Hans-Christian Pfohl

Logistics Management

Conception and Functions

Springer

Logistics Management

Hans-Christian Pfohl

Logistics Management

Conception and Functions

Springer

Hans-Christian Pfohl
Technische Universität Darmstadt
Darmstadt, Hessen, Germany

ISBN 978-3-662-66563-3 ISBN 978-3-662-66564-0 (eBook)
https://doi.org/10.1007/978-3-662-66564-0

Responsible Editior: Axel Garbers
This Springer imprint is published by the registered company Springer-Verlag GmbH, DE, part of Springer Nature.
The registered company address is: Heidelberger Platz 3, 14197 Berlin, Germany

For Dagi

Preface

The present fourth edition retains the structure of the third edition by covering the conception of logistics management including the corporate policy basic principles as well as the management functions of planning and control, organisation, personnel management. In doing so, the technological, economic, social and ecological development trends relevant to logistics management are taken into account. In addition to the update, which also affects the literature used, the new edition contains the following new content in particular:

In Part I "Conception of Logistics Management", the explanations on logistics management in excellent companies are supplemented by newer empirical studies. Logistics excellence is accordingly characterized by digital transformation. Based on the previous empirical studies, "differentiate", "cooperate", "regionalize" and "digital transform" are the success positions for logistics excellence.

In Part II "Logistics Planning and Control", the risk analysis of network strategies is extended in the strategic logistics planning. Because what effects supply chain risks have on corporate goals depends on the vulnerability and resilience of the supply chain, which are influenced by strategic decisions on the design of networks.

In Part III "Logistics Organization", the technological potentials for connecting information and goods flow are discussed in more detail in the process organization. The use of these potentials requires that logistics management intensively deals with them.

In Part IV "Personnel Management in Logistics", more space is given to the importance of the image of the logistics industry for the management of personnel shortages. On the one hand, activities of professional associations and, on the other hand, professional public relations of companies contribute to the image improvement. With regard to the change of job profiles through digitalization, further education as part of the "Employer Branding" is gaining more and more attention.

I would like to express my sincere thanks to my student assistant, Mr. Philipp Bart, for his active support in the editorial preparation of the print-ready manuscript.

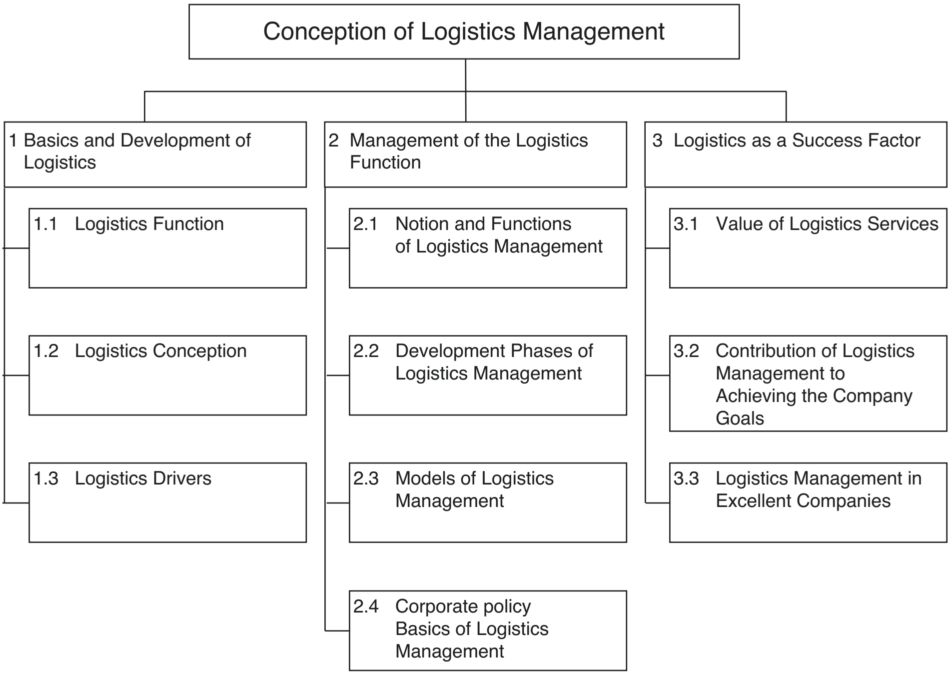
I dedicate this book to my wife Dagmar with great gratitude.

Darmstadt, in November 2020 Hans-Christian Pfohl

Contents

Part I

Conception of Logistics Management



The presentation of the Conception of logistics management begins with a discussion of the basics and development of logistics. After delineating the logistics function and the logistics conception, the relevant drivers of logistics are presented. This is followed by characterizing logistics management as management of the logistics function. The conception and functions of logistics management provide the frame of reference for this paper. The functions of management are distinguished as policy, planning and control, organization and personnel management. The corporate policy provides the basis for the design of the other three management functions. To conclude the chapter, logistics is presented as success factor. In addition to the value of logistics services, the contribution of logistics to the achievement of corporate goals is explicitly discussed and evaluated on the basis of characteristics for excellent logistics managementconcretised.

1 Basics and Development of Logistics

1.1 Logistics Function

Logistics is an ubiquitous phenomenon especially in economically developed societies. Traditional companies of the basic materials industry can no more do without bulk transport than young companies of the information industry can do without the performances of courier, express and parcel services, in order to supply their customers quickly and reliably.

The *origin* of the logistics term lies in the military field.[1] Logistics is used there as a collective term for the totality of tasks that serve to support the armed forces. With his fundamental essay, Morgenstern already overcame this orientation towards military facts in 1955 and thus set the essential course for the development of logistics as a business discipline, although he considers company logistics to be comparatively simple compared to military logistics.[2]

The theoretical engagement with logistics began in the German-speaking area at the end of the 60s or the beginning of the 70s, when several publications on logistics appeared independently of each other.[3] With a certain delay compared to the USA, the logistics conception was increasingly taken up in science and practice in the second half of the 70s. While the focus of logistics in the USA remained relatively long in the area of distribution, great attention was soon paid to procurement and production logistics in Germany under the influence of the development of material flow systems for the automotive industry.

[1] See in detail Klaus and Müller (2012), pp. 3 ff.

[2] Morgenstern (1955), p. 133.

[3] Cf. Pfohl (2022), pp. 10 ff. as well as Klaus and Müller (2012), p. 81; Large (2012), pp. 16 ff.

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_1

Today, a variety of sometimes very different *definitions of logistics* can be found in the scientific literature, in publications by companies and business associations, as well as in national and international standards[4]. Generally, three different approaches to defining logistics can be cited.[5] At this point, it may suffice to go into more detail on the flow-oriented definition of logistics, which underlies this book. The flow-oriented definition of logistics puts the flow of goods at the center of logistical considerations. An example of a flow-oriented description of logistics is the "4r-rule" already known from the classical material management. According to this, logistics has to ensure that a receiving point is supplied by a delivery point with the right product, in the right condition, at the right time, at the right place at the minimum cost according to its demand.

The flow-oriented definition of the American logistics association *"Council of Supply Chain Management Professionals"* (CSCMP) enjoys wide popularity today. The definition of the CSCMP, which has been adapted several times to the current development, reads in its current version: Logistics is "the part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements."[6]

Logistics thus comprises both activities of planning and control as well as of realization of goods flows. In other words, one can say that the function of logistics consists both in the management and in the execution of efficient inter-organizational flows of goods and the related information flows for the demand-oriented supply of customers. The flow of goods and information ideally extends over the entire supply chain and begins with the creation of goods and ends with the consumption by an end customer. This inter-organizational perspective was characteristic for the logistics understanding of the CSCMP from the beginning, although the image of the supply chain was only included in the definition in 1999 against the background of the supply chain management discussion. In connection with this discussion, the flows of funds and rights related to the goods flows are also counted among the objects of logistics management.[7]

The overall function of logistics can be divided into sub-functions in different ways.[8] In order to realize the flow of goods, various activities or sub-functions have to

---

[4] Examples of this are the French standard AFNOR X50-600 "Logistique. Terminologie", the German DIN 69906 "Logistik. Grundbegriffe" and the European draft standard CEN 273001 "Logistik. Struktur, Basisbegriffe und Definitionen der Logistik".

[5] See in detail Pfohl (2022), pp. 11 ff. See also Göpfert (2013), pp. 6 ff. for different definitions and Bretzke (2015), pp. 1 ff. for the problem of definition.

[6] Council of Supply Chain Management Professionals (2019).

[7] For the characterization of supply chain management as a concept of managing the supply chain, cf. Pfohl (2000), pp. 6 ff. as well as Sect. 2.2 of this chapter. The flow of persons is not an object of logistics management, but of mobility management. For the demand for an integrated development of mobility and logistics with regard to the macro-logistics infrastructure, cf. Acatech (2012).

[8] Cf. Pfohl (2022), pp. 15 ff. as well as Large (2012), pp. 11 ff.

be fulfilled integratively. Besides the two basic functions of physical storage and transport, these are mainly the sub-functions of packaging, warehousing and order processing. These logistical sub-functions have to be fulfilled in all sub-areas of a company. Logistics thus permeates the basic functions of procurement, production and sales and can therefore be described as a cross-sectional function of business administration. In addition, logistics permeates inter-organizational systems that result from the cooperation with other companies by performing these flow-related services.

According to our understanding, logistics thus comprises both the *integrative management* and the *integrative fulfillment of a bundle of goods flow-related tasks* within and outside the company. Integrative means that not only the flow of goods itself, but also the related flows of information, funds and rights are included in the management.

However, this already touches on the logistics conception, which is discussed in the following section.

1.2 Logistics Conception

In addition to identifying a bundle of flow-oriented execution and management functions, the term logistics also serves to name a specific *management conception.* Similar to the case of controlling and marketing, this creates a certain conceptual ambiguity. Therefore, a distinction should always be made between logistics as a function and the logistics conception. While logistics describes a function, the logistics conception shows how this function is to be fulfilled. The logistics conception is thus a conceptual grid, a special perspective, for defining and solving material and goods flow problems.

Since, as shown, logistics permeates a company or a comprehensive supply chain in terms of a cross-sectional function, the logistics conception can also be understood as a comprehensive management conception that places the flow orientation of the overall company or the supply chain/delivery chain at the center of attention. In short, the logistics conception as an *enterprise principle* demands the corporate policy anchoring of a perspective that leads to new problem insights and solutions through its cross-sectional and flow-oriented view of the entire value chain.

The aspect of logistics as a conception is often *mixed with functional* statements in many logistics definitions. For example, Ihde defines logistics as a “business attitude, a management conception, which is characterized by the cross-sectional view of the entire entrepreneurial value chain and—with consistent organizational implementation—the responsibility for all associated goods movements and inventories.”[9] Similarly, Göpfert defines: “Logistics is a modern management conception for the development, design, control and realization of effective and efficient flows of objects (goods, information,

[9] Ihde (1987), p. 703.

money and financial flows) in company-wide and cross-company value creation systems."[10]

The logistics function characterizes the purpose, the object of logistics and thus comprises on the one hand the overall function of the goods flow and the related other object flows and on the other hand the flow-oriented sub-functions that have already been addressed in the previous section. The logistics conception, on the other hand, makes statements about the should, i.e. it shows *how the logistics function is to be fulfilled*. Essential *elements of the logistics conception* are the value thinking, which emphasizes the value-added contribution of logistics processes, the integrative thinking, which sees logistics in a system context (system thinking) and in particular the necessity of considering all relevant costs in logistics decisions (total cost thinking), as well as the utility thinking derived from the marketing conception, concretized in logistics as service thinking. The fifth element is the efficiency thinking, which is always fundamental for a business approach. The elements of the logistics conception will not be further elaborated here.[11]

It is fundamental for the development of a logistics management that the five elements of the logistics conception are incorporated into its content and instrumental design. Before the influence of the logistics conception on the logistics management is shown, the following section first presents the current trends and their influence on the design of logistics conception and logistics function.

1.3 Logistics Drivers

The development of logistics is characterized by the increasing *value orientation* in the companies. The logistics management is measured against whether it makes an appropriate contribution to the value enhancement of the company. The drivers of this development, which are characterized by the need for logistics innovations[12], which have been identified in various studies, can be summarized under the terms "customer orientation", "internationalization/globalization", "sustainability orientation" and "digitalization".[13]

The reason for this development is the compelling required *customer orientation* of the company or the companies cooperating in the "supply chain". Logistics process innovations contribute significantly to providing the company with the customer proximity necessary for customer loyalty. Another reason is the *internationalization* of

[10] Göpfert (2013), p. 22.

[11] For a detailed discussion, see Pfohl (2022), pp. 21 ff.

[12] On the innovations, see Pfohl et al. (2007), pp. 19 ff. and Part II, Sect. 4.8.4.

[13] On the logistics trends on which these logistics drivers are based, see Straube and Pfohl 2008; Deutsche Post 2012; Fontius 2013, pp. 79 ff.; Handfield et al. 2013; Kersten et al. 2017, pp. 20 ff.; Schwemmer 2018, pp. 3 ff.; Schwemmer 2019, pp. 3 ff.; DHL Customer Solutions & Innovation 2020), Kersten et al. (2020), pp. 6 ff.

procurement, production and distribution for companies of all sizes. The global division of labor can only be efficiently and effectively ensured on the basis of a highly developed logistics. Successful companies manage to move better than others in the field of tension between global integration to exploit synergy effects and local adaptation to national conditions. “Glocal” companies have to master differentiated logistics systems. Globalization reinforces the increasing importance of *sustainability orientation.* In economically highly developed countries, different stakeholder groups in society demand that companies take into account not only the economic dimension, but also the ecological and social dimension. This applies in particular to logistics, which is clearly visible with its space- and time-bridging inter-company flows of goods. Last but not least, however, *digitalization* is also a driver of logistics. The rapid development of “e-based” technologies enables innovative logistics solutions on the one hand and poses extreme challenges for logistics on the other hand for non-digitizable goods, as the information flows have to be supplemented by the corresponding flows of goods.

These logistics drivers, which will be discussed below, often require innovations that can relate to the product (the service) or the process, but also to the business model. However, the opportunities as well as the dangers for innovations depend crucially on how the *markets* will develop worldwide. For the markets, today and in the future, it applies that they have to develop in a world that can be aptly characterized by the abbreviation *VUCA*.[14] It is volatile, uncertain, complex and ambiguous.

Gehmawat[15] sees the development of the markets influenced by three trends, all of which lead to the fact that the innovations have to take place in a very complex market environment. The first trend is the increasing importance of emerging markets for corporate growth. This leads to the need to adapt products and services to the demand in these emerging markets. The second trend is the increasing influence of national governments through regulation of national markets. Since the political systems in the countries are very different, different barriers arise that have to be overcome when cultivating the markets. Closely related to the second trend is the third trend, namely the increase in protectionist measures. These lead to a hindrance of the flows of goods, information and finance, but also of the mobility of labor.

These trends lead to the fact that the markets in this millennium have to be processed differently than the markets at the end of the last millennium. At that time, global markets were in the foreground, which were associated with global strategies with global standards and cosmopolitan worldview. Today, the focus is on processing “semi-global” markets, which require differentiated strategies that take into account the spatial and cultural distances between the markets. This market development influences all logistics drivers. In particular, the issue becomes clear with the logistics driver “internationalization/globalization”. All five logistics drivers are explained below.

---

[14] Cf. Bennett and Lemoine (2014).

[15] Gehmawat (2011), pp. 3 ff. and especially the table on p. 20.

1.3.1 Value Orientation

Logistics has an impact on the value of the company, it is an essential lever for increasing shareholder value. This development is also confirmed by empirical studies. For example, a study conducted in Germany in 1999 impressively showed the impact of logistics on companies that can be described as logistics leaders on the *business success*[16]: 40% of the market success (sales growth), 27% of the economic success (sales margin) and 27 % of the adaptability of the company to new market developments (adaptability) can be explained by the contribution of logistics. A case study of the branded goods company Procter & Gamble shows,[17] that the management of the logistics chain after the introduction of the supply chain management concept between 1992 and 1997 sustainably increased the company's success. The market share increased in this period from 24.5% to 28%, the sales margin increased from 6.4% to 9.5% and the return on equity reached an average of 38% in the period between 1995 and 1997 compared to the average of 21% in the 10 years before. An examination of the stock prices on Wall Street between 1989 and 1999 shows that disruptions in the logistics processes have a negative impact on the stock price, both for the responsible service providers and for the affected industrial companies.[18] A study conducted between 2005 and 2008 among more than 250 American and European industrial companies shows that companies that have consistently derived their supply chain strategy from the corporate and competitive strategy achieve on average twice as high a return on invested capital and a 19 % higher market capitalization compared to the companies where this is not the case.[19]

Figure 1.1 shows the five drivers and their essential efficiency indicators that are responsible for increasing the value of the company. Logistics managers must be able to demonstrate the relationships between measures in the logistics area, the *value drivers* and the value of the company. Empirical studies show such effects of logistics measures.[20]

The measurement of the value of logistics or the contribution of logistics to the company value is gaining importance for two reasons. On the one hand, it is of interest in the internal communication with the management, in order to avoid the impression of a merely cost-causing logistics. On the other hand, the communication of the value created for the customer is also important. This serves above all to compensate for a better service with an appropriate price. In addition to customer satisfaction, the *'Customer*

[16] Cf. Weber and Dehler (2000), pp. 65 f.

[17] Cf. Christopher and Ryals (1999), pp. 7 f. For further empirical studies cf. Boschet et al. (2003); D'Avanzo et al. (2003).

[18] Cf. Singhai and Hendricks (2002), pp. 20 ff. See also Anderson and Delattre (2002), p. 26.

[19] Cf. Locker and Grosse-Ruyken (2013), pp. 2 f.

[20] Cf. Cap Gemini Ernst and Young/Industry Week (2000), pp. 10 ff.

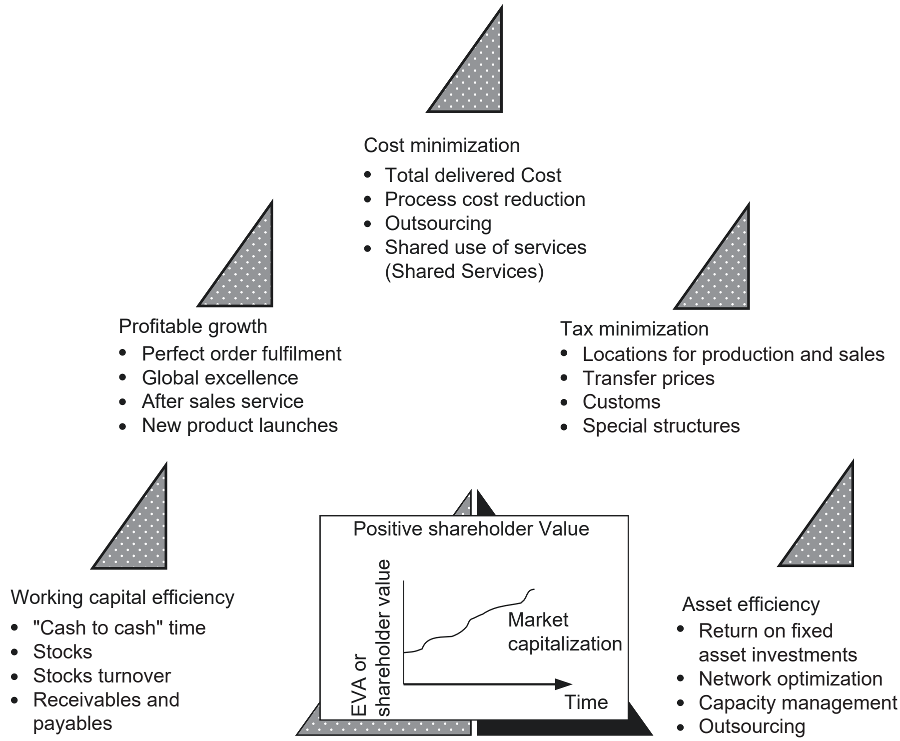


Fig. 1.1 Drivers for increasing the value of the company. *Source* Cap Gemini Ernst and Young/ Industry Week 2000, p. 7, retranslated.

Value-Added' can be used as a measure. It reflects the ratio of the perceived value of the offer of a company to the offer of a competitor.[21]

The focus of the discussion of value-oriented management is the *shareholder value*. According to this, value is created by logistics measures when the costs of the associated investment, which must also correctly reflect the investment risk, are exceeded. An important role here is played by the cash flow (CFROI: Cash Flow Return on Investment), which should be accelerated, stabilized or increased by logistics measures. Another financial indicator for assessing the value of logistics measures, which is often used today, is the "Economic Value Added" (EVA = Operating profit − capital costs). The evaluation of the logistics activities based on such indicators within the framework of value-oriented management requires the constant examination of the advantages of "outsourcing". Here, a trend towards reducing the *logistics depth* can be observed in many industries—analogous to the reduction of the production depth. The companies focus on the value-added processes in which they have core competencies.

[21] For the measurement of the value of logistics cf. Lambert (2014), pp. 17 f.

1.3.2 Sustainability Orientation

Sustainability is understood as a development that meets the needs of present generations without compromising the ability of future generations to meet their own needs.[22] Sustainability is usually limited to the ecological dimension. However, sustainability also encompasses the social and economic dimension. The sustainability concept requires the simultaneous consideration of these three dimensions in entrepreneurial decision-making processes (see Fig. 1.2).

The sustainability orientation is a social trend. The demand for socially responsible (e.g. "Fairtrade") and "green" (ecological) products and services is increasing.[23] Companies have to account for the social and ecological consequences of their economic actions to their customers. Therefore, social and ecological objectives, in addition to the already established *economic dimension,* have to be taken into account.

The goal of the *ecological dimension* is the preservation of the ecological capital.[24] By preserving the ecological capital, the functionality of the natural balance should be secured in the long term. Logistics can make a significant contribution to achieving this goal, which is also expressed in the term "Green Logistics". Especially in purchasing and distribution, potentials can be exploited. Purchasing has a "Begin of Pipe" function with regard to the ecological dimension. Decisions in purchasing about material and supplier largely determine the environmental impact of the company. In distribution, environmental impacts are mainly caused by CO_2 emissions. The earliest starting point to counteract this is the logistics-oriented product design.[25] For example, by reducing the bulkiness of products, the cargo space requirement can be reduced, which means that fewer transport vehicles are needed in the distribution network for the same amount of products. In addition, improved route planning and the use of environmentally friendly transport vehicles are effective measures to implement the sustainability concept within distribution. CO_2 emissions are in the focus of ecological discussions due to their impact on climate change. A sustainable logistics management must also consider other ecological effects of logistics decisions. These are essentially the consumption of natural resources, especially energy, and land use.

[22] Cf. United Nations (1987).

[23] Cf. Handfield et al. (2013), p. 28. Rising energy costs, increasing traffic infrastructure bottlenecks, growing public pressure and massive government interventions are discussed as influencing factors that force the sustainability orientation of logistics systems by Bretzke and Barkawi (2010), pp. 27 ff.

[24] Cf. Straube et al. (2013), p. 7.

[25] Cf. Pfohl 2022, pp. 205 ff.; Bretzke and Barkawi (2010), pp. 79 f. For possible development phases and fields of action of Green Logistics, see Rausch et al. (2010), pp. 684 ff. For the heterogeneous degree of implementation in companies, see N. A. (2020) and Kersten et al. (2020), pp. 19 ff.

Fig. 1.2 Areas of responsibility of sustainability orientation. *Source* Adapted from Imug 2012, p. 6

Through global sourcing, the *social dimension* is receiving more attention. The neglect of the social dimension led to image and reputation losses in the past, especially for companies in the high-tech and textile industries. Keywords in this context are child labor and inadequate working and safety conditions. Logistics must increasingly take into account the social impact of activities in its decisions. It must be ensured that suppliers produce their products and services with respect for human rights and under acceptable working conditions. To ensure social sustainability, companies have developed specific codes of conduct, whose implementation is also demanded by their cooperation partners. The assumption of social responsibility for the supply chain becomes a competitive factor, especially for strong brands.[26] It is controversially discussed whether the compliance with minimum standards should be voluntary by companies or prescribed by a “supply chain law”.[27]

1.3.3 Customer orientation

Customer orientation means the alignment of the company with the needs of the customer. The ability to solve customer problems is the basic legitimacy of any business activity. In this context, a development away from individual solution components towards integrated problem solving from a single source can be observed. This applies

[26] Cf. Systain Consulting (2013), p. 3.

[27] Cf. Meitinger (2020).

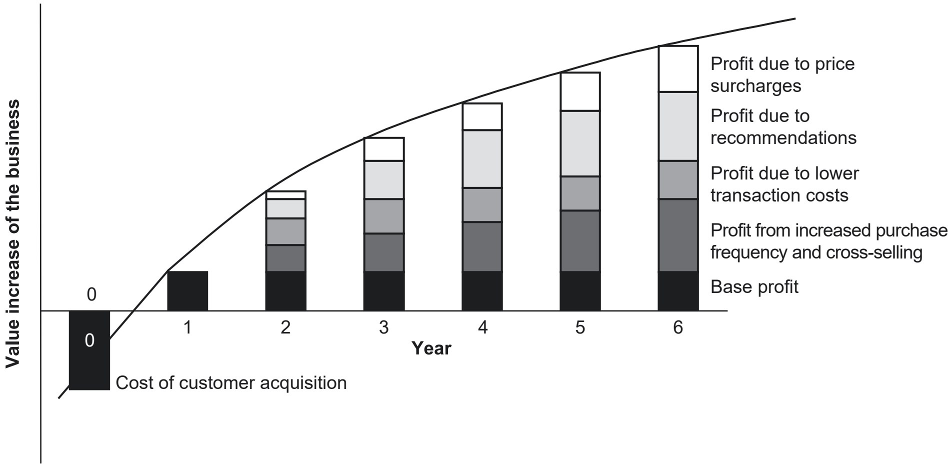


Fig. 1.3 Relationship between customer satisfaction and long-term business success. *Source* With minor changes taken from Simon and Homburg 1995, p. 18

especially to logistics services, which at the same time takes into account the logistics systems thinking. To achieve customer proximity, on the one hand, the ability to identify the service features that are relevant for the customer is necessary. In addition, however, the logistics processes must also be aligned with the customer requirements and be adaptable if necessary. This leads to a stronger customer loyalty on the one hand, but on the other hand, it requires a differentiation of logistics in order to offer customer-specific services.

The advantages of a higher *customer satisfaction* and the resulting stronger customer loyalty lie mainly in a lower price elasticity and the saving of acquisition costs. In addition, loyal customers have a higher value for the company. The longer a customer is satisfied with the own products or services, the higher is the profit that can be attributed to this customer (see Fig. 1.3). This results from an increased turnover due to a higher purchase frequency, the sale of additional products from the range to this customer, from lower transaction costs and from referrals.[28]

Target variables of customer orientation are the "classic" components of delivery service: delivery time, delivery reliability, delivery condition and delivery flexibility.[29] This shows that in customer orientation, in addition to the basic cost aspects, time, quality and flexibility aspects are also important. In terms of time, the key figure "time to customer" is a relevant measure for the customer and his evaluation of the processes. Savings potentials exist here mainly in the area of administrative processes of order processing. 100% process and product quality in fulfilling customer wishes is a prerequisite

[28] Cf. Simon and Homburg 1995, p. 18; Hinterhuber and Matzler (2003), pp. 12 ff.

[29] For the components of delivery service see Pfohl (2022), pp. 34 ff.

for a long-term cooperation with the customer. The orientation of production to customer wishes leads to smaller batch sizes and consequently also to smaller shipments in the course of a stronger desired flexibility. This has changes in the logistics processes as a consequence, whereby above all the increasing logistics complexity must be mastered.

By applying tools of "Customer Relationship Management" (CRM) as a logical consequence of the pull principle[30] a development towards the integration of customers in the value chain results. Customer relationship management includes the identification of customer needs and the continuous measurement of customer satisfaction. The latter serves as a control variable for the success of the activities in the field of customer orientation, such as key account management, complaint management, etc. Logistics can serve as a platform for customer retention measures and thus enable differentiation from competitors. This applies especially to the after-sales area. The service offered here, for example in spare parts supply, contributes significantly to lasting customer loyalty.[31] The information gained in this way also forms a valuable basis for developing new problem solutions. The further development of CRM to an "Enterprise Relationship Management", which also includes the relationships with suppliers and logistics service providers, with an intensified linkage along the value chain, is enabled by modern information and communication technologies. From the data obtained in this way, for example, starting points for an optimized customer segmentation or a customer-specific adaptation of the product and service offer ("customization") can be derived.

1.3.4 Internationalization

In the course of internationalization, logistics is one of the essential prerequisites for ensuring the success of the company.[32] In addition to the increase in cross-border transport volume, the internationalization of companies is associated with an *increasing complexity* of goods and information flows. This is not only due to the increasing distances, but also to the need to take national circumstances into account. Overall, an increase in the necessary control effort can be expected, which results in particular from the need to develop differentiated logistics systems. They must correspond to the glocal compromise between "global integration" and "local adaptation" ("glocalization") (see Fig. 1.4). This results from the basic problem of international management, namely the balance of the opposing requirements arising from the need to adapt to different national conditions

---

30 See Part II, Sect. 4.4.4.

31 For more details see Ester (1997), pp. 128 ff.

32 Cf. Handfield et al. (2013), pp. 21 ff.

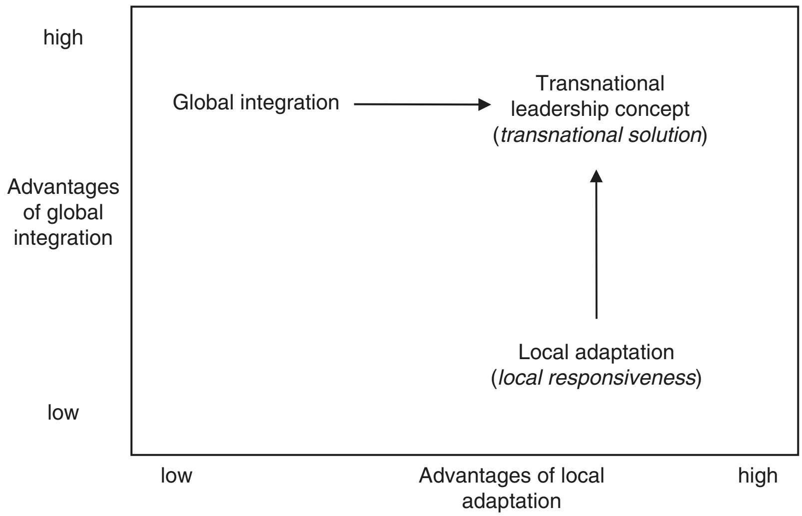


Fig. 1.4 Globalization and localization framework. *Source* Holtbrügge and Welge 2015, p. 47

and from the need to integrate all activities as globally as possible.[33] Since globalization occurs in waves[34] and phases of strong ("hyperglobalization") and weak *("deglobalization"),* caused by the increase or decrease of liberalizing and protectionist measures, alternate, this balance has to be found always depending on the phase.

In the *procurement* process, economic reasons in the form of price advantages are mainly cited as advantages of a globally integrated procurement with regard to a "global sourcing". They arise both from the bundling of quantities ("economies of scale") and from the exploitation of price differences ("economics of arbitrage"). To use these advantages, however, a sufficiently flexible and fast supply network is necessary. At the same time, regional or local peculiarities, e.g. in the form of "local content" regulations, have to be taken into account. With regard to the risk of crises (e.g. Corona crisis) occurring, the supply networks have to be robust, which can be supported by an international diversification of the supply chains.[35]

These considerations also apply to the configuration of the *production* network. On the one hand, a trend towards local presence can be observed, i.e. production follows the markets. Especially in strongly growing economies, such as China, a local production site, which can also take over tasks of the global production network, is essential for a

[33] Cf. Holtbrügge and Welge (2015), pp. 46 f.

[34] Cf. Stocker (2020).

[35] Cf. Felbermayr (2020).

successful market development.[36] On the other hand, the international or global arrangement of production sites is often associated with a concentration at certain locations.

This concentration results in increased requirements for the *distribution.* The coordination of the worldwide distribution of products requires, on the one hand, the determination of the transport and storage configuration. On the other hand, the information and financial flows have to be controlled and monitored. This results in increased requirements for the information and communication management.

To cope with the complexity of international or global production and logistics networks, a more intensive cooperation of industry, trade and logistics service providers is necessary.

1.3.5 Digitalization

The logistics drivers already described increase the requirements regarding the location, time and quantity accuracy of the goods flow and thus require a fast, secure and efficient information flow. Due to the increasing complexity of networked corporate structures, the role of digitalization as an "enabler" for logistics becomes more and more important. "The digital transformation of the supply chain enables a better control of its increasing complexity. This can be achieved by a continuous transparency of all flows in the supply chain based on real-time data. All actors in the supply chain are informed early about occurences ("events") and can adapt their processes. This aspect of digitalization is characterized as "connectivity". If digitalization generates a lot of data, the question arises how to use it. This aspect is characterized as "data science". Through "artificial intelligence" large amounts of data can be analyzed ("data analytics"), which leads to better forecasts. Self-learning devices ("machine learning"), e.g. self-optimizing vehicles, lead to the reduction of empty runs."[37] The "Internet of Things" offers the vision of self-controlling logistics systems, in which autonomous objects (e.g. containers) determine their own routes and can order the necessary resources independently.[38] The continuous digital networking is also associated with the term "Industry 4.0", whose historical development is illustrated in Fig. 1.5.

Digitalization also has an impact on logistics in the area of *three-dimensional (3D) development.* This applies first of all to the planning and control of e.g. material flow systems.[39] 3D models allow material flow systems to be virtually mapped in real factory halls, with which interaction is possible. The visualization of the layout and the

[36] See also the trend towards regionalization within the framework of globalization by European Logistics Association and AT Kearney (2009), pp. 27 ff.

[37] Pfohl (2020).

[38] Cf. Brand et al. (2009), p. 9.

[39] Cf. Günthner (2010), pp. 659 ff.

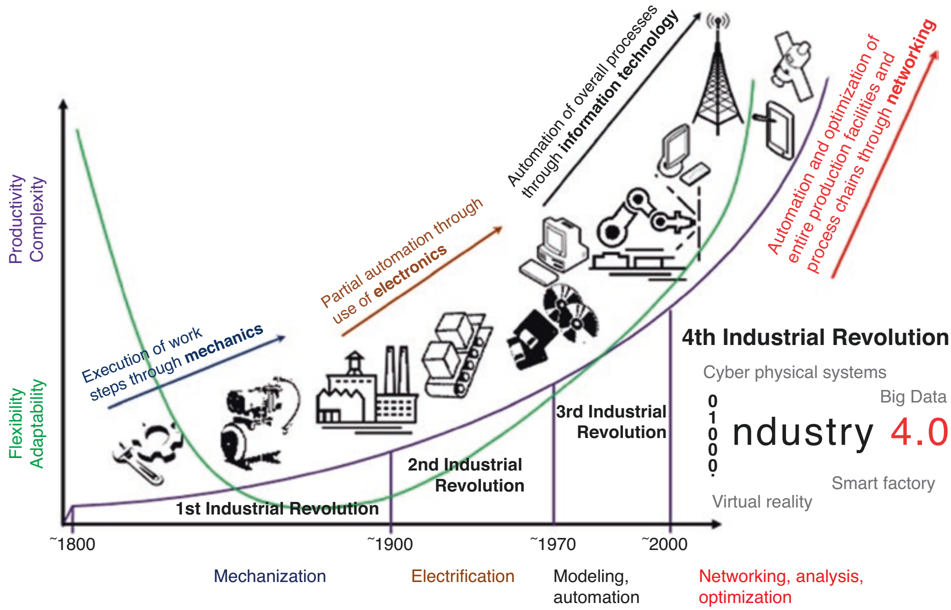


Fig. 1.5 Industry 4.0. *Source* Aunkofer 2013

sequence of processes creates a virtual reality that improves decision support. A completely different area is affected by 3D printing, in which components are printed in layers from powder at the user's site.[40] Digitalization also plays a role here, as design data must be transmitted to the printer. Effects also arise from 3D printing on the goods flows. Because then individual components, e.g. spare parts, do not have to be transported to the place of use, but only the powder as raw material.

In order to increase the transparency along the supply chain, cross-company solutions are also being further developed in addition to departmental solutions. However, most of these systems are not yet fully integrated, so that data, processes, rules, decisions, workflows and content cannot be completely exchanged. The development of the supporting *application software* can also be described analogously to the phase model of logistics.[41] The production planning and control systems (PPS) and the integrated "Manufacturing Execution Systems" (MES) provide the necessary tools for planning, controlling and monitoring the essential logistics functions in production. The claim of process orientation led to the demand for an integration of the individual information systems and thus to the emergence of so-called "Enterprise Resource Planning" systems (ERP). They enable the integrated processing of operational performance processes across the different

[40] Cf. Fastermann (2012), pp. 7 ff.

[41] Cf. Hausladen (2011), p. 72. For the phases of the goods flow see also Pfohl (2022), p. 16.

functional areas of the company. A weakness, however, lies in the insufficient inclusion of planning functionalities, which led to the development of so-called "Advanced Planning" systems (APS).[42] They complement the ERP systems by using the data available there to optimize the company-wide goods and information flows.

With the described development, the current requirements for the technological support of logistics in long-term relationships are covered. However, developments with regard to rather short-term business relationships must also be taken into account, which are handled on the *electronic marketplaces* (platforms) for logistics services. These marketplaces are part of the concept of *"eCommerce"*, which enables the electronic interlocking and integration of different value chains, cross-company business processes and the management of business relationships. The great challenge is to connect the existing corporate information systems to the marketplace and thus enable the purchase of complex goods or services.

References

Acatech (2012) Menschen und Güter bewegen. Integrative Entwicklung von Mobilität und Logistik für mehr Lebensqualität und Wohlstand. Acatech POSITION, Berlin

Anderson DL, Delattre AJ (2002) Five predictions that will make you rethink your supply chain. Supply Chain Manag Rev 6(5):25–30

Aunkofer B (2013) Industrie 4.0 – die story. https://www.der-wirtschaftsingenieur.de/index.php/industrie-4-0-die-story/. Accessed: January 2015

Bennett N, Lemoine GJ (2014) What a difference a word makes. Understanding threats to performance in a VUCA world. BH 57(3):311–317

Boschet S et al (2003) Performance financière et Supply Chain des entreprises européennes 2003. Logist Manag 11(1):1–34

Brand L et al (2009) Internet der Dinge. Übersichtsstudie. Zukünftige Technologien Consulting der VDI Technologiezentrum GmbH, Düsseldorf

Bretzke W-R (2015) Logistische Netzwerke, 3. ed. Springer, Berlin

Bretzke W-R, Barkawi K (2010) Nachhaltige Logistik. Antworten auf eine globale Herausforderung. Springer, Heidelberg

Cap Gemini Ernst, Young/Industry Week (2000) High performance value chains. A report on the 2000 value chain survey. Philadelphia/Boston

Christopher M, Ryals L (1999) Supply chain strategy: its impact on shareholder value. Int J Logist Manag 10(1):1–10

Council of Supply Chain Management Professionals (2019) CSCMP supply chain management definitions and glossary. https://cscmp.org/CSCMP/Academia/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx

D'Avanzo R, von Lewinski H, van Wassenhove LN (2003) The link between supply chain and financial performance. Supply Chain Manag Rev 7(6):40–47

Deutsche Post AG (2012) Delivering tomorrow: logistics 2050. A scenario study. Deutsche Post AG, Bonn

[42] Cf. in detail Part II, Sect. 6.4.1.

