizing product portfolios. For this reason, approaches to product portfolio assessment offer methods that allow a financial or market-oriented valuation of existing products in portfolios. When assessing products in product portfolios, conventional approaches do not explicitly take the logistical impact of products on the logistics performance or costs of the production into account. The consequence of neglecting the logistical assessment dimension to product portfolios is that products, that have a negative impact on the logistics performance of a company, are not part of a critical examination. This paper therefore presents an approach that aims at developing a methodology to assess product portfolios both from a logistical as well as from financial or market-oriented perspectives. To this end, the approach initially works the influence of individual products and product characteristics on the logistics performance and logistics costs of production out. The consolidation of these findings with further evaluation variables then enables a product portfolio optimization with explicit consideration of a logistic assessment dimension.

Keywords

Product portfolio analysis; portfolio optimization; portfolio assessment; production logistics

1. Introduction

Global competition, the opening and development of new sales markets as well as dynamically changing customer requirements lead to a constantly growing and more individualized product variety [1, 2]. Furthermore, the constant shortening of product life cycles requires frequent adjustments to the product portfolio [3]. The above-mentioned factors lead to an increased inclusion of new products and variants in product portfolios of manufacturing companies. Exotic products with low production volumes can cause high complexity induced production costs, while high-volume standard products cause lower costs. Higher complexity induced production costs result from higher set-up times and non-productive time in production [4]. Especially in the case of product portfolios that have grown over the long term, a lack of transparency regarding the impact of exotic and standard products on the logistics performance or logistics costs of companies can lead to the retention of exotic products with high logistics expenditures product portfolios. The deletion of products from portfolios being an unappealing managing decision reinforces this effect [5].

The retention of exotic products can lead to their cross-subsidisation by standard products, whereby the spread between the costs caused by exotic products and their selling price is being subsidised by the profit of standard products in the portfolio. This leads to a competitive disadvantage regarding standard products caused by a loss of profits through said cross-subsidisation [4]. Figure 1 illustrates this problem.

DOI: https://doi.org/10.15488/9689

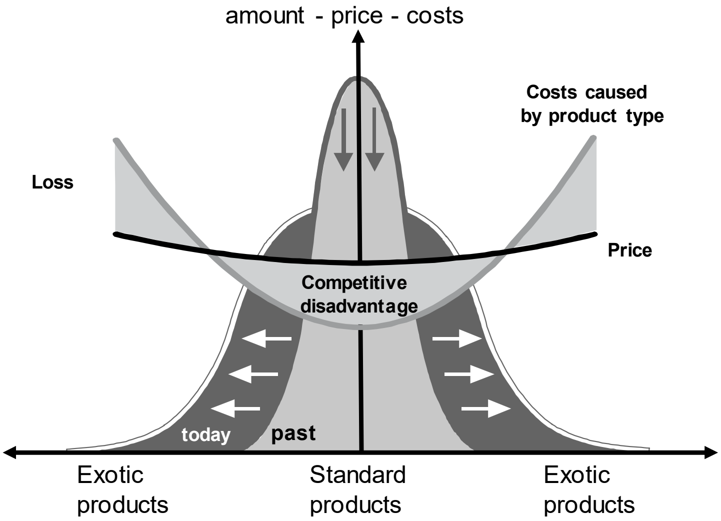


Figure 1: Need for action in managing complexity in product portfolios [4]

The systematic analysis and control of variant diversity induced complexity is of high importance and at the same time a challenge for industrial companies. A joint study conducted by several production technology institutes shows, that half of the 170 industrial companies within the survey are highlighting complexity through variant diversity as a key challenge for their production planning and control activities [6]. Existing approaches of strategic product portfolio management offer strategies regarding the continuation or rejection of products or support the identification of target areas for successful marketing based on known strengths and weaknesses of a company [7, 8]. However, these approaches mostly focus on economic aspects while neglecting logistical aspects of product portfolios. This circumstance carries the risk that products, that meet financial margins or demands regarding their respective market potential, but at the same time have a negative influence on the logistics performance of a company, are not subject to a critical examination. The deletion of such products has an impact on the entire supply chain [4]. Increasing transparency with regard to logistics-relevant characteristics of product portfolios in the course of product portfolio management is therefore of great importance. For this reason, this paper describes an approach that focuses on the development of a methodology to logistical product portfolio assessment in section 3. A literature review regarding existing approaches for the assessment of product portfolios and products in Section 2 precedes the description of the approach. These approaches form an important basis for multi-criteria portfolio assessment.