DHL Customer Solutions & Innovation (2020) The Logistics Trend Radar. 5. ed. DHL Customer Solutions & Innovation, Troisdorf

Ester B (1997) Benchmarks für die Ersatzteillogistik. Erich Schmidt, Berlin

European Logistics Association, Kearney AT (2009) Supply chain excellence amidst the global economic crisis. ELA, Brussels

Fastermann P (2012) 3D-druck/rapid prototyping. Eine Zukunftstechnologie – kompakt erklärt. Springer, Heidelberg

Felbermayr G (2020) Globalisierung. Teil der Lösung und nicht des Problems. Forschung & Lehre 5:402–404

Fontius J (2013) Megatrends und ihre Implikationen für die Logistik. Schriftenreihe Logistik der Technischen Universität, Berlin

Ghemawat P (2011) World 3.0: Global prosperity and how to achieve it. Harvard Business Review Press, Boston

Göpfert I (2013) Logistik: Führungskonzeption und Management von Supply Chains, 3. ed. Vahlen, München

Günthner W (2010) Logistik Digital. Die virtuelle Welt der Logistik. In: Schönberger R, Elbert R (Hrsg) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, S 659–679

Handfield R, Straube F, Pfohl H-Chr, Wieland A (2013) Trends und Strategien in Logistik und Supply Chain Management. Vorteile im Wettbewerb durch Beherrschung von Komplexität. DVV Media Group, Hamburg

Hausladen I (2011) IT-gestützte Logistik. Systeme – Prozesse – Anwendungen, 1. ed. Gabler, Wiesbaden

Hinterhuber H, Matzler K (2003) Kundenzufriedenheit durch Kernkompetenzen, 2. ed. Gabler, Wiesbaden

Holtbrügge D, Welge M (2015) Internationales Management. Theorien, Funktionen, Fallstudien, 6., rev. ed. Schäffer-Poeschel, Stuttgart

Ihde G (1987) Stand und Entwicklung der Logistik. DBW 47(6):703–716

Imug (2012) Nachhaltigkeitsbericht. imug Beratungsgesellschaft für sozial-ökologische Innovationen mbH, Hannover

Kersten W et al (2017) Trends und Strategien in Logistik und Supply Chain Management: Chancen der digitalen Transformation. Studie der Bundesvereinigung Logistik. DVV Media Group, Hamburg

Kersten W et al (2020) Trends und Strategien in Logistik und Supply Chain Management: Entwicklungen und Perspektiven einer nachhaltigen und digitalen Transformation. Studie der Bundesvereinigung Logistik. BVL.digital, Bremen

Klaus P, Müller S (Hrsg) (2012) The roots of logistics. A reader of classical contributions to the history and conceptual foundations of the science of logistics. Springer, Berlin

Lambert D (2014) Supply chain management. Process, relationship, performance, 4. ed. Supply Chain Management Institute, Ponte Vedra Beach

Large R (2012) Logistikfunktionen. Betriebswirtschaftliche Logistik, Vol 1. De Gruyter, München

Locker A, Grosse-Ruyken P (2013) Chefsache Finanzen in Einkauf und Supply Chain. Mit Strategie-, Performance- und Risikokonzepten Millionenwerte schaffen, Springer Fachmedien, Wiesbaden

Meitinger T (2020) Am Ende der Lieferkette. LH 42(3):28–33

Morgenstern O (1955) Note of the formulation of the theory of logistics. Nav Res Logist Q 2:129–136

N. A. (2020) Nachhaltigkeit: Der gute Wille ist meist da. LH 42(7–8):46–47

Pfohl H-Chr (2000) Supply chain management: Konzept, Trends, Strategien. In: Pfohl H-Chr (Ed) Supply chain management. Logistik plus? Logistikkette – Marketingkette – Finanzkette. Erich Schmidt, Berlin, pp 1–42

Pfohl H-Chr (2020) Digitalisierung der Supply Chain: Effizienzsteigerung industrieller Lieferketten. Manager Magazin 50(1):7 (Manager-Wissen)

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. ed. Springer, Berlin

Pfohl H-Chr, Frunzke H, Köhler H (2007) Grundlagen für ein Innovationsmanagement in der Logistik. In: Pfohl H-Chr (Ed) Innovationsmanagement in der Logistik. Gestaltungsansätze und praktische Umsetzung. Dt. Verkehrs, Hamburg, pp 16–105

Rausch K-F, Kadow M, Elbert R (2010) Grüne Logistik. Handlungsfelder und -strategien für Logistikdienstleiter am Beispiel von DB Schenker. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Gabler, Wiesbaden, pp 681–707

Schwemmer M (2018) Top 100 der Logistik 2018/2019: Marktgrößen, Marktsegmente und Marktführer. DVV Media Group, Hamburg

Schwemmer M (2019) Top 100 in European transport and logistics services 2019/2020. DVV Media Group, Hamburg

Simon H, Homburg Chr (1995) Kundenzufriedenheit als strategischer Erfolgsfaktor – Einführende Überlegungen. Gabler, Wiesbaden, pp 1–25

Singhai V, Hendricks B (2002) How supply chain glitches torpedo shareholder value. Supply Chain Manag Rev 6(1):18–24

Stocker F (2020) Große Grafik Globalisierung: Zwei Schritte vor, einer zurück. Welt am Sonntag 27:42

Straube F, Pfohl H-Chr (2008) Trends und Strategien in der Logistik – Globale Netzwerke im Wandel. Umwelt, Sicherheit, Internationalisierung, Menschen. DVV Media Group, Hamburg

Straube F, Wutke S, Doch S (2013) Nachhaltigkeit in der Logistik. Messbarkeit ökologischer und sozialer Faktoren und die Einbindung von Supply Chain Partnern. Industrie Management 29(5):7–10

Systain Consulting (2013) Die Zukunft der globalen Wertschöpfung. Wettbewerbsfaktor Social Compliance Management. n. p.

United Nations (1987) Report of the world comission on environment and development: out common future. https://www.un-documents.net/wced-ocf.htm. Accessed: 12. January 2016

Weber J, Dehler M (2000) Entwicklungsstand der Logistik. In: Pfohl H-Chr (Ed) Supply Chain Management: Logistik plus? Logistikkette – Marketingkette – Finanzkette. Erich Schmidt, Berlin, pp 45–68

2 Management of the Logistics Function

2.1 Notion and Functions of Logistics Management

Considering logistics as a business function, it encompasses not only the realization of the material flows and the related object flows, but also the management of the logistical tasks. Logistics consists of management tasks and executive tasks.

To specify the tasks of *management*, we refer to the classification of Ulrich and Fluri, who distinguish four basic functions of management: 1) corporate philosophy, corporate ethics and corporate policy, 2) corporate planning and control, 3) organization and leadership and 4) executive development.[1] Based on these four basic functions, logistics management[2] is divided into the following sub-functions:

- Logistics policy
- Logistics planning and control
- Logistics organization
- Personnel management in logistics.

Corporate philosophy and ethics provide the moral foundations for logistics management. This involves especially specific problems related to environmental protection, labor and logistics cooperation. Logistics policy deals with integration of the logistics conception into the corporate policy. Logistics planning and control covers operational and strategic issues, for which the controlling conception is used as a reference framework.[3]

[1] Ulrich and Fluri (1995, p. 17).

[2] For another approach to logistics management, see Göpfert (2013, pp. 143 ff.).

[3] See Pfohl and Stölzle (1997, pp. 34 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_2

Logistics organization has, in addition to the traditional intra-organizational areas of logistics structure and logistics process organization, also the organization of company boundary crossing systems (inter-organization) as its object. The management area of personnel management in logistics integrates all issues that arise from the use and leadership of personnel in logistical processes.

Logistics management has *two basic functions.* First, logistics management concerns the *management of the individual logistical subsystems* physical storage (warehouse), transport, packaging, inventory and order processing. Therefore, one can distinguish a warehouse management, transport management, etc. In a finer subdivision, based on the above classification, e.g. the tasks of warehouse planning, warehouse organization and staff management in the warehouse. These specific sub-areas of logistics management are partly well developed. Therefore, a large potential of methods and procedures can be used. Examples are tour planning, material requirements planning or storage space planning. Second, logistics management—and this is the far more important aspect—concerns the implementation of the logistics conception by *coordinating and integrating management activities* (integration aspect).[4] In particular, the system and value thinking requires the coordination and holistic consideration of logistics systems and processes. An important coordination measure are comprehensive plans that cover several technical subsystems, several organizational units and today also increasingly several organizations. By structural and procedural measures, interfaces between logistics systems or at least their negative effects can be avoided. People management, also across organizational boundaries, enables a flexible coordination between logistical subsystems. The service, total cost and efficiency thinking also requires a sufficient degree of quantification, so that logistics systems and processes and their alternatives can be comprehensively and based on costs and performance evaluated. The holistic planning, organization and leadership, as well as the comprehensive controlling, therefore have a key position in the implementation of the logistics conception.

Based on our logistics understanding developed in Sect. 1.1, we can define *logistics management* as the totality of management activities that are required both for the realization of individual logistics processes and for the realization of a comprehensive, possibly spanning several companies overall process of logistics. Management is also referred to as a leadership system and the realization as an achievement system.

While management activities for the realization of individual logistics processes were developed and applied long before the emergence of the logistics conception, conclusions can be drawn from the degree of consideration of the integration aspect in logistics on the state of development of logistics management. The development stages of logistics management are examined in more detail in the following section.

[4] See also Stölzle and Gareis (2002).

2.2 Development Phases of Logistics Management

To differentiate the development phases of logistics management, various criteria can be used, whose change can serve as a measure of development. In the following, the logistics system, the flow orientation, the responsibility and the action level are examined as indicators of logistics management development.

2.2.1 System

First, *four stages of development* of logistics management can be identified based on the *different scope of the logistics system*. Looking back at the emergence of logistics management, two original nuclei can be discerned, both of which are characterized by a *limitation of logistics management to logistics subsystems* of the company. In the USA, logistics management was initially limited to the management of physical distribution ("Physical Distribution Management") due to a dominance of the consumer goods industry and the consumer goods trade. This was associated with a focus on the management of the performance areas of transport, handling and storage in the sales area (THS logistics). In Germany, logistics management initially concentrated on the area of traditional materials management and thus on the factor of material and the input area of the company due to a dominance of the automotive industry. Both nuclei thus have a limitation to one performance area of the company in common.

With the emergence of company logistics as a total system, this one-sided orientation was overcome and the second stage of development of logistics management emerged. Through the holistic logistics consideration of procurement, production and sales as components of a company-wide logistics system[5], the requirements for the integration aspect of logistics management increased. The *management of company logistics* requires much more coordinating management activities than the isolated consideration of distribution or materials management. However, this effort is justified, as the internal integration of logistics has a positive influence on the level of logistic performance.[6]

In the third stage of logistics management, the object area is extended to individual inter-organizational logistics systems. The focus of interest of the third stage is the *management of logistics cooperation*.[7] Essential for this was the insight that the coordination of the logistics processes in the distribution or procurement channel is only possible by involving the participating companies.

This inter-organizational approach is also constitutive for the fourth stage of development of logistics management. In contrast to the third stage, not the individual

[5] Cf. Pfohl (2022, pp. 15 ff.).

[6] Cf. Stank et al. (2001, pp. 36 f.).

[7] Cf. Kleer (1991); Pfohl and Large (1992); Pfohl (2004, pp. 1 ff.).

inter-organizational logistics systems are considered as the object of logistics management, but the entire logistics system from the origin of the raw materials to the use of a good. This *company boundary crossing management* realizes for the first time the claim that must be derived from the above-mentioned logistics definition of the CSCMP: the planning and control of an efficient flow of goods from the origin to the use. Often today this stage of development of logistics management is labeled with the term *Supply Chain Management*.[8] Logistics management of the fourth stage of development thus has the synchronization of the entire logistics processes of the companies involved in a supply chain as its object. Without taking up the intensive and critical discussion of supply chain management at this point,[9] it should be noted that a supply chain integrates not only the flow of goods and information, but also the financial flows and the rights flows between the participating companies. Generally, however, the term chain conveys a false picture of inter-organizational logistics systems. Apart from the few cases of manufacturing companies with continuous production, most industrial companies have a synthetic or regrouping structure of material processing. The resulting "supply chains" are thus rather "supply networks" and thus the supply chain management rather a *Supply Net Management.* The logistics management tasks in comprehensive networks include, in addition to the operational management tasks for the realization of the logistics performance, mainly those that have the establishment and further development of the cross-organizational and internal logistics systems, their planning and repeated adaptation as their object.

2.2.2 Flow

Weber developed a similar phase approach of logistics, which distinguishes the development phases according to the degree of implementation of the *flow orientation in the company*.[10] From the state of development of logistics in a company, conclusions can be drawn about the underlying logistics management. Three phases of logistics development can be identified:

- Logistics as functional specialization
- Logistics as cross-functional and cross-organizational coordination function
- Logistics as implementation of the flow orientation.

The last phase can also be differentiated according to whether the implementation of the flow orientation refers only to internal structures or whether it also extends to inter-

[8] Cf. e.g. Göpfert (2013, p. 23).

[9] Cf. Pfohl (2000, pp. 4 ff.); Gomm (2008, pp. 31 ff.); Eßig et al. (2013, pp. 27 ff.).

[10] See Weber and Dehler (2000, pp. 48 ff.).

organizational logistics systems of the supply chain. An empirical study from 1999 based on 500 responses from readers of a German logistics magazine shows a profile of corporate management for each stage of development, which differs significantly in terms of all management functions. The basis for the classification is the flow orientation index. A flow-oriented logistics management requires not only the flow-oriented design of the logistics execution processes, but also of the logistics management itself. This follows the necessity of a high degree of process orientation of the organization, the planning and the control.

2.2.3 Responsibility

Besides the scope of the logistics system or the flow orientation, the *responsibility* of logistics is an essential indicator for the development stage of logistics management. The breadth of responsibility provides information about the extent to which tasks and competencies as well as the resulting responsibility for logistics processes are consolidated in a central logistics unit.[11] By concentrating the logistic tasks in a specialized organizational unit, the systems thinking is facilitated and thus an essential prerequisite for the realization of the logistics conception is created. The criterion for assessing the development of logistics management is therefore the *organizational integration of logistics*. This approach is based on the thesis that a developed logistics management can be identified by the characteristic of a strong organizational integration of logistics activities.

The existence of different organizational models is interpreted as a result of a varying understanding of logistics management from company to company. Following Persson, the “One-Way Approach”, the “Life-Cycle Approach” and the “Contingency Approach” can be distinguished as approaches to explain the logistics organization.[12] The “Life-Cycle Approach” of interest here assumes that different, but increasingly concentrated, logistics organizational structures can be found in companies over time.[13] Already at the end of the 60s, three “generations” of logistics management with different degrees of line and staff responsibility were referred to.[14]

Meanwhile, there is a large number of studies on the organization of logistics.[15] The focus is mainly on studies on the centralization (task division) and hierarchical integration (structure type) of logistics. The studies show that only the hybrid form, i.e. the mix

[11] Competency here refers to the right to act, to take measures that are necessary for the proper fulfillment of tasks. According to the most important principle of organization, task, competency and responsibility must always correspond. See Ulrich and Fluri (1995, p. 174).

[12] Persson (1982).

[13] See Bowersox and Daugherty (1987).

[14] See Pfohl (1970, p. 258).

[15] See Pfohl (2022, pp. 233 ff.) and the literature cited there. See also Cooper et al. (2012, p. 11) and Handfield et al. (2013, pp. 42 f.).

of decentralized and central organizational units, shows an increasing tendency. The number of companies with central logistics (central unit or separate logistics division) is rather declining. Companies with decentralized logistics play a minor role.

According to the thesis introduced above, according to which the degree of development of logistics management can be measured by the degree of consolidation of logistics activities in an organizational unit, logistics management would have developed negatively. The "Life-Cycle Approach" must therefore be considered as outdated today. The organization of logistics is not only dependent on the development of logistics management, but on a multitude of internal and external influencing factors. In different companies, different—but still equally efficient—manifestations of the logistics organizational structure are possible.[16] The organizational form of logistics can therefore only be considered as an indicator of the development of logistics management for the early phases of logistics development, since in this period (about 1975-1985) a dominant influence of the new logistics conception for many companies on the organization can be assumed.

2.2.4 Action Level

A clear indicator for the development of logistics management, on the other hand, are the three action levels of management, which are schematically distinguished in Fig. 2.1. According to this, the phases of logistics can also be characterized by whether the logistics conception is only given importance on the operational action level or also on the strategic or even on the normative action level. The first phase can thus be called operational logistics management, the second phase strategic logistics management and the third phase normative logistics management. On the three levels of logistics management, the problems outlined in Fig. 2.1 must be recognized and solved.

In *operational logistics management*, the logistics managers focus on the creation of individual, specific and short-term sub-plans with a high degree of formalization. Due to the fundamental scarcity of resources, short-term productivity potentials must be identified and exploited.

The *strategic logistics management* considers overall plans that enable a long-term coordination of the logistical sub-areas based on the logistics conception. The problems that logisticians deal with at the level of strategic logistics management are complex and poorly defined. These include all long-term decisions that affect success, which cannot be revised at all in the short term or only at the expense of significant reductions in success. These logistical basic decisions include the determination of the service policy to be pursued, the determination of the basic structure of the logistics system (network) and the fundamental decision on the type of organizational integration of logistics in the

[16] See the situational approach of organization theory in Part III Sect. 7.3.1.

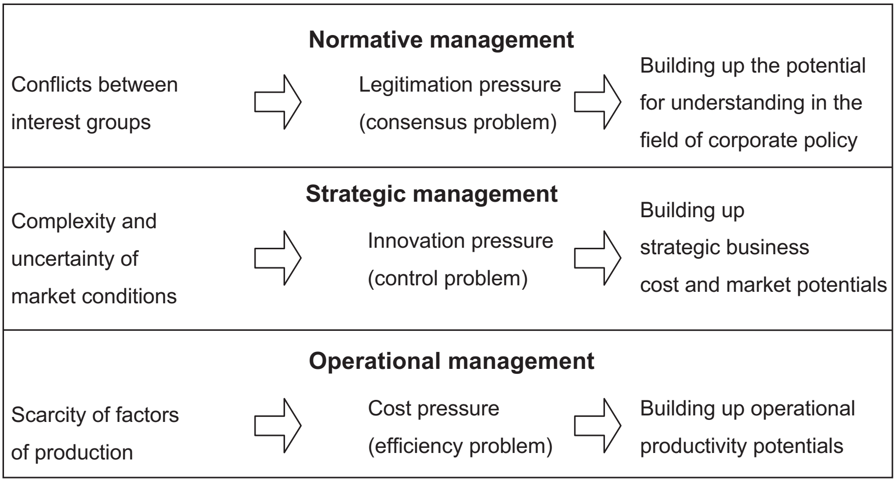


Fig. 2.1 The three action levels of management. *Source* Based on Ulrich and Fluri 1995, p. 19

company and the outsourcing of logistics tasks to external companies (outsourcing of parts of the logistics system).

Characteristic for the strategic logistics management is that the logistics planning is both cross-functional and cross-company, i.e. it covers the entire logistics system. On the other hand, it is integrated into the overall planning and thus takes place on all planning levels. This means that the logistics area is both integrated into the strategic planning system and into the controlling system of the company. Emphasizing the inter-organizational aspect, the logistics management must be aligned so that the goals of designing an excellent supply chain can be achieved.

On the *normative action level* of logistics management, it is about the contribution of logistics to answering the value questions of entrepreneurial action. This involves clarifying the position of logistics within the company in relation to the other business functional areas. In addition, the interests of the interest groups („stakeholders") that are influenced by logistics must be taken into account. For this, the necessary communication and credibility potentials must be built up. Especially in environmental issues, logistics is often associated with negative external effects. Therefore, as part of the corporate policy, clear values must be articulated to provide the decision-makers in the company with a suitable basis.

The holistic consideration of all action levels of logistics in the company characterizes the highest stage of the development phases of logistics management.

After presenting possible development phases of a logistics management, the following section will analyze possible tasks of logistics management. For this, various models of logistics management will be presented, which represent different reference frames for the structuring of logistical management tasks.

2.3 Models of Logistics Management

2.3.1 Logistics Levels

The logistics cube in Fig. 2.2 gives an overview of the complexity of logistics decisions. This complexity requires coordinating and integrating measures.

On one level, the functional, on another level, the institutional system interrelations are indicated, which have to be considered in logistics decisions.[17] On the *functional* level, different contents of logistics tasks are reflected. On the *institutional* level, it is about the organizational assignment of these tasks within the company (intra-organizational) and between companies (inter-organizational), in order to exploit the division of labor optimally, i.e. also taking into account the aspects of coordination and motivation of the people involved. The service providers include not only the logistics service providers, but also the information and financial service providers. Also part of the institutions is the public sector, which is a key actor in inter-organizational cooperation through its decisions in the field of logistics infrastructure. In a 2013 survey of shippers, this was cited as the main cause of a deterioration in delivery reliability, along with increasing traffic density, congestion and obstructions on highways and roads.[18]

On the third level, the *flows* in the “Supply Chain” are listed, whose interrelations have to be considered according to the concept of “Supply Chain Management” in strategic logistics management.[19] Because the capital commitment in the goods flows has a direct influence on the financial flows. The flow of rights has a direct influence on the possibility to dispose of goods and information. Moreover, the responsibility for the bound capital depends on the ownership of the goods.

2.3.2 Logistics Variables

Basically, four variables of the logistics system can be distinguished, based on the model of Leavitt, with which logistics processes can be designed.[20] These are the by logistics management *influencable logistics variables* (design variables) “task”, “employee”,

[17] See in detail Part II and IV of Pfohl (2022).

[18] Cf. Cordes (2013, p. 23). Cf. also the negative influences on logistics capabilities in Handfield et al. (2013, p. 25). See also the public sector as an actor in the logistics chain in Abele et al. (2012, pp. 29 ff.) and on cooperation with authorities in Handfield et al. (2013, p. 60).

[19] See Pfohl (2000, pp. 6 ff.); Gomm (2008, pp. 31 ff.) On the goods flow with its phase-specific logistics subsystems, see in detail Part III of Pfohl (2022) as well as the contributions in Furmans and Kilger (2019). On the financial flow, see Part II, Sect. 5.6. On the design and interdependence of the flows, see Part III, Chap. 8.

[20] Cf. Pfohl (1999, pp. 178 f.).

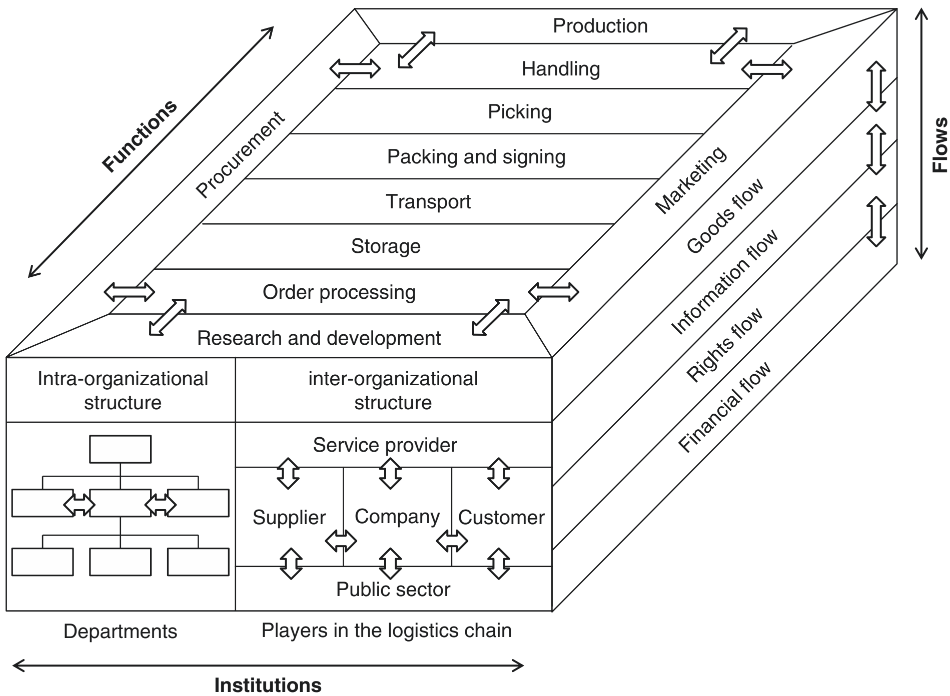


Fig. 2.2 Logistics levels

"technology" and "organization" characterized in Fig. 2.3. First of all, it can be assumed that logistics management will try to fulfill the logistics task more efficiently by taking appropriate design measures for the employees, the technology or the organization. It should be noted here that there are close relationships between these design variables, so that, for example, changes in the logistics organization must always be accompanied by changes in the technology (e.g. different picking systems) and in the employees (e.g. different level of education). There are also mutual dependencies with the logistics task itself, which is why it should also be considered as a design variable.

If the logistics task is defined as ensuring a certain level of supply or delivery service, then different levels of service can be achieved by changing the employees, the technology or the organization.

The possibilities for increasing efficiency are limited by a number of *uninfluencable variables*. These include first of all the company-external variables that are normally not influenced by logistics management. In addition, there are those company-internal variables that logistics management also has to accept as given. These uninfluencable variables (constraints) are the context variables, i.e. the variables within which logistics processes have to be designed and controlled.

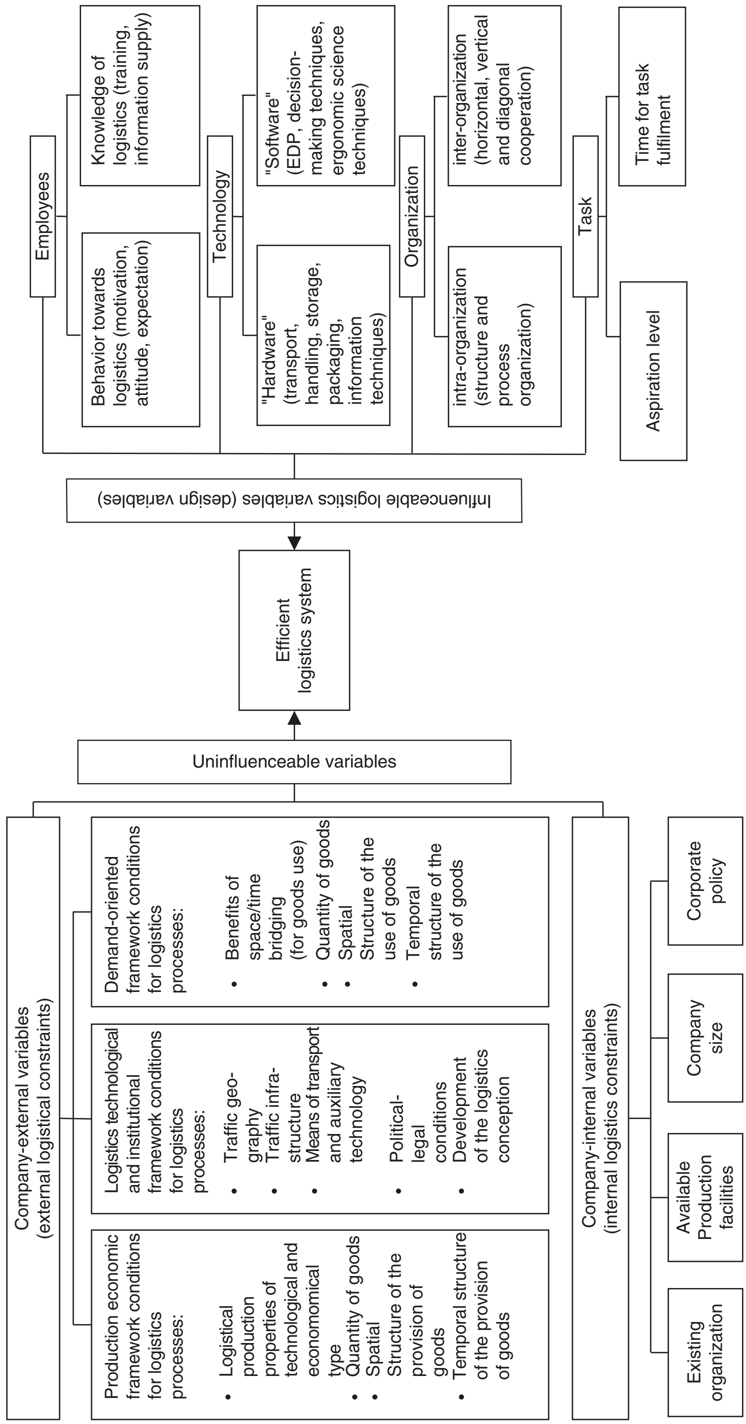


Fig. 2.3 Logistics variables

Changes in these logistics constraints can entail changes in the design variables of the logistics system. For example, the development of the Internet enables a closely networked exchange of information that also involves small and medium-sized suppliers who could not use traditional forms of EDI for personnel and financial reasons.[21] Logistics management must therefore not only constantly inform itself about changes in the influencable logistics variables (e.g. development of a picking robot for small parts), but also about changes in the uninfluencable company-external (e.g. liberalization of the transport market) and company-internal (e.g. closure of a plant) variables.

2.3.3 Logistics Production Factors (-Resources)

In every company, economic—and therefore scarce—goods are used as input to produce other goods that are in demand on the market as output. The goods used are also called production factors, and the process of creating and utilizing performance in the company can be described and explained as a combination of production factors. Business administration knows different *classifications* of production factors. In all proposals, the production factors *"labor", "equipment"* and *"material"* appear, albeit with different names. In the case of labor, a distinction is often made between dispositive and object-related labor. Equipment includes tools, machines and any facilities as well as land. The material comprises raw, auxiliary and operating materials (including energy) as well as purchased parts. Often, *information* is also listed as an independent production factor.[22]

According to the *principle of efficiency*, it is the task of management to combine the production factors in such a way that a given performance is achieved at minimal costs or with given costs a maximum performance is achieved. As can be seen from Fig. 2.4, the combination of production factors in the logistics system of the company refers to the well-known logistics processes of transport, storage, handling, picking, packaging and order processing.

Essential for good logistics management is the knowledge of the costs that production factors cause and their relevant properties for the logistics performance. Since both the costs and the performance characteristics of production factors change due to technological progress and new concepts regarding their use and the costs additionally due to different price developments for the production factors, logistics management must have knowledge of the substitutability of production factors. At least within certain limits, this is given for many production factors, so that cost reductions and/or performance increases can be achieved by new production factor combinations.

[21] Cf. European Logistics Association and AT Kearney (1999, pp. 29 f.).

[22] Cf. Pfohl (1985, p. 3) and the literature cited there.

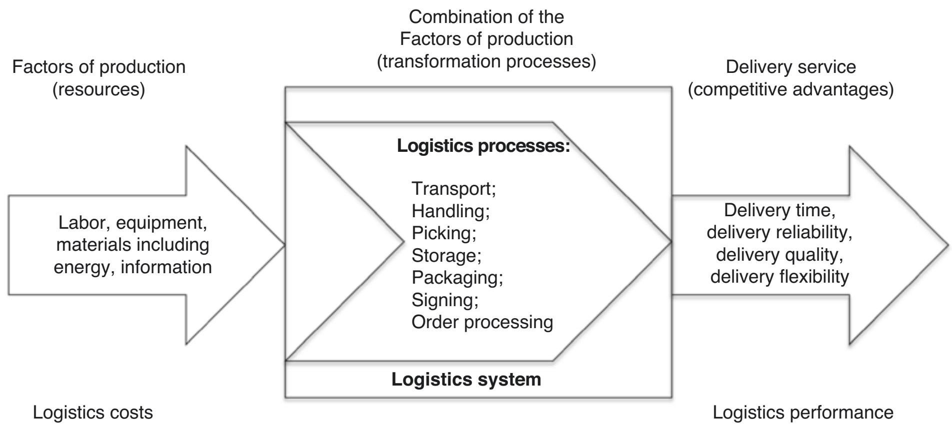


Fig. 2.4 Combination of production factors in the logistics system

The following are examples of typical substitution possibilities in the combination of production factors in the logistics system:[23]

- Substitution of object-related labor by equipment:
  - Creation of "logistics units" (standardization of storage, transport, packaging, handling and delivery units by means of pallets and containers)
  - Combined transport
  - Selective automation in the warehouse
  - Order processing by electronic data processing.
- Substitution of equipment by information:
  - Standardization of documents in the transport chain
  - Improvement of communication between the institutions involved in the transport chain (suppliers, logistics companies, recipients)
  - Creation of "timed goods" in the transport chain.
- Substitution of material by information:
  - Lower inventory holding by improved inventory disposition and control
  - Lower inventory holding by improved communication between supplier and customer in planning
  - Lower inventory holding by shifting inventories from finished products to semi-finished products or raw materials as a result of improved market information.
- Substitution of "human" disposition (dispositive labor) by "computer-aided" disposition (equipment):

[23] Cf. LaLonde (1985, pp. 58 f.).

– Automated information acquisition and evaluation
– Operations Research (mathematical methods of decision preparation).

The differentiation in competition ultimately depends on the use of the given resources and the competencies based on them. The supply of a company with the production factors mentioned thus represents the company-specific resources as input factors. The resources acquire strategic importance when they are valuable, rare, inimitable and non-substitutable.[24]

In the course of performance creation and utilization, however, the competencies, which find their expression in the way of planning, execution, control and monitoring of operational processes, are of particular importance. They form the sources of advantage or "potential success factors".[25] Only their consistent use leads to competitive advantages in the market, so that the supply of the company with production factors or their substitution only leads to success in combination with the competencies. The last chapter of part 1 will further pursue this question by showing the influence of logistics on the success of the company and analyzing logistics as a success factor. The role of logistics as a success factor also depends on the anchoring of the logistics conception in the corporate policy. This will be discussed in the following section.

2.4 Corporate Policy Basics of Logistics Management

2.4.1 Corporate Policy

The corporate policy specifies the *official values* for the company. "Official" means that the values are authorized and bindingly prescribed by the responsible organizational units. This is intended to ensure that the basic goals and behaviors are followed in the same way in a company.

Already in Sect. 1.2 the character of logistics as a management conception was emphasized. While logistics describes a function, the logistics conception shows how the function of logistics should be fulfilled. The logistics conception requires as a corporate principle the corporate policy anchoring of a perspective that leads to new problem insights and solutions through its cross-sectional and flow-oriented view of the entire value chain.

[24] Resources are valuable when they can increase the efficiency and effectiveness of the company. They are rare when as few competitors as possible have access to them. They are inimitable and non-substitutable when competitors cannot copy them and replace them with other company-specific resources. Cf. Barney (1991, pp. 105 ff.) For the evaluation of the resources cf. Mikus (2003, pp. 281 ff.).

[25] Cf. Zöllner (1990, p. 233).

Division of labor companies are characterized by *collective decision processes*, i.e. by decision processes in which several persons of the company are involved. In addition, a cross-company logistics requires decisions that employees and managers of different companies of the supply chain have to make together. The resulting difficulty for the decision making can be traced back to the fact that the participants rarely start from the same decision premises. The cause for this lies in the different value systems of the participants and in the subjective view of the real problem situation by the participants. For the management of a company, the formulation of the corporate policy is therefore of outstanding importance as a basis for a uniform action in the company.

In the corporate policy, the *value system (norm system)* that is decisive for the action of the company is first determined as far as possible in writing, based on the corporate philosophy and ethics. In the case of a cross-company understanding of value creation, even a policy for the entire supply chain or the entire network makes sense in order to achieve a uniform orientation of the decision makers.[26]

However, the definition of a common norm system as part of the corporate policy is not sufficient for behavioral alignment. Even if the employees of a company start from the same norms, the subjectively different view of problems leads to different problem definitions and solutions. The human being perceives reality only selectively due to his limited perception and information processing capacity. He sees it always through a subjective "lens", by mapping the complex reality in a simplified model. The corporate policy therefore also provides *conceptual grids* for mapping complex decision situations. The aim is to ensure that in a company the decision problems are basically structured in the same way. The logistics conception is such a conceptual grid for the perspective of material or goods flow problems and the related problems of information, rights and financial flows, i.e. for mapping decision problems of spatial and temporal bridging in simplified models.

As shown in Sect. 1.2, the basic elements of this conceptual grid are the value and utility oriented thinking, the integrative thinking (system thinking), derived from this the total or overall cost thinking, the service thinking derived from the marketing conception and finally the efficiency thinking, which is always necessary for economic considerations.[27] Ultimately, a coordinated and thus efficient flow from source to sink should be created. In other words, one can also speak of the corporate policy anchoring of the flow principle in the management system of the company.[28]

In order to be able to enforce the logistic view of problems throughout the company, the logistics conception should be written down as a corporate principle in the corporate

---

[26] Cf. Cooper and Ellram (1993, p. 17).

[27] See in detail Pfohl (2022, pp. 23 ff.).

[28] Cf. Weber and Dehler (2000, p. 52).

policy.*Corporate principles* belong to the following three interdependent problem areas, to which corporate policy statements should be formulated[29]:

- *Corporate purpose:* This is the economic basic function of a company, i.e. the type of goods or services that characterize the performance creation and utilization of a company. It is legally to be recorded as the purpose of the company in the statutes and articles of association or in the partnership agreement (e.g. activity in all areas where combustion engines are used).
- *Supreme corporate goals:* These are the long-term goals to be pursued, whose fulfillment ensures the existence of the company in the market and in the society, which can be characterized by the influence of the most diverse interest groups. These include, for example, profitability goals, market position goals or social goals.
- *Corporate principles:* These are the guiding principles that indicate how to proceed in fulfilling the corporate purpose and the corporate goals. These include first of all the behavioral principles, which are intended to regulate the behavior towards the various interest groups of the company (e.g. basic behavior towards employees, customers, suppliers or public). Furthermore, these include the management principles, which are intended to regulate the methodical approach to defining and solving problems. Examples for this are the marketing, the controlling or the logistics conception.

The importance of the logistics conception as a corporate principle depends first of all on the purpose of the business. Because the type of goods or services typical for a company determines the importance of the logistics costs and the delivery service[30] and thus the cost and market potential that can be exploited by the logistical perspective of problems. Regardless of the purpose of the business, however, corporate principles can lose or gain importance as a result of changing environmental conditions and thus changing requirements for management. Schumpeter already formulated a kind of *bottleneck rule:* for the priority of the tasks to be mastered by management: “The character of the enterprise and the entrepreneurial activity always depends on the nature of the partial task that poses the greatest difficulties.”[31] Increasingly, these are problems in the company that require logistical thinking for their structuring and solution. As already shown, many definitions of logistics contain elements that point to the character of logistics as a corporate principle. Essentially, there are two fundamental developments that give the logistics conception as a corporate principle a high priority.

First, *time* is increasingly becoming the decisive factor in competition. “In this context, process orientation and time orientation are complementary to each other, since the success potentials of a process-oriented organizational structure cannot be exploited

---

[29] Cf. similarly also Ulrich and Fluri (1995, pp. 9 ff.).

[30] Cf. Pfohl (2022, pp. 57 ff.).

[31] Schumpeter (1927, p. 480).

without a focus on time reduction goals in all business processes."[32] Too long development and lead times lead to significant competitive disadvantages. The importance of reducing the response time of companies both in the development of new products and in the production and distribution of the existing product range is vividly expressed in the term "Economies of Speed"[33]. Long lead times in the value chain make forecasts necessary, which inevitably become more inaccurate the longer the forecast period is. This leads to increasing inventory levels, missing parts and rush orders as well as a poorer delivery service. The shortening of innovation cycles (product life cycles) observed in competition leads to an increasing importance of the share of development time in product life time. Long development times mean that only a smaller market share remains compared to the faster competitor and experience curve disadvantages have to be accepted. On the other hand, shorter development times also offer the possibility to observe the market longer.