2. Approaches to the assessment of product portfolios and products

The origin of portfolio assessment approaches lies in the financial sector. In 1952, MARKOWITZ published an essay on the optimized composition of securities [8]. According to MARKOWITZ, the basic problem of portfolio composition is the uncertainty of future returns. He therefore models financial returns as random variables with an expected value, standard deviation and correlation. The expected values of the returns should be maximised, whereas the standard deviation of the return, i.e. the financial risk, should be kept as low as possible. In the context of contribution margin accounting [9], cost and performance accounting evaluates the profitability of products within a portfolio. The difference between revenues and variable costs, which is the amount available to cover the fixed costs in the company, is calculated. Depending on the contribution margin, strategies can be derived for corresponding products. For example, it is conceivable to withdraw products with a low or even negative contribution margin from the market and to invest more in products with a high contribution margin in order to strengthen their market position.

The Portfolio Market Matrix [10] establishes a link between a company's products and their target market. This approach considers the extent to which the company has already penetrated a market and the extent, a change in the product portfolio is necessary. The growth–share matrix [11] sorts products of companies in a matrix based on their relative market shares and forecasted market growth. The approach arranges the products into four categories, while connecting the categories with strategies such as market or product development. Another prominent approach to product portfolio assessment is the GE multifactorial analysis [12], developed in a collaboration between McKinsey and General Electric. The approach encourages selecting a list of influencing factors on the market attractiveness and business strength of products at the beginning of the analysis. Instead of four categories, the approach defines nine categories with corresponding standard strategies and arranges analysed products into said categories. Due to the refined breakdown of variables and the multifactorial assessment, more differentiated strategies can be derived with this portfolio analysis than with the approach described in [11]. Due to the subjective selection of the parameters, however, the approach bears the risk of misinterpretation and insufficient comparability.

KLIMKE shows that a change in the portfolio position within the growth-share matrix also influences production-related variables and thus logistical target values [13]. In his analysis, the products are first classified using the market share market growth portfolio. This classification and the defined standard strategies form the basis for deriving possible adjustments to the production. These adjustments include material flow optimization, changes to production control methods or changes to the goods distribution systems.

The variant tree [14] developed by SCHUH represents an approach to control the diversity of product variants in companies. Through its application, variants can be identified which do not offer any significant financial benefit to the company. With the aim of developing a variant-oriented product design method, CAESAR adapted SCHUH'S ideas and developed a methodology based on the Failure Mode and Effect Analysis (FMEA) to design a wide variety of serial products in accordance with cost aspects [15]. The so-called Variant Mode and Effect Analysis (VMEA) pursues the goal of technical and cost-based control of variant diversity. Here, a reference to the disciplines product planning, product development and product design is established [15]. Thus, the VMEA is not really an assessment approach for product portfolios, but rather a methodology for strategic portfolio optimization through a cost-oriented design of product variants. Besides aiming at a reduction of the number of variants, the approach aims at increasing the average profit contribution per variant.

LÖSCH describes an approach for controlling and designing the diversity of variants, taking the cost and benefit effects of the assessed variants into account [16]. The essential idea of this approach is the determination of the optimal diversity of variants. BROSCH has presented an approach for capturing and evaluating product-variation-induced complexity as well as to point out possibilities for its reduction [17]. Both the product and the value chain are included in this process - this is why BROSCH refers to it as Design for Value Chain. The methodology consists of two method blocks: The identification of strategic fields of action and the support in product development. As part of the identification of strategic fields of action, the approach records the external and internal product diversity and identifies the complexity drivers. By prioritizing these drivers and assigning them to generic fields of action in complexity management, BROSCH's approach enables the derivation of company-specific strategies for reducing complexity. Based on this, the approach records the target product variety and various alternatives for product and order processing (e.g. alternatives for the positioning of the customer order decoupling point and variant development point).