The second development is the trend towards the transition *from hierarchies to networks* in and between companies (interdependencies, mutual dependencies, connectedness). "Simply put, a network … is a group of people who talk to each other, exchange their ideas, information or provide each other with resources."[34] The distribution of tasks in the network among the network partners should be done in such a way that the efficiency and effectiveness of the network is increased. While hierarchical structures in the company are unilaterally vertically oriented and thus the subsystems of the company have no direct connection with each other, networks are multidirectionally oriented and allow especially horizontal connections of subsystems on the same level. This applies both to functionally and divisionally organized companies. But also completely new connections that go beyond the boundaries of the individual company will emerge. The spectrum of such networks ranges today from relatively simple inter-organizational logistics systems between two companies to complex supply chains spanning several companies.[35]

Thinking in the dimension of time and thinking in networks or interdependencies is characteristic of the logistical systems thinking. The anchoring of a corporate principle corresponding to this perspective of problems in the corporate policy is served by the formulation of a logistical mission statement. The formulation of a corporate mission statement is seen as a possibility to inform both the internal and external stakeholders of a company in a targeted way about the central values and behaviors and thus to influence their behavior.[36] It also serves the image building of the company within the framework of the corporate identity. In the following, the principles applicable to corporate mission

[32] Wildemann (2001, p. 9).
[33] Cf. Chandler (1977, p. 281).
[34] Naisbitt (1984, p. 273).
[35] Cf. Pfohl (2000).
[36] Cf. Ulrich and Fluri (1995, pp. 92 ff.).

statements are transferred to the *logistics mission statement*. The logistics mission statement can either serve as a supplement to a corporate mission statement or replace it, e.g. in logistics companies. The anchoring of corporate policy in a logistics mission statement is all the more important, the more fundamentally the competitiveness of a company depends on its logistics know-how.

The *flow- or process orientation* that is expressed in the logistics chain is at the center of the required logistics guiding principle. This flow orientation or flow optimization ("Managing Processes") in the entire logistics chain contrasts with inventory optimization or functional optimization ("Managing Buffers") in each link of the logistics chain. In inventory or functional optimization, the goal of maximizing the capacity utilization of fixed assets and personnel while maintaining deadlines dominates, whereby buffer stocks decouple the links of the logistics chain. In contrast, in flow orientation or optimization, the goal of reducing throughput times while taking into account opportunity costs of a too low delivery service level dominates, whereby the links of the logistics chain are networked with each other informatively. The flow orientation assumes, due to the increased forecasting uncertainty, that it is more appropriate to hold "capacities" in fixed assets rather than in current assets. Because in the product diversity given in many companies, even with high inventory levels, it can be observed that the customer demands precisely the products that are not in stock. With the help of the necessary qualitative and quantitative capacities in fixed assets, on the other hand, the demand can be responded to in the short term with the right product variant. The flow orientation also sees the danger in holding inventories that errors are concealed. Because inventories obscure error-prone processes, uncoordinated capacities, lack of flexibility, scrap or a poor delivery service of the supplier.

The flow orientation as a logistics guiding principle in the management conception of a company also requires a reorientation of its *behavioral principles*. This first affects the relationships of the logistics area to the other business areas of the company. Because the logistics costs are not only caused by the activities in the logistics chain, but much earlier by decisions in marketing (e.g. expansion of the product range and product design), in research and development (e.g. part variety and "logistics-unfriendly" design of parts) or in purchasing (e.g. supplier structure). Therefore, the cooperation across business area boundaries must be intensified. Area-egoistic antagonism must be replaced by a cooperation that corresponds to the network idea.

This network idea also applies to the relationships with suppliers. Because the flow orientation, in which each storage is initially to be questioned as an undesirable interruption of the material flow, corresponds to the principle of production-synchronous procurement (Just-in-Time-delivery). This principle is based on a partnership relationship between supplier and customer, which is reflected in close communication relationships and mutually coordinated procedural rules. It includes the tendency to reduce the number of suppliers, whereby the selection criteria of adaptability in terms of desired delivery frequency, exact deadlines and a high quality standard gain in importance. There is a new division of tasks between supplier and customer. For example, the responsibility for quality control is transferred to the supplier. Since the control of the delivery behavior through competition becomes more difficult, other control instruments will come to the fore. These include, for example, the permanent value analysis of the supplied parts at the supplier by employees of the customer or the evaluation of the experience curve theory to estimate the cost reduction potential at the supplier.

For *logistics companies*, the flow orientation may mean that the corporate purpose has to be redefined. The more, for example, the transport is integrated into the intra- or inter-company logistics of the industrial and commercial companies, the more differentiated services are demanded from the transport industry, which require a complete organizational and service-oriented change.[37]

The *example* in Fig. 2.5 shows an excerpt from the guiding principle of a forwarding company.[38] It becomes clear that for logistics companies, the corporate guiding principle is synonymous with the logistics guiding principle. An essential basis for the formulation of logistics guiding principles in particular and the formulation of corporate policy in general is corporate ethics. This will be discussed in more detail below.

2.4.2 Business Ethics

The *business ethics* is a subfield of ethics. In contrast to the comprehensive economic ethics, the microeconomic aspect is emphasized. The question arises, what significance morality has for the company. First, the moral basis of a society, the values accepted in a society, is part of the institutional framework of a company.[39] This part of the institutional environment is particularly important when other institutional elements—especially the law—cannot perform their function of *behavioral orientation and stabilization*. This is the case, on the one hand, when clarifying laws do not exist and business partners have not made sufficient agreements. Secondly, a manager will never know all existing laws and agreements in detail. It is therefore obvious that morality also has a catch-all function in this case. Even if a logistics manager does not know all environmental laws, his moral foundation will help him make decisions that are compatible with the norms and expectations of society for environmental protection. In other words, business ethics deals with the question of how to deal responsibly with the remaining freedoms in the market economy.[40] In addition to this main function of morality for the functioning of companies, the aspect of *legitimation* must be mentioned secondly, which, however, has less importance for the further consideration.

[37] Cf. Freichel (1992, pp. 21 ff.).

[38] For logistics guiding principles, see also Prockl (2007, pp. 92 ff.).

[39] Cf. Large (2010, p. 481).

[40] Cf. van Luijk (1995, p. 208).

We give our customers the best possible service in the field of integrated logistics.

This is equivalent to

- Use of the most modern means of communication, EDP strategies and working techniques in each case
- Continuous personal development
- Focus on clearly defined business areas

We focus on

- The organization of European groupage transports
- The storage and distribution of consumer goods with a focus on "white" and "brown" goods and new furniture
- Individual services within the transport chain (value added services)
- The system partnership with the parcel service German Parcel

We only operate our own branches in our traditional catchment area. Otherwise, we work together with the regionally market-leading partners.

The expansion and safeguarding of this network between all important European major trading centers is continuously ensured. Membership in cooperative ventures such as "IDS" and "ILS is part of this strategy.

In principle, the priority of external procurement applies to the transport service. The selection of the carrier is made in ecological responsibility between rail, inland waterway and truck.

All corporate divisions are geared towards economically viable, organic growth.

We accept our responsibility for the environment. Innovative, resource-saving logistics solutions enjoy priority.

Every employee is responsible for the success of our company.

Fig. 2.5 Example of a logistics guiding principle. Excerpt from the company principles of Pracht Spedition + Logistik. *Source* Göpfert 2013, p. 193

The aspect of behavioral orientation in complex and uncertain situations is reflected, for example, in the formulation of business ethics as “the doctrine of the right action of corporate management in (far-reaching) conflicts with stakeholder groups of the company".[41] It is not about a conflict between economic requirements and morality. Also the economic principle and the principle of generating and distributing profits are de facto prevailing norms and thus part of the morality of our cultural circle. Profit generation can therefore not be immoral,[42] as long as the majority in our society accepts it as a norm.

The relevance of business ethics for logistics management shall be exemplified. Large mentions five fields of action for a sustainable logistics management,[43] which are not solely determined by legal regulations and by customer requirements, which is why business ethics is of fundamental importance for them. The fields of action are: "reduce transport intensity", "reduce land use by logistics", "select transport modes taking into account criteria of sustainable development", "permanently improve working conditions in logistics", "contribute to qualified employment". In the following, the necessity of ethical foundations for logistics management will be demonstrated by means of two examples.

Logistics is one of the business functions for which ecological requirements for the relief of the natural environment by avoidance, reduction and elimination are of the highest relevance. Of central importance is the relationship between *external transport and environmental protection.* The strong increase in traffic volume has led to an increasing burden on the natural environment despite technological improvements in the field of transport technology. On the one hand, logistic technology enables humans to control space and time. On the other hand, it imposes constraints and negative consequences for the environment on humans.[44] Despite governmental regulations in the form of environmental legislation and customer demands, there remains a tension that must be filled by ethical norms. This concerns especially the avoidance of transports and the consciously environmentally oriented choice of transport modes. A prerequisite for taking environmental morals into account in decision-making processes is the formulation of independent environmental goals and their integration into the logistics concept.

Another ethical problem area of logistics is the problem of *pseudo self-employment in the transport sector.* Although in Germany, with the "Law on Corrections in Social Security and the Protection of Workers' Rights" and the "Law on Combating Undeclared Work and Illegal Employment", essential steps have been taken to combat pseudo self-employment, the trend of shifting entrepreneurial risk to dependent "subcontractors" is still present. These subcontractors, who only have a single vehicle and are managed like employees, enjoy neither the employee protection rights nor is there sufficient social security. Although this practice from the perspective of the contracting freight transport companies brings a high degree of flexibility, combined with low costs, there are moral

[41] Steinmann (1993, p. 4336).

[42] Cf. Schneider (1990).

[43] Large (2010, pp. 487 ff.).

[44] Cf. Onckenfels (1998, p. 184).

concerns. In addition to the social situation of the subcontractors, the effects of this situation on traffic safety must also be considered.

After the identification of the problem areas and relevant norms, the second task of business ethics is to ensure the consideration of the norms recognized as right and important in the realization of logistics processes in the company. It is therefore necessary to link logistics ethics with logistics management and thus make the moral orientations of action available in concrete decision situations. The rules laid down in the corporate constitution also serve this purpose.

2.4.3 Corporate Constitution

Corporate governance and compliance are part of the corporate constitution.[45] The corporate constitution provides the framework for all company activities and is the basis for corporate oversight. Two essential questions are answered by the corporate constitution. On the one hand, the question of legitimacy, by whom the goals and policies of the company are determined. On the other hand, the question of control, by which organizational arrangements are made for aligning the company activities with the framework.

Corporate governance encompasses all legal rules and recognized standards for corporate management and the legal and factual integration of the company into its environment.[46] The aspects to be regulated range from the determination of the overarching objective, the structures, processes and staff of corporate management, the regular evaluation of management activities to proactive corporate communication.[47] The determination of the overarching objective is done to provide the management with a direction of action, with which conflicts of interest between the stakeholders can be resolved in individual cases. Structures, processes and staff of corporate management form the cornerstones with which the overarching objective is to be achieved. The regular evaluation of management activities serves to analyze and continuously improve management. Finally, transparency is to be created by proactive corporate communication, thereby gaining the trust of stakeholders and securing their support. The rules for corporate governance can stem from legal regulations and/or from voluntary, sub-legal governance standards of the company. Sub-legal governance standards are all company-relevant social and ethical norms, corporate guidelines and policies, employment contracts, rules of procedure and codes of conduct and ethics that go beyond the law. Legal regulations include, among others, environmental law, tax law, capital market law, anti-corruption law, data protection law and foreign trade law. A cross-company set of rules is the “German Corporate

[45] See Küting and Busch (2009, p. 1367).

[46] Cf. von Werder (2008, p. 1).

[47] Cf. von Werder (2008, pp. 9 f.).

Governance Code" adopted by the Federal Ministry of Justice in 2002. The code comprises legal rules as well as recognized standards of diligent corporate management.[48]

To be distinguished from corporate governance is the term compliance. *Compliance,* derived from "to comply", means "in accordance with requirements". It describes the obligation to comply with principles and governance standards applicable to the company.[49] The task of compliance is risk prevention and damage defense. The effects of legal and rule violations on the image of a company, the motivation of its employees, the acceptance of its products in the market, ultimately influence its economic success.[50] A deficiency in compliance of a company can have far-reaching consequences, from loss of reputation, exclusion from public and private contract awards, significant financial losses to criminal measures.

Companies are responsible for their corporate activities. Legal rules and customer requirements have led to this responsibility being extended to the entire value chain. Companies are therefore forced to demand compliance with legal rules and governance standards from their suppliers as well, in order to prevent disadvantages from compliance violations by suppliers.

Compliance with rules can be achieved by minimizing risks with regard to possible legal violations, fair competition and regular review and development of a supplier pool.[51] To do this, risks from the compliance environment must be identified and then integrated into supplier management. In addition to the core elements, such as reliability, competence, performance and costs, country-specific risks must also be considered. Various indicators are available for assessing country-specific risks. These indicators include, among others, the corruption warning index, Bertelsmann Transformation Index, Environmental Performance Index or an OECD membership.[52]

References

Abele E et al (2012) Überwindung von Zielkonflikten in Netzwerken der Automobilindustrie. Wettbewerbsfähigkeit durch Integration von Produktion, Logistik und Verkehr. Industrie Manag 28(5):29–32

Barney J (1991) Firm resources and sustained competitive advantage. J Manag Stud 17(1):99–120

Bowersox D, Daugherty P (1987) Emerging patterns of logistical organization. J Bus Logist 8(1):46–60

[48] Cf. Corporate Governance Code (2013a).

[49] Cf. Corporate Governance Code (2013b).

[50] Cf. Porter and Kramer (2007, p. 83).

[51] Cf. Federal Association of Materials Management, Purchasing and Logistics e. V. (2012, p. 5).

[52] Cf. ibid.

Bundesverband Materialwirtschaft, Einkauf und Logistik (BME) e. V. (2012) Der Standard BME C 1000. Anforderungen an einen Compliance/CSR-Prozess im Lieferantenmanagement. BME, Frankfurt a. M.
Chandler A (1977) The visible hand. The managerial revolution in American business. Belknap Press, Cambridge
Cooper M, Ellram L (1993) Characteristics of supply chain management and the implications for purchasing and logistics strategy. Int J Logist Manag 4(2):13–24
Cooper M et al (2012) The Ohio State University 2012 survey of career patterns in logistics and supply chain management. CLM, Oak Brook
Cordes M (2013) Wer hat an der Uhr gedreht? Verkehrsrundschau 67(42):22–27
Corporate Governance Kodex (2013a) Deutscher Corporate Governance Kodex. https://www.dcgk.de/de/kodex/archiv.html?file=files/dcgk/usercontent/de/download/kodex/D_CorGov_Endfassung_2013.pdf. Accessed: 15. Dec 2015
Corporate Governance Kodex (2013b) Deutscher Corporate Governance Kodex in der Fassung vom 13. Mai 2013 mit Beschlüssen aus der Plenarsitzung vom 13. Mai 2013. Frankfurt a. M.
Eßig M, Hofmann E, Stölzle W (2013) Supply chain management. Vahlen, München
European Logistics Association ELA, Kearney AT (1999) Insight to impact. Results of the fourth quinquennial European logistics study. ELA, Brussels
Freichel S (1992) Organisation von Logistikservice-Netzwerken. Theoretische Konzeption und empirische Fallstudien. Erich Schmidt, Berlin
Furmans K, Kilger C (Eds) (2019) Betrieb von Logistiksystemen. Springer, Berlin
Gomm M (2008) Supply Chain Finanzierung. Optimierung der Finanzflüsse in Wertschöpfungsketten. Erich Schmidt, Berlin
Göpfert I (2013) Logistik: Führungskonzeption und Management von Supply Chains, 3. Ed. Vahlen, München
Handfield R, Straube F, Pfohl H-C, Wieland A (2013) Trends und Strategien in Logistik und Supply Chain Management. Vorteile im Wettbewerb durch Beherrschung von Komplexität. DVV Media Group, Hamburg
Kleer M (1991) Effiziente Gestaltung des Logistikkanals mittels Kooperation zwischen Hersteller und Logistikunternehmen – theoretische Überlegungen und empirische Befunde. Erich Schmidt, Berlin
Küting K, Busch J (2009) Zum Wirrwarr des Überwachungsbegriff. Der Betrieb 62(26):1361–1367
Lalonde B (1985) A reconfiguration of logistics systems in the 1980s: strategies and challenges. In: Robeson J (Ed) The distribution handbook. Free Press, New York, pp 54–60
Large R (2010) Nachhaltigkeit und Logistik. Überlegungen zur normativen Ebene des Logistikmanagements. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, pp 477–494
Mikus B (2003) Strategisches Logistikmanagement. Ein markt-, prozess- und ressourcenorientiertes Konzept. Dt. Universitäts, Wiesbaden
Naisbitt J (1984) Megatrends: ten new directions transforming our lives. Warner Books, New York
Ockenfels W (1998) Ökologie und Technik in sozialethischer Perspektive. Duncker & Humblot, Berlin
Persson G (1982) Organization design strategies for business logistics. Phy Distrib Mater Manage 13(3):27–36
Pfohl H-Chr (1970) Marketing-Logistik. Ohne richtige Organisation kein Erfolg. Mark J 3(4):256–258
Pfohl H-Chr (1985) Produktionsfaktor „Information" in der Logistik. In: Institut für Logistik, Deutsche Gesellschaft für Logistik e. V. (Ed) Informationssysteme in der Logistik. DGfL, Dortmund, pp 1–28

Pfohl H-Chr (1999) Ständiger Wandel. Änderung der Organisations- und Personalstruktur als Voraussetzung zur Logistikexzellenz. In: Pfohl H-Chr (Ed) Logistik 2000plus. Visionen, Märkte, Ressourcen. Erich Schmidt, Berlin, pp 167–220

Pfohl H-Chr (2000) Supply Chain Management: Konzept, Trends, Strategien. In: Pfohl H-Chr (Ed) Supply Chain Management. Logistik plus? Logistikkette – marketingkette – Finanzkette. Erich Schmidt, Berlin, pp 1–42

Pfohl H-Chr (2004) Grundlagen der Kooperation in Logistiknetzwerken. In: Pfohl H-Chr (Ed) Erfolgsfaktor Kooperation in der Logistik. Outsourcing – Beziehungsmanagement – Finanzielle Performance. Erich Schmidt, Berlin, pp 1–36

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev a. act. ed. Springer, Berlin

Pfohl H-Chr, Large R (1992) Gestaltung interorganisatorischer Logistiksysteme auf der Grundlage der Transaktionskostentheorie. Z Verkehrswissensch 63(1):15–51

Pfohl H-Chr, Stölzle W (1997) Planung und Kontrolle. Konzeption, Gestaltung, Implementierung, 2., rev. ed. Vahlen, München

Porter M, Kramer R (2007) Corporate social responsibility. Harv Bus Manager 29(1):16–34

Prockl G (2007) Logistik-Management im Spannungsfeld zwischen wissenschaftlicher Erklärung und praktischer Handlung. Gabler, Wiesbaden

Schneider D (1990) Unternehmensethik und Gewinnprinzip in der Betriebswirtschaftslehre. ZfbF 42(10):869–891

Schumpeter J (1928) Stichwort „Unternehmer". In: Elster L, Weber A, Wieser F (Eds) Handwörterbuch der Staatswissenschaften, Bd VIII., 4. ed. Gustav Fischer, Jena, pp 476–487

Stank T, Keller S, Daugherty P (2001) Supply chain collaboration and logistical service performance. J Bus Logist 22(1):29–48

Steinmann H (1993) Unternehmensethik. In: Wittmann et al (Eds) Handwörterbuch der Betriebswirtschaftslehre, 5. ed. Schäffer-Poeschel, Stuttgart, pp 4331–4343

Stölzle W, Gareis K (Eds) (2002) Integrative Management- und Logistikkonzepte. Gabler, Wiesbaden

Ulrich P, Fluri E (1995) Management. Eine konzentrierte Einführung, 7, corr. ed. Haupt, Bern

Van Luijk H (1995) Search of a theory. Gustav Schmoller on economic justice: a guide to present problems in business ethics? Springer, Berlin Heidelberg

von Werder A (2008) Führungsorganisation. Grundlagen der Corporate Governance, Spitzen- und Leitungsorganisation, 2., act. a. ext. ed. Gabler, Wiesbaden

Weber J, Dehler M (2000) Entwicklungsstand der Logistik. In: Pfohl H-C (Ed) Supply Chain Management: Logistik plus? Logistikkette – Marketingkette – Finanzkette. Erich-Schmidt, Berlin, pp 45–68

Wildemann H (2001) Das Just-in-time-Konzept. Produktion und Zulieferung auf Abruf, 5. ed. TCW, München

Zöllner W (1990) Strategische Absatzmarktplanung. Kunden- und Wettbewerbsanalyse für Logistikunternehmen, Springer, Berlin

3 Logistics as a Success Factor

3.1 Value of Logistics Services

3.1.1 Logistics as Value Creation

A necessary prerequisite for a success factor "logistics" is the positive contribution of logistic services to the value creation of a company or the entire supply chain. This raises the fundamental question of the value creation contribution of logistics services. The concept of value in economic science has a long tradition and is a very complex phenomenon that cannot be discussed comprehensively here. Following Large, however, three elementary value creation processes can be distinguished: transformation processes, transfer processes and transaction processes.[1] Each of these processes generates a relative value property, which is indispensable for the creation of the use value of a good. From the transformation processes, the suitability value of the goods arises. Transactions establish the legal availability by transferring rights of disposal. Logistics creates the factual availability of goods for a demander by transfer processes, which can also be called spatio-temporal goods transformations.[2] Only if the factual availability is given, a person gains in addition to the suitability value an additional space and time value and thus a use value from this good.[3] Logistics services are therefore value creation processes in the form of services. Figure 3.1 shows an example of the value creation by logistics services. If the customer is willing to accept a higher market price as a result of a shorter delivery time (throughput time) and it is possible to shorten the delivery time by using a logistics control, the subfigure b shows the value creation of logistics compared to the subfigure a.

[1] See the following Large (2012, pp. 1 ff.).

[2] Cf. also Pfohl (2022, pp. 3 f.).

[3] On the types of values see Pfohl (2018, pp. 23 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_3

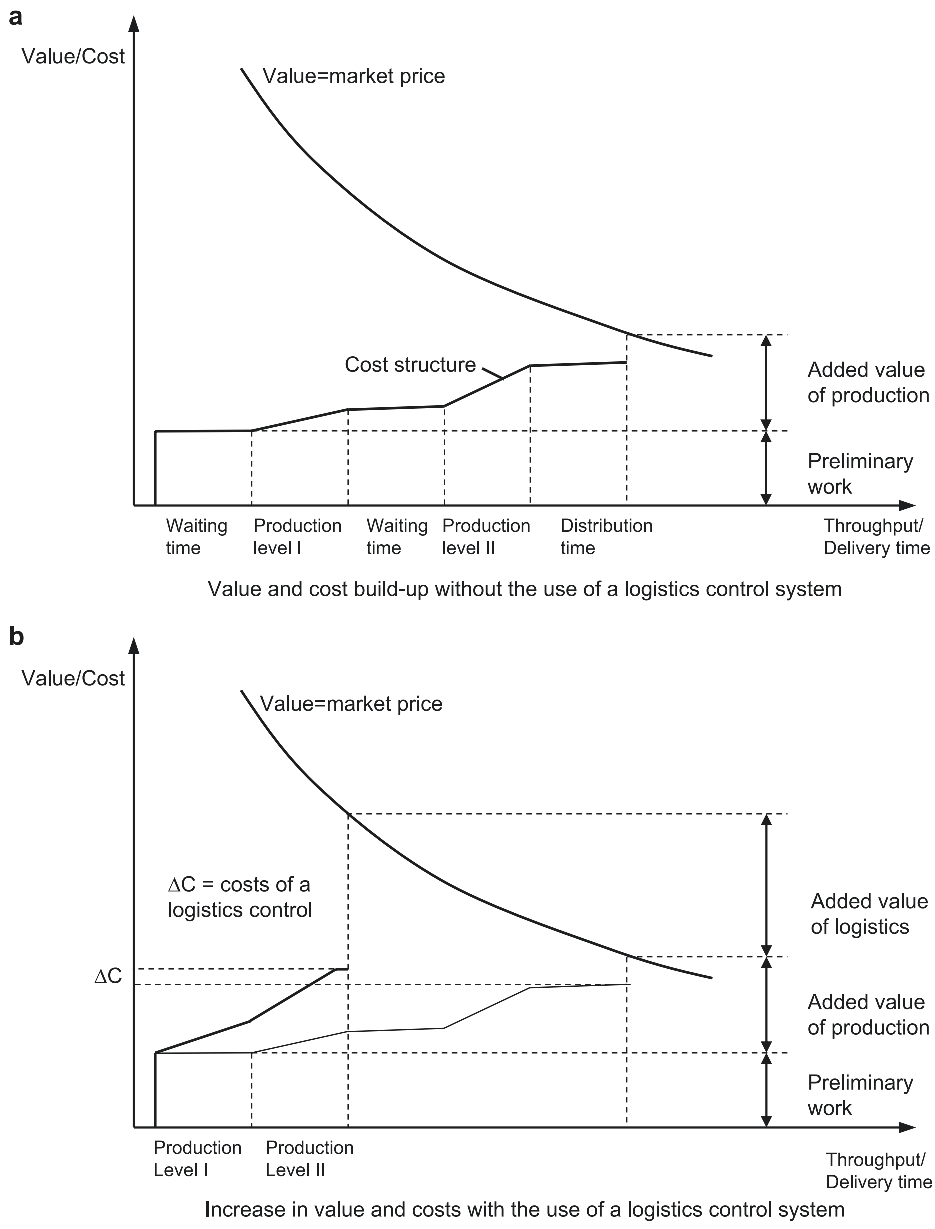


Fig. 3.1 Value creation by shortening the delivery time. *Source* Zeterberg 1989, p. 5 and 7

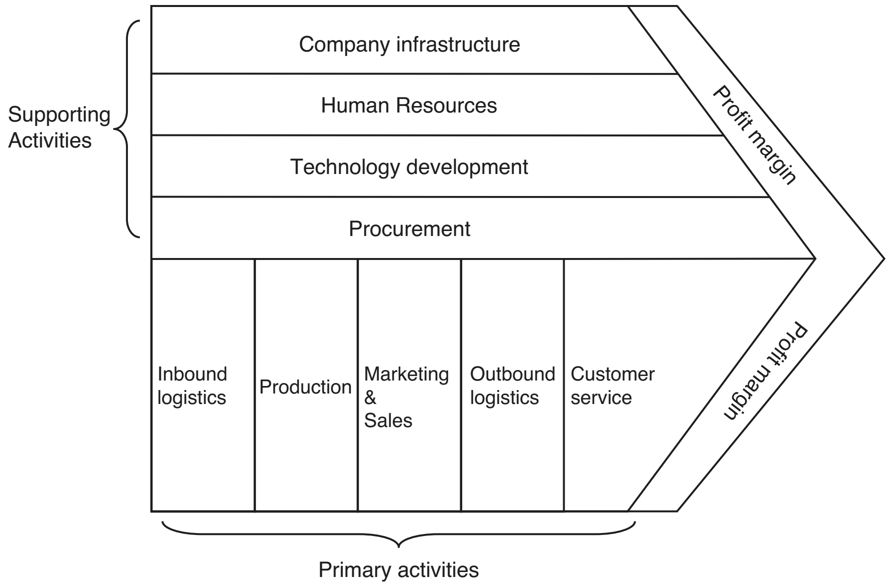


Fig. 3.2 Model of the value chain. *Source* With minor modifications taken from Porter 2014, p. 66

3.1.2 Logistics in the Value Chain

The value of logistic services can be further concretized by using the model of the value chain[4] The value chain of a company for a product shows how its total value is composed of the *value activities* and the profit margin. As Fig. 3.2 illustrates, two types of value activities can be distinguished. Primary activities deal with the production, sales, delivery and customer service. Porter explicitly lists procurement (inbound) logistics and distribution (outbound) logistics among them. Production logistics is included in production ("operations"). Supporting activities sustain the primary activities and each other by purchasing material and fixed assets, recruiting and developing personnel, developing new technologies and providing a corporate infrastructure in the form of organization, planning, accounting, finance, etc.

The value chain is an analytical tool for breaking down a company into the activities that allow cost reductions or performance improvements. Since the value activities are linked to each other, this depends not only on the design of the individual activities, but also on the nature of their *linkage*. This makes the importance of logistics management for the value chain immediately evident. Because the consideration of the interdependen-

[4] Cf. Porter (2014, pp. 61 ff.).

cies between functions, institutions and flows was in the logistics cube (Fig. 2.2) presented as an essential characteristic of logistics management.

The institutional interdependencies are highlighted in the model of the value chain as links with the value chains of the companies cooperating in the procurement and distribution channel as significant in addition to the links within a value chain. Each supply chain can therefore be understood as a concatenation or better networking of individual value chains. The value of a product or service for the customer ultimately results from the fact that all members of the supply chain influence each other in such a way that the total costs are reduced or the performance is increased.

The value of logistics services is thus generally proven. In the next section, the improvement of the company efficiency by logistics management will be shown by using some specific indicators.

3.2 Contribution of Logistics Management to Achieving the Company Goals

3.2.1 Approaches to Efficiency Measurement

How all other subareas of a company (e.g. production or finance) also have the logistics area to contribute to increasing the overall efficiency of the company. How this Efficiency is measured depends on the goals pursued by the company. Without going into the discussion of corporate goals in detail, it can be stated that the efficiency of the company can primarily be measured by by *input-output relations*.

It is characteristic of every company that it has to assume the scarcity of resources. Therefore, the basic goal for the company is economic efficiency, according to which an optimal ratio of resources and corresponding results is to be sought. The input-output approach underlying this principle can be captured both in the *technological* and in the *economic efficiency* dimension described in Fig. 3.3.[5] The technological dimension of the company requires thinking in quantities and times, while the economic dimension is based on thinking in values. A typical goal captured in the technological dimension is productivity, defined as the quotient of output quantity to input quantity. If the input-output quantities are valued, one arrives at economic cost-benefit or cost-performance relations. Since it is not only important in a market economy to produce goods economically (performance creation), but also to sell them on the market (performance utilization), the profitability, measured as the quotient of achieved profit and invested capital, is of decisive importance as an economic input-output relation.

Of course, there are *further approaches to efficiency measurement* besides the efficiency measurement by input-output relations, both in the economic and in the techno-

[5] See also the dimensions of the balanced scorecard in Part II, Sect. 5.3.

Technological dimension	Economical dimension	Social dimension	Ecological dimension
Thinking in quantities and times	Thinking in values	Thinking in terms of needs and roles	Thinking in environmental impacts
- Performance capability problems • quantitative capacity • qualitative capacity • elasticity	- Problems of prices • on the procurement market • on the sales market • in the company (internal transfer prices)	- Problems of motivation ("wanting") – extrinsic – intrinsic	- Problems of production-related environmental pollution • Input side (consumption of natural resources) • Output side (release of emissions and residues)
- Performance readiness problems • Failure frequency • User-friendliness (ease of use)	- Problems of revenue and costs • Market position and growth • Cost types, cost centers and cost objects • Cost relevance of processes • Problems of deposits and withdrawals	- Problems of the role ("may or must") • Behavioral expectations in the company • Behavioral expectations in society towards the company	- Problems of product-related environmental pollution • in the phase of product use/ -consumption • in the phase of product disposal phase
- Productivity - Lead time - Capacity utilization	- Liquidity - Success (profitability) - Enterprise value - Success potential	- Employee satisfaction - Long-term maintenance of employee health - Complying with requirements of the community	- Environmental compatibility in all phases of the ecological product life cycle

Fig. 3.3 Dimensions of efficiency of a company

logical dimension. On the technological level, these are on the one hand quantitative input relations (capacity utilization, economy of resource use) or quantitative output relations (yield of resource use), and on the other hand also qualitative demands on the input and output. This concerns both the functional quality of used and produced goods (qualitative capacity, elasticity, failure frequency and user-friendliness) and their integration quality, i.e. their suitability to be combined with other goods in a coordinated way (e.g. coordination of the quantitative or qualitative capacities of operating resources). Last but not least, the approaches to capturing throughput times of goods belong to the efficiency measurement on the technological level.

On the economic level, besides the profitability goal, the corporate value goal, i.e. the sustainable increase of the corporate value, the liquidity goal, i.e. the goal of maintaining the ability to pay at any time, and the success potential goal (or success source), i.e. the goal of creating potentials from which profits can be generated in the future, are important.

Due to the changed values in society, the *social efficiency* gains increasing importance in addition to the technological and economic efficiency. A company is socially efficient if it succeeds in meeting the expectations of its employees and relevant interest groups from the company's environment (e.g. expectations of suppliers or the municipality). Typical goals in the social dimension are the satisfaction of the employees or the long-term preservation of their health. An example of a goal from the social environment of the company would be the support of small and medium-sized suppliers in maintaining their independence.

With the increasing environmental awareness in the population, companies are increasingly faced with the demand to strive for *ecological efficiency* in processes and products. In this context, the consumption of natural resources in production processes should be reduced by an appropriate production technology or by the increased use of secondary raw materials (raw materials recovered from residues) and the output of emissions should be reduced by additive or integrated environmental protection technologies.

With regard to product-related environmental protection, the focus is on reducing the environmental impact in the phases of product creation or consumption and disposal. Therefore, it is important to increase the environmental compatibility in all phases of the ecological product life cycle as a characteristic goal of the ecological dimension. The logistics management can contribute to this by, for example, creating the conditions for reducing the amount of waste to be disposed of by organizing residue cycles for used products and packaging from the consumer to the manufacturer.

The potential contribution of logistics management to the corporate goals is discussed below using the examples of productivity, profitability, corporate value, success source, job satisfaction and environmental compatibility.

3.2.2 Productivity

In the past, great successes have been achieved in improving the productivity of logistics systems. However, operational logistics projects, which include projects aimed at increasing productivity, are still of importance for logistics management.[6] The productivity of the production factors available in a company per unit (e.g. productivity of an available man-hour) can be mathematically broken down by the following *productivity equation*[7]:

$$\frac{\textit{Output Act}}{\textit{Input Avail}} = \frac{\textit{Output Targ}}{\textit{Input Used}} \times \frac{\textit{Input Used}}{\textit{Input Avail}} \times \frac{\textit{Output Act}}{\textit{Output Targ}}$$

Actual Productivity of the available unit of a production factor	Potential productivity of the used unit of a production factor when using a specific Logistics technology ("Productivity of logistics technology")	Capacity utilization - degree	Performance level (yield level)

Output Actual	=	Actual yield achieved with the available unit of a production factor
Input Avail	=	Available unit of a production factor
Input Used	=	Used unit of a production factor
Output Target	=	Potential yield of the used unit of a production factor as a property of a specific logistics technology

As can be seen from this productivity equation and the corresponding example in Fig. 3.4, there are thus three possibilities of productivity improvement.

First, the logistics technology can be improved both in the hardware and software areas. This includes, for example, the automation of a warehouse or the number and locations of the warehouses. Another example to characterize a specific logistics technology is the type of trucks used in a fleet and the route planning for the use of this fleet. Each logistics technology has its own productivity.

Second, productivity can be improved by aligning the capacities of the available and actually required production factors. If a warehouse has a capacity of 200,000 storage units, but only 100,000 are needed at peak times, then the excess capacity burdens each unit that is stored in the warehouse. The key to better capacity utilization lies in proper capacity planning. Once excess capacities are built up, capacity utilization can often no longer be improved.

[6] Cf. the main objectives of logistics projects in the study by Straube and Pfohl (2008, pp. 30 ff.).

[7] Cf. the following NCPDM (1984, pp. 35 ff.).

Productivity improvement	Potential productivity of the deployed technology	X	Capacity utilization	X	Performance level	=	Actual productivity
Units of measurement	Standard article number / Picker working hours	X	Picker working hours / Available man-hours	X	Actual item count / Standard article number	=	Actual item count / Available man-hours
1. Current productivity	20	X	0.75	X	0.80	=	12
- Technology: hand trolley - 20 articles/hour - Capacity: 30 hours per week per employee (75%) - Performance: 16 as opposed to 20 articles (80%)							
2. Improved technology	35	X	0.75	X	0.80	=	21
Electric trolley, picking by zones - Technology: 35 articles/hour - Capacity: as above (75%) - Performance: 28 as opposed to 35 articles (80%)							
3. Improved capacity utilization	35	X	0.90	X	0.80	=	25.2
"Completion of backlog" for the provision of 36 hours of picking work per employee - Technology: as above (35) - Capacity: 7.2 out of 8 hours (90%) - Performance: as above (80%)							
4. Improved performance level	35	X	0.90	X	0.95	=	29.9
Determination of standards according to ergonomical methods and establishment of a feedback system - Technology: as above (35) - Capacity: as above (90%) - Performance: 33.2 opposed to 35 articles (95%)							

Fig. 3.4 Example of the possibilities for improving productivity. *Source* NCPDM 1984, retranslated.

Thirdly, productivity can be improved by increasing the efficiency of the production factors used. Given a logistics technology, this is possible by a higher willingness to perform of the production factor labor, which will be discussed later in the treatment of the goal "job satisfaction". If the logistics technology used in a warehouse allows a turnover of 36 pallets per hour, but only 31 are turned over, then the introduction of a performance-based wage may enable an improvement of the efficiency and thus the productivity.

3.2.3 Profitability

The possible contribution of logistics management to improving the profitability has been demonstrated in empirical studies.[8] The profitability of the capital employed in a company can be mathematically broken down by the following *profitability equation*:

$$\frac{Profit}{Capital} = \frac{Profit}{Sales} \times \frac{Sales}{Capital}$$

Return on investment	Return on sales	Capital turnover

Since the profit is equal to the difference between revenue and costs, there are three possibilities for profitability improvement from the profitability equation, namely reducing costs, reducing capital commitment or increasing revenue. All three possibilities can be exploited by logistics management.

An *increase in revenue* can be achieved by an appropriate delivery service policy, if the delivery service is an instrument of the marketing policy on the sales market of a company.[9] The increase in revenue can be achieved either by a higher sales volume, by acquiring new customers with the help of a better delivery service. The increase in revenue can also be achieved by raising prices, if customers are willing to pay a corresponding price for a good delivery service. In this case, the delivery service assumes the function of "protecting the profit margin".

The *logistics costs* are measured as a cost block as a percentage of revenue[10] in most companies so large that a reduction in logistics costs can be expected to result in a noticeable improvement in profitability. For some branded products, logistics costs even represent the most significant cost block after advertising costs. Moreover, to assess the

[8] See also Sect. 1.3.2 and the literature cited by Pfohl (2001).

[9] On the importance and breakdown of the delivery service, see Pfohl (2022, pp. 32 ff.).

[10] On the importance and breakdown of the cost block, see Schwemmer (2019, pp. 40 f.), Pfohl (2022, pp. 50 ff.) and the literature cited there; Handfield et al. (2013, pp. 19 and 68).

logistics costs as a starting point for cost reduction measures, not only their share of revenue, but especially their share of value added in the company is important. For a "typical" industrial company, even years ago, when the depth of production was generally higher than today, about 57% of revenue was "pass-through items" (raw, auxiliary, operating materials, purchased parts, merchandise, services) and only 43% was value added in the company. If this value added is set at 100%, the logistics costs had a share of 22.5% of it at that time.[11]

Due to the previous neglect of this cost block, there are often still opportunities for cost reduction in all production factors (labor, equipment, material and information). However, the costs caused by the production factors are very different in terms of their influence (reducibility). For example, if the production factor costs are classified as fixed or variable, there are large differences. If one wants to characterize them roughly, building costs are fixed, information system costs are largely fixed, machine and labor costs are partly fixed, partly variable, but the material costs are variable. A reduction of the costs caused by material will therefore generally encounter comparatively less difficulties in companies than a reduction of the costs caused by other production factors.

Logistics management has a great influence on the *capital tied-up.* Because an analysis of the asset structure of companies shows that often a large part of the assets consists of inventories, whose management is part of the core task area of logistics management. A reduction of the inventory levels leads to a lower capital tied-up, a higher capital turnover and thus to an improvement of the capital profitability. Due to the lower capital tied-up, funds are also released that are available for financing other purposes, resulting in a positive contribution to liquidity. At the same time, the management of receivables and payables as other influencing factors of the net working capital becomes increasingly important. Here, too, logistics management can contribute to increasing liquidity in the design of procurement and delivery contracts. The capital tied-up in the fixed assets of the logistics area can, however, increase if this area still has a backlog of modern technology.

An example of the potential contribution of logistics management to profitability improvement through the reduction of costs and inventories is given in Fig. 3.5, in which the profitability equation is mathematically broken down in a familiar way by further ratios. However, it should be taken into account that the material costs are influenced to a large extent not by logistics management, but by purchasing management via the material price. A comparable profitability increase via the revenue will certainly require a much higher percentage increase in revenue. The "leverage effect" of costs and capital tied-up on profitability is greater than that of revenue, which is of great importance especially on markets with lower growth.

[11] Cf. NCPDM (1984, p. 23).

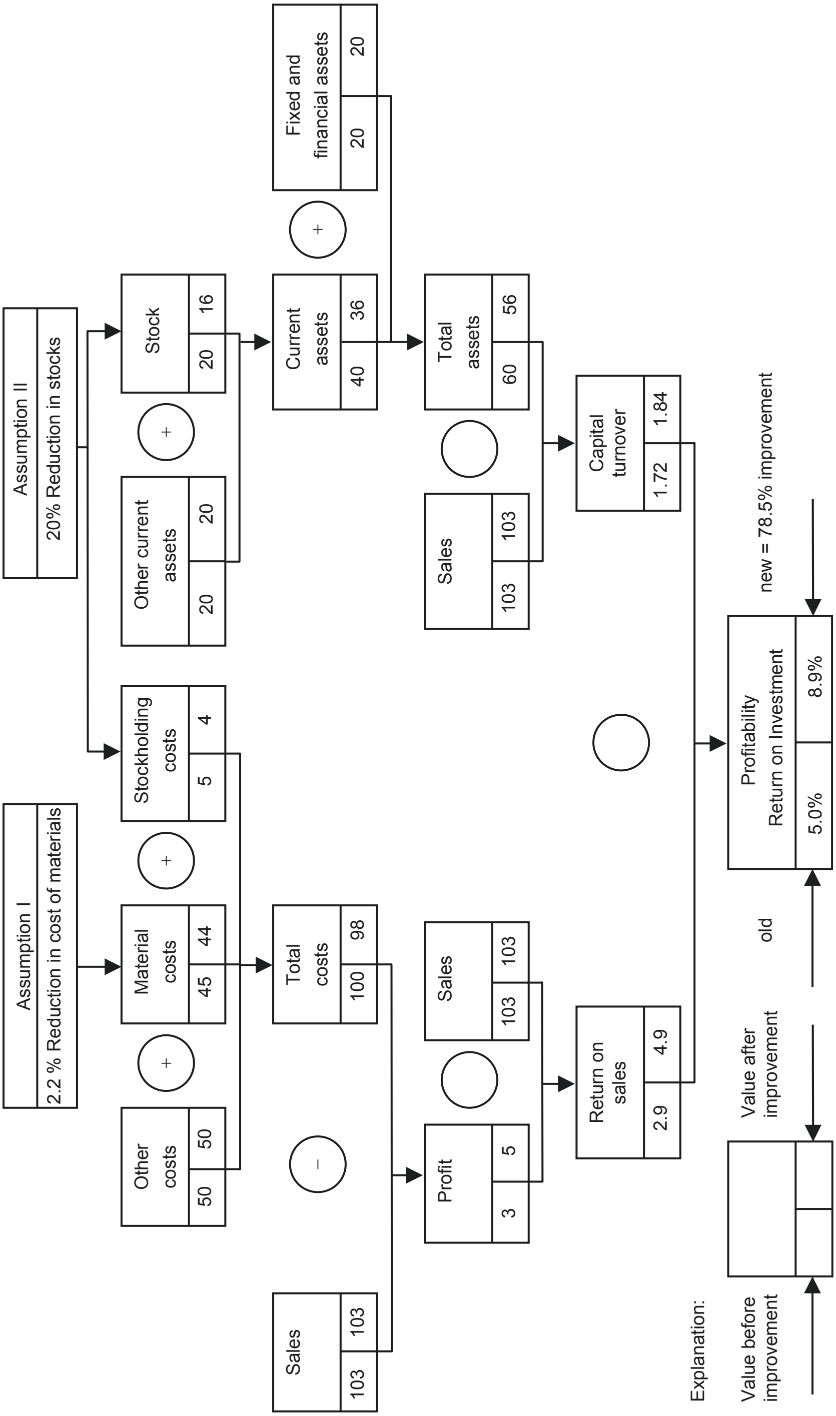


Fig. 3.5 Profitability effect of a reduction of material costs and stocks. *Source* Grochla et al. 1984, p. 28

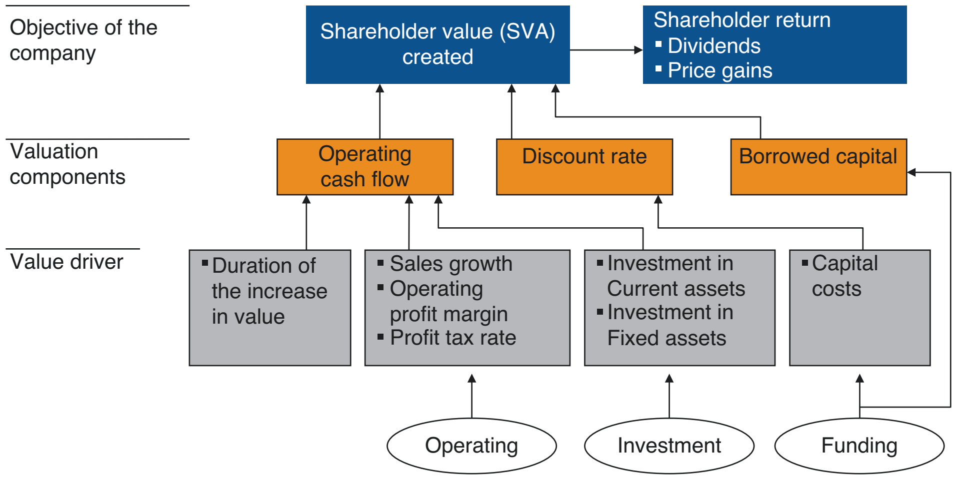


Fig. 3.6 Shareholder value network of Rappaport. *Source* Rappaport 1999, p. 88

3.2.4 Corporate Value

The possible contribution of logistics to increasing the corporate value has also been empirically proven.[12] In contrast to the profitability-oriented performance measurement, which is based on the figures of the external accounting system, the value-oriented performance measurement assumes that an additional value is only created when the generated result exceeds the risk-specific costs of equity and debt capital.[13] Risk and cost of equity are not included in the figures of the external accounting system. The value-oriented performance measurement, on the other hand, is based on the calculation of the "shareholder value", which is shown in Fig. 3.6.

In literature and practice, various *value drivers* are used and recommended for determining the corporate value. The decision for a specific valuation method has to be made company- and industry-specific. In particular, the selection is likely to depend on the practical feasibility of different methods. Often, "shareholder value" and "economic value added" are used as value drivers.[14] According to the two value drivers DCF and EVA, two *corporate value equations* can be formulated.

Following the useful definition of corporate value by Rappaport, it results from the sum of debt and equity at market values. The equity portion of the corporate value is the *shareholder* value. The valuation components that affect the shareholder value are fur-

[12] See Sect. 1.3.1.

[13] Cf. Gomm (2008, pp. 17 ff.).

[14] See Pfohl et al. (2003, pp. 23 ff.) and Gomm (2008, pp. 23 ff.).

ther subdivided into their value drivers. Management decisions regarding logistics have to start from these value drivers. The valuation components in the shareholder value network are defined as follows.

The operating cash flow results from the difference between inflows and outflows from the operating performance. In Rappaport's definition of the operating cash flow, the expansion investments are already deducted. Thus, Rappaport's definition of the operating cash flow is equivalent to the definition of the free cash flow, which is calculated as follows:

	Operating inflows
–	*Operating outflows (incl. replacement investments)*
=	Operating cash flow
–	*Tax payments*
–	*Expansion investments*
=	Free cash flow

The cost of capital, expressed in the discount rate, reflects the opportunity costs of alternative uses. The opportunity costs are the return on capital that can be expected in an investment of equal risk. The discount rate can be calculated using the Weighted Average Cost of Capital (WACC) method, which is the weighted average of debt and equity costs. These free cash flow values must be determined for all periods of the forecast horizon.

The *Economic Value Added (EVA)*—originally advocated by the consulting firm Stern Stewart—is calculated by multiplying the difference between the return on capital and the cost of capital, also called the "spread", by the capital employed:

$$\text{EVA} = (\text{Return on invested capital} - \text{Capital cost rate}) \times \text{Invested capital}$$

The literature on the EVA method usually focuses on the EVA of one period. The long-term and sustainable character that underlies the shareholder value concept is therefore not fully reflected here.

To determine relevant value drivers and to link the operational and strategic planning, an *operational value driver hierarchy* is proposed. An analysis of this operational value driver hierarchy can identify the key value drivers with high influence and high controllability.[15] These value drivers should therefore also be the focus of the measures to optimize the company value. However, it should be noted that the value influence and controllability are subject to a dynamic that requires a continuous value driver analysis. This dynamic can result from both external and internal changes in the company.

[15] Cf. Rappaport (1999, p. 204). For possibilities to influence the cash flow in the core business process "management of the supply chain" see Fig. 5.9 in Part II, Sect. 5.2.8.

3.2.5 Source of Success

The strategic importance of logistics is increasingly recognized with the advancing development of logistics management in companies.[16] Only in companies that lag behind the development of logistics might the statement still apply today, which LaLonde made at the beginning of the 80s for American management: “American management's philosophy has typically been: If youre smart enough to make it, aggressive enough to sell it—then any dummy can get it there! And now we're paying for that philosophy!”[17]

On a strategic level, the success objective (profit objective) of the company can no longer be quantified in terms of profitability indicators that are typical for the operational level of action. Because strategic decisions concern the long-term achievable success, whereby one has to rely more on “soft” than on “hard” information, which are hardly accessible to quantification. On a strategic level, only sources of success can be formulated, i.e. the sources from which the company will achieve its success after several years. Since success is defined as the difference between revenues and costs achieved in the market, the source of success is divided into cost and market potentials according to the following *source of success equation*:

$$\text{Source of success} = \text{Cost potential} + \text{Market potential}$$

The *cost potential* of logistics results from the fact that the production cost share decreases for many goods due to modern manufacturing technologies and cost reduction reserves will be found in the future mainly in the “non-production area” of the company.[18] Cost potentials exist for all production factors.

When using equipment, the transport, handling, storage and packaging technology still offer wide fields for mechanization and automation (e.g. palletizing and picking robots), as the logistics area is “under-technologized” compared to the production area.

When using material, new intra- and inter-organizational forms of inventory management offer themselves due to the logistical systems thinking. Taking into account the increasing value added, which the materials as well as semi-finished and finished products in the goods flow experience through the companies and between the companies, and the stability of demand, the inventories or the capital tied up by them can be reduced in the entire logistics channel.

When using labor, on the one hand there are possibilities to improve the workplaces by applying proven ergonomics knowledge, in order to make the workplaces more attractive for qualified workers. On the other hand, there are also great opportunities in the qualification of the workers within the framework of a continuous personnel development. Because only workers with a much higher qualification than is often still found

[16] Cf. European Logistics Association/BearingPoint (2002, pp. 10 ff.).

[17] Johnson and Wood (1982, p. 3).

[18] Cf. Göpfert (2013, p. 118).

in the logistics area today are able to cope with the higher demands resulting from the logistics conception when fulfilling logistics tasks.

Last but not least, the "new" production factor information in the field of logistics offers a great cost potential. The developments towards a more powerful computer-aided information processing both in the hardware and software area offer new possibilities of substituting other production factors by information.

The *market potential* of logistics results from the fact that on many markets the substitutability of the tangible assets increases and thus services play an increasingly important role in satisfying customer needs (solving customer problems). The creation of market potentials by logistical problem solutions offers itself both for industrial and trade companies as well as for logistics companies.

On markets with substitutable material goods, the products offered by industrial and trade companies as main or primary performances cannot be differentiated by the product design, i.e. by the type of function fulfillment or quality. But they can be differentiated by offering additional services as secondary performances in addition to the primary performances. Secondary performances are characterized by the fact that the provider takes over additional functions that can also be fulfilled by the customer. The basis for the secondary performances is therefore the takeover of additional functions and thus usually of costs that affect the procurement and production process of the customer. These secondary performances include the delivery service, which is offered by industrial and trade companies in connection with the sale of material goods (products). By offering a delivery service, functions are taken over by the system of distribution logistics of the supplier, which would otherwise have to be taken over by the system of procurement or production logistics of the customer.

The transport markets are increasingly developing into competitive markets.[19] For logistics companies, the alignment of their market task to the customer needs becomes as necessary a prerequisite for their existence as it has been for industrial and trade companies on most markets for a long time. By offering logistical problem solutions that are tailored to the customer problems, be it in the form of complete logistical service packages or in the form of an offer of transport services that better take into account the transport needs of the shipping industry, many market potentials can still be tapped on transport markets.

[19] Cf. Aberle (2009, p. 66).

3.2.6 Job Satisfaction

Job satisfaction is a factor influencing work performance, which can be concretized by the following *work performance equation* [20]:

$$\text{Work performances} = \text{f (Performance ability, Performance willingness)}$$

Under *performance ability* one understands the performance that a person is capable of delivering. It depends on individual factors (performance capacity) and situational factors (e.g. climate). Under *performance willingness* one understands the utilization of the performance ability under given conditions. It is divided into the physiological performance willingness, which is mainly determined by the vegetative—i.e. not subject to the will—nervous system, and the psychological performance willingness, for which the performance will plays a decisive role.

The value change in society has led to the fact that the *performance willingness* of the employees can not be taken for granted today in the companies. This is evident in the fact that more than half of the employees in German companies are unengaged at work and only deliver "performance according to regulations". The spectrum of employee expectations has become more extensive.[21] In addition to an appropriate payment, this spectrum includes, for example, the security of the workplace, interesting tasks, professional development opportunities, recognition, social contacts and a balanced relationship between professional and private life.

If the *job satisfaction* is also difficult to measure, it is nevertheless proven that the respective employee expectation has a direct influence on the job satisfaction, which shows the necessity of considering the expectations of the employees in the companies. Because the job satisfaction in turn, albeit only under certain conditions and often only in the long term, has a positive influence on the performance willingness and thus on the performance.[22] The job satisfaction is thus not only a goal, with which the social efficiency of a company can be assessed, but also has effects on its technological, economic and ecological efficiency.

The logistics conception can contribute to the fulfillment of all expectations that influence the job satisfaction of the employees. As shown in the treatment of the sources of success, the logistics conception offers first of all diverse opportunities for the existence security and thus for the security of the workplace both of industrial and trade companies as well as of logistics companies.

Since logistics is increasingly recognized as an independent business function alongside procurement, production and sales in the company, there are also diverse opportunities for the employees in this from personnel administration long neglected area. The

[20] Cf. also Pfohl et al. (2009, p. 5).

[21] Cf. ibid., p. 3.

[22] Cf. Ulrich and Fluri (1995, p. 165).

holistic view of the previously isolated perceived logistics tasks is the basis for interesting and challenging activities both on the different management levels and on the execution level. However, especially on the execution level, the logistics activity has a comparatively bad image due to the practice partly still practiced in companies today, of "shunting" employees who can no longer be used elsewhere into the logistics area.

With the higher qualification of the employees required on most workplaces in the logistics area today, a higher income and also the possibility of further qualification in the company are generally associated. Because of the lack of supply of logisticians for all levels, many companies offer their employees opportunities for further education and thus for the fulfillment of the interest in further qualification.[23] As constantly demanded further education contents on the management level, one can identify in particular financing, knowledge in the area of information and communication systems, international logistics as well as general tasks of the company management.

Regarding the interest in social relations, the logistics area often has better conditions than the production area. Because the execution of transport and handling activities offers comparatively good possibilities for the perception of social contacts. Moreover, there has rarely been such a far-reaching division of labor as in the production area in the logistics area of the company.

Regarding the interest in maintaining the long-term work force of the employees, however, the logistics area has a backlog to catch up compared to the production area. With the help of ergonomic techniques, the workplaces can often be improved so that this interest can also be fully met.[24]

3.2.7 Environmental Compatibility

The impacts on the natural environment induced by a company can be captured by the following *environmental impact equation*:

$$\text{Environmental impacts} = \text{f (Production processes, Products)}$$

In the *production processes*, the environmental burdens caused can be reduced by so-called "end-of-pipe" technologies. These are environmental protection technologies that are downstream of the actual manufacturing processes, such as filters for exhaust gas purification or wastewater treatment plants. On the other hand, integrated environmental

[23] The lack of qualified employees is one of the strongest negative influencing factors for the logistic performance of companies. Further education of the employees is today and also in the future the most important personnel management strategy to cope with this lack. Cf. Handfield et al. (2013, pp. 25 and 37).

[24] For human-friendly work systems in logistics see Bruder and Rademacher (2009). See also Part IV, Sect. 11.4.2.

protection technologies are used, which provide for the integration of environmental protection-specific components into the manufacturing processes with the aim of preventing emissions or residues from occurring in such processes.

Environmental impacts in connection with the *products* arise in the phases of product use and disposal. The success of environmental protection measures is determined in both areas by a technological and a social component. For example, during product use and consumption, the resource and energy consumption can be reduced by low-consumption units and the emissions by catalysts, for example. On the other hand, a reduction of the consumption values and emissions can also be achieved by environmentally conscious behavior of the consumers. The technological measures of product disposal aim at the reusability of the products and their packaging in the course of use or recycling. The implementation of such recycling activities depends crucially on the willingness of consumers to collect and separate the discarded products and packaging by type.

The logistics conception offers several starting points to improve the environmental compatibility in all phases of the *ecological product life cycle*, i.e. from raw material extraction to product disposal. For example, logistics can contribute to increasing the reuse rates of residues with regard to disposal. Thus, the identification of residues as a prerequisite for recycling is the responsibility of the subsystem of disposal logistics[25] The separate collection of secondary raw materials and waste already at their sources of origin saves costly later separation processes and enables the establishment of different disposal logistics systems adapted to the specific properties of secondary raw materials and waste. Against the background of an increasing centralization of processing, treatment and disposal plants, a separation of local and long-distance transport of residues with the involvement of transfer stations is recommended in the outside area. At least for long-distance transport, the use of comparatively environmentally friendly modes of transport such as inland waterway or rail is then advisable. In the area of storage at the sources of origin, in transfer stations as well as in processing, treatment and disposal plants, environmental protection is taken into account by setting up safety storage facilities for hazardous goods.

To what extent the contributions to the corporate objectives are actually realized depends on the type of logistics management. Therefore, the following section will discuss the logistics management of excellent companies.

[25] Cf. on this and on the consideration of ecological objectives in the other logistical subsystems Stölzle (1993) and Pfohl (2022, pp. 221 ff.).

3.3 Logistics Management in Excellent Companies

3.3.1 Success Factors: Success Potentials and Success Positions

As theoretical[26] basis for the identification of the success-relevant characteristics of excellent (successful) companies, the research on strategic management can be drawn on, which deals with success potentials and success positions of companies. In this context, the success potentials and success positions of a company are referred to as success factors. Success potentials are the competencies and resources of a company that form the basis of the company's success. They are to be distinguished from the success indicators, which are only used to measure the company's success. To illustrate this, the model of the *competitive advantage* by Day/Wensley can be used.[27] They distinguish sources of advantage from positional advantages and the performance outcome.[28] According to this, the success potentials correspond to the sources of advantage, which enable the company to perform better than its competitors. These are the superior competencies and resources. The competencies in turn consist of various abilities. Sources of advantage must be converted into positional advantages (success positions), which consist either of higher customer benefit (differentiation advantage) or lower costs (cost advantage). These success positions must in turn be converted into a performance outcome, which initially materializes as customer satisfaction or customer loyalty and then in market share or profitability.

The central question for strategic management of the differences in success and competitiveness between companies leads to an intensive examination of strategy contents. Strategy content approaches as part of strategic management formulate “strategic views” that can describe, explain and predict the success of a company, a business unit or a function reductionistically in dependence on a central, content-based aspect (e.g. market position or resource supply). In formulating strategic views, two theoretical approaches have prevailed, which lead to a distinction between external and internal orientation of strategy contents.

The *external orientation* is based on the positioning of the company in its business environment as the basis of strategy contents. Only a sound understanding of the company's business environment (opportunities and risks) leads to an optimal positioning. It is about adapting the company to its given business environment or influencing the

[26] The following closely based on Hofmann (2004, pp. 48 ff.) and Pfohl (2005, pp. 567–571). See also Mentzer et al. (2004).

[27] Day and Wensley (1988). For a critique of the success factor research see Nicolai and Kieser (2002, pp. 580 ff.) For a critical review of integrative logistics concepts for corporate success see Kotzab (2001, pp. 17 ff.).

[28] Cf. also Zöllner (1990, pp. 232 ff.), and the model of logistics management based on the production factors in Sect. 2.3.3.

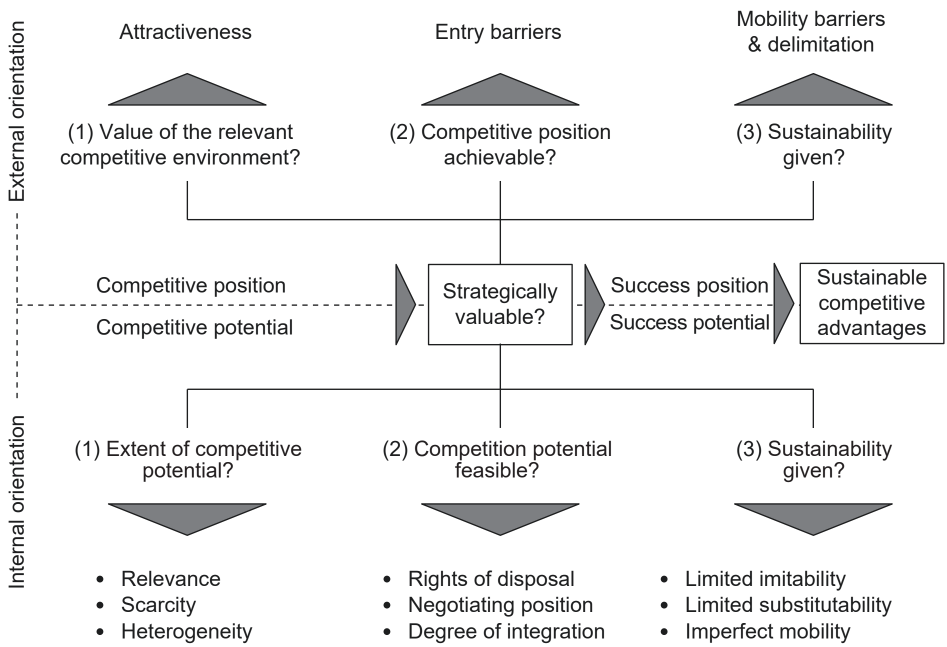


Fig. 3.7 Conditions for sustainable competitive advantages. *Source* Hofmann 2004, p. 52

environment in the company's sense. In the context of external orientation, one also speaks of success positions that allow the company to achieve sustainable success.

The *internal orientation* assumes that the resources, knowledge and skills of the company form the prerequisite for influencing industry structures and standards sustainably (strengths and weaknesses). It is therefore about building unique success potentials on the basis of valuable resources that allow the company to achieve sustainable success.

To achieve sustainable competitive advantages, internal and external orientation must be combined (see Fig. 3.7). The development of success potentials does not automatically lead to success, but must be translated into success positions.

The first externally oriented strategy content approach is known as the *"Market-based View of Strategy"*. Competitive advantages are either based on a cost leadership, a product differentiation or a focus on priorities.[29] The quality of the strategic success position is based on the industry knowledge that the companies have. Success differences result from the heterogeneity of the sales market.

An externally oriented strategy approach that is of particular importance for supply chain management is the *"Relational-based View of Strategy"*. Because it is often argued that the future competition will not take place between individual companies, but

[29] See also the business strategies in Part II, Sect. 4.2.1.

between supply chains. The strategic success position is then based on the relationships that companies maintain with external actors in networks as part of the value creation process. To build such relationships, a cooperative competence ("network competence") is required at the companies.[30]

The internally oriented strategy content approaches assume that there are internal prerequisites and causes—resources, capabilities and competencies—for the emergence of competitive advantages. The first internally oriented strategy approach is known as the *"Resource-based View of Strategy"*. The focus is on company-specific resources that can be described as *"strategically valuable"* if they are limitedly imitable, limitedly substitutable and limitedly mobile.

The approach *"Knowledge-based View of Strategy"* specifically picks up an intangible resource and examines how company-specific knowledge can contribute to achieving sustainable competitive advantages. Likewise, the approach *"Capability-based View of Strategy"* is based on the resource-oriented approach in terms of content and conception. Capabilities are a specific combination of resources, and can be understood as complex patterns of interaction, coordination and problem solving.

Internal and external approaches find their connection in the approach of the *"Competence-based View of Strategy"*. Competencies can be understood as market-oriented bundles of resources, knowledge and skills. They represent a central link between the market and the resources of a company. Strengths and weaknesses of the company must be aligned with the opportunities and risks of the market. In strategic management, this is often referred to as the focus on the *core competencies*. Core competencies are those competencies that differentiate a company in the competition and ensure the long-term viability of the company.

After the basic discussion of strategy content approaches in strategic management, results of empirical studies on logistics management in excellent companies are presented. These companies are characterized by the fact that they successfully combine internal and external strategy content approaches in logistics management.

3.3.2 Logistics Excellence

One of the most comprehensive empirical studies on logistics excellence was conducted by the European Logistics Association and the management consultancy A.T. Kearny in Europe.[31] In total, six studies on the state of logistics are available between 1982 and

---

[30] For details, see Pfohl (2004) and Frunzke (2004, pp. 33 ff.) as well as the explanations on the theory of network competence in Part III, Sect. 9.3.2.

[31] For the last three studies see European Logistics Association and AT Kearney (1999, 2004, 2009). In addition to the studies presented below see Bowersox et al. (1999), Pfohl and Pfohl (2002), Thonemann et al. (2003), O'Marah and Hofmann (2009) and Horváth and Partners (2011).

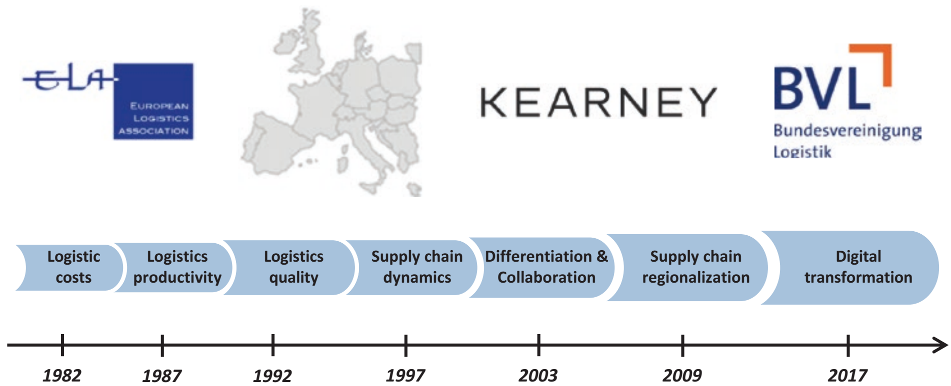


Fig. 3.8 Competitive advantages through logistics excellence. *Source* Adapted from European Logistics Association and AT Kearney 2009, p. 6 and supplemented by BVL 2017

2009. The results presented here are based on the survey of leading European companies using questionnaires and personal interviews. The results on the competitive advantages of excellent logistics are summarized in Fig. 3.8. These studies, which are no longer conducted, were supplemented by a study carried out in 2016 and published in 2017 by the German Logistics Association, which identifies the digital transformation of the supply chain as a new source of competitive advantage.[32] The main result of the studies is that the sources of competitive advantage identified in the past lose differentiation potential over time. This shows that also the success potentials are subject to change in a changing environment. Thus, the criteria mentioned are still important individually. However, to differentiate in the market, additional success factors are needed, in which the "old" success factors are integrated.

Based on the theoretical framework of the internally oriented strategy content approaches, the potential for success for logistics excellence of companies compiled in Fig. 3.9 and 3.10 were determined: responsiveness, agility, leanness and intelligence.

- *Responsiveness:* In the future, it will not be enough for companies to recognize needs early and react faster than competitors. It is rather necessary to proactively approach current and potential customers, understand their needs and satisfy unexpected needs as soon as they arise. Successful companies differ from average ones in that they can cope not only with predictable, but also with unpredictable situations.
- *Agility:* In view of ever shorter product life cycles and strongly fluctuating irregular demand patterns, companies must be able to change the processes for creating and realizing value in such a way that an optimal cost and service structure can be main-

[32] See also Kersten et al. (2017); see also Kersten et al. (2020).

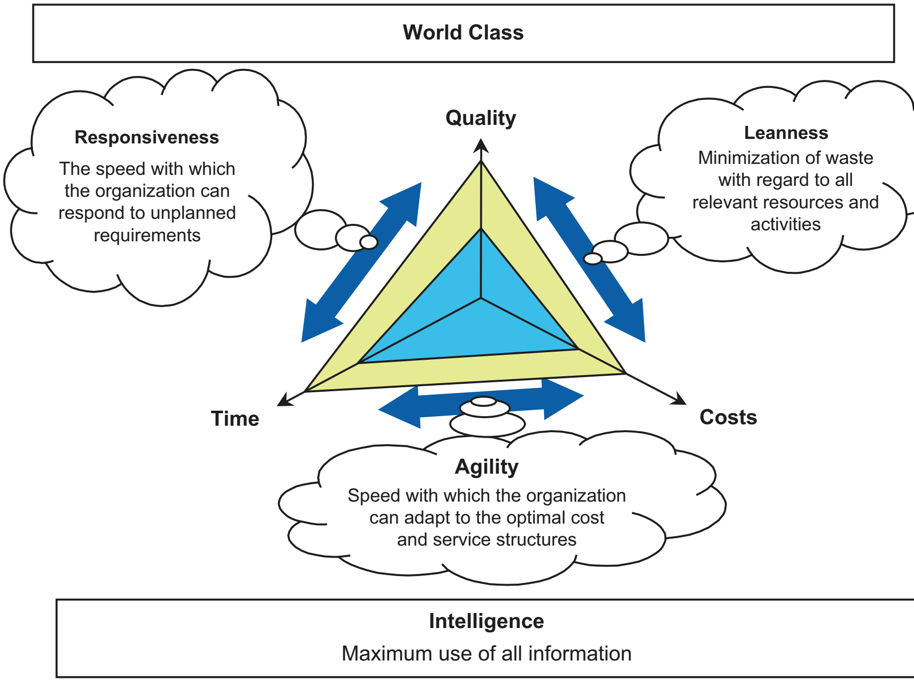


Fig. 3.9 Competencies for logistics excellence. *Source* Adapted from Pfohl and Mayer 1999, p. 280

tained. Agility (adaptability or changeability) is therefore the speed with which the system can be reorganized by skillful use of internal and external resources to achieve efficient and effective value creation and realization.

- *Leanness:* Leanness means the systematic prevention of any kind of waste that does not lead to a fulfillment of customer value. This leads to cost-effective processes and structures, low resource requirements, minimal environmental impact and optimal return. This is accompanied by a concentration of the company on its core competencies. By applying the principle of leanness to the entire supply chain, unnecessary inventories are reduced and an efficient object flow is ensured.
- *Intelligence:* Serving ever smaller market segments requires detailed knowledge of customer (customer of customer) wishes and needs. The use of this knowledge must be done in a way that enables the development of agility, responsiveness and leanness. In this sense, intelligence is seen as the ability to efficiently use comprehensive knowledge of customer wishes and needs and to fulfill them through efficient supply chains. To do this, it is necessary to draw on all information relevant to the supply chain and to process it using appropriate tools.

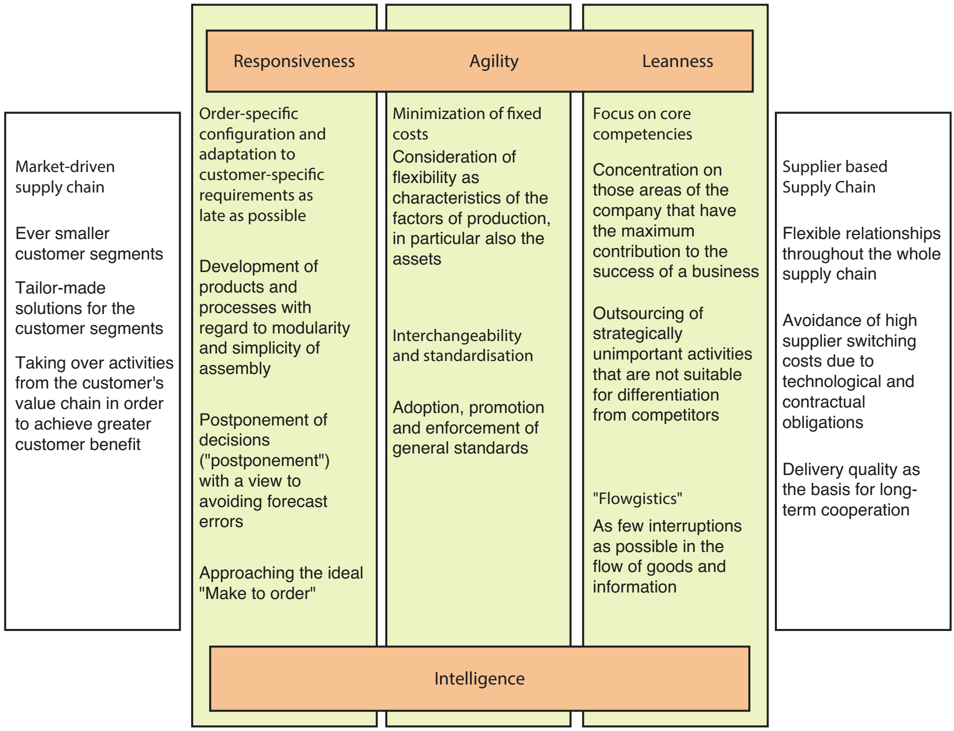


Fig. 3.10 Competencies and capabilities for logistics excellence. *Source* Based on European Logistics Association and AT Kearney 1999, p. 33

The "new" success factors responsiveness, agility, leanness and intelligence are closely related to the "traditional" success factors of the strategic triangle, time, quality and cost[33] as they have to be combined with each other. Therefore, the "traditional" success factors should not be neglected. The necessary potential for success compared to the competition are rather to be developed on the basis of these. If this succeeds, it is possible to contribute significantly to the achievement of the corporate goals through a logistics management oriented towards responsiveness, agility, leanness and intelligence.

The capabilities and their relationship with the explained competencies that are necessary for an excellent logistics management according to the results of the study are shown in Fig. 3.10.

Based on the theoretical framework of the externally oriented strategy content approaches, the success positions for logistics excellence of companies compiled in

[33] Of the success factors identified in the first three studies (see Fig. 3.8), productivity is included in the "costs" of the strategic triangle. The "time" in terms of delivery time is included in the logistics quality.

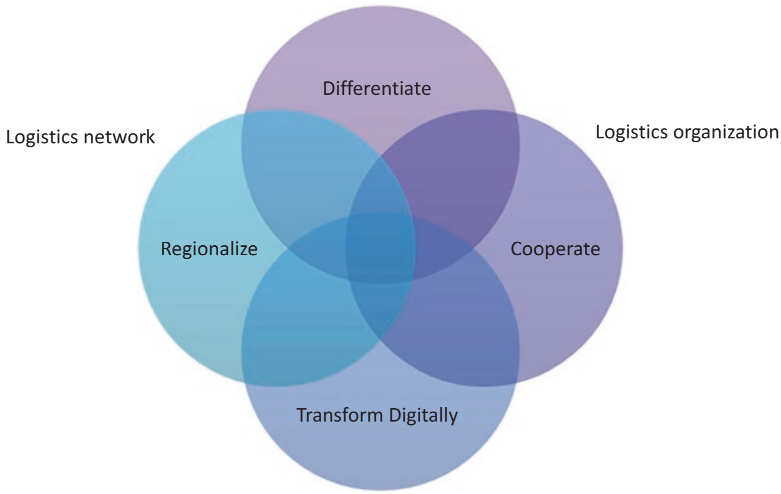


Fig. 3.11 Success positions for logistics excellence. *Source* Results of the studies by European Logistics Association and AT Kearney 2004, 2009 as well as by the Bundesvereinigung Logistik at Kersten et al. 2017

Fig. 3.11 were determined, which are based both on the development of the necessary structure of logistics networks and on the development of the necessary division of labor and coordination through an appropriate logistics organization:

- *Differentiate:* The characteristics of the market-driven and supplier-based supply chain listed in Fig. 3.10 lead to the strategy of differentiation as a success position. It requires a focus of the supply chain on the specific requirements that are characterized by the business models and the customer and supplier problems of the industries that distinguish the sales and procurement markets. Figure 3.12 shows three basic models for the strategy of differentiation.[34] The increasing complexity of the supply chain resulting from the requirements of the markets cannot be met with a single design. Different "optimal" supply chains have to be developed. However, this raises the question again whether synergy effects can be exploited, at least by using parts of the supply chains together. The term "Omni Channel" was created for this purpose in the USA.
- *Regionalize:* The strategy of regionalization can also be seen as a special form of the strategy of differentiation. Because this strategy also aims at adapting to the specific requirements in the sales and procurement markets, whereby the aspect of globalization of the markets is in the foreground. All the trend studies mentioned in Sect. 1.3

[34] For different types of supply chains, see also Klaus (2005, pp. 367 ff.) and Meyr and Stadtler (2015, pp. 65 ff.). See also Part II, Sect. 4.5.

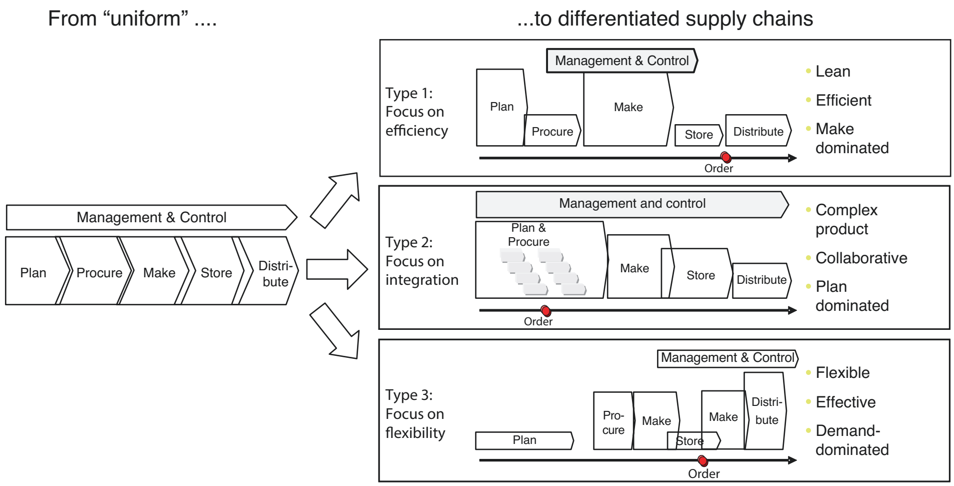


Fig. 3.12 Models of a differentiated supply chain management. *Source* Based on European Logistics Association and AT Kearney 2004, p. 3

show that internationalization will continue to be a dominant driver of logistics. However, excellent companies pursue a strategy of "Global Regionalization". Such a strategy requires production in one region to supply that region. This allows on the one hand an adaptation to the specific customer requirements and to the increased volatility of the local/regional demand in the sales market. On the other hand, it enables the exploitation of advantages of low production costs (e.g. due to low wages) and low purchasing and logistics costs through a local/regional supplier structure. With a reduction of the transport distances, ecological advantages can also result.