RIESENER et al. analyse correlations among portfolio-relevant corporate key performance indicators [18]. The methodology uses a neural network to model correlations and to predict future trends for analysed key performance indicators. The methodology aims at supporting companies in proactively managing their product portfolio by anticipating the product portfolios future development. While RIESENER et al. do analyse cause-effect correlations of portfolio-relevant KPI´s, they do not take driver variables of products or portfolios like the number of products in a portfolio into account. In addition, RIESENER et al. do not systematically link said driver variables to logistical target values.

BOHL investigates the complex interdependencies between product and production complexity [19]. By modelling the complexity-related dependencies between product and production, he enables standardization. Initially, BOHL defines a system with the four sub-areas: product range, product architecture, production structure and supply chain. He captures specific parameters that characterize complexity for each subarea. By marking the dependencies between the sub-areas and the parameters, the approach creates a qualitative model of cause-effect relationships within the system. BOHL subsequently models important cause-effect relationships in the form of characteristic curves. The work of BOHL outlines some of the relevant cause-effect relationships that are relevant for the development of the approach that this paper describes.

3. Development of a logistical product portfolio assessment methodology

The approaches to product portfolio assessment presented here show gaps in the consideration of cause-effect relationships between the product portfolio and logistics performance and cost parameters. For this reason, the Institute of Production Systems and Logistics (IFA) develops an approach for the logistical assessment of product portfolios and their products.

The primary goal of the approach described here is to be able to identify problematic products from a logistical point of view and, in addition, to derive optimization strategies. Figure 2 shows the approach to the development of a logistical product portfolio assessment methodology. This chapter subsequently describes necessary steps to create said methodology in detail.