- *Cooperate:* The strategy of cooperation requires a more intensive cross-company cooperation in the supply chain with suppliers, customers and logistics service providers. Examples of instruments for such cooperation are VMI ('Vendor Managed Inventory") or CPFR ("Collaborative Planning, Forecasting, and Replenishment"). Cooperation enables a reduction of the value-added costs in the supply chain (see Fig. 3.13). Through a greater inter-company division of labor in the form of specialization, production costs can be reduced. The higher number of actors involved leads to an increase in coordination costs. Through cooperation, this increase can be mitigated, leading to lower total costs.
- *Digitally Transform:* The strategy of digital transformation requires a data-based supply chain from the supplier to the customer throughout and affects both the planning and the realization of all activities. Such an integrated approach leads to the digital networking of the functions, the flows and the institutions in the supply chain and

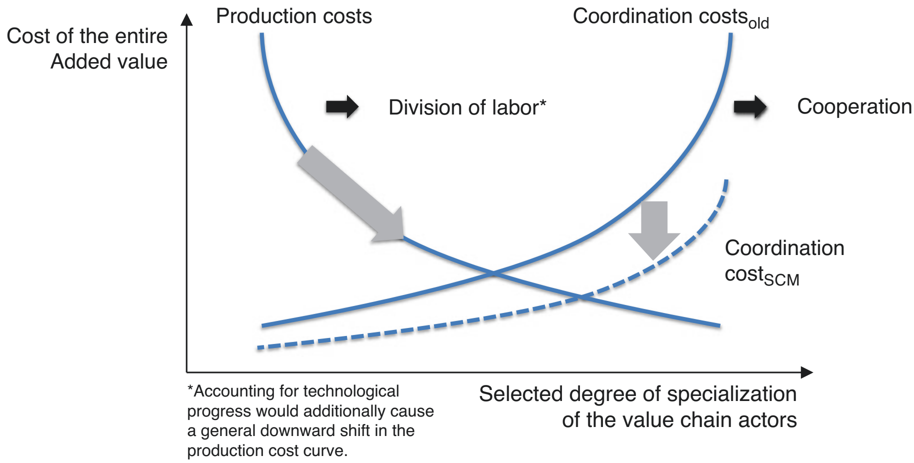


Fig. 3.13 Supply chain management and specialization. *Source* Adapted with minor changes from Eßig et al. 2013, p. 8

corresponds to the system approach of logistics.[35] It characterizes the "Digital Champions" who use their higher digital maturity as a competitive advantage over their competitors.[36] The "Digital Champions" already achieved about 50 % of their sales in 2018 with digitally supported services or pure digital services. The driver of the digital transformation is the end of the value chain (see Fig. 3.14).

The results of the studies can be summarized as follows with regard to potential for success and success positions in logistics/supply chain management: First, the top management in excellent companies has recognized the importance of building such potential for success and of implementing them in success positions to achieve sustainable competitive advantages for the company. Second, excellent companies build the potential for success according to the internally oriented strategy content approach by developing capabilities to achieve responsiveness, agility, leanness and intelligence. Third, according to the externally oriented strategy content approach, excellent companies use these capabilities to build success positions by differentiating, regionalizing, cooperating and digitally transforming the supply chain. The following chapter discusses the approaches of planning and control available for the realization of logistics management.

[35] See also the logistics cube in Fig. 2.2.

[36] For the characteristics and strategies of the "Digital Champions" see PwC (2018, 2020).

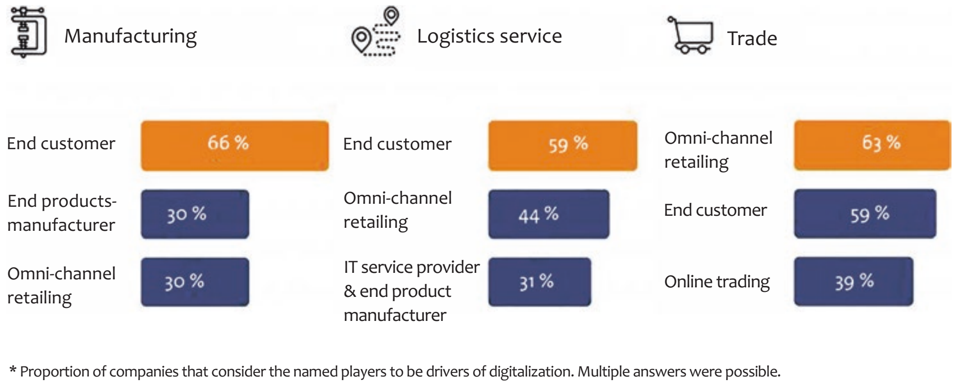


Fig. 3.14 Top 3 drivers of digital transformation* from the perspective of the surveyed sectors. *Source* Kersten et al. 2017, p. 24

References

Aberle G (2009) Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 8., rev. a. ext. ed. Oldenbourg, München

Bowersox D, Closs D, Stank T (1999) 21st century logistics. Making supply chain integration a reality. CLM, Oak Brook

Bruder R, Rademacher H (2009) Abgleich von Anforderungs- und Fähigkeitsanalysen für menschengerechte Arbeitssysteme in der Logistik. In: Pfohl H-C (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., rev. a. ext. ed. DVV Media Group, Hamburg, pp 216–243

Day G, Wensley R (1988) Assessing advantage. A framework for diagnosing competitive superiority. J Mark 52(4):1–20

Eßig M, Hofmann E, Stölzle W (2013) Supply chain management. Vahlen, München

European Logistics Association, BearingPoint (2002) What matters to top management? A survey on the influence of supply chain management on strategy and finance. ELA, Brussels

European Logistics Association, Kearney AT (1999) Insight to impact. Results of the fourth quinquennial European logistics study. ELA, Brussels

European Logistics Association, Kearney AT (2004) Differentiation for performance. Excellence in logistics 2004. ELA, Brussels

European Logistics Association, Kearney AT (2009) Supply chain excellence amidst the global economic crisis. ELA, Brussels

Frunzke H (2004) Von der Kompetenz im strategischen Management zur Netzkompetenz. In: Pfohl H-C (Ed) Netzkompetenz in supply chains. Grundlagen und Umsetzung. Gabler, Wiesbaden, pp 13–41

Gomm M (2008) Supply Chain Finanzierung. Optimierung der Finanzflüsse in Wertschöpfungsketten. Erich Schmidt, Berlin

Göpfert I (2013) Logistik: Führungskonzeption und Management von Supply Chains, 3. ed. Vahlen, München

Grochla E, Fieten R, Puhlmann M (1984) Aktive Materialwirtschaft in mittelständischen Unternehmen. Ein Leitfaden zur Verbesserung des Unternehmensergebnisses. Dt Instituts, Köln

Handfield R, Straube F, Pfohl, H-C, Wieland A, (2013) Trends und Strategien in Logistik und Supply Chain Management. Vorteile im Wettbewerb durch Beherrschung von Komplexität. DVV Media Group, Hamburg

Hofmann E (2004) Strategisches Synergie- und Dyssynergiemanagement. Eul, Lohmar

Horváth & Partners (2011) Suppy chain performance management. IPRI-Praxis, Stuttgart

Johnson J, Wood D (1982) Contemporary physical distribution and logistics. Macmillan, Tulsa

Kersten W et al (2017) Trends und Strategien in Logistik und Supply Chain Management: Chancen der digitalen Transformation. Studie der Bundesvereinigung Logistik. DVV Media Group, Bremen

Kersten W et al (2020) Trends und Strategien in Logistik und Supply Chain Management: Entwicklungen und Perspektiven einer nachhaltigen und digitalen Transformation. Studie der Bundesvereinigung Logistik. DVV Media Group, Bremen

Klaus P (2005) Die Frage der optimalen Komplexität in Supply-Chains und Supply-Netzwerken. In: Eßig M (Ed) Perspektiven des Supply Managements: Konzepte und Anwendungen. Festschrift für Ulli Arnold. Springer, Berlin, pp 361–375

Kotzab H (2001) Der Beitrag integrativer Logistikkonzepte zum Unternehmenserfolg – Kritische Bestandsaufnahme theoretischer und empirischer Befunde. Logistikmanagement 3(1):17–33

Large R (2012) Logistikfunktionen. Betriebswirtschaftliche Logistik, Bd 1. Oldenbourg, München

Mentzer J, Min S, Bobbit L (2004) Towards a unified theory of logistics. Int J Phys Distrib Logist Manag 34(8):606–627

Meyr H, Stadtler H (2015) Types of supply chains. In: Stadtler H, Kilger C (Eds) Supply chain management and advanced planning. Concepts, models, software and case studies, 5. ed. Springer, Berlin, pp 55–69

NCPDM (1984) Measuring and improving productivity in physical distribution 1984. Prepared by A.T. Kearney. NCPDM, Oak Brook

Nicolai A, Kieser A (2002) Trotz eklatanter Erfolglosigkeit: Die Erfolgsfaktorenforschung weiter auf Erfolgskurs. DBW 62(6):579–596

O'Marah K, Hofmann D (2009) 25 top supply chains. Supply Chain Manag Rev 13(7):12–19

Pfohl H-Chr (2001) Wertsteigerung durch Innovation in der Logistik. In: Pfohl H-Chr (Ed) Jahrhundert der Logistik. Wertsteigerung des Unternehmens: customer related, glocal, e-based. Erich Schmidt, Berlin, pp 187–235

Pfohl H-Chr (2004) Grundlagen der Kooperation in Logistiknetzwerken. In: Pfohl H-Chr (Ed) Erfolgsfaktor Kooperation in der Logistik. Outsourcing – Beziehungsmanagement – Finanzielle Performance. Erich Schmidt, Berlin, pp 1–36

Pfohl H-Chr (2005) Erfolgspotentiale und Erfolgspositionen in Logistik/Supply Chain Management. In: Amelingmeyer J, Harland P (Eds) Technologiemanagement & Marketing. Herausforderungen eines integrierten Innovationsmanagement. Dt Universitäts, Wiesbaden, pp 563–585

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. upd. ed. Springer, Berlin

Pfohl H-Chr, Mayer S (1999) Wettbewerbsvorteile durch exzellentes Logistikmanagement. Ergebnisse der vierten ELA/AT Kearney Logistikstudie. Logist Manag 1(4):275–281

Pfohl H-Chr, Pfohl P (2002) Supply Chain Exzellenz. Ergebnisse einer empirischen Untersuchung von europäischen Logistikpreisträgern. In: Hossner R (Ed) Jahrbuch Logistik 2002. Handelsblatt, Düsseldorf, pp 234–239

Pfohl H-Chr, Elbert R, Hofmann E (2003) Management der „finanziellen" Supply Chain: Charakterisierung – Aufgabenbereiche – Interdependenzen. In: Bundesvereinigung Logistik (BVL) e. V. (Ed) Finanzierung – eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Erich Schmidt, Berlin, pp 1–64

Pfohl H-Chr, Gomm M, Frunzke H (2009) Der Motivations-Mix des Personalmanagements. Ein abgestimmtes System von Anreizen zur Steigerung von Mitarbeitermotivation und -leistung in der Logistik. In: Pfohl H-C (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., rev. a. ext. ed. DVV Media Group, Hamburg, pp 1–91

Porter M (2014) Wettbewerbsvorteile. Spitzenleistungen erreichen und behaupten, 8. Aufl. Campus, Frankfurt a. M.

PwC (2018) Global digital operations study 2018: digital champions. How industry leaders build integrated operations ecosystems to deliver end-to-end customer solutions. PwC, o. O.

PwC (2020) Connected and autonomous supply chain ecosystems 2025. PwC, o. O.

Rappaport A (1999) Shareholder-Value: Ein Handbuch für Manager und Investoren, 2., rev. a. act. ed. Schäffer-Poeschel, Stuttgart

Schwemmer M (2019) Top 100 in European transport and logistics services 2019/2020. DVV Media Group, Hamburg

Stölzle W (1993) Umweltschutz und Entsorgungslogistik: theoretische Grundlagen mit ersten empirischen Ergebnissen zur innerbetrieblichen Entsorgungslogistik. Erich Schmidt, Berlin

Straube F, Pfohl H-C (2008) Trends und Strategien in der Logistik – Globale Netzwerke im Wandel. Umwelt, Sicherheit, Internationalisierung, Menschen. DVV Media Group, Hamburg

Thonemann U (Ed) (2003) Supply chain champions. Was sie tun und wie Sie einer werden. Gabler, Wiesbaden

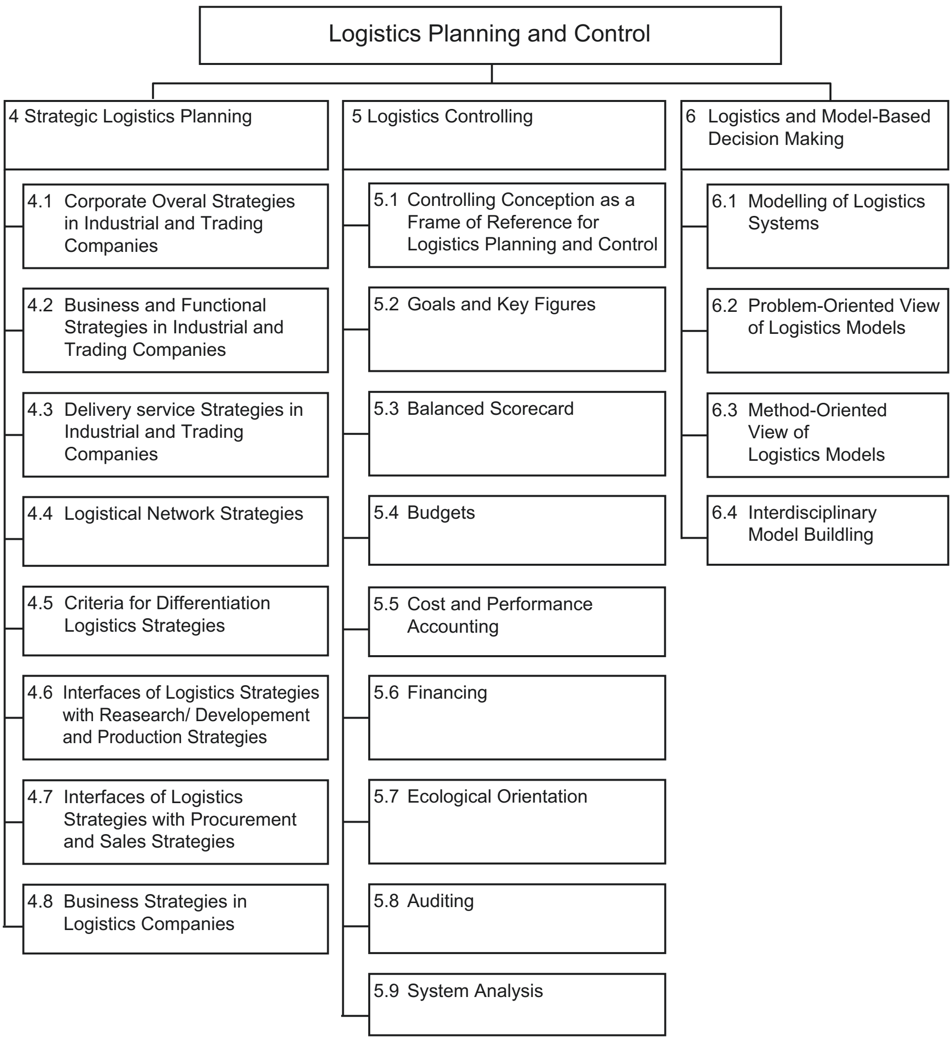
Ulrich P, Fluri E (1995) Management. Eine konzentrierte Einführung, 7., corr. ed. Haupt, Bern

Zeterberg U (1989) Ziele und Aufgaben des Logistik-Controlling. In: Baumgarten H et al (Eds) RKW-Handbuch Logistik. Springer, Berlin, S. Kennziffer 1540; pp 1–20

Zöllner W (1990) Strategische Absatzmarktplanung. Kunden- und Wettbewerbsanalyse für Logistikunternehmen. Springer, Berlin

Part II

Logistics Planning and Control



To support logistics management. a variety of planning and control techniques (methods and instruments) are available, as in the other areas of a company. In the context of this discussion of logistics management, there is no need to go into detail about the techniques known from the general management literature. It is sufficient to start at a higher level of aggregation with strategic planning, controlling and model-based decision-making. to pick out three areas of management support in the company that are necessary to implement the logistics conception. are of particular importance. The importance of strategic planning stems from the need for the development of strategic logistics already addressed in Part I. The existence of suitable controlling is a necessary prerequisite for recording the cost and performance consequences of the conflicting objectives typical of logistics systems. Likewise, techniques of model-based decision-making are necessary. After all, the first approaches to decision-making with the help of quantitatively formulated models originated in the logistics sector. Obviously, this is one of the corporate areas in which the problem structures can be captured comparatively well quantitatively.

Strategic Logistics Planning

4

4.1 Corporate Overall Strategies in Industrial and Commercial Enterprises

4.1.1 Types of Strategies

Goal of strategic planning is the development of success potentials and success positions for the company. In the following, the essential techniques of strategic planning in their connection to logistics are outlined. For this purpose, a distinction between corporate overall strategies, business strategies and functional strategies is helpful.[1]

The *corporate overall strategies* refer to the orientation of the entire company and encompass the entire business activity. For large companies, this business activity can be divided into strategic business areas, for which separate strategic decisions can be made,[2] so that a company can adopt several different *business strategies*. The basis for the formation of strategic business areas are usually product-market combinations, which are distinguished by a certain technological development and the associated opportunities and threats, by certain main competitors and by a certain market growth. To realize the corporate overall strategies or the business strategies, a company must develop *functional strategies,* e.g. logistics strategies. Both strategic business areas (e.g. in the form of a division) and business functions (e.g. in the form of a department of research and development) can, but do not have to be institutionalized in organizational units of a company. If they are institutionalized, strategic business areas are called strategic business units.

[1] For a detailed discussion of these types of strategies, which are used as a basis in the following, see Welge et al. (2017, pp. 459 ff.).

[2] For the delimitation of such business areas, see fundamentally Ansoff (1988, p. 108).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_4

4.1.2 Strategic Direction of Development

According to the direction of development, the overall corporate strategies can be distinguished into growth, stabilization- and shrinking strategies. For the growth strategies, the strategy spectrum of the product-market matrix by Ansoff, shown in Fig. 4.1, is of fundamental importance. Obviously, the four different *growth strategies* pose different requirements for the logistics.

The strategy of market penetration only entails increased requirements for the quantitative or—if the increased market penetration is to be achieved through an improved delivery service level—for the qualitative capacity of the existing logistics system. The strategy of product development poses new requirements for the logistics system, if the logistical requirements of the new product differ from those of the previous product range due to its physical or economic characteristics. The same applies to the strategy of market development, if new customer groups have to be addressed through new distribution channels, or they are located in regions (e.g. other countries) that have not been supplied before. For the diversification strategies, a distinction is usually made between vertical, horizontal and lateral diversification. Vertical diversification aims to include products that belong to an upstream (backward integration) or downstream (forward integration) production stage. In the first case, the procurement logistics, in the second case, the distribution logistics of the existing logistics system are affected. In both cases, the logistical span of control in the supply chain is extended and the connection of the production logistics systems of the different production stages is facilitated. While horizontal diversification expands the product range by adding services that are related to the existing product-market combinations in a factual context, while maintaining the same production depth, this is no longer the case for lateral diversification. If horizontal diversification may still allow for synergy effects in the existing logistics system, lateral diversification basically requires new logistics systems.

What generally applies to the assessment of the four growth strategies also applies to their specific impact on logistics systems: The uncertainties are lowest for market penetration and highest for diversification. The synergy effects, on the other hand, are greatest for market penetration and lowest for diversification.

Market / Product	Currently	New
Currently	Market penetration (-intensification)	Market development (-open up)
New	Product development	Diversification

Fig. 4.1 Product-market matrix according to Ansoff. *Source* Taken with minor changes from Ansoff 1966, p. 132. Cf. also Ansoff 1966, p. 83

To the *stabilization strategies* belong on the one hand hold or normal strategies and on the other hand consolidation strategies. The former aim at maintaining the status quo, because the set corporate goals are achieved. Since no other strategies are to be pursued, there are also no new requirements for the logistics. On the other hand, consolidation strategies, which are intended to improve the strategic starting position and close earnings gaps by a conscious self-restraint, often affect the logistics directly. They serve to streamline the product range and reduce excess capacities after phases of strong growth. This includes, for example, the reduction of inventory levels.

The importance of *shrinking- or divestment strategies* was recognized especially with the emergence of the portfolio technique, which will be discussed later. In addition to permanent losses, internal organizational reasons, such as disrupted communication flow and coordination problems, can be reasons for abandoning a strategic business unit. Such coordination problems are also conceivable in the logistics system. On the other hand, exit barriers can prevent a divestment strategy that is otherwise necessary. These include, among others, investments made in highly specialized assets, which lead to low liquidation rates or cause significant conversion costs. Such highly specialized assets may also be found in the logistics system of the company. Even if they are not highly specialized assets, the phenomenon of cost remanence[3] can lead to the failure to achieve the cost savings intended with the shrinkage.

4.1.3 Strategy Portfolio

The portfolio technique can make a significant contribution to the assessment of the overall corporate strategy. The basic idea of the portfolio technique[4] is the view of the company as a "balanced" composition (portfolio) of investments in *product-market combinations* (in the sense of strategic business areas). Balance here has to exist with regard to sources of success, success and liquidity aspects.

The portfolio technique assumes that the multitude of strategic influencing factors that can be determined by company and business environment analyses can be condensed into two key factors, one of which represents the business environment and the other the company component. With these two strategic influencing factors, a matrix is formed, into which the product-market combinations of the company are classified. The best-known matrix has market growth as the business environment component and relative, i.e. based on the market share of the strongest competitor, market share as the company component. As indicated in Fig. 4.2, the product-market life cycle curve, according to which different phases can be distinguished in terms of sales growth and also cash flow

---

[3] Cost remanence occurs when capacity-dependent costs adjust to a decrease in the utilization level of the company only with a time lag.

[4] Cf. also Pfohl and Stölzle (1997, p. 168).

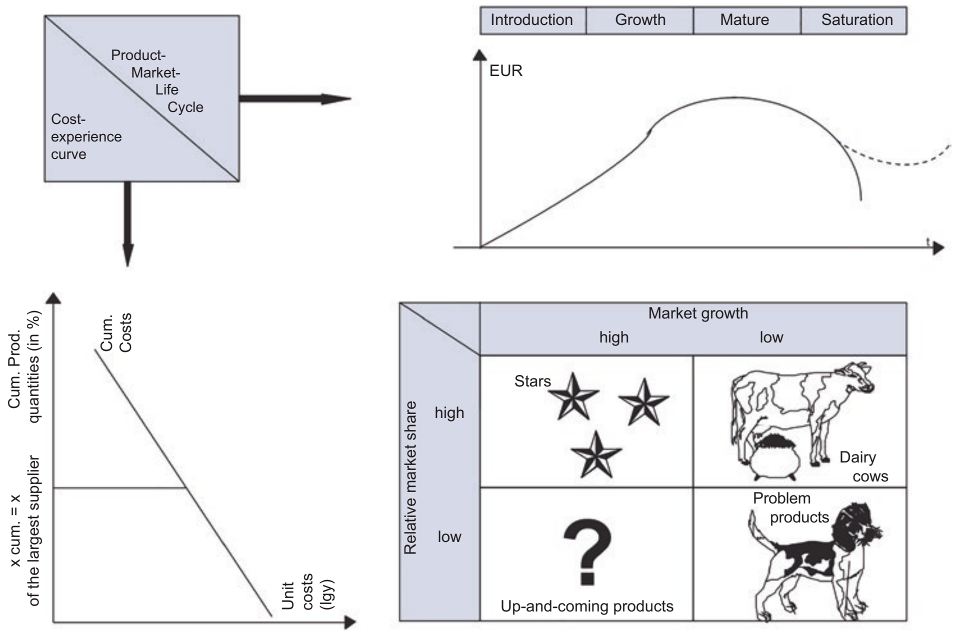


Fig. 4.2 Concept of the market growth-market share matrix. *Source* With minor modifications taken from Welge et al. 2017, p. 488

of a product, as well as the cost experience curve, according to which the unit costs of a product potentially decrease by 20% to 30% when the cumulative production quantity doubles, provide the theoretical basis. Likewise, standard strategies (strategic basic rules) can be assigned to the individual phases of the product life cycle, from which corresponding consequences for logistics can then be derived (see Fig. 4.3).[5] In general, the following problems can be addressed on the basis of the portfolio technique:

- "Which business units or success objects require an increased allocation of financial resources and which can be deprived of resources?
- Is the company in a financial equilibrium, so that there is a certain balance between resource-binding and resource-releasing business units?
- Do new business units or success objects have to be acquired and others disposed of?"[6]

[5] For the requirements in the different life cycle phases for logistics, see Havighorst (1980, pp. 251 ff.; Rink and Kaminski 1986).

[6] Welge et al. (2017, p. 483).

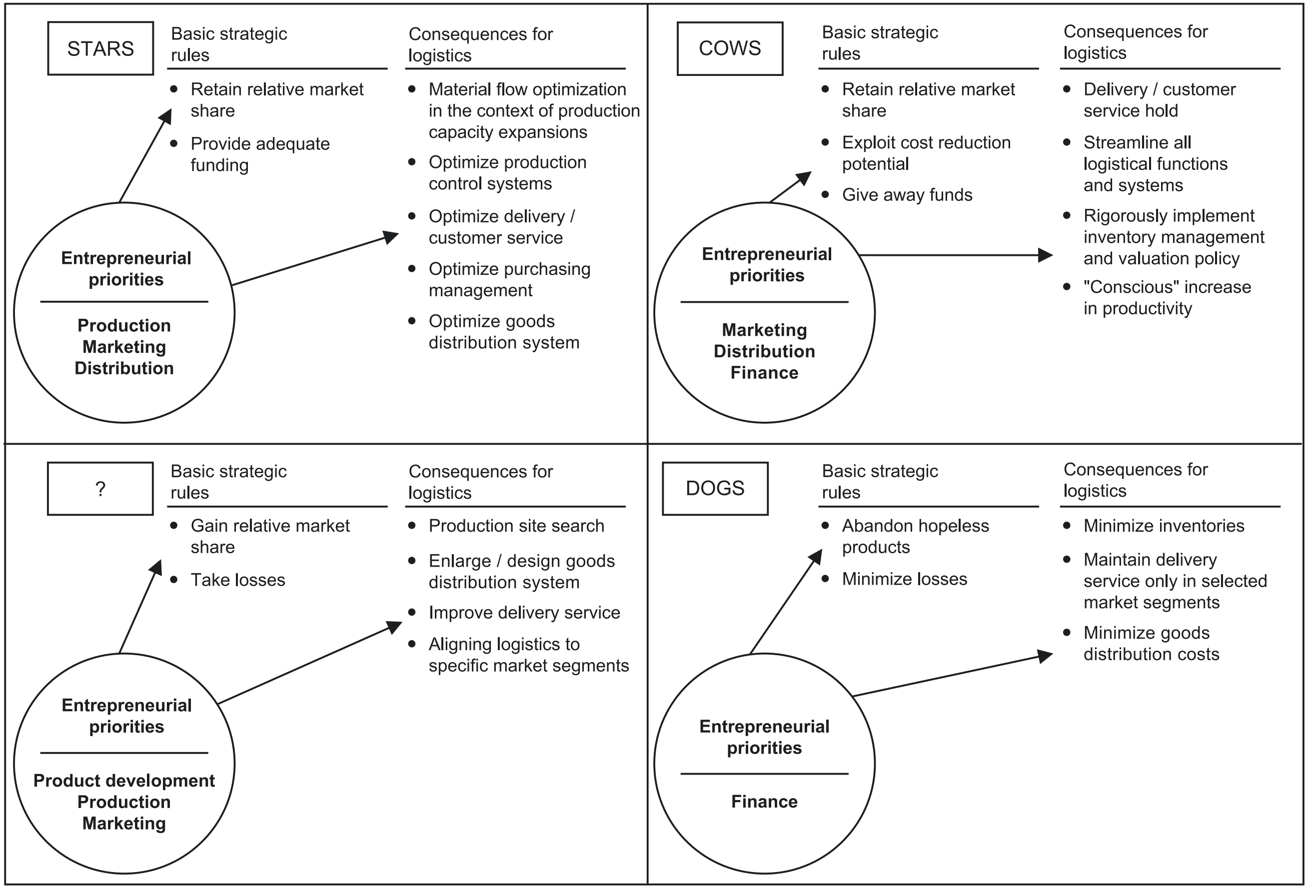


Fig. 4.3 Consequences for logistics derived from the strategic basic rules of the market growth-market share matrix. *Source* With minor modifications taken from Klimke 1983, p. 218

4.2 Business and Functional Strategies in Industrial and Trading Companies

4.2.1 Business Strategies

Business strategies (business area strategies) are characterized as competitive strategies, by which it is determined how competitive advantages can be achieved in the respective product-market area.[7] According to Porter, as shown in Fig. 4.4, there are the three promising strategy types *(generic competitive strategies),* to outperform other companies in an industry: the overall cost leadership, the industry-wide differentiation and the focus on priorities (market niches), whereby the latter can also be interpreted as the application of the first two strategies when limiting oneself to a market segment.

The strategy of overall *cost leadership* in an industry requires above all a consistent exploitation of the experience curve effect to reduce the unit costs and, associated with this, a control of the structure of capacity utilization. It is also referred to as a volume strategy. Logistics systems must be able to handle large quantities of goods in spatially extended markets at the lowest possible cost. A company that pursues a strategy of cost leadership must rely on logistical process capabilities that enable simple and anticipatory logistics processes. Examples of such capabilities are technological capabilities for carrying out material flows, the ability to simplify processes and the ability to identify necessary processes in advance.[8] Profits are achieved with this strategy through large sales volumes at low prices and are still generated even when competitors no longer make profits due to lower experience curve effects.

The strategy of *differentiation* consists in giving the product a special position in the eyes of the customers, so that it is regarded as unique throughout the industry. The differentiation can either be achieved by creating a brand image, or by the product quality or the provision of additional services. Such differentiating services include, in particular, a high level of delivery service. The basis for this are mainly customer-oriented capabilities, such as a consistent market segmentation, a good responsiveness and high flexibility, which have a positive influence on the company's success.[9] The differentiation shields against competitors and binds customers to the product. Since customers are willing to pay higher prices for the image and/or the quality or the additional services, the profit with this strategy is not achieved through high sales quantities, but larger profit margins.

The strategy of *focus* on priorities (market niches) requires a limitation to a specific group of buyers, a regional market or a narrow product line within an industry. It

[7] Cf. Welge et al. (2017, pp. 524 f.).

[8] Cf. Lynch et al. (2000, pp. 54 f. and 61 f.).

[9] Cf. Zhao et al. (2001, p. 102). See also the distinction of customer requirements into “basic requirements”, “performance requirements” and “delight requirements” by Pfohl (2022, p. 32).

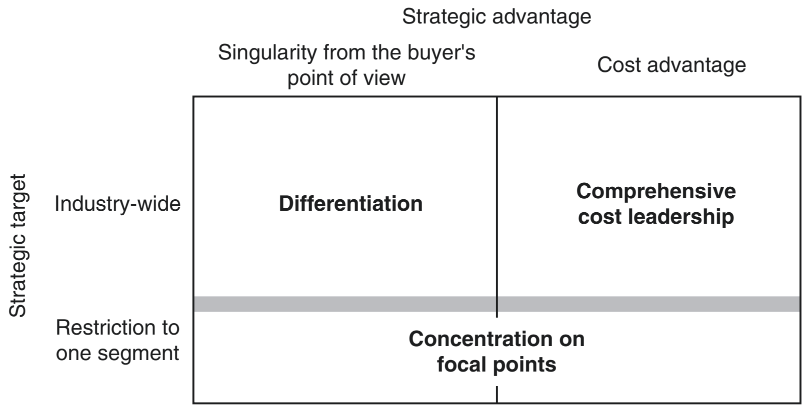


Fig. 4.4 Types of competitive strategies according to Porter. *Source* Based on Porter 2014, p. 38

is also referred to as a specialization strategy and is based on the assumption that the company can achieve a narrowly defined strategic goal more efficiently than competitors who are in the broader competition of the entire industry. The competitive advantage is achieved through differentiation by adapting to the specific needs of a market segment and/or through cost advantages in this market segment. The differentiation is done in an increased individual customer-oriented manner, by offering new services permanently and striving for high flexibility with regard to specific customer wishes.[10] The cost advantages are based, unlike the strategy of cost leadership, not on the experience curve effect associated with a large sales volume, but on the fact that certain costs do not arise at all (such as no storage costs for distribution warehouses, if a regional market is to be supplied directly from the plant). The focus on market niches can result in simpler logistics systems, if no logistical networks are required to supply extended markets. But it can also require a special adjustment of the logistics system to the service needs of a specific market segment.

Logistics can be seen as a very suitable field for the use of *hybrid* strategies. This means the simultaneous, i.e. at the same time pursuit of the cost leadership and the differentiation strategy.[11] As an example, the mass customization concept can be cited. It is based on a postponement[12] of the variant determination (customizing) and the use of size and synergy effects in the production of standardized modules. This enables both a high customer benefit through variety (differentiation) and cost leadership. An "*Outpacing*

---

[10] Cf. Lynch et al. (2000, p. 61).

[11] Cf. Corsten (1998, pp. 1437 ff.).

[12] For the postponement approaches see Sect. 4.4.4.

strategy" is a strategy to combine differentiation and cost leadership based on a new technology or value chain. Such a strategy for higher quality through improved service and lower costs through high sales is attributed to e-commerce.[13]

4.2.2 Functional Strategies

Functional strategies[14] have a *detailing function.* In them, the consequences of corporate overall strategies and business strategies for the functional areas of a company are detailed. Due to the characteristic of logistics being a cross-sectional function, logistical problem areas become evident already during the business area analysis and the design of business area strategies. For example, a competitive analysis only yields meaningful results if the logistical performance of the competitors is also taken into account.

Functional strategies have, in addition to the detailing, also a *integration- and coordination function.* Because, on the one hand, it becomes apparent to what extent the strategies in different functional areas have to be coordinated (harmonized) with each other. Logistics strategies are not independent of each other, but have cross-sectional effects. In Sect. 4.6 and 4.7, this integration function becomes evident when discussing the consequences of procurement, production and distribution strategies for logistics. On the other hand, it becomes apparent whether different business strategies, which place very different demands on functional strategies, can be implemented at all. If the synergy effects of a business strategy are very low at the functional level, high integration costs argue against pursuing this strategy.

If a company has weaknesses in certain functional areas, corporate overall or business strategies that require a dominant functional orientation in precisely these areas cannot be implemented. A company can obtain an overall picture of its functional capabilities by analyzing the capabilities and competencies in the individual functional areas. This can identify individual problem areas, e.g. deficiencies in the professional qualification of employees. The assessment of the functional *strengths and weaknesses* is made here relative to the main competitor. Even more informative is the so-called competence matrix.[15] In it, the functional profile is combined with the resource profile.

The logistics area itself can be detailed by an analysis of the relative strengths in the various service components. Figure 4.5 contains an example in which the performance in the delivery service elements is compared to the main competitor for a manufacturer of durable consumer goods. In this example, the manufacturer has weaknesses in precisely those delivery service components that are rated as highly important by its retail customers.

---

[13] Cf. Welge et al. (2017, pp. 567 f.).

[14] Cf. Welge et al. (2017, pp. 568 ff.) On the role of logistics as a functional strategy, see Prockl (2007, pp. 56 ff.; Abrahamsson 2010).

[15] Cf. Ansoff (1988, pp. 66 ff.).

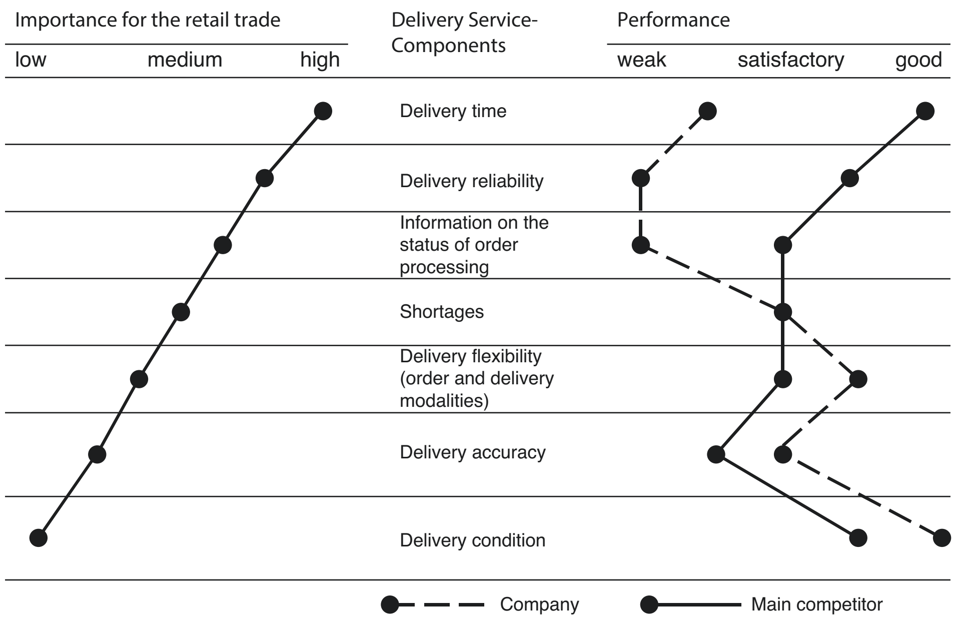


Fig. 4.5 Analysis of the strengths in various delivery service components of a manufacturer of durable consumer goods. *Source* With minor modifications taken from Sharman 1984, p. 76

For sound strategic decisions in the logistics area, which will be discussed in more depth later, not only the knowledge of the strengths and weaknesses, but also the *opportunities and risks* is a necessary prerequisite. The business environmental analysis to be carried out for this purpose must cover all uncontrollable external variables that are relevant for the design of logistics systems.[16] Changes and trends in these variables must be recognized in time.[17] The volumes of goods to be handled by logistics systems as well as the structure of the provision and use of goods are decisively determined in the long term by a changing economic—and thus also demographic—development of different regions. An example of this is currently the "east-west divide" of economic development and the associated migration movement in the population in Europe. Another important external variable is the technological framework. It does not require any further explanation that the development of information and communication technology has a significant influence on logistics strategies and their implementation.[18]

To *identify logistics-relevant trends* in the economy and society, expert surveys, especially in the form of the Delphi method, or "scenario writing" to identify different logis-

[16] See Figure 2.3 in Part I, Sect. 2.3.2.

[17] See Fontius (2013).

[18] Cf. e.g. Pfohl (2001, pp. 206 f.).

tics scenarios are suitable.[19] The mutual effect of environmental variables and company variables can be captured by the interdependency matrix.[20] In such a matrix, e.g. the external logistics constraints from Fig. 2.3 in Part I are listed in the header and the logistics design variables in the front column. In the matrix fields, it can then be recorded how possible changes (discontinuities) in the external logistics constraints affect the logistics variables.

The strategic decisions in the logistics area are determined not least by the *strategic goal* that is to be achieved with the logistics system. Three main goals can be distinguished here.[21] Logistics systems can first serve to create entry barriers for competitors. Entry barriers for competitors result, for example, from a close cooperation between the supplier and his customer in the logistics area or from a high capital requirement for logistics-specific investments. Logistics systems can secondly serve to achieve a higher level of delivery service, in order to compensate for existing competitive advantages of competitors or to maintain or create one's own competitive advantages. This can generate an increase in the value of the primary product.[22] Logistics systems can thirdly serve to create new business areas. An example of this is the offer of a company to competitors or even companies from other industries to share its logistics resources. This usually involves the spin-off of one's own logistics unit or parts of it into a legally independent company.