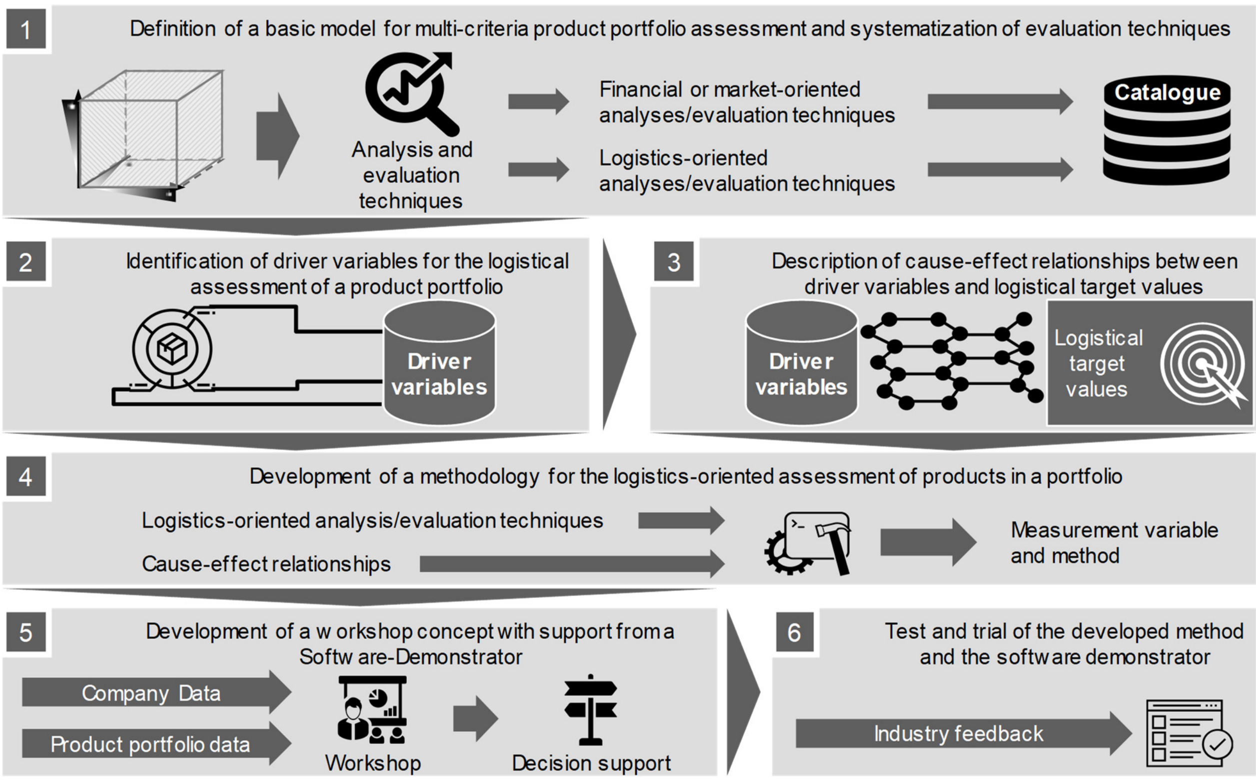


Figure 2: Approach to the development of a logistical product portfolio assessment methodology

A mere assessment of a product portfolio according to logistical criteria does not appear to make sense. If, for example, a product has high sales numbers and a high margin, any company will continue to rely on this product, even if it is to be rated critically from a logistical point of view. Here other measures than a discontinuation of the product are conceivable as for example a product design adapted to the requirements of production. Section 2 shows that a large variety of methods for product portfolio assessment already exists. The majority of these methods focus on financial and market fixated assessment parameters. The aim of the approach presented in this paper is to combine these valuation dimensions with the logistical assessment dimension. Figure 3 shows an exemplary basic model of the multi-criteria product portfolio evaluation.

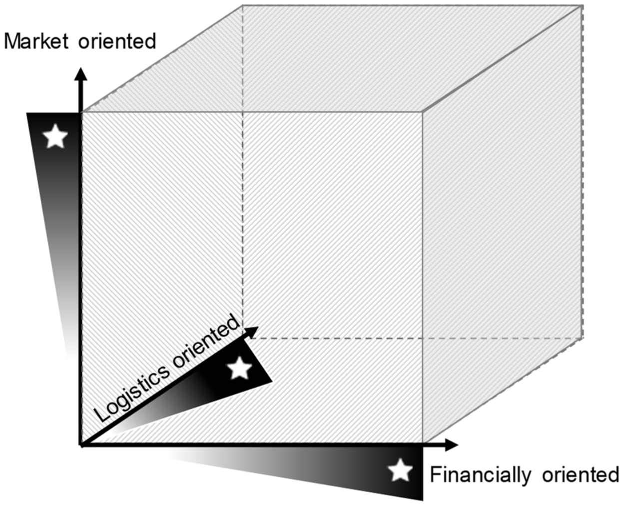


Figure 3: Possible dimensions of a multi-criteria product portfolio assessment method

The assessment of products in a portfolio from a logistical point of view requires the linkage of logistical target values with driver variables. Logistics performance and logistics costs are the two categories of logistical target values. To be able to link driver variables to target values of the logistics performance and costs such as delivery reliability, step 2 of the presented approach requires the identification of relevant variables. Driver variables can be properties of products, of product portfolios as well as properties of the supply chain. Figure 4 shows examples of possible driver variables (such as set-up-requirements of products, mean set-up-requirements of the portfolio or the position of the variant formation point in the supply chain) and its assignment to the three mentioned levels.