4.3 Delivery Service Strategies in Industrial and Trading Companies

4.3.1 Scope for the Design of the Delivery Service

The characteristic for the logistics efficiency thinking[23] trade-off between the pursuit of low logistics costs and the pursuit of a high delivery service is not the only decisive factor for the design of the delivery service. Rather, this depends on legal, technical and economic framework conditions. This results in the scope for the design of the delivery service.[24]

The *legal framework conditions,* which must be taken into account when formulating a delivery service strategy, are hardly manageable. First of all, these include the general norms of the law of obligations. For example, the aspect of performance delay in Ger-

[19] See Göpfert (2009, pp. 66 ff.).

[20] Cf. Pfohl and Stölzle (1997, p. 172).

[21] Cf. Persson (1991, pp. 7 f.).

[22] Cf. Göpfert (2013, p. 118).

[23] Cf. Pfohl (2022, pp. 38 ff.).

[24] Cf. Havighorst (1980, p. 192).

man law according to §280 II BGB and its legal consequences can be mentioned here. In addition, there are a multitude of special norms for the transport sector. Not least, the entire area of environmental liability law must be mentioned, which sets requirements for the delivery reliability and quality.

The *technical framework conditions* of the delivery service result from the physical product characteristics of the goods for which logistic services are to be provided. Requirements for the delivery service are initially based on natural (physical, chemical, biological) product characteristics, such as shock, temperature and radiation sensitivity, as well as sensitivity to the duration of transport and storage (perishability). In addition, requirements arise from the external product characteristics, such as spatial dimensions and weights.

In addition to the legal and technical framework conditions, minimum requirements for the delivery service also result from *economic framework conditions*. Since the instruments in the marketing mix are only substitutable within certain limits, there is a service minimum, below which no provider can go with his delivery service offer. Even if goods have, for example, the highest quality or lowest prices, they cannot be sold without a minimum level of service quality.[25] The service minimum belongs to the obligatory bundle of goods and services that are indispensable for the customer. Delivery service policy can only be pursued in the service-operational area above the service minimum. This is entered in Fig. 4.6 into the well-known cost- and market reaction functions of logistics.

The service maximum is determined by the economic viability of the delivery service by a good. Apart from the cases of a mixed calculation, which may prove necessary for complementary products in the product range of a company, a burdening of a product with the logistics costs caused by a higher delivery service is only justifiable as long as the product price achievable on the sales market is not exceeded.

How large the scope for the design of the delivery service for a specific product or for a specific customer is, depends not least on the *differentiability* of the service performances. If one wants to offer a customer different delivery service levels for two products, for example, based on cost and revenue considerations, this can fail because the customer expects a homogeneous bundle of services from the supplier and the lowering of the delivery service level for one product affects the overall "service image" of the supplier. In addition, the question arises to what extent the customer's habituation to a certain service level allows a lowering of the service level.

Moreover, empirical studies have shown that a high delivery service only has a positive effect on the market share if it succeeds in generating a high *customer loyalty* through permanent and comprehensive performance.[26]

[25] Cf. Daugherty et al. 1998, p. 46).

[26] Cf. Daugherty et al. (1998, p. 47).

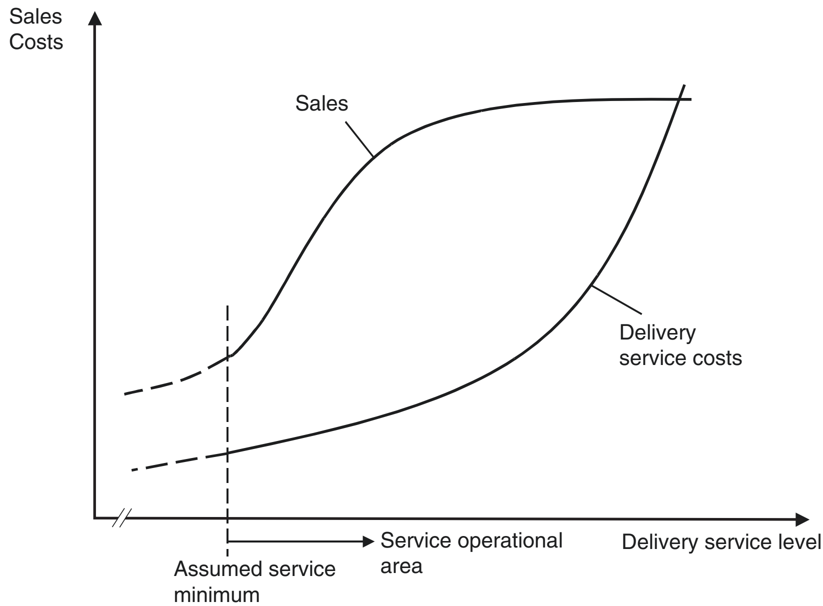


Fig. 4.6 Service-operational area for the formulation of a delivery service policy depending on the cost and revenue effects of the delivery service. *Source* Pfohl 1977, p. 254

4.3.2 Product Dependence of the Delivery Service

The importance of the delivery service and the possibilities for its realization depend on the products or industries for which logistical services are provided. It is obvious that the influence of individual delivery service components on the satisfaction of customers of different customer segments is not identical. As the discussion of the framework conditions has also shown, the technical and economic product characteristics therefore largely determine the delivery service that a logistics system must or can provide.

An approach to product classification for consumer goods, which does not focus on the product characteristics, but on the *buying behavior for consumer goods*, also provides valuable insights for the strategic importance of the delivery service as an instrument in the marketing mix. The basis for the approaches to such a product classification is a classification scheme that distinguishes between goods of effortless purchase („Convenience Goods"), goods of search and comparison purchase („Shopping Goods"), goods of special purchase („Speciality Goods") and goods of externally initiated purchase („Unsought Goods")[27]:

[27] Cf. Kotler et al. (2017, p. 462).

- Goods of effortless purchase are consumer goods whose procurement the customer normally does frequently without hesitation and with a minimum of comparison and sales efforts. This group can be further divided into goods of regular purchase, impulse purchase and urgency purchase. Goods of regular purchase are bought repeatedly with high regularity, such as a certain daily newspaper. Spontaneously bought goods or impulsively bought goods („Impulse Goods") are characterized by an impulsive buying behavior of the buyer. They differ from the goods of regular purchase, which are characterized by a strongly habitual buying behavior, by a strongly situationally motivated buying behavior, which is usually unplanned (e.g. chocolate bars, chewing gum). Urgency goods are bought in „emergency situations", i.e. they are characterized by a high urgency and lack of purchase planning. An example of this is the purchase of antifreeze in case of a sudden onset of winter.
- Goods of search and comparison purchase are consumer goods of higher demand, for which the customer generally makes critical comparisons according to specific criteria, such as style, quality, price and appearance, before selecting and buying them (e.g. furniture, clothing of the higher price segment, used cars and household appliances).
- Goods of special purchase are consumer goods that have unique characteristics. Their buyers show a high degree of brand identification and are willing to make special purchase efforts. Examples of these are designer clothing, luxury food and art objects.
- Goods of externally initiated purchase are goods that the consumer does not yet know or that he is aware of, but does not initially think of buying. These are essentially new goods, where the main focus from a marketing perspective is to increase the level of awareness through marketing communication.

This product classification assumes that the type and extent of the purchase efforts are of great importance for the marketing strategy. From the different purchase efforts of the consumer, however, statements can also be made about the different requirements for the delivery service.[28]

In the case of goods of *regular purchase*, there is no fixation on a specific brand, but the buyer is indifferent to comparable products. Presence gaps (shortages) in the initially preferred good lead to substitution by present goods. The trade is therefore able to increase the delivery service for such goods by acceptable substitution goods.[29] Since in this case the non-present good only leads to a loss of sales for the manufacturer, the delivery service is of high importance for the manufacturer in particular. This also applies to the goods of *urgency purchase.*

In the case of goods of *impulse purchase*, the presence as well as the form of presentation of the goods triggers the purchase reaction. The impulse buying behavior occurs

[28] For the following explanations, see also Havighorst (1980, pp. 224 ff.).

[29] See also the example of improving the service level by two substitution items from 70% to 97% in Kerres (1991, p. 324).

in the form of additional purchases when there is visual contact with presented goods and in the form of spontaneous substitution of sold-out goods by present goods. Obviously, the delivery service is of high importance for these goods, both from the perspective of the trade and from the perspective of the manufacturer, as non-present goods lead to sales losses for both.

In the case of goods of *search and comparison purchase*, the buyer decides on a product only after intensive comparisons. Here, a distinction must be made between the „inter-shop“ comparison and the „intra-shop“ comparison. In the first case, a buyer definitely visits several shops, while in the second case he limits himself to visiting a single shop with a concentrated offer. The importance of the delivery service for goods of search and comparison purchase is less clear than for the other product classes. In any case, the risk of sales loss for the manufacturer is lower in the case of the „inter-shop“ comparison than in the case of the „intra-shop“ comparison, since the search-friendly buyer in the first case is likely to find the non-present item in another shop. The importance of the delivery service is thus lower for the manufacturer in the first case, and the same for the individual retailer in both cases.

Goods of *special purchase* are characterized by a high degree of product differentiation and brand loyalty. In the eyes of the buyer, these goods have such „unique“ characteristics that he is willing to postpone his purchase and wait until the shortage is eliminated in case of occurring shortages. The delivery service is of low importance for such goods.

Although the marketing communication is primarily in demand for the goods of the *externally initiated purchase*, the delivery service also plays a significant role here. Above all, the immediate availability of the goods must be guaranteed as soon as advertising measures or measures of sales promotion have been successful, otherwise a aroused need cannot be satisfied.

In the previous discussion of product dependence, the delivery service in consumer goods marketing was primarily characterized by the availability of the goods (stock presence, shortages). However, statements are also possible on the product dependence of individual *delivery service components*.[30]

Short delivery times, for example, are necessary prerequisites for goods that are perishable in time. The demand for such goods is highly inelastic in time, so that a short delivery time becomes the minimum service. The temporal perishability of a good is expressed, among other things, in the physical spoilage (e.g. for food), in the loss of topicality (e.g. for many press products) or in the change of opinions and attitudes towards the appearance of products (e.g. for fashionable items). Short delivery times are especially required in online trading. If the customer can place his orders over the Internet in real time, he also expects a correspondingly fast delivery.

[30] Cf. Havighorst (1980, pp. 201 ff.).

A fixed delivery rhythm (delivery frequency) is, for example, a necessary prerequisite for weekly magazines, for perishable products, where expiration dates are controlled by the supplier, or for products, where a regular control of the presence stock in the shelves of the trade is carried out by the supplier, in order to secure the acquisition function of the stocks.

If one disregards the impulse goods, then the considerations made for the other classes of goods can basically also be transferred to the *buying behavior for production goods*. An important classification that allows conclusions about the importance of the delivery service is the one according to the specificity. With regard to the specificity of production goods, non-specific, supplier-specific, customer-specific and relationship-specific production goods can be distinguished.[31]

For suppliers of *non-specific production goods,* e.g. standard parts, industry standards and non-specific raw materials, a high logistics capability, especially in the components delivery time and delivery quality is of particular importance, besides the ability to grant low prices. Since the industrial customers do not want to keep any or only a low inventory of these generally available products, a very short delivery time (24 h, "Same Day") or even the provision in consignment warehouses is expected. If a supplier cannot meet these service expectations, then this will result in an immediate supplier change and thus loss of sales for the previous supplier due to the non-specificity of the production goods.

Supplier-specific production goods are those that are offered by only one supplier in a specific specification. Examples are special catalog goods that do not conform to any industry standard. In the short term, a poor delivery service will not result in any loss of sales for this group of production goods, as the buyer has adapted his production processes to these goods and cannot make a spontaneous supplier change. However, in case of permanently poor delivery service, the buyer will also look for substitutes with a similar specification in this case.

A supplier change is easier for *customer-specific production goods,* although there are also barriers to the change here. These are production goods that are required by only one customer in a specific specification. Examples are parts and assemblies that are manufactured according to drawing. Due to the special production for the customer and thus a comparatively long production time, the requirements for the delivery time are rather low, because its share of the total delivery time is low. More important abilities that play a role in the supplier selection are, on the other hand, the delivery reliability and the delivery flexibility, as the delivery by the supplier has to be integrated into the processes of the customer in terms of process organization.

For *relationship-specific production goods*, the repeated purchase over a fixed period (series contract) and a high requirement for delivery reliability and delivery quality are typical. The delivery times are short due to a forward-looking demand planning. A high delivery reliability and predictability is especially a necessary prerequisite for goods with

[31] Cf. Large (2013, pp. 12 ff., 78 and 85).

production- or use-synchronous ("Just-in-Time") delivery. In the short term, defects in the delivery service usually result in contractual penalties. In the medium term, insufficient logistics capabilities lead to the fact that a supplier is no longer considered as a partner for new supply components.

4.3.3 Demand Effect of the Delivery Service

If a supplier offers a higher delivery service level than his competitors, a customer will tend to be willing to place a higher share of his demand with this supplier and possibly even pay a premium for this special logistics performance. Likewise, an inadequate delivery service is a significant trigger for a supplier change or at least for the relocation of purchasing volume to an alternative supplier. Therefore, one can basically assume a *positive influence* of the delivery service level on the revenue, as it is also shown in Fig. 4.6.

Different influencing factors lead to differences in customer reactions to changes in delivery service, which make a generally valid statement about the demand effect of delivery service difficult. Above all, customer satisfaction as a prerequisite for a lasting positive demand effect depends on many influencing variables. Because how a customer reacts to changes in delivery service depends first of all on his *subjective perception* of the delivery service, which does not have to correspond to the subjective perception of the delivery service by the supplier or the objective conditions.[32] On the other hand, customer satisfaction and thus future purchase intention are largely determined by the deviation between the perceived delivery service and the service expectations.[33] The customer's reaction to changes in delivery service also depends on the extent of the change in the level of delivery service, in which it occurs. There are "indifference zones", within which the customer does not react to changes in delivery service.[34]

An essential influencing factor for the customer's reaction to a change in delivery service is also the *competitive situation.* If a supplier with a monopoly-like position worsens his delivery service, the customer will react less negatively than if there are other suppliers of the product or of substitute products on the market, to which the customer demand can easily switch.

The delivery service components always only have an effect on the customer in their *combination*, so that their demand effect also depends on their mutual coordination. Since the individual instruments of marketing policy also only have an effect on the customer in their combination, the customer's reaction to changes in delivery service is

---

[32] For differences in the assessment of delivery service by the supplier and customer, see Pfohl (1980, pp. 429 f.).

[33] See the basic model of service quality in Sect. 5.9.3.

[34] See Delfmann (1978, pp. 87 ff.).

finally also determined by the extent to which they are coordinated with all instruments in the marketing mix.

For the determination of a *demand function (market reaction function)* of the level of delivery service (delivery service-sales function) there is initially the same difficulty as with the other instruments of the marketing mix.[35] A very plausible hypothesis about the demand effect of delivery service is the S-shaped course of demand as a function of the level of delivery service shown in Fig. 4.6. This hypothesis can be derived from the proposition that the demand for a good depends on the utility that the customer assigns to it. If one starts from the marginal utility that an increasing level of delivery service provides, then the following result emerges from utility-theoretical considerations: The improvement of a very poor level of delivery service leads only to a low, but increasing utility increase for the customer. The improvement of an already very good level of delivery service also brings only a low, but decreasing utility increase. Then there must be such a curve shape that has a turning point between these weakly rising areas, and thus the improvement in the middle delivery service area leads to large utility increases.

The demand curve also seems plausible from another point of view. If one considers a market on which the suppliers use the delivery service because of its importance as a marketing policy instrument, and other criteria for supplier selection (e.g. also personal preferences of the customer for a certain supplier) in the concrete case do not lead to the fact that the offer of the delivery service is substituted by the offer of another criterion, then the following consideration can be made: If one considers the average offered level of delivery service, then improvements of a very poor level of delivery service only lead to a low increase in demand, because one is still too bad compared to the competition. If one is already far above the average level of delivery service of the market, then one achieves only low demand increases with an improvement of the delivery service. Because the customers who value a very good delivery service, one has already pulled away from the competition before.

Empirical studies on the impact of delivery service on demand could not falsify this hypothesis at least in the form of a tendency statement in the service operational area.[36] Further empirical studies problematize less the course of the demand curve, but rather focus more on the complex relationship between delivery service, customer satisfaction, demand and market share.[37]

However, it has been assumed so far that the costs caused by a higher delivery service are not borne by the customer. If one assumes, on the other hand, that the customer has to pay for a better *delivery service*,[38] then the hypothesis presented here is certainly to be

[35] See for the following basic Pfohl (1977, pp. 249 f.) as well as Havighorst (1980, pp. 108 ff.).

[36] See Pfohl (1977, p. 252).

[37] See e.g. Daugherty et al. (1998).

[38] For a price-delivery time function, which represents the effects of delivery time changes on the price willingness over a time elasticity of the price, see Mikus (2003, pp. 104 f.).

changed. As can be seen from Fig. 4.6, the costs caused by the delivery service increase with increasing level of delivery service at first weakly, but in the area of a good delivery service very strongly progressive. This cost curve is "ceteris paribus", as can be easily demonstrated, for example, by the relationship between delivery readiness and inventory holding costs for the safety stock, well-founded and also empirically confirmed many times and generally valid. If the customer now has to bear the delivery service costs, he will not be willing to bear the associated costs from a certain level of delivery service. Customers will increasingly switch to a supplier who offers a slightly worse delivery service, but at a much lower price. The hypothesis is therefore to be changed so that the demand curve does not asymptotically approach a saturation level, but falls again from a certain level of delivery service.

4.4 Logistics Network Strategies

4.4.1 Logistics Network

The logistics channel (the logistics chain) between procurement and sales market can be graphically represented as a network, in which the transport, handling and storage processes for bridging space and time as well as the associated information processes take place.[39] The network is the *model* for mapping the basic structure of logistics systems. This can be both complex logistical overall systems with the delivery points (sources) at the procurement market and the receiving points (sinks) at the sales market as well as logistical subsystems, for example of production logistics with the delivery points in the production segment A and the receiving points in the production segment B. Figure 4.7 shows the basic structures of such logistics systems.

By the *logistics network strategy* the basic structure of the logistics system and the associated logistics capacity for the execution of the logistics processes (transfer processes for bridging space and time) are determined. The logistics capacity is subdivided into transport/handling capacity, storage capacity and information capacity. Since this capacity not only depends on the basic structure of the logistics system, but also on the flow velocity of goods and information between the network nodes, the decision on the basic process type also belongs to the strategic planning level.[40] The process type determines the transport frequency between the network nodes. The planning of the logistic processes within given network structures then no longer belongs to the strategic planning. "For example, for a highly decentralized external storage system with daily deliv-

[39] Cf. Pfohl (2022, pp. 7 ff.).

[40] For the integration of the process type planning alongside the structure planning in the strategic logistics planning cf. Darr (1992, pp. 301 f.) For the subproblems of network configuration cf. also Bretzke (2015, pp. 204 ff.).

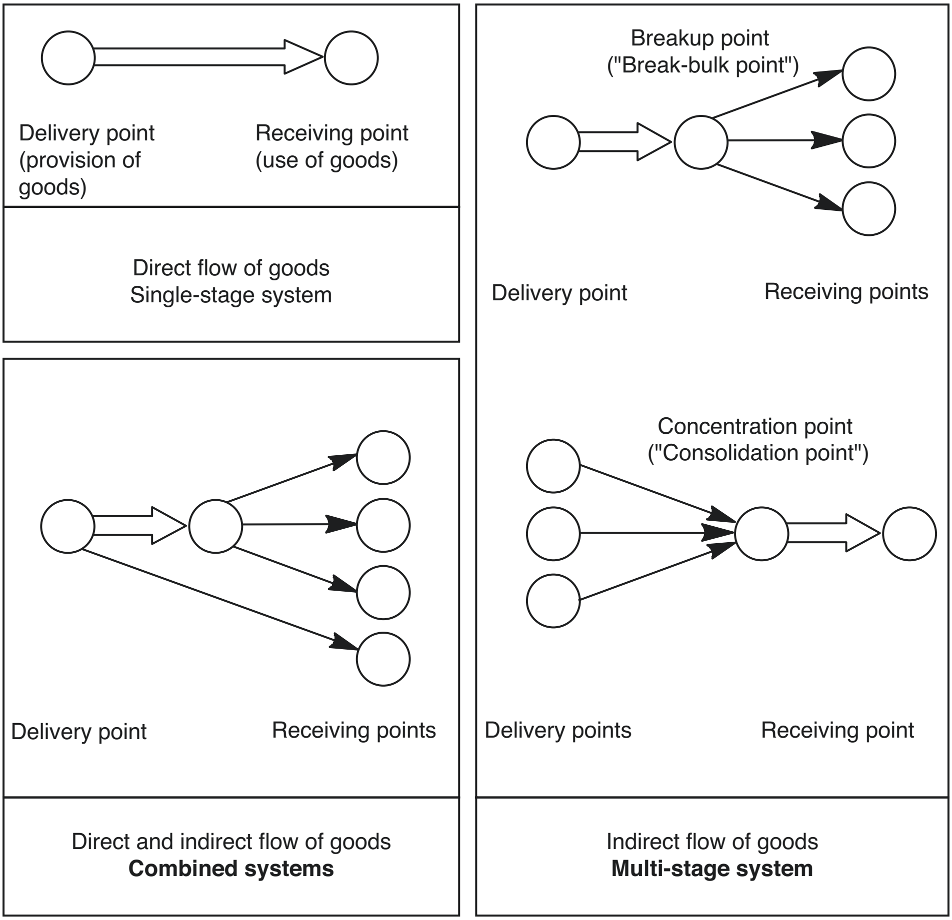


Fig. 4.7 Basic structures of logistics systems. *Source* Pfohl 2022, p. 6

ery, it must be determined which routes and tours for the transport volume underlying that day have the highest degree of goal achievement."[41] This planning problem arises in a completely different way, if a two-day transport frequency is determined by the process type.

In analogy to the macrologistical infrastructure[42] in the national economy, the logistic network can also be called *micro- or mesologistical infrastructure* for the goods and information flows. According to the logistics systems thinking, the structure for the goods flows and the structure for the information flows have to be planned integrally.

[41] Darr (1992, p. 301).

[42] Cf. Pfohl (2022, pp. 321 ff.).

This is especially true in view of the fact that a certain logistics performance can be provided by a logistics capacity that consists of different logistics partial capacities, since these are mutually substitutable to a certain extent.

The basis for the network strategy are *economic-geographic considerations*. The first starting point for the decision on the network underlying a complex logistics overall system is the *long-term development of customer demand* for goods and services in terms of quantity, composition and geographic distribution. To determine this, a differentiated set of instruments for strategic customer analysis is available. However, first indications for this result from an analysis of strongly aggregated economic indicators such as population size or gross national product. For example, the growth of the population in a region can lead to the fact that the production of goods, which were previously delivered from other regions, becomes profitable in this region due to the now usable economies of scale. The decline of the population in certain regions, for example as a result of the demographic development or the increasing urbanization, can trigger the opposite effect. This changes the goods flows between the regions. Another example is that the sales for some goods in Europe are regionally distributed similarly to the gross national product.

The demand development is also influenced by political changes and integration efforts of states. An important example of this is the EU integration with regard to the enlargement to Central and Eastern Europe. The "banana" extending from Birmingham to Milan as the optimal settlement area for logistics properties experiences, as shown in Fig. 4.8, a change by corridors to the east due to the EU enlargement to the east. Another example is China, where targeted measures by the government, in conjunction with the rising labor costs in the coastal regions, economic growth and increase in domestic demand are shifted from the rich coastal regions to the interior of the country to Central and Western China.[43] A further example is the effort of the government in the USA to relocate production from China back to the USA. This would change the "port orientation" of the warehouse locations, which is shaped by the strong import from China, to more production and demand center oriented warehouse locations.[44]

A second starting point for the decision on the network underlying a complex overall logistics system are the required *delivery time* by the customers and the delivery time that can be realized due to the macrologistical infrastructure. First indications for the delivery times that can be realized from a warehouse location are given by iso-time diagrams (isochrones). From the isochrones, time windows can be derived for potential locations of distribution or supply warehouses, within which target points can be reached. Isochrones can also be set up for long-distance transport with different modes of transport. If a 24-hour service is required in the more distant European regions, a central warehouse system must be switched to a decentralized warehouse system. Due to the geographical shape, national, regional and central networks can be distinguished. The

[43] Cf. Pfohl and Moraitakis (2014).

[44] Cf. Boyd (2020).

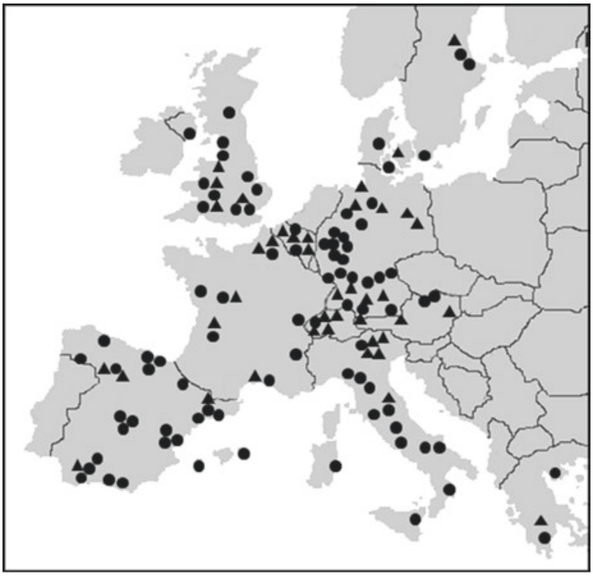
Fig. 4.8 Locations of logistics centers in Europe. *Source* Cushman & Wakefield Healey & Baker 2003, p. 4, retranslated.

Figs. 4.9, 4.10, 4.11 and 4.12 show examples of such networks for Europe. In the figures, it is shown in each case in which situations these networks are advantageous.

In assessing the advantages of the networks, design goals for networks were already implicitly assumed. The following will focus more on design goals and principles for logistics networks.

4.4.2 Design Goals and Principles for Logistics Networks

The characteristics of a system (network) designed for logistics depend on the requirements that are placed on the system, and the weight that is given to these requirements. These requirements are the design goals or evaluation criteria for the system design. The basic evaluation criteria are for each system its performance characteristics or its benefit and the costs for generating this benefit. In a *cost-benefit analysis* of the system, these criteria are compared with each other. However, this requires a monetary quantification of the performance of the overall system. For example, the sales revenues can be used in the case of a distribution system. In Fig. 4.13 the performance characteristics and the associated costs of a system are plotted over its complexity. It is typical for any system that its performance characteristics increase degressively, initially very strongly, but with increasing complexity, weaker and weaker. This reflects the law of diminishing marginal

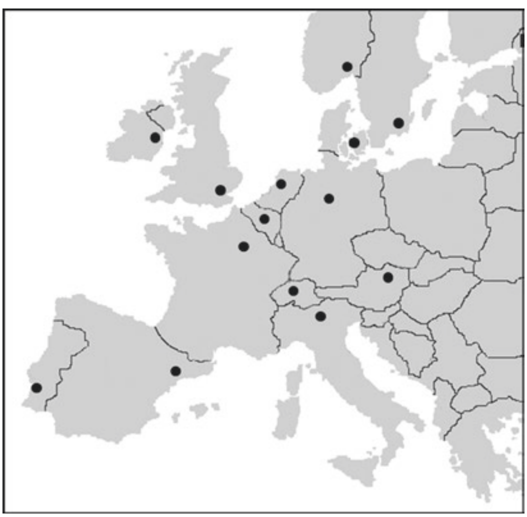


- Narrow range
- Low shelf life
- "Same day delivery"
- Decentralized production structure
- Low value
- Collection customers

e.g.
- Dairy products
- Bulk building materials
- Fresh service

▲ Storage
● Platform

Fig. 4.9 Decentralized national networks. *Source* Hoppe and Conzen 2002, p. 25



- Medium range
- Shelf life > 1 month
- 24 hours or "next morning delivery"
- Consumer goods/ National products
- Central production structures
- Medium value
- Self-collectors only in metropolitan areas

e.g.
- Books
- z. T. Food (dry goods)
- Consumer electronics

Fig. 4.10 Country-specific central warehouses. *Source* Hoppe and Conzen 2002, p. 27

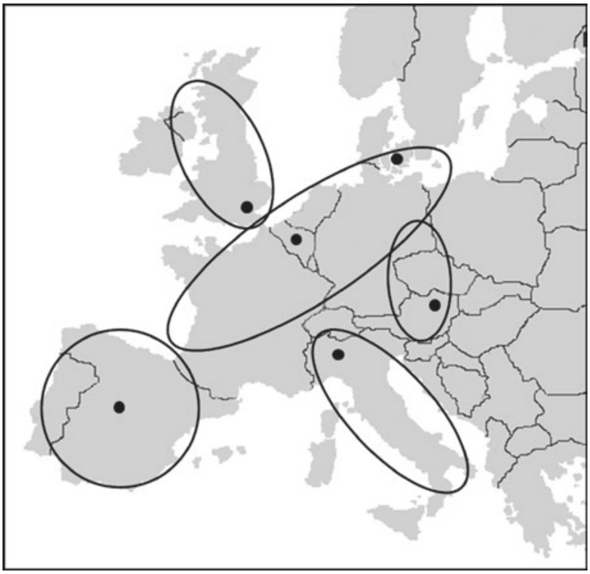


Fig. 4.11 Regional networks. *Source* Hoppe and Conzen 2002, p. 29

utility. The costs, on the other hand, increase progressively, initially very weakly, but with increasing complexity, stronger and stronger. The complexity of the logistics network captures factors such as the number of distribution warehouses, the number of delivery points, the number of different products and load carriers, or the diversity of transport modes for supplying a submarket.

The logistics costs have to be compared with its performance characteristics for the evaluation of the logistics system. The most important performance characteristic is the delivery or supply service. In other words, a *cost-effectiveness analysis* has to be performed. However, in this case, the individual utility values cannot be bundled into a total utility.[45]

Depending on the requirements that are placed on the system in each case, various specific performance characteristics may also occur.[46] However, for each logistics network, in addition to the service, five other generally valid performance characteristics

[45] Cf. Pfohl and Stölzle (1997, p. 175).

[46] For a checklist to capture the specific requirements for a logistics network, see Bretzke (2015, pp. 171 f.).

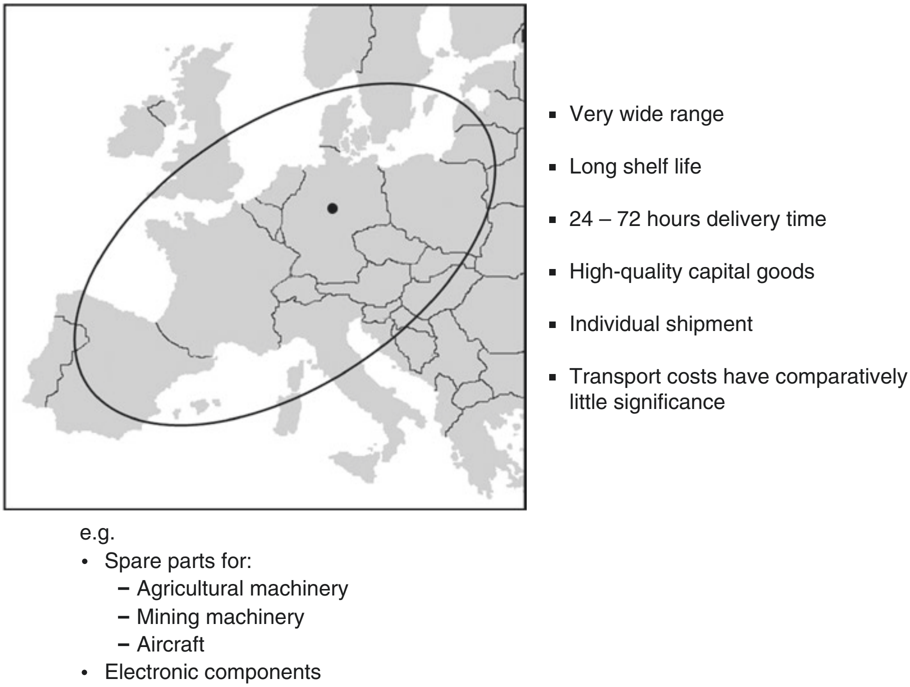
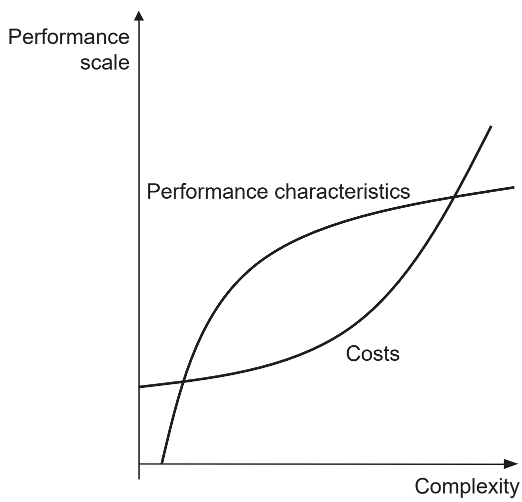


Fig. 4.12 European networks (central warehouses). *Source* Hoppe and Conzen 2002, p. 33

Fig. 4.13 Performance characteristics and costs as functions of system complexity



can be mentioned. If the performance characteristics are structured in this way, the following seven evaluation criteria for the logistics network result:

1. Logistics costs
2. Delivery or supply service
3. Adaptability
4. Vulnerability
5. Ecological and social effectiveness
6. Transparency
7. Time for the planning and construction of the system.

The logistics network is not only developed for a specific point in time, but also for a future period of time. The dynamics of economic development can make a change in the system of logistics necessary. Therefore, the system has to be *adaptable* enough to allow easy adaptation to changes in market requirements (changes in the level and geographical distribution of demand, change of products) and to technological changes (e.g. new developments in the transport sector).

Another evaluation criterion besides adaptability is the *vulnerability* of the logistics system. If a system is vulnerable, for example, orders may not be processed temporarily, or there may be an interruption in the order assembly, or the transport vehicles for delivering the orders may not be used temporarily. Vulnerability means for a certain time always complete failure or partial reduction of the performance of the system as well as additional costs for eliminating the disturbances. Risks of a system failure can be countered by redundancy in logistics capacities (e.g. two suppliers instead of one supplier or two warehouses instead of one warehouse).

The *ecological and social effectiveness* also has to be taken into account as an evaluation criterion. Logistics networks can only be implemented if they are accepted by the relevant stakeholder groups in a society at the local, national or global level. Also, the resource consumption and the environmental impact of logistics networks play an increasingly larger role as evaluation criteria.

The *transparency* (“visibility”) in the logistics system is the prerequisite for making decisions based on systems thinking. Transparency concerns, for example, the capacities, the inventories, the processes or the orders. Transparency makes it possible that all institutions connected by the logistics network can have the same information as a basis for decision making. Transparency requires a rational and error-free information collection and communication in the logistics network.

Not least, the *time* required for the planning and construction of the system also plays a role for its evaluation. It makes little sense to work out a perfect logistics system, if the time required until its completion becomes too long. In this case, a satisfactory working system, but which is ready for use in time, is preferable.

Which target level should be specified in each individual case, i.e. which values of the objectives or evaluation criteria are to be considered as desirable, depends on the circumstances of each company as well as on the technical and economic possibilities for the realization of a system. The question of "what" a system should achieve, therefore, cannot be answered completely independently of the question of "how" the requirements can be met, what extent of the requirements a system is able to fulfill under given conditions (e.g. under given macrologistical infrastructure).

For the design of logistics networks, design principles can be mentioned with regard to the objectives to be pursued, which have emerged in practice. In Fig. 4.14 such principles for the design of logistics networks are compiled.[47] When applying the design principles, it is always necessary to pay attention that they are relativized situationally. This requirement corresponds to the differentiation of logistics systems, which will be discussed in the next section.

When designing logistics networks, five interdependent strategic decisions have to be made, using the design principles, which determine the configuration of the networks: Central—Decentral, Postpone—Speculate, Direct—Indirect, Integration—Loose Coupling, Vulnerability—Resilience.

4.4.3 Central—Decentral

The problem of centralized or decentralized networks is discussed below using the example of distribution logistics. In principle, these considerations also apply to procurement or production logistics. The logistics network structure has a horizontal and a vertical dimension.[48] The vertical dimension captures the number of warehouse (depot) levels, namely factory, central, regional and delivery warehouses. The horizontal dimension characterizes the number of warehouses of one level.

The degree of *horizontal centralization* or more generally speaking the optimal number of warehouses on one warehouse level depends on a multitude of influencing factors. Besides performance aspects, the costs can be considered first. In Fig. 4.15 the relationship between the total costs and the number of warehouses is indicated.

In explaining the cost curves, it is assumed that the turnover of a warehouse depends only on the number of warehouses. The larger the number of warehouses per level, the lower the turnover per warehouse. The total volume thus remains constant. The *inventory costs* decrease with increasing centralization, because the average inventory to ensure a given delivery readiness in a market is lower, the smaller the number of warehouses is, where inventories are held to supply the market. The primary cause for this effect is the

---

[47] For a compilation of design principles see also Ihde and Janz (2000, pp. 332 ff.; Bretzke 2015, pp. 113 ff.).

[48] See also Schulte (2017, pp. 698 ff.).

1. A network configuration is logistically all the better, the

1.1 shorter, straighter, less interrupted the chains between critical sources and and sinks are ("principle of the shortest paths", the "chain shortening" and "network simplification"),

1.2 stronger bundled and interlinked activities are in terms of time/space (principle of "relation formation", "flow island formation"),

1.3 tighter the coupling, or the more perfect the integration of physical flows with information flows related to them is (e.g. the "Andon" concept, "eyeball management"),

1.4 further "upstream" warehousing and transshipment points can be placed and the further "downstream" value-added, customer-specific activities can be placed (the "postponement" concept),

1.5 higher is the "integrity" of customer need, product and process.

2. Flows are all the more rational, the

2.1 fewer "media breaks" occur along the flow (principle of the "unification" of objects, demand for continuous chains of information, relationships and "trust"),

2.2 smoother and faster flow is ("leveling", "pulse reduction", "Economies of Speed"),

2.3 earlier and the more robust error prevention is started ("Poka Yoke"),

2.4 more powerful alarm signals are powerful in the event of faults and overloads occurring nevertheless ("Taguchi" principle),

2.5 higher the degree of overlap of successive processes and the better the handover processes at interfaces are coordinated.

3. For operational flow control and regulation are to be preferred

3.1 demand-oriented versus resource-oriented control, fetch systems versus bring systems ("just-in-time"),

3.2 individualized, object-oriented controls as opposed to controls based on aggregated trigger information (lot size "one");

3.3 internal self-regulation systems versus external, analytical control systems.

Fig. 4.14 Design principles of logistics networks. *Source* Klaus 2002, p. 29

reduction of safety stocks. The inventory is proportional to the square root of the number of warehouses and can be estimated by the following formula[49]:

$$S_n = S_1 \times \sqrt{n}$$

[49] See Pfohl (2022, pp. 104 ff.).