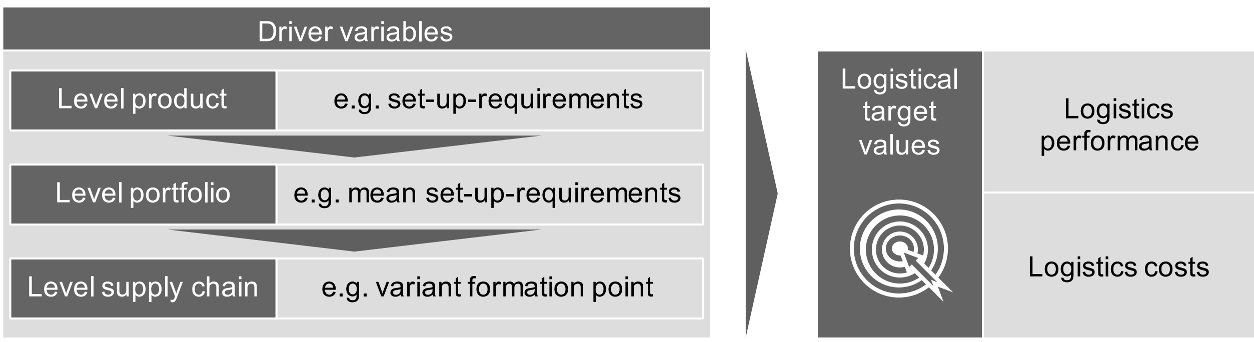


Figure 4: Possible hierarchy of driver variables

The identification of relevant driver variables of products and product portfolios forms a fundamental basis for the development of qualitative cause-effect models. These cause-effect models describe the relationships between driver variables and logistical target values. The relationships can be used in the estimation of effects of changes to products or product portfolios with regard to logistical target values such as delivery reliability or delivery time. For this reason, the modelling of cause-effect relationships represents a key step in the development of the logistical product portfolio assessment method.

The previously described identification of techniques, that assess products and portfolios from a market or financially oriented perspective in step 1 and the modelling of cause-effect relationships between driver variables and logistical target values in step 3 enables their combination within one multi-criterial portfolio assessment method.

In order to ensure a purposive use of the resulting assessment method, the approach develops a workshop concept. The workshop concept represents the methodical framework of product portfolio assessment and optimization. A software demonstrator supports the workshop concept in the visualization and implementation of results. Systematic tests based on real data records from industry partners verify the workshop concept and the software demonstrator.

4. Conclusion

This paper describes necessary steps to develop a methodology for assessing product portfolios from a production logistics perspective. To this end, the paper discusses relevant approaches and methods for assessing product portfolios and respective products. The discussion enabled the derivation of research gaps in the field of product portfolio management. The gaps identified are apparent in the form of missing links between product portfolios and logistical target values.

The presented approach aims at closing these research gaps by developing a methodology that allows the assessment of products and product portfolios from a production logistics perspective. In order to achieve this goal, the approach links product and product portfolio properties with logistical target values within cause-effect models as a first step. Subsequently, the approach combines the developed cause-effect models with financially and market oriented approaches to portfolio assessment. The combination of traditional and logistics-oriented assessment dimensions enables a multi criterial assessment and optimization of product portfolios. In form of a workshop concept, the applicability of research findings in relevant industrial companies is to be assured. The concept supports manufacturing companies in product portfolio management by deriving measures to optimize portfolios within a step-by-step procedure.

Acknowledgements

Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – 423857520. The authors kindly thank the DFG for the financial support to accomplish the research project "Logistische Produktportfoliobewertung".

References

[1] Albach, H., 1997. Marketing, Gabler Verlag, Wiesbaden.

[2] Brosch, M., 2014. Eine Methode zur Reduzierung der produktvarianteninduzierten Komplexität, TuTech Verlag, Hamburg.

[3] Kieckhäfer, K., 2013. Marktsimulation zur strategischen Planung von Produktportfolios, Springer Fachmedien, Wiesbaden.

[4] Schuh, G, 2005. Produktkomplexität managen. Strategien. Methoden. Tools. Carl Hanser Verlag, München, Wien.

[5] Zhu, Q., Kouhizadeh, M., 2019. Blockchain Technology, Supply Chain Information, and Strategic Product Deletion Management, in: IEEE Engineering Management Review, vol. 1.