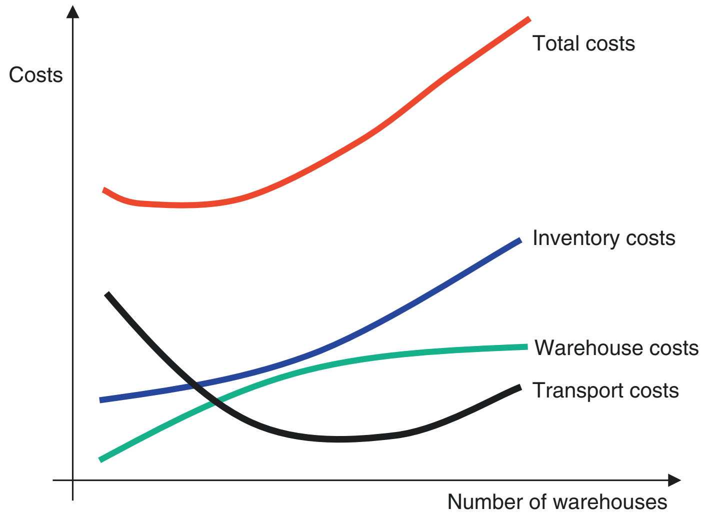


Fig. 4.15 Relationship between total costs and number of warehouses. *Source* Grant et al. 2006, p. 246, retranslated.

with:

S_1 = average inventory to satisfy a certain demand by one warehouse,
n = number of warehouses, if this demand is satisfied by several warehouses,
S_n = total average inventory with n warehouses.

However, this formula only applies to the safety stocks if the demands to be satisfied by the individual warehouses are statistically uncorrelated, and to the average inventory levels only if the classical order quantity formula[50] is applied and the same proportion of the total market demand is allocated to each warehouse. For most practical problems, the formula provides a good approximation anyway.

The *warehouse costs* increase with the number of warehouses, as a larger number of warehouses have to be built, maintained or rented. Moreover, with an increasing number of warehouses, the possibility of exploiting economies of scale in the warehouse decreases.[51] However, the cost increase will be less than proportional due to experience advantages in the construction (building, renting) of warehouses.

The *transport costs* for supplying the warehouses and for delivering from there to the customers will initially decrease with an increasing number of warehouses, as the delivery costs decrease due to shorter distances to the customers. However, the average

[50] For the order quantity formula see Pfohl (2022, p. 97). For the application of the “square root law” to safety stock and average stock see Evers (1995).

[51] For the problem of economies of scale effects in warehouses see Pfohl et al. (1992).

distance between the warehouses and the customers does not decrease linearly, but less than proportionally. This is because the distance is inversely proportional to the square root of the number of warehouses and can be estimated by the following formula[52]:

$$D = k \times \sqrt{\frac{F}{n}}$$

with:

k = constant,
F = geographical extent of the served market,
n = number of warehouses,
D = average distance between customer and warehouse.

On the other hand, with an increasing number of warehouses, the transport costs for supplying the warehouses increase, as relatively small quantities have to be transported over long distances. The supply costs of a warehouse decrease with increasing centralization, as the procurement volumes of a warehouse increase and thus economies of scale can be exploited.

With a decreasing number of warehouses, the choice of location becomes more important, as cost disadvantages of suboptimal warehouse locations cannot be compensated by deliveries from other warehouses. In addition to the traditional, delivery cost-based location choice, a multi-stage location choice is therefore necessary, which takes into account various, also non-quantitative, objectives.[53]

In addition to the cost considerations made so far, the problem of whether to deliver directly from the factory or central warehouse or indirectly via further storage stages arises in the case of *vertical centralization*.[54] In the case of indirect delivery, transport and picking are carried out in at least two storage stages. This has the advantage that the storage stage closer to the customer can be supplied with large transport units at a low transport cost rate and the higher transport cost rate for the smaller transport units only applies to the shorter delivery distances to the customer. Tendingly, the establishment of an additional storage stage is more advantageous, the higher the cost difference of the two transport cost rates is, the lower the costs incurred in the additional storage stage are and the further the customers to be supplied are from existing warehouses.

Prerequisite for a centralization of logistics networks is the existence of efficient communication, handling and transport technologies. Because only they enable in many cases the guarantee of the short delivery times demanded by the market, which could previ-

[52] See also Hayes and Wheelwright (1984, p. 62). The effect of greater customer proximity thus diminishes. See Bretzke (2015, pp. 122 f.).

[53] See Ashayeri and Rongen (1997, pp. 221 ff.).

[54] For the basic cost considerations that argue for the establishment of a delivery warehouse, see Pfohl (2022, pp. 115 f.).

ously only be provided by decentralized logistics networks. A prerequisite for efficient replacement deliveries by another, possibly more distant warehouse is a networked inventory management, which allows an immediate verification of the delivery capability.

The *limits* of centralization are reached when the performance of the technologies does not meet the market requirements or cannot be fully utilized due to poor macrologistical infrastructure. Also purchasing habits of the customers, e.g. the desire for self-collection, can argue against a centralization. An inhomogeneous customer structure, i.e. the concentration of customers in certain sub-markets, also speaks against a centralization. General diseconomies of scale also argue against a centralization. Problematic here can be especially long internal transport distances in large central warehouses, which lead to a high material handling effort. Larger organizational units also tend to bureaucratize, which slows down the decision processes, reduces the flexibility and impairs the identification of the employees with the organizational unit. The higher complexity of larger organizational units leads to greater coordination problems; however, it should be taken into account that the overall complexity of decentralized networks with a larger number of warehouses can be even greater.

Finally, the risk increases with the concentration of logistics activities at one location. The vulnerability to natural disasters, fire, accident, strike, but also mismanagement of executives increases. Last but not least, it can become difficult to meet the labor demand at a central location.

In Fig. 4.16 the basic effects of centralization as well as the advantages and disadvantages of central warehouse concepts are summarized.[55] One possibility to achieve the advantages of centralization and at the same time avoid the associated disadvantages are *warehouse network systems*. These are networked decentralized storage systems that are connected by cross-deliveries. Stocks are thus not physically, but virtually centralized by means of a corresponding information system. In case of need, stocks can then be redistributed. For the receiving warehouse, this is called “cross docking” if the goods are delivered pre-picked and only transshipped.

4.4.4 Postpone—Specule

The decision on a centralized or decentralized storage of inventory will also depend on the *inventory risk*. This refers to the danger that goods are produced and/or stored in insufficient quantity or composition based on forecasts. This risk can be countered with a principle for handling uncertainty that is generally known from planning, namely postponing the decision for a plan.[56] This is intended to shorten the forecast range, whereby

[55] Cf. also Schulte (2017, p. 474) for criteria that speak for the establishment of central or decentralized warehouses.

[56] Cf. Pfohl and Stölzle (1997, p. 102).

Base effects of centralization

Putting together / integration of operational processes

- **Synergy / interaction**
  - → Productivity improvement through compensation
  - → Bundling and multiplication of existing knowledge
  - → Bundling of goods flows
  - → Bundling and joint use of production factors
- **Specialization**
  - → Integration from different areas allows the formation and promotion of specialists
  - → Opportunities for more productive and cost-effective processes
- **Standardization**
  - → Identical procedures and methods offer the advantage of a simpler and easier to understand organization (reduction of complexity)
  - → Danger of uniformity!

	Advantages	Disadvantages
Trade	• Increase of article presence • Improved assortment policy • Faster replenishment • Better use of space • Reduction of stocks • Reduction of administrative expenditure • Reduction of transport and packaging costs • Opportunities to improve conditions • Use of better storage, picking and transport technology	• Not suitable for all assortments • Higher capital commitment • High conversion effort • "Vulnerability" to strike, boycott, etc.
Industry	• Reduced handling • Fulfillment of higher service requirements of the trade • Reduction of inventories • Reduced distribution costs • More flexible expansion of technical facilities • More flexible distribution systems	• Responding to "special requests" is becoming more difficult • Not suitable for all assortments (ABC analysis) • High capital commitment • Higher degree of integration with trading partners necessary
Logistics service provider	• Higher specialization possible compared to trade and industry • Better utilization of logistics functions • Assumption of logistics functions for several manufacturers and trading companies • Increasing the service component of logistics performance • Assumption of functions in the non-logistical area (merchandising, factoring,...)	• Greater dependence on partners • Higher management requirements • Higher capital commitment

Fig. 4.16 Basic effects of centralization as well as advantages and disadvantages of central warehouse concepts from the perspective of trade, industry and logistics service providers. *Source* Liebmann 1991, p. 21 and p. 24

one can generally assume that by postponing the decision point, new information will be obtained that will better substantiate the forecast. Ultimately, this approach is about finding the optimal decision point. In the limit case, the decision is only made when the expectation variable, e.g. the demand, no longer has to be forecasted, but is already certain, e.g. in the form of fixed customer orders. In this case, a transition from stock production to order production takes place.

		Logistics	
		Speculation (decentralized stocks)	Postponement (central stocks)
Production	Speculation (stock production)	Full Speculation Strategy	Logistics Postponement Strategy
	Postponement (order production)	Manufacturing Postponement Strategy	Full Postponement Strategy

Fig. 4.17 Basic "postponement-speculation" strategies. *Source* Pagh and Cooper 1998, p. 15, retanslated.

Production and logistics processes can thus be planned or scheduled based on uncertain demand forecasts or fixed customer orders. In the literature, a distinction is made in this regard between postponing a decision ("postponement") and speculatively making a decision ("speculation") in the logistics channel.[57] *Postponing* means that the product is kept as long as possible at the beginning of the logistics channel in a "neutral" state without assignment to a customer or submarket. *Speculating* means that the product is brought to the end of the logistics channel as early as possible based on the forecasted customer demand. Speculating is associated with a low risk if a regular demand pattern, a product range with few product variants and a concentration of customers in certain submarkets exist. However, with a large number of product variants and widely dispersed customers, it can hardly be predicted how much, when and where a product variant is needed. This can be countered by postponement strategies.

Postponement strategies either affect production ("assembly postponement") or logistics ("geographic postponement"). In the first case, the production activities that lead to product differentiation are postponed to the end of the logistics channel. In the second case, the transport of already differentiated products to submarkets is postponed as long as possible. The differentiated products are thus stored at central locations. This allows for four basic "postponement-speculation" strategies, which are shown in Fig. 4.17.

The "Full Speculation" strategy is the traditional forecast-based strategy. All production activities are completed before an order is placed and the good is available in a delivery warehouse assigned to the customer. The "Manufacturing Postponement" strat-

[57] Cf. Pagh and Cooper (1998); Pfohl and Pfohl (2000); Delfmann (2004); Vahrenkamp (2007, pp. 32 ff.).

egy is based on a postponement of the customer-specific production and assembly contents. These can be carried out by the manufacturer itself but also at downstream storage levels. Today, a relocation of these activities to logistics service providers is also common. In the case of a "Logistics Postponement" strategy, the inventories are initially held at the central warehouse level and only delivered through the corresponding channels of the distribution system after the customer order is received. The "Full Postponement" strategy is the combination of both postponement strategies. In this case, both the production and the logistics activities are initiated by the customer order. At the same time, this is the most demanding form of postponement, as the maximum permissible delivery time must be sufficient to carry out the remaining value-added processes.

If the logistics and production postponement is further subdivided, then five types of postponement can be distinguished: manufacturing, assembly, labeling, packaging, and inventory postponement. Figure 4.18 gives an overview of typical postponement decisions and the cost tendencies associated with them. It also shows, as a result of a simulation study, the allocation of postponement types as particularly suitable for certain types of companies.

The interface between the forecast-based expected production and the order-based production, which is important for the postponement decision, is also called *decoupling point* ("Order-Penetration-Point", "Freezing Point"). At the decoupling point, the point where a large number of product variants are created should coincide with the point from which the customer orders control the logistics channel; because then the variants can be manufactured and distributed without inventory and obsolescence risks. The decoupling point is the point in the logistics channel up to which "speculative" inventory levels must be maintained. The determination of the decoupling point is therefore also referred to as the determination of the stocking level in the logistics channel.[58] It should be located at a level of low value added with regard to the inventory holding costs. Up to the decoupling point, the flow of goods is driven by forecast information (push principle). From the decoupling point, the flow of goods is pulled by customer orders (pull principle). The delivery times from the decoupling point must meet the customer requirements.

Figure 4.19 gives an overview of logistics channels with different decoupling points. Postponement is of high relevance for the strategic decision. Because postponement is a supporting pillar of the "*Mass-Customization" concept* (concept of a tailored or individualized mass production), which aims at both cost-effectiveness and high customer benefit through individualization/diversity.[59] This makes it possible to move from the competitive strategies of "cost leadership" or "differentiation" to a hybrid competitive strategy in which "cost leadership" can be linked with "differentiation".[60]

---

[58] Cf. Schulte (2017, p. 390).

[59] For the connection between customizing and postponement, see Lee (1998).

[60] See also the explanations in Sect. 4.2.1.

Postponement type	Cost types	Cost effect of postponing the decision
A Labelling	Inventory costs Processing (labelling)	Decrease Increase
B Packaging	Transportation Inventory costs Processing (packaging)	Decrease Decrease Increase
C Assembly	Transportation Inventory costs Processing (assembly) Shortage costs	Decrease Decrease Increase Increase
D Manufacturing	Transportation Inventory costs Processing (manufacturing) Shortage costs	Decrease Decrease Increase Increase
E Warehousing	Transportation Inventory costs Shortage costs	Increase Decrease Increase

Postponement type	Company type
A Labelling	• Companies selling a product under different brand names • Companies with high-value products • Companies with high sales fluctuations
B Packaging	• Companies selling a product in different package sizes • Companies with high-value products • Companies with high sales fluctuations
C Assembly	• Companies selling products in different versions • Companies selling products whose space requirements decrease considerably when delivered in disassembled state • Companies with high-value products • Companies with high sales fluctuations
D Manufacturing	• Companies selling products with a high proportion of materials available everywhere (ubiquities) • Companies with high-value products • Companies with high sales fluctuations
E Warehousing	• Company with high quality products • Companies with a large number of distribution warehouses • Companies with high sales fluctuations

Fig. 4.18 Cost effects of postponement types and their suitability for certain types of companies. *Source* Zinn and Bowersox 1988, p. 123 and p. 133, retranslated.

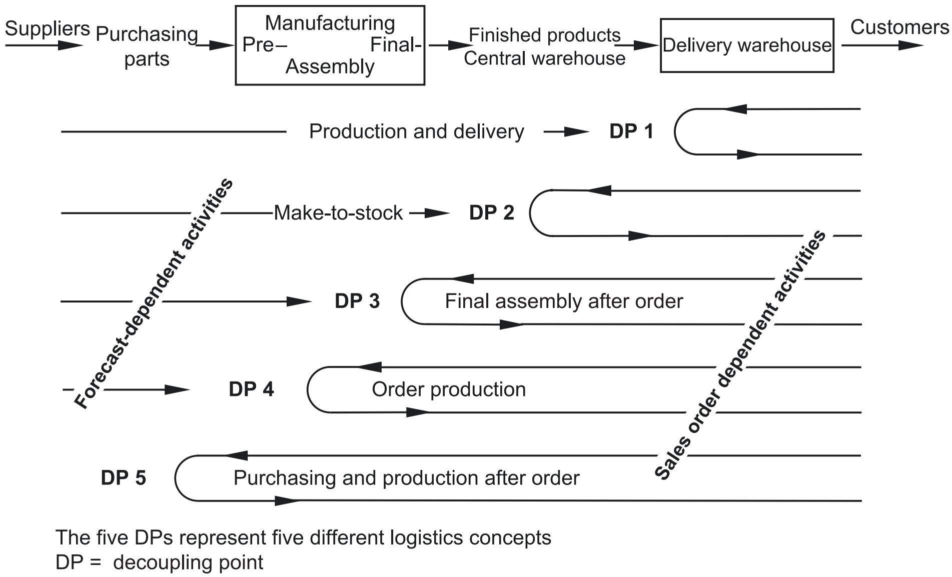


Fig. 4.19 Decoupling points in the logistics channel. *Source* Jordan 1988, p. 55, retranslated.

4.4.5 Direct—Indirect

The direct flow of goods between the delivery and receiving point ideally corresponds to the logistical guiding principle of flow orientation. Nevertheless, an interruption of the flow of goods to dissolve or bundle (concentrate) the goods can be sensible.

The purpose of an *indirect flow of goods* is always to exploit cost degression advantages up to the breaking point or from the breaking point. *Bundling*—often referred to as consolidation in line with the Anglo-Saxon term "Consolidation"—occurs whenever the goods to be transported are combined into larger transport lots in order to reduce the transport unit costs and the unit costs of the goods output at the delivery point and the goods input at the receiving point. However, this is offset by the possibly increasing costs of storage, handling and order processing associated with the interruption. The three forms of bundling shown in Fig. 4.20 can be distinguished.[61]

The simplest form is the *inventory bundling* or temporal bundling. This form of bundling is achieved by delaying deliveries until a certain transport lot is reached, or by collecting the deliveries at a certain receiving point and executing them at a predetermined

[61] Cf. Hall (1987, pp. 58 ff.); for the distinction between temporal and spatial transport consolidation, see also Darr (1992, pp. 340 ff.) For bundling effects, see also Bretzke (2015, pp. 115 ff.).

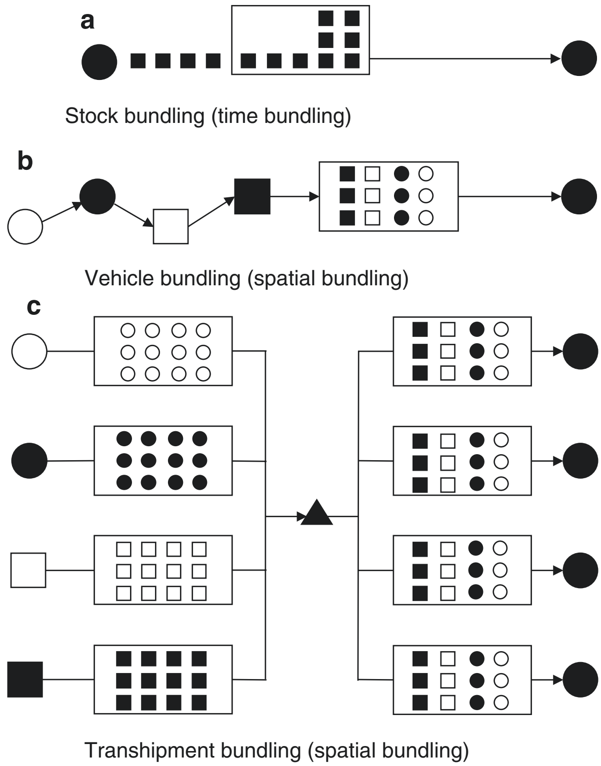


Fig. 4.20 Forms of bundling of goods flows. *Source* Hall 1987, p. 59

time. The cost conflict to be considered here is known from the discussion of the optimal order quantity.

The *vehicle bundling* is a form of spatial bundling. This form of bundling is achieved by a vehicle collecting goods from several delivery points during a tour or delivering goods to several receiving points during a tour. In addition to the costs arising from the temporal bundling, the costs of the collection or delivery tour are incurred, which can be minimized by means of a sound tour planning.

A second form of spatial bundling is the *transshipment warehouse or transshipment terminal bundling*. In the transshipment warehouses, the goods received from the delivery points are sorted, loaded onto new vehicles and brought to the receiving points. This can reduce the number of connections between delivery and receiving points. For example, if $100^2 = 10{,}000$ connections are required to maintain the relations between 100 delivery points and 100 receiving points by direct links, only 200 connections are required for the indirect link via the transshipment warehouse bundling, namely 100 between the delivery points and the transshipment warehouse and 100 between the transshipment warehouse and the receiving points. In addition to the costs of vehicle bundling, the costs incurred by the construction and operation of the transshipment warehouse are also incurred.

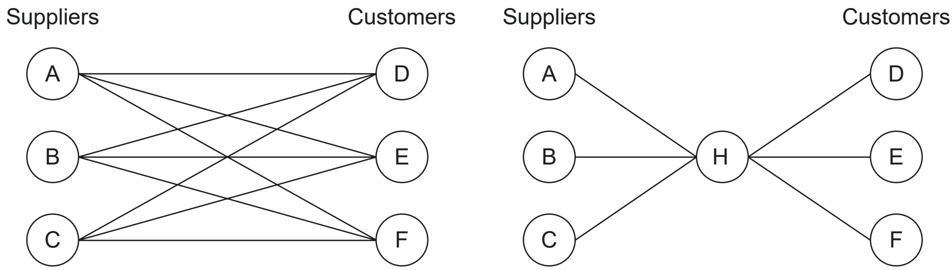


Fig. 4.21 Schematic representation of the advantages of hub-spoke-systems

When distinguishing between direct logistics networks and indirect logistics networks with transshipment warehouse bundling, one also speaks of grid systems and star systems. The latter are also referred to as *hub-spoke-systems* in line with the Anglo-Saxon term. Figure 4.21 shows such logistics networks.

The hub-spoke structure is fundamental for the distribution systems of courier, express and parcel services (CEP services). The advantages and disadvantages of hub-spoke systems are manifold[62] and a general advantage is by no means always given, even from a cost perspective. Above all, it must be taken into account that the savings due to bundling effects must be sufficient to cover the operating costs of the hub and the higher transport costs due to longer transport routes.

When deciding for hub-spoke -systems, three factors are of decisive importance[63]:

- the transport volume (low for the individual relation)
- the bundling of available time reserves (no too narrow time windows)
- the additional costs required for the establishment of the bundling station (not too high).

While the indirect flow of goods is based on the approach of cost degression advantages, the *direct flow of goods* is based on the approach of Just-in-Time advantages. *Just-in-Time* (JiT) is defined as a “philosophy” whose aim is “to create a product or service by means of appropriate planning, control and monitoring of all material flows and the associated information flows just in time, i.e. without wasting time, material, labor and energy according to the wishes of the customer regarding price, quality and delivery service.”[64] Any process that does not contribute to value creation is considered waste in the sense of this definition. The Just-in-Time approach is based on the following prin-

[62] Cf. Bretzke (2015, pp. 369 ff.); Aberle (2009, pp. 535 f.).
[63] Cf. Heinrichmeyer (1998, pp. 187 ff.).
[64] Zibell (1990, pp. 18 f.).

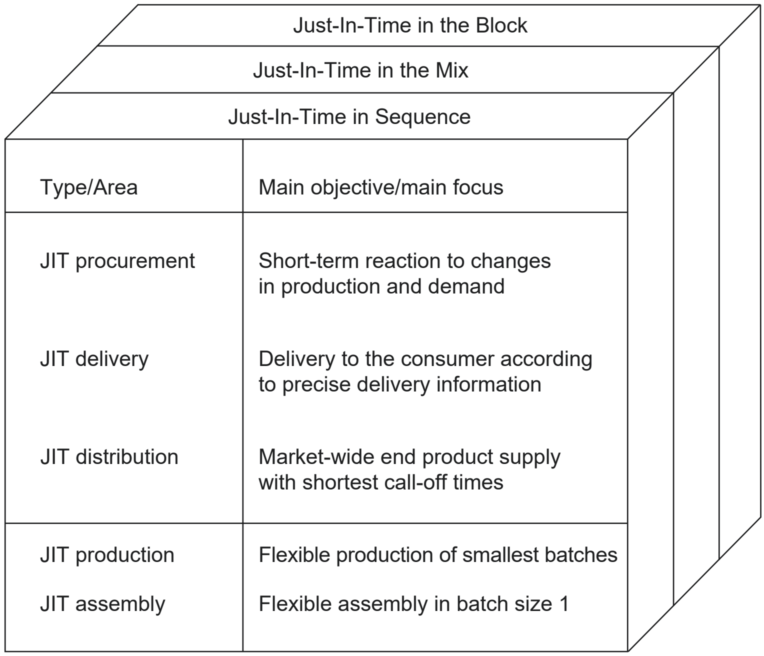


Fig. 4.22 Just-in-Time main areas of application. *Source* Schmidt 1990, p. 103

ciples, which are directly related to each other: reduction of lead times, order orientation in producing, reduction of setup times, provision of capacities and simplification of processes.[65] In principle, the Just-in-Time approach can be applied in procurement, production and distribution logistics. However, JiT strategies have found the strongest distribution in procurement logistics, especially in the automotive industry.

The main areas of application of the Just-in-Time approach are summarised in Fig. 4.22. Depending on the accuracy, the following Just-in-Time variants can be distinguished:

In *Just-in-Time in sequence* or short Just-in-Sequence, the provision of the materials required at a point of demand is done exactly in the required order. This can be done by order-oriented picking near the point of demand (customer-near), by production synchronised from the point of demand near the producer (customer-far) or between the two locations. To realize the customer-near Just-in-Time in sequence delivery, industrial park concepts have gained in importance.[66]

In *Just-in-Time in block*, the provision of the materials required at a point of demand is done in individual type-pure logistical units. The grouping of a certain quantity in a

[65] Cf. Zibell (1990, pp. 21 f.).

[66] Cf. Gareis (2002).

logistics unit can be done by repacking into smaller containers near the point of demand, by direct production into the containers near the producer or between the two locations.

In *Just-in-Time in mix*, the provision of the materials required at a point of demand is done in logistical units in the composition in which they are jointly needed at the time of consumption. Therefore, a demand-oriented picking is required. Analogous to the block variant, this can be done customer-near, -far or between the locations.

In all three variants, the provision should be as close as possible to the current consumption. The more precisely and longer-term the demand can be forecasted, and the more reliable the bridging of space is possible, the greater distances are feasible between delivery and receiving points. Prerequisites for the introduction of the JiT approach are sufficient procurement volumes and predictability of demand.

4.4.6 Integration—Loose Coupling

Another important strategic decision regarding the design of logistics networks is the determination of the size of the network combined with the degree of logistics integration of the cooperating elements or subsystems.[67] A logistics system can assume different states of integrality, whose gradations range between the state of a non-integrated or rather *loosely coupled* logistics system and the state of a completely *integrated* logistics system.[68]

How far the integration should go depends on the effects it has on the objectives pursued with the network. Here, network objectives and objectives of the companies involved in the network can be differentiated.

A significant network goal that is often mentioned is the achievement of competitive advantages. This also belongs to the goals of the companies involved in the network. To achieve these goals, the exploitation of synergy effects can contribute, which occur when individual elements of a network are integrated in the form of *network effects*.[69] Here, one distinguishes between cost- and benefit-based network effects. Cost-based network effects („Supply Side Network Economies") can be identified by means of the

[67] Logistics integration can be described as the anticipatory structuring design of the relationships between logistics system elements, within which the coordination of the situational control of occurring events serves. Cf. Häusler (2002, pp. 334 f.).

[68] Cf. Pfohl (2022, p. 26).

[69] Cf. Ihde and Kloster (2001, pp. 25 ff.); see also Henning et al. (2003, pp. 399 ff.) The possible exploitation of such network effects is also based on the concept of the *Physical Internet*. Analogous to the concept of the Digital Internet, the heterogeneous and independent logistics networks are to be replaced by an open, coherent logistics network. The basis for the linkage in the network is provided by the development of a standard set of modular containers and standardized transport protocols. This is intended to enable the sharing of warehouses and transport vehicles. Cf. Ballot et al. (2014).

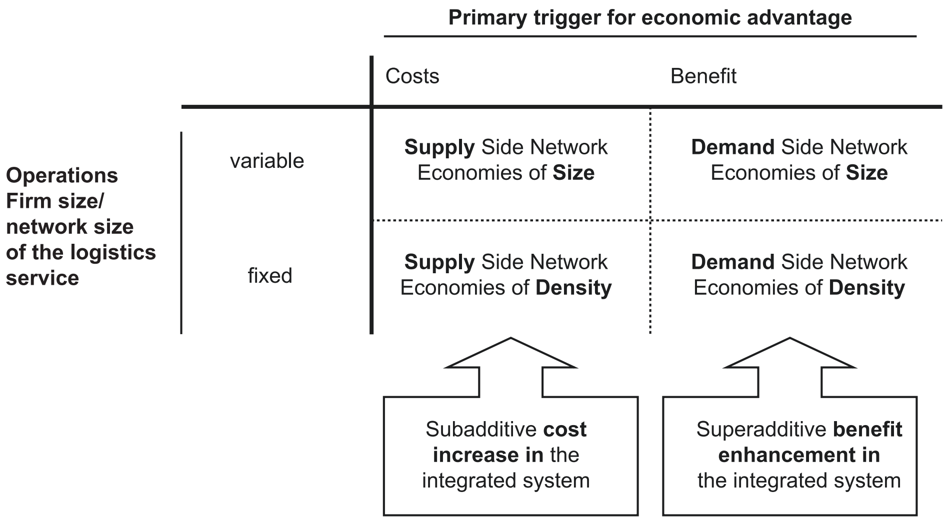


Fig. 4.23 Differentiation of Network Economies. *Source* Ihde and Kloster 2001, p. 30

subadditive cost increase that occurs in an integrated system. This can be triggered, for example, by the use of larger and thus more efficient transport vehicles („Supply Economies of Size") or by a better utilization of existing transport vehicles („Supply Economies of Density") within a logistics network. Benefit-based network effects („Demand Side Network Economies") arise, on the other hand, from a superadditive increase in utility in an integrated logistics system. As a result of a larger supply of source-sink-relations („Demand Economies of Size") or by an improved quality of the existing relations („Demand Economies of Density"), the attractiveness of the integrated network increases. Networks can thus increase their attractiveness by offering new relations or the existing relations in higher density or better quality (e.g. by shorter transport times, higher transport frequencies or increased transport reliability). An overview of these network effects is given in Fig. 4.23.

Logistical integration measures are initially associated with an increase in *costs*. One can think here of one-time cost-effective expenditures, for example, for the development of network-wide procedural guidelines. As ongoing cost increases, for example, depreciation on technical integration investments (integrated material and information flow technologies) are incurred.[70] However, logistical integration can also reduce costs. This is mainly done by dissolving activities without value added: e.g. reduction of redundant data storage and maintenance at several companies, reduction of inventory stocks held by both the supplier and the customer, or reduction of empty costs due to underutilized transport vehicles. Since these cost-reducing effects tend to follow the cost-increasing

[70] Cf. Häusler (2002, p. 339).

effects in time, integrated networks have to be designed for the long term. However, these often only indirectly cost-effective integration effects are generally difficult to assign and quantify.[71]

Organizational and technical integration measures can achieve *time advantages* by shortening existing lead times and thus lead to a reduction of delivery times as well as an increase in delivery reliability. To this end, programs for anticipatory lead time-reducing coupling of cross-company logistics processes as well as modern information and communication systems for avoiding media breaks at the technical interfaces can contribute. However, the necessity to achieve time advantages is also questioned. Because of the associated disadvantages of higher complexity of logistics networks, a change of perspective in logistics by deceleration and decoupling is therefore also demanded.[72]

The effect of logistical integration on the *adaptability* of a logistics network has to be considered in a differentiated way. On the one hand, many integration measures, such as plans or programs, increase the flexibility within existing structures. On the other hand, they tend to reduce the adaptability of the existing logistics network structure. The risk of impaired adaptability of integrated networks diminishes the advantages of integration already shown and makes a looser coupling of the system elements appear as a suitable alternative. However, the lower adaptability that occurs in the integrated system must be contrasted with the weaker communication between the subsystems that occurs in the context of a loosely coupled network. Because this leads to a suboptimal use of resources.

When coupling the system elements, different *levels of interface management* can be distinguished: "Managed Process Links", "Monitored Process Links", "Not-Managed Process Links" and "Nonmember Process Links". This means that the focal company of a network[73] wants to integrate certain cross-company processes due to their high importance for its own company goals ("Managed Process Links"*)* and transfers the integration of further processes to the partner companies in the network due to their lower importance and only monitors them ("Monitored Process Links"). Likewise, the focal company can leave the complete design and monitoring of individual processes to participants of the network ("Not-Managed Process Links"). In addition, there are relationships between the participants of one's own logistics network and companies of other networks, which can indeed influence the goals and performance of the focal company, for example, in terms of product availability, improved quality and reduced total logistics costs ("Nonmember Process Links"). Therefore, despite the disadvantages of integration already explained, it can sometimes be important to also consider and integrate those

[71] Cf. on this and the following Häusler (2002, pp. 340 f.).

[72] Cf. Delfmann (2010).

[73] See Pfohl (2022, p. 301) for the term focal company. For the levels of interface management, see Lambert (2014, pp. 210 ff.).

processes in a supply chain or a logistics network that are not directly related to one's own company, instead of coupling them rather loosely to the network.

With regard to the characteristics that speak for an integrated management of the supply chain or of logistics networks across several stages, it has been shown that this will primarily be relevant for companies

- "that operate in a "long-linked" industry,
- that have sufficient power to enforce cooperation in case of doubt,
- that work with "perishable" goods,
- that operate in long, multi-stage supply chains,
- that operate in an uncertain environment,
- that see a chance to initiate a common strategic orientation of the actors in the chain,
- that have relatively high logistics costs,
- that are able to reorganize links in the value creation network at least periodically."[74]

4.4.7 Vulnerability—Resilience

Risks are all future developments or events that lead to a disruption or interruption of value creation, which can cause a failure to achieve the goals of a company. They are usually statistically described by their probability of occurrence multiplied by the potential damage caused (expected value).[75] With all logistics network strategies, increasing attention must be paid to the risk associated with them. Because certain long-standing trends that influence the design of logistics networks act as *risk drivers*.[76] These are mainly the internationalization, the reduction of production and distribution sites as well as the number of suppliers, the reduction of value-added depth as well as the reduction of organizational buffers (reserves, redundancies). The internationalization of procurement, production and sales leads to global supply chains. These entail additional risks due to higher coordination effort, longer transport distances and cultural differences. The reduction of production and distribution sites as well as the number of suppliers creates the possibility of achieving scale effects. At the same time, however, the dependence on individual plants, warehouses or suppliers is increased. This results in resource supply risks that can lead to a disruption or interruption of value creation. The reduction of value-added depth by transferring parts of the value creation to other companies leads to a fragmentation of the supply chains. The unclear responsibilities and insufficient control possibilities that may be associated with outsourcing create increased risks. Finally,

---

[74] Otto and Kotzab (2001, p. 172).

[75] See Berbner (2017, pp. 42 ff. and 61 ff.) for the concept of risk.

[76] See Pfohl et al. (2008, pp. 10 ff.); Pfohl et al. (2010, pp. 33 ff.); Köhler (2011, pp. 23 ff.) See also Christopher (2016, pp. 215 ff.).

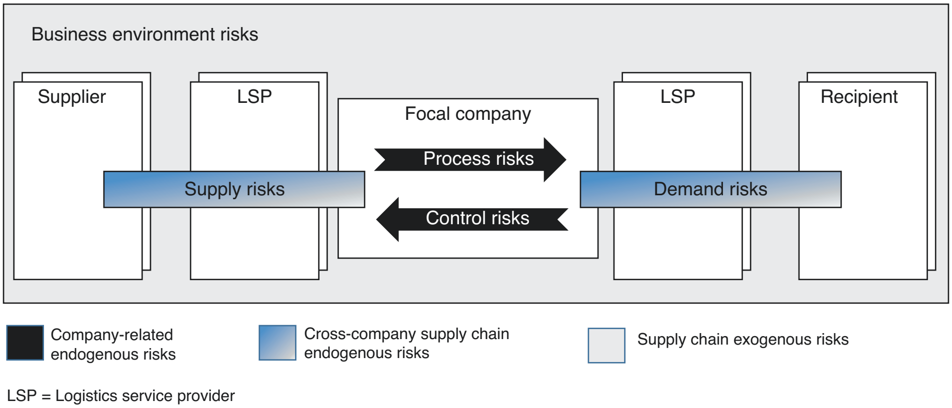


Fig. 4.24 Supply chain risks. *Source* Köhler 2011, p. 43

a reduction of organizational buffers ("organizational slack")[77] in the form of capacity, inventory and time buffers, oriented towards one-sided cost goals, leads to an increased risk. Because the impact of, for example, the failure of a machine can no longer be absorbed by buffers.

Supply chain risks include risks that can be attributed to a disruption or interruption of the flows in the network and have negative impacts on the goal achievement of the individual companies or the entire supply chain with regard to the end customer. In Fig. 4.24 the supply chain risks are differentiated according to their origin. Process risks concern events in the value creation process of a company, e.g. a failure of an operating resource. Control risks concern events in the management of a company, e.g. a wrongly planned lot size. Supply risks concern events at the suppliers or logistics service providers upstream in the supply chain, e.g. unreliability in the supply service of the supplier. Demand risks concern events at the customers or logistics service providers downstream in the supply chain, e.g. fashionable or seasonal demand fluctuations. Business environment risks concern risks outside the supply chain, e.g. natural disasters. The impact of the supply chain risks on the company objectives depends on the vulnerability and resilience of the supply chain, which are influenced by strategic decisions on the design of the networks.[78]

Vulnerability in the sense of the susceptibility of supply chain determines the impairment of the supply chain in the event of risk events. It results from certain supply chain structures, which can be described by dependency-influencing and complexity-influencing characteristics. The greater the dependency and complexity of a supply chain, the greater its vulnerability. Figure 4.25 gives an overview of vulnerability-influencing structural characteristics of a supply chain.

[77] See Pfohl and Stölzle (1997, pp. 266 ff.) on this.

[78] Cf. the following Berbner (2017, pp. 72 ff.).

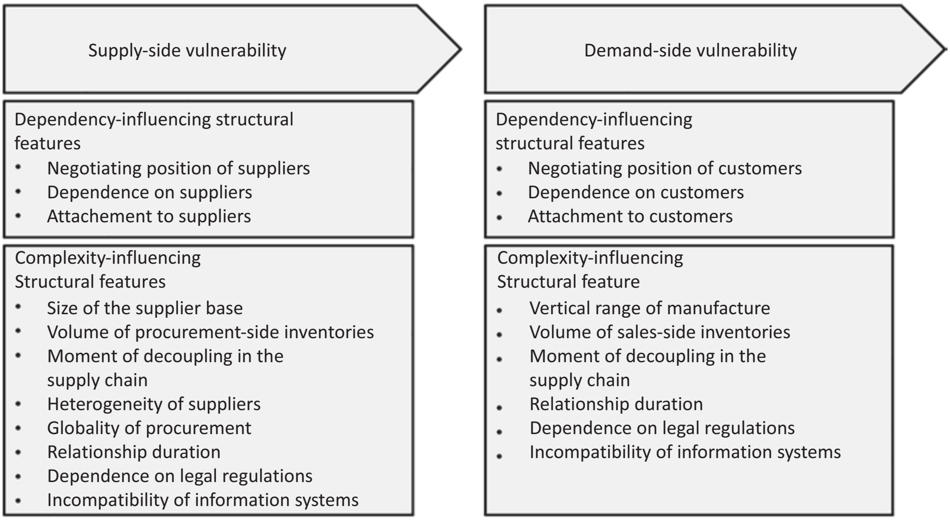


Fig. 4.25 Overview of vulnerability-influencing structural characteristics. *Source* Adapted from Berbner 2017, p. 75

Resilience refers to the ability of a supply chain to return to its original position after the occurrence of a risk event. It results from its robustness and agility. Robust supply chain are characterized by reliable and/or redundant resources that maintain their functionality when the risk occurs. It is based on the possibility of anticipating future changes and preparing the supply chain preventively for them. “Agility, on the other hand, has a reactive character and is based on the perception of current changes and the ability to react quickly to them.”[79] Figure 4.26 gives an overview of the concept of resilience.

There are various instruments of risk management, which cannot be discussed in detail here. Depending on the corporate objectives, it has to be determined whether a risk is to be avoided, self-carried, insured or actively influenced by *risk control*. The following risk management strategies are available for handling or reducing the risk in the supply chain[80]:

[79] Berbner (2017, p. 76). The concept of resilience is also used to characterize countries, which can significantly influence the location choice of a company. The insurance company FM Global has developed a resilience index and evaluated 130 countries with it. In 2020, Germany ranks 4th after Norway, Switzerland and Denmark. Cf. FM Global 2020.

[80] Cf. Jüttner et al. (2003, p. 206). For risk control in the supply chain, see also Pfohl (2002, pp. 36 ff.); Berbner (2017, pp. 123 ff.); Wang et al. (2017, pp. 124 ff.) For a roadmap of the implementation of supply chain risk management, see Pfohl et al. (2010, pp. 40 ff.).