[6] Mayer, J., Pielmeier, J., Berger, C., Engehausen, F., Hempel, T., Hünnekes, P., 2016. Aktuellen Herausforderungen der Produktionsplanung und -steuerung mittels Industrie 4.0 begegnen, in: Nyhuis, P. (Ed.): Berichte aus dem IFA, Band 2016, PZH-Verlag, Garbsen.

[7] Preißner, A., 2008. Marketing auf den Punkt gebracht, Oldenbourg Wissenschaftsverlag, München.

[8] Markowitz, 1952. Portfolio Selection, in: The Journal of Finance, vol. 7.

[9] Agthe, K., 1958. Die Abweichungen in der Plankostenrechnung. Ihre Ermittlung, Analyse und Verrechnung, Haufe, Freiburg im Breisgau.

[10] Ansoff, H.I., 1965. Checklist for Competitive and Competence Profiles, McGraw-Hill, New York.

[11] Henderson, B., 1970. The Product Portfolio, available online http://image-src.bcg.com/Images/BCG_The_Product_Portfolio_tcm9-139921.pdf, accessed 8 January 2020.

[12] Business Week, 1975. Corporate Planning, Piercing Future Fog in the Executive Suit, vol. 4.

[13] Klimke, W., 1983. Basis-Strategien zur Ausrichtung der Logistik-Konzeption eines Unternehmens, in: Institut für Logistik der DGfL (Ed.), Logistik. Herausforderung an die Zukunft, 4. Internationaler Logistik Kongress.

[14] Schuh, G., 1989. Gestaltung und Bewertung von Produktvarianten: Ein Beitrag zur systematischen Planung von Serienprodukten, VDI-Verlag, Düsseldorf.

[15] Caesar, C., 1991. Kostenorientierte Gestaltungsmethodik für variantenreiche Serienprodukte: Variant mode and effects analysis (VMEA). VDI-Verlag, Düsseldorf.

[16] Lösch, J., 2001. Controlling der Variantenvielfalt: Eine koordinationsorientierte Konzeption zur Steuerung von Produktvarianten. Shaker, Aachen.

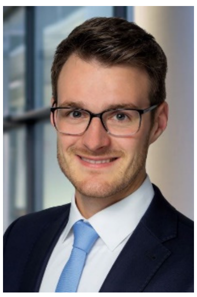
[17] Brosch, M., 2014. Eine Methode zur Reduzierung der produktvarianteninduzierten Komplexität. TuTech Verlag, Hamburg.

[18] Riesener, M., Doelle, C., Schuh, G., Zhang, W., Jank, M.-H., 2019. Implementing Neural Networks within Portfolio Management to Support Decision-Making Processes, in: Proceedings of PICMET 19: Technology Management in the World of Intelligent Systems.

[19] Bohl, A., 2015. Kennlinien der Produkt- und Produktionskomplexität. Apprimus Verlag, Aachen.

Biography

Tim Kämpfer, M.Sc. (*1992) studied production engineering and logistics at Leibniz University Hannover and works as a research associate in the field of production management at the Institute of Production Systems and Logistics (IFA) at the Leibniz University Hannover since 2019.



Torben Lucht, M.Sc. (*1991) studied industrial engineering with the focus on production technology at RWTH Aachen University. Since 2018, he works as a research associate in the field of production management at the Institute of Production Systems and Logistics (IFA) at the Leibniz University Hannover.

Dipl. Ing. Philipp Schäfers, MBA (*1987) studied Mechanical Engineering at Karlsruhe Institute of Technology. Subsequently he completed a MBA programme. From 2014 to 2019 he worked as a research associate at IFA of Leibniz University Hannover.

Prof. Dr.-Ing. habil. Peter Nyhuis (*1957) studied mechanical engineering at Leibniz University Hannover and subsequently worked as a research assistant at IFA. After completing his doctorate in engineering, he received his habilitation before working as a manager in the field of supply chain management in the electronics and mechanical engineering industry. He is heading the IFA since 2003. In 2008 he became managing partner of the IPH - Institut für Integrierte Produktion Hannover gGmbH.