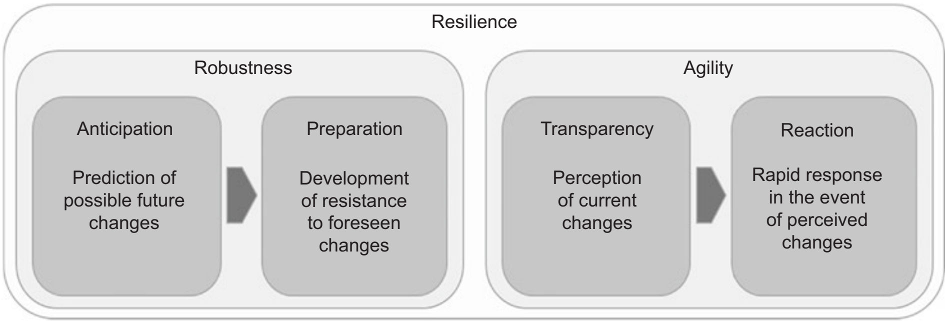


Fig. 4.26 Overview of the concept of resilience. *Source* Berbner 2017, p. 76

- Avoidance: Dropping certain products/ geographic markets/ suppliers and/or customers
- Control: Vertical integration
  - Increasing inventory and use of buffer stocks
  - Maintaining excess capacities in production, storage, handling and/or transport
  - Contractual obligations of suppliers
- Cooperation: Joint activities to increase supply chain transparency and supply chain understanding
  - Joint activities to exchange risk-relevant information
  - Joint activities to continuously develop and change relationships
- Flexibility: Postponement
  - Multiple sourcing
  - Local sourcing

Improved forecasting and higher transparency to avoid risk are given increased attention based on improved information and communication technology in the supply chain. This also includes the "event management" (event-oriented supply chain management) developed in analogy to the "management by exception". Deviations from the plan in the supply chain are to be detected in time and, if they exceed a defined tolerance range, communicated to the decision maker. He or she should then take proactive control measures.[81]

Which of these risk management strategies are to be applied also depends on the differentiation of logistics strategies, which will be discussed in the following.

[81] See Heusler et al. (2006); Reiche et al. (2009). For a different use of the term event management (event in the sense of organizing an event) see Bobel (2009).

4.5 Criteria for Differentiating Logistics Strategies

4.5.1 Basics of Differentiation

The need for differentiation of logistics strategies was already pointed out several times in the discussion of the relationship between logistics and strategic planning. In another place[82] selective inventory management was treated as an example of differentiated logistics thinking. The basis of all considerations for differentiation of logistics strategies are the two curves shown in Fig. 4.27 and 4.28, in which two generally observable system properties are expressed.

The Fig. 4.27 shows the relationship between the *degree of goal achievement* of a system and the costs caused by it under the assumption that no process innovation exists, which would allow a jump to a new curve with a different course. Examples of such curves with decreasing marginal utility in logistics systems are the relationships between the delivery service level and the costs of the delivery service level[83] in general or specifically between the delivery readiness and the safety stock,[84] between the complexity of the logistics system and the logistics system costs[85] or between the delivery service or rationalization effect of automation in logistics systems and the investment amount for this automation. From the "law" underlying these curves, the question arises whether logistics strategies with the same degree of goal achievement of the logistics system are to be developed for all product-market combinations, or rather differentiated logistics strategies with different degrees of goal achievement of the logistics systems.

The curve in Fig. 4.28 shows the relationship between the *importance of system problems* and the number of problems occurring in a system. According to the so-called "Pareto principle", there are always few really important problems in a system compared to a multitude of trivial problems. The Italian economist and sociologist Pareto formulated this principle as early as 1906, but only with regard to the distribution of income and wealth in a society. He had observed that a relatively small number of people accumulated the largest share of income or wealth, and formulated the thesis of the unequal income or wealth distribution.

The phenomenon that only a small percentage of the variables that produce a certain effect contribute the largest share to the total effect has meanwhile been proven in many areas of an organization. A frequently cited example from inventory management is the "80–20" rule of thumb, according to which about 80% of the turnover is carried by 20%

[82] Cf. Pfohl (2022, pp. 106 ff.) For different approaches to differentiation of logistics strategies cf. Doch (2009, pp. 52 ff.) For a configuration of logistics strategies according to the modular principle cf. Grothausmann (2009).

[83] See Fig. 4.6 in Sect. 4.3.1.

[84] Cf. Pfohl (2022, p. 104).

[85] See Fig. 4.13 in Sect. 4.4.2.

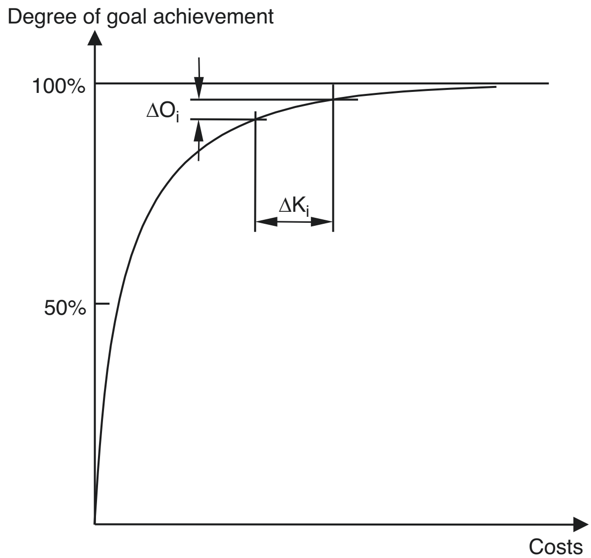


Fig. 4.27 Decreasing marginal utility at goal achievement of a system and the costs necessary for it

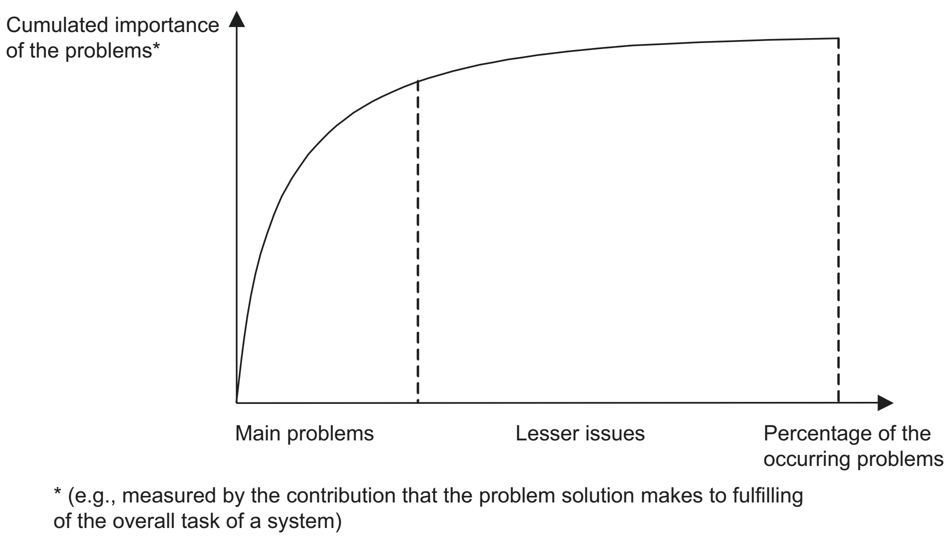


Fig. 4.28 Concentration (unequal distribution) of the importance of system problems according to the Pareto principle

of the items.[86] Similar concentration curves can also be found for the share of orders or customers in turnover or the share of suppliers in purchasing volume. From the "law" underlying these curves, the question arises whether the same logistics strategies are to be developed for all items, orders, customers or suppliers. An alternative would be differentiated logistics strategies depending on the importance of the items, orders, customers or suppliers, e.g. measured by their contribution to turnover.

The basis for assessing the need for differentiation is the analysis of the logistics systems according to criteria, according to which a logistics system can be divided into homogeneous logistics subsystems. This approach to differentiation of logistics strategies corresponds to the approach of market segmentation, in which a market is divided into submarkets with homogeneous demand profiles.

4.5.2 Differentiation Criteria

In analogy to the 7-S model of management characteristics[87] a *7-V model* of differentiation criteria can be sketched[88]:

- "Volume": Large-volume or small-volume goods, for example, require very different amounts of the scarce resource "storage space".
- "Value": High- or low-value goods, for example, have different effects on the capital tied up in inventories. The capital tied up, however, depends not only on the value of the individual good, but also on the quantity of goods demanded or consumed.
- "Variability": Goods with regular consumption (high forecasting accuracy) or goods with fluctuating or even irregular consumption (low forecasting accuracy) allow, for example, different disposition methods for planning, controlling and monitoring the goods flows.
- "Variety": Large or small variety of types, for example, has different effects on the inventories to be maintained.
- "Versatility": Large or small interchangeability (substitutability) of goods, for example, affects the level of inventories to ensure the availability of these goods.
- "Vulnerability": Large or small dependence on a good (large or small importance factor or "critical value" of a good), for example, poses different requirements for the delivery time.
- "Velocity": Large or small turnover frequency of a good, for example, affects the centralization or decentralization of storage.

[86] For examples of such concentration curves for the item-turnover relationship see Pfohl (2022, pp. 106 ff.).

[87] Cf. Fig. 7.1 in Part III, Sect. 7.1.3.

[88] Cf. for examples of such criteria Pfohl (2022, pp. 63 ff., 106 ff. and 121 ff.).

4.5.3 Differentiation Examples

The differentiation criteria value (Value) and regularity of consumption (Variability) can be used, for example, to *differentiate the procurement policy*. For this, an ABC (value) and RSU analysis (consumption structure) are required. By combining the three classes of each analysis, a nine-field matrix is created, to which supply strategies can be assigned. Value, consumption structure and quantity (procurement volume) of the parts to be procured are often used in combination of ABC analysis, RSU analysis and XYZ analysis, as shown in Fig. 4.29, to assess the Just-in-Time-suitability of procurement goods. Accordingly, parts with a high value, a uniform consumption and a large quantity are suitable for just-in-time procurement.

The starting point for differentiation must always be the customer and the expected delivery service. Based on key figures on the profitability and stability of a customer relationship, a segmentation of customers can be carried out. These segments are then assigned an appropriate delivery service level. The basis for a *differentiation of the deliv-*

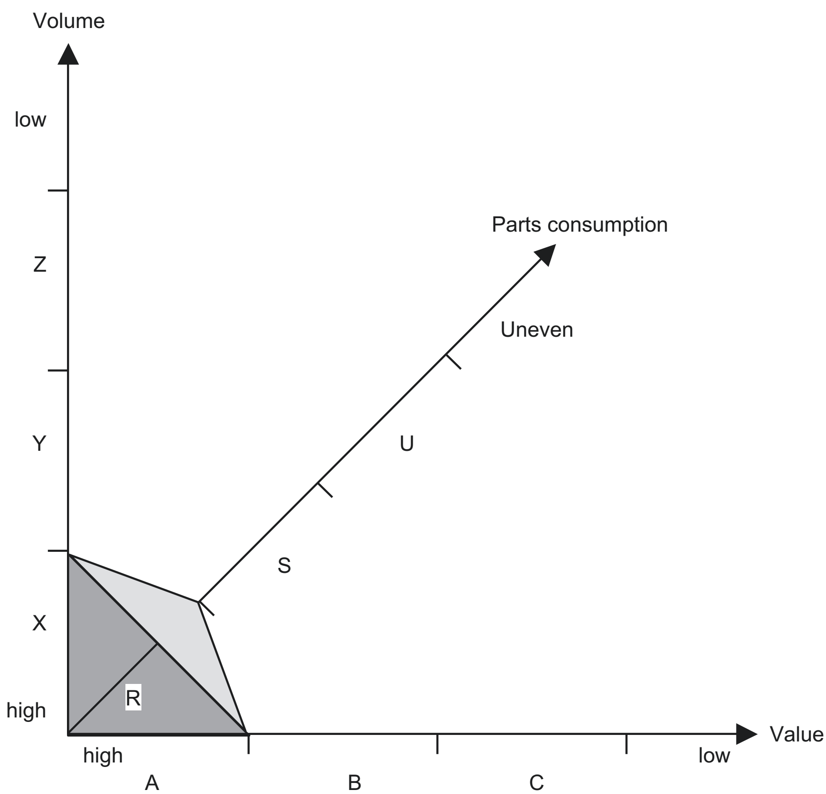


Fig. 4.29 Just-in-time suitability of goods. *Source* Adapted from Zibell 1990, p. 20

ery service policy is therefore an analysis of the customers (markets) and products. As criteria for the concentration of delivery service efforts on a product or customer group, for example, their contribution margin can be mentioned. A higher delivery service level is then offered to the product-customer(-market) combination that contributes most to long-term profit generation and securing or expanding the market position.

Trading companies with a broad range of products traditionally distinguish between product ranges with different logistical requirements. An example of this is the following *product differentiation of a department store group*[89]:

- Stackable goods: This refers to the product range whose items are unchanged and normally purchased repeatedly and routinely from the same supplier. This includes large parts of the hardware and textiles.
- Fashionable goods: The items in this product range are highly seasonal and subject to constant change. Fashionable goods are ordered based on offers from the textile industry. If too little of an item is ordered, there is a great risk of delivery inability, as it is not or only produced in small quantities on stock. If too much is ordered, there is a great risk of fashion obsolescence.
- Food: As far as it is the so-called dry assortment (e.g. canned goods, spirits), the food actually belongs to the stackable goods. However, special logistical requirements are imposed due to the large quantities and weights per item and the need for short replenishment times for the branches. The so-called fresh assortment (e.g. fruit and vegetables, dairy products, beverages) poses additional logistical requirements due to the perishability or deposit processing for reusable packaging.
- Large pieces: This product range includes bulky goods such as furniture, large electrical appliances or bicycles. In addition to the volume, the product range is characterized by type diversity and transport cost sensitivity.
- Special product areas: This product range includes items with relatively low sales shares such as sound carriers, books, fabrics, optical products or gastronomy. They pose very different logistical requirements and demand highly diverse logistics strategies.

The necessity and possibility of differentiating logistics strategies is not only determined by logistical factors. Due to the cross-functional character of logistics, the interdependencies with other functional strategies must also be taken into account, which are discussed in the following two sections.

[89] Cf. Lendzion (1991, pp. 37 f.).

4.6 Interfaces of Logistics Strategies with Research/Development and Production Strategies

Research and development strategies (R&D strategies) are treated here together with production strategies, as the aspects of research and development that are relevant for logistics, namely the consideration of logistical requirements in product design, are also closely related to the production processes that are relevant for logistics. The course of the production processes, in which production and logistics activities are directly linked, is determined by the type of division of labor (organization of production) in the production process and its planning and control. Logistics plays a special role between research, development and production in the start-up phase of production.

4.6.1 Product Design

Taking into account logistical requirements for product design is an essential concern of the *concept of life cycle costs*.[90] This concept is based on the life cycle of a product or system in terms of its lifespan. Definitions of the term life cycle assume that a system is created by measures of planning, design and development and is finally decommissioned or scrapped after a period of operation.[91] The concept of life cycle costs demands a comprehensive planning of the system over its entire life cycle, which is supposed to contribute to a reduction of the total life cycle costs or to an increase of the system performance. The application of the total cost thinking to the life cycle is especially important because at the end of the conception phase (pre-development) of a product, 70% to 80% of the total life cycle costs are fixed. By relatively low-cost planning activities in this phase, large cost savings can be achieved in the later life cycle phases, e.g. in the production logistics costs in the manufacturing phase or the disposal logistics costs in the recycling phase.

The life cycle cost thinking also has consequences for the design of a product. The demands for an assembly-friendly or a maintenance- and repair-friendly design have been known for a long time. Relatively new, however, are the demands for a disposal-friendly and a logistics-friendly design. Both demands will be discussed here, as the disposal largely poses disposal logistics problems.

The focus of a *disposal-friendly design* is the use of environmentally friendly materials, the use of recyclable materials and the dismantling-friendly design. The more environmentally friendly the materials are, the less disposal logistics problems have to be

[90] For the concept see Pfohl M (2002).

[91] See also the life cycle-oriented definition of logistics by Pfohl (2022, p. 11).

solved. The recycling- and dismantling-friendly design enables the establishment of residue cycles for removed components.[92]

The demand for a disposal-friendly design can lead to a greater variety of parts as well as a greater variety of types (differences in the basic utility of a product) and variants (differences in the additional utility with the same basic utility) in the product range. Because *more complex product ranges* and *greater variety of parts* are not only the result of marketing policy efforts of a company, with product differentiation (offering different products at a certain point in time) and product variation (changing the offered products over time) to satisfy the differentiated and constantly changing needs of the customers. They are also the result of value analysis efforts to increase the function fulfillment of a product and to reduce the costs caused by this function fulfillment. The subject of value analysis will increasingly be the disposal function, which becomes a must-function of a product due to legal regulations (obligation to take back old products or used packaging) or ecologically conscious customers from a desirable or can-function.

More variants and parts cause costs due to the increasing complexity of the processes and the more difficult coordination, for which a reverse experience curve law can be formulated[93]: With every doubling of the variety of variants, the unit costs increase by 20% to 30% with conventional manufacturing technology. With flexibly automated and reorganized factories according to the principle of production segments, this cost increase can be limited to 10% to 15%. A significant part of these complexity costs arises in the logistics area.

A necessary component of a *logistics-friendly design* is therefore first of all the transport-, handling-, storage- and packaging-friendly design, which is supposed to make a product easy to move through the logistics system.[94] Logistics-friendly design also includes a simplification of the variant and part management. For this purpose, six possibilities are available[95]:

- Reduction of customer width
- Reduction of program width
- Reduction of semi-finished product variety
- Reduction of raw, auxiliary and operating material variety
- Shifting the variant determination point towards the end of the value chain
- Production segmentation.

[92] See Stölzle (1993, pp. 72 ff.); Müller-Steinfahrt (2013).

[93] See Wildemann (1990, p. 37).

[94] See Pfohl (2022, pp. 205).

[95] See Wildemann (1990, pp. 39 f.); for complexity reduction in the supply chain see also Christopher (2010) as well as (2016, pp. 173 ff.) and Williams and Mahmoodi (2019).

The first four possibilities are manifestations of a *strategy of complexity reduction*. The first two possibilities are interdependent and differ only in the starting point of the analysis, namely the analysis of customer groups or product groups according to their contribution margins. However, these are often not reliably determined due to the lack of a suitable controlling instrument for the causal allocation of costs to customers and products and the lack of a suitable market research instrument for capturing the demand effect of different product programs. Therefore, many companies tend to reduce complexity rather on production stages below the finished product level by reducing the variety of parts. This can be done on the one hand by reducing the depth of production with the help of the involvement of system suppliers. On the other hand, this is done by the standardization of product image-neutral parts, both on the semi-finished product level and on the raw, auxiliary and operating material level, which can be used in as many finished products as possible. In order to control the variety of parts in the production and logistics process and at the same time offer a high variety of products on the final product level, the motto for the design must be: "Design the product so that many parts and modules have few variants and few parts and modules have many variants!"[96] By standardization and modular design, the number of required parts can be reduced despite the expansion of the product range. Figure 4.30 shows the application of this design principle using the example of a washing machine. The numbers indicate the number of different versions per module. There are thus 320 product variants.

To the *strategy of complexity management* belong from the six listed possibilities of variant management the shifting of the product variant determination point towards the end of the value chain and the production segmentation. The first possibility corresponds to the postponement strategy shown in Fig. 4.17 for the network strategies of postponement in the form of the "Manufacturing Postponement" strategy. The corresponding motto for the design is: "Design the products so that the destination for the final product can be defined as late as possible!"[97] By following this motto, "the number of variants is reduced on all upstream production stages, so that the inventories as well as the administrative and operational effort are reduced, the forecast reliability is increased and the transparency in production is increased."[98] Thus, this strategy overlaps with the strategy of complexity reduction. For it also includes the standardization in upstream production stages. In the upstream production stages, consumption-controlled production can be done in standard quantities on stock, while in the downstream production stages, the customer-specific variants are assembled. The order level is the decoupling point, over whose ordering alternatives in the logistics channel the Fig. 4.19 gives information.

[96] Pawellek and Schulte (1987, p. 38).

[97] Pawellek and Schulte (1987, p. 38).

[98] Wildemann (1990, p. 40).

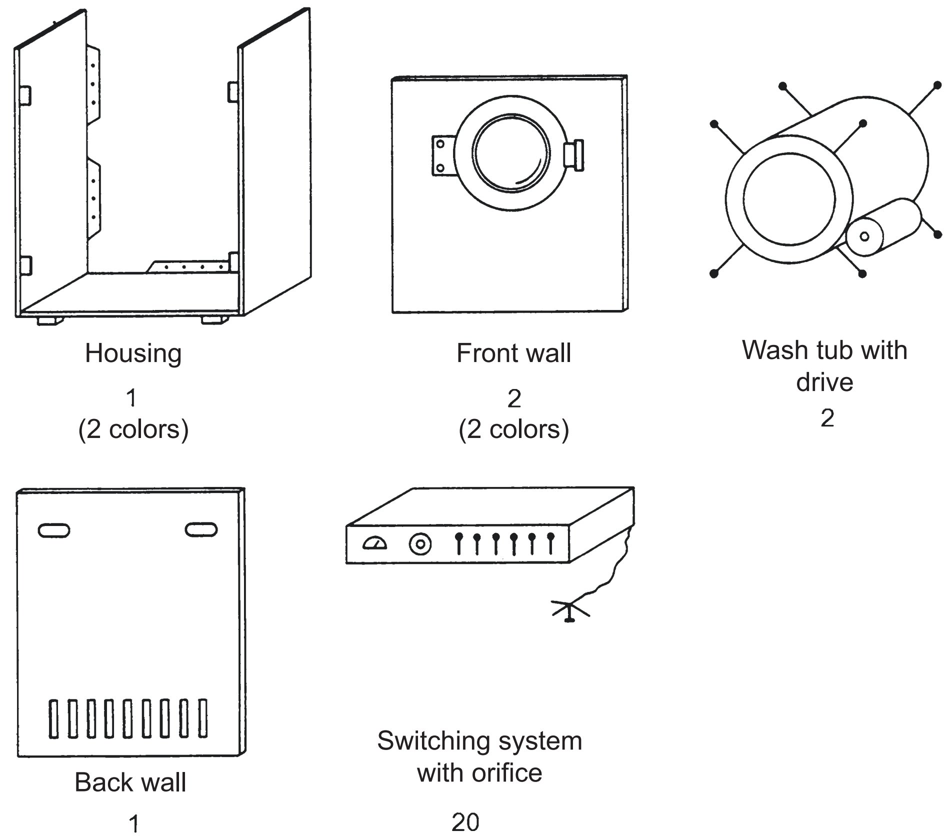


Fig. 4.30 Principle of logistics-oriented product design using the example of a washing machine. *Source* Pawellek and Schulte 1987, p. 38

Closely related to the product design is the start-up phase of production. The special requirements for logistics in this phase are discussed below.[99]

4.6.2 Start-up Phase of Production

The dynamics of technical development combined with the increasing competitive pressure in many industries leads to a *shortening of product life cycles.* This results in the demand for as short as possible development phases and a smooth transition phase from development to series production. This can improve the strategic "time-to-market".

[99] Cf. for the following Pfohl and Gareis (2000). Furthermore, see Schuh et al. (2008).

Logistics can make a contribution in two areas. On the one hand, logistics processes are necessary in the start-up phase to handle the material flow and to test for the series. On the other hand, the consideration of logistics already in the development phase, which was discussed in the previous section, can enable an optimal fulfillment of the logistics function in the series. Furthermore, logistics must be coordinated between the partners in the logistics network, the phases in the product life cycle and between different start-up projects.

To structure the development processes of new products, phase models are proposed. These phase models are based on the assumptions that certain activities occur in every development process, that similar activities can be bundled, and that there is a logically compelling or advantageous sequence of activities. Figure 4.31 shows such a phase scheme of production introduction.

Characteristic for this phase scheme is that the development result has to be transferred from the laboratory conditions of the development to a customer product, which can be produced stably in the environment of the series. The term *start-up phase* has been established to describe the transition phase, in which the environment of the development is gradually replaced by the environment of the series. Differences between the phases exist in the use of the production factors by the materials used, the tools, equipment, facilities and processes used, and the employees involved. In addition, there are different requirements for the result of the production process. These include requirements for the quantity to be produced, as well as quality, cost and time requirements. The start-up phase begins when the integration of the designed components in a prototype is completed, and ends when a secured production is possible. A start-up phase is necessary when a new product or a substantial product change is to be implemented in production.

The start-up phase serves to verify the reproducibility of the development result in the environment of the series, to increase the quantities in the reproduction, to train the employees and to supply tests and presentations with products manufactured close to the series. In addition to the changes in the environment that are passed through in the start-up phase, the high costs that can be attributed to this phase illustrate the importance of the start-up phase. Significant coordination problems arise at the transitions between the phases of development and production. *Coordination needs* arise as a result of the

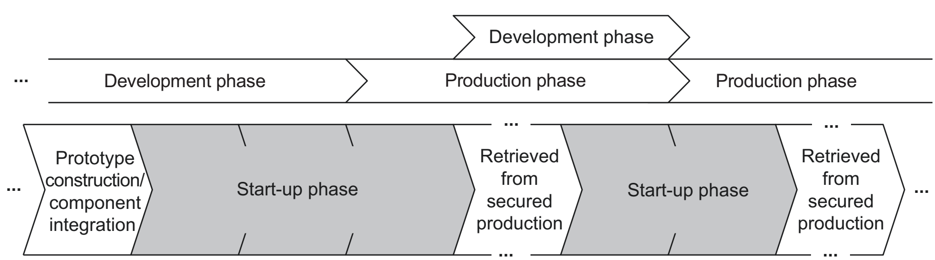


Fig. 4.31 Phase scheme of production introduction. *Source* Pfohl and Gareis 2000, p. 1191

division of labor, especially as a result of the kind division of labor and the associated *specialization*. The coordination needs can be reduced or covered by assigning appropriate coordination instruments.

With regard to the presented phase model, logistics activities are necessary for the first time when a physical product model is built. This happens before the start-up phase as part of the prototype construction. The logistics systems present in the start-up phase differ from those of the series. Considerable problems result from the lack of availability of the bill of materials, numerous changes, poor part availability and information deficits.

The *coordination of logistics between companies and between functions* is already necessary in the start-up phase. Because there, on the one hand, material and information flows take place, and on the other hand, decisions are made that determine the later execution in production. Further coordination needs related to logistics arise when a phase-related specialization of logistics is carried out. In this case, a *coordination of logistics between the phases,* development, start-up and production phase, must take place, for example, to coordinate the transfer of responsibilities in the product life cycle and to define phase overlaps. The logistics in the production phase are the focus of the following explanations.

4.6.3 Organization of Production

The organizational forms of production—in connection with organizational forms, the term manufacturing is generally used instead of production—differ according to the type of division of labor grouping of tasks into organizational units and their spatial arrangement. The resulting production structure also largely determines the material flow through production.[100]

The organizational forms of production are primarily systematized according to the principles of task and object centralization. Task centralization leads to the production type of *shop production*, in which operating resources and workplaces are arranged so that operating resources and workplaces with similar tasks are grouped together. The operating resources are usually universally applicable machines, resulting in the advantage of a high flexibility of job shop production. Another advantage is that the goal of capacity utilization is supported, since the capacities between which resource interdependencies exist are grouped together. A major disadvantage, on the other hand, are the long lead times, since the internal performance interdependencies between the various specialized workshops can be taken into account too little.

Short lead times can be achieved by *flow production*, in which operating resources and workplaces are grouped together according to the principle of object centralization. The arrangement is thus such that different tasks can be performed in an ordered

[100] On the connection between these organizational forms and logistics, see Pfohl (2022, pp. 185 ff.).

sequence on the same object. In addition to rigid flow production, arrangements are also possible that provide for partial buffers and possibilities of insertion and removal.

Job shop production and flow production are the classic forms of production organization. In hybrid forms such as the *group production (center production)*, one tries to combine the advantages of job shop production with the advantages of flow production. In the *group production*, operating resources and workplaces are grouped together so that processing of similar objects (products or parts) is possible. Such objects form product or part families. The organizational units for processing product or part families can also be referred to as *production segments* if the following characteristics are given[101]:

- Product orientation: Production segments are oriented towards specific products or parts in order to reduce the coordination effort in production. The formation of the production segments has to be done in such a way that as few performance interdependencies as possible occur between the segments and as many synergy and specialization advantages as possible are achieved within the segment. The basis of this orientation is the group technology, according to which products/parts with the same or similar shapes or processing methods are grouped together using cluster methods. Accordingly, the operating resources for the complete processing of these product or part families are then grouped together.
- Logistics orientation: The objects grouped together in production segments have the same or similar processing sequences. Production segments thus contain several stages of the logistical chain of a product, making information and material flows simpler and more transparent. The basis of this orientation is the system and flow thinking of the logistics concept.
- Market orientation: Production segments are oriented towards specific competitive strategies. Cost leadership strategies, for example, require specialized production facilities, while differentiation strategies require flexible production facilities. The basis of this orientation is the "focused factory" concept, according to which the production potentials of a company should be focused on the optimal implementation of competitive strategic requirements. This focus distinguishes production segments from production islands, which otherwise have the same characteristics as production segments.
- Employee orientation: Production segments are aimed at increasing the performance of employees by increasing their performance ability and their willingness to perform on the strength of more self-responsibility. The employees in production segments are organized as semi-autonomous work groups, to whom indirect functions are also transferred to increase the quality of work. Since the production segments perform not only the executing but also the associated planning and control functions, they can assume a high degree of cost responsibility. They are then to be regarded as "cost centers".

[101] Cf. Wildemann (1989, pp. 28 ff.).

With regard to the logistical activities of transport, handling and storage, the transition from a job shop production to a group production, e.g. in the form of production segments, means that the scope of these activities shrinks considerably due to the spatial proximity of the workplaces required for the processing sequence and that they are performed decentrally. In particular, the containers used can perform not only the transport function but also the information and picking function, thus fulfilling their function as "logistical units" more adequately.

4.6.4 Production Planning and Control

Systems for production planning and -control (*PPC systems*) can be classified according to the degree of centralization of the decisions to be made as follows[102]:

- Purely central PPC systems: All decisions concerning the production execution (determination of the production orders by type and quantity as well as processing dates of the individual work processes) are made centrally. The production only has to carry out the tasks (see the PPC system in Fig. 4.32).
- Area-wise central PPC systems: The production execution is only centrally planned for the production units that represent bottlenecks for the order throughput. The bottleneck planning is done, for example, with the OPT "Optimization Production Technology" method.
- Decentralized PPC systems: Only framework decisions are made centrally. All detailed decisions on production execution are made at the subordinate production level. A prominent example of this is the KANBAN control.

In the following, only the central PPC system and the decentralized KANBAN system are described with regard to the consequences for logistics.

In the purely central PPC system shown in Fig. 4.32, the *production planning* starts from the production program planning ("Master Production Schedule", *MPS*), which determines the temporal and quantitative course of production. The basis for the production program planning is the sales program, which consists of existing customer orders in the case of order production. In the case of stock production, demand forecasts form the basis for the sales program. Taking into account the capacity of bottleneck machines and facilities in a rough way, the final products to be produced are determined by type, quantity and date (primary demand). Based on the specifications of the program planning, the material requirements planning ("Materials Requirements Planning", *MRP*) deals with the determination of the quantities of product components (parts and modules) to be produced and materials to be procured (secondary demand). This module also roughly

[102] Cf. Zäpfel and Missbauer (1987).

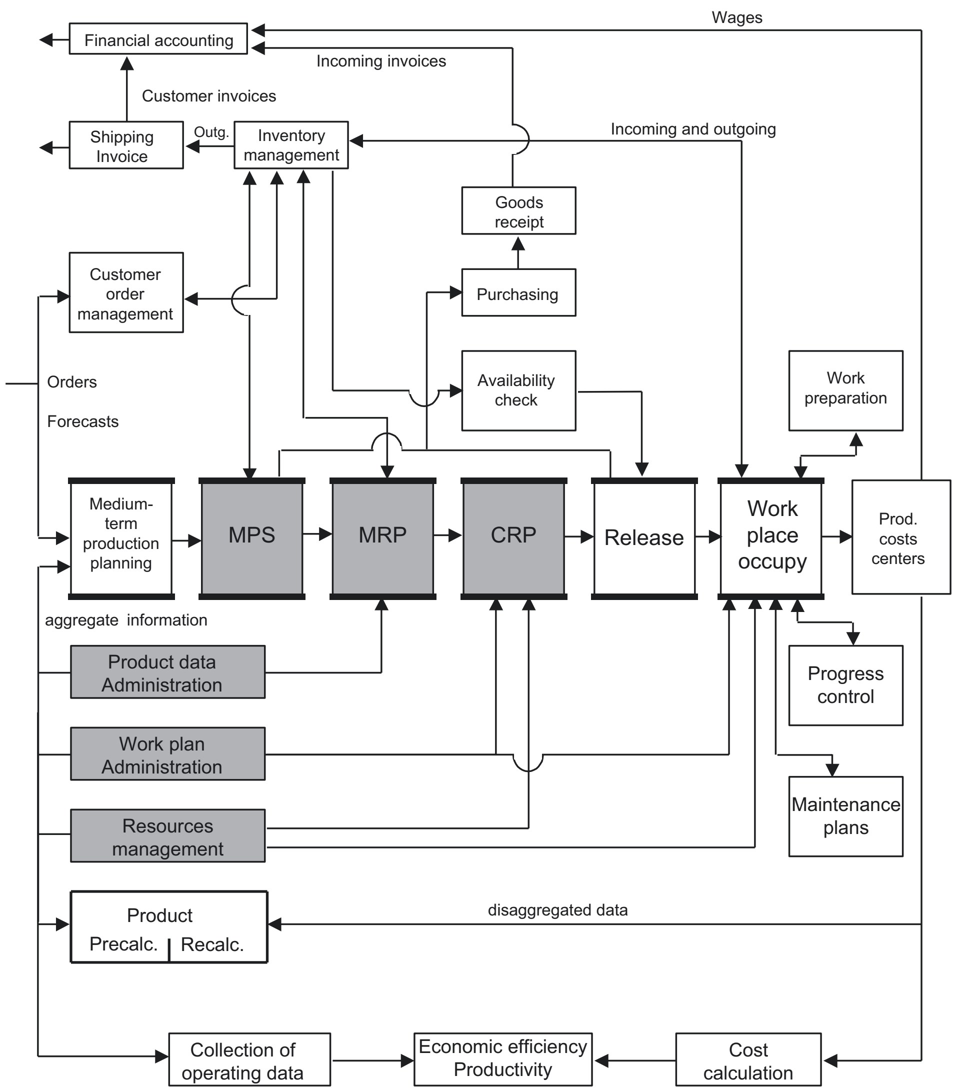


Fig. 4.32 Components of an integrated PPC system. *Source* With minor changes taken from Schneeweiß 2002, p. 285

plans the lot sizes and the release dates. With the throughput scheduling and the capacity matching ("Capacity Requirements Planning", *CRP*), the production dates of the operations are determined and matched with the available capacity. With an improvement of the capacity planning, the transition from MRP-I systems ("Materials Requirement Planning" systems) to the MRP-II systems ("Manufacturing Resources Planning" systems) was created. These systems are supposed to take into account all the resources needed in production and enable capacity adjustment measures.

The production control follows the production planning. The *production control* (shop floor control) includes first the functional group of order initiation. It includes the order release, the material availability control, the work distribution and the transport control. The functional group of order monitoring and securing the production serves the realization of the production in the manufacturing stations and initiates the intervention of the control instances in case of deviations from the plan.

Thus, *MRP-II systems as ideal models* are quite logistics-friendly. The ideal MRP concept includes the reduction of unplanned inventories by their targeted recording. The avoidance of unnecessary inventory stocks by an accurate net requirement determination, the systematic comparison of incoming goods, production and finished goods inventories by the backward scheduling of orders, as well as the resulting possibility of demand-synchronous procurement of raw parts lead to a significant reduction of logistics costs.

The extension of the MRP-I to the MRP-II also includes the introduction of suitable production control systems. The central evaluation of the work progress reported by operational data acquisition devices enables the fast control of the plan implementation. The completed orders are immediately recorded manually by responsible persons or by operational data acquisition systems. The immediate feedback of individual orders or finished parts is enabled by barcodes with corresponding reading devices and by optical sensors. The aim of these measures is the seamless control of the material flow along the logistics chain.

MRP-II systems in reality do not work in such an ideal way. First of all, the production process is not a deterministic process, i.e. there are always changes to the original plan. These shifts are based, for example, on unforeseen disturbances of the production process due to the failure of capacity units, or a short-term shift in demand. The reaction to such events requires a short-term plan change. If there is not enough time between the point in time when the need for plan revision is recognized and the point in time when production starts to carry out a new "Material Requirements and Capacity Requirements Planning", improvisation is required. Improvisation means in this context the deliberate deviation from the plan specifications of the MRP system. The motivation for such action can either result from the short-term recognition of errors, which either result from the data material or the planning assumptions, or from the short-term reassignment of demand positions. Since such situations cannot be excluded and are normally corrected by the responsible decision makers, e.g. the production foremen or production planners, the uncritical acceptance of MRP specifications would lead to suboptimal results.

Another point of criticism of traditional PPC systems is based on the fact that they are centralized PPC systems that follow the *push principle* and push the material flow demand-driven through the logistics chain based on the primary demand specified in the production program. However, this is rarely achieved due to the many possibilities of disturbance and the resulting need for changes in planning. Some of the fundamental points of criticism are addressed by the development of Advanced Planning Systems (APS), which are discussed in the section on model-based decision making in logistics.[103]

In contrast to the central demand-oriented MRP system, the decentralized *KANBAN-system* operates consumption-driven, so that the material flow in the logistics chain is "sucked" by the consuming point according to the *pull principle*.[104] KANBAN, the Japanese term for sign or card, has its origin in developments of the Japanese Toyota Motor Company. The organization of production and material flow according to the department store principle represents the basic idea of the KANBAN system. A consumer who needs material at any production stage takes a certain product in a defined quantity from the stock. The resulting material shortage is noticed and replenished in the short term. The traditional consumption-driven disposition can be regarded as the basic form of the KANBAN system. When the minimum stock of a component or assembly falls below a certain level, a purchase order or a production order is triggered. The minimum stock, which is also called the order stock, should be sufficient to cover the consumption during the replenishment or production period. The difference between KANBAN and the traditional consumption-driven disposition lies in the area of application of both methods. The traditional consumption-driven disposition is preferred for simple and cheap mass parts of the lower production stages, which have a constant consumption. In contrast to these goods, which are classified as C-parts in the ABC analysis, KANBAN is also used for the consumption-driven disposition of expensive parts, A and B positions.

Based on the production program, an order-related disposition is carried out with the KANBAN principle. The last production stage within the entire logistics chain, for example the final assembly, reports its demand to the upstream stage in the production process. The upstream stage in turn communicates its material demand to its predecessor. This process repeats itself in a cascade-like manner until the information flow reaches the stage of raw material provision. Contrary to the direction of information flow, the material flow now begins with a time delay and flows through all the stages of the logistics chain involved to the last production stage. Figure 4.33 shows the basic difference between a central production control with the MRP system and a decentralized production control with the KANBAN-system.

The decentralized production control according to the KANBAN principle is structured in the form of organizational control loops. Each control loop is assigned a buffer stock that stores a precisely defined quantity of components and products. The buffer stock contains the input materials of the considered production stage, from which the final product of the stage emerges after order receipt. If the specified minimum stock of a product in the buffer stock falls below a certain level, the consumer triggers an order from the producer. The consumer hands over an order card to the producer, which is

[103] See Sect. 6.4.1 For the different PPC systems, see, e.g., Schulte (2017, pp. 661 ff.).

[104] For the distinction between demand- and consumption-driven material flow, see Pfohl (2022, pp. 93 ff. and 189 f.).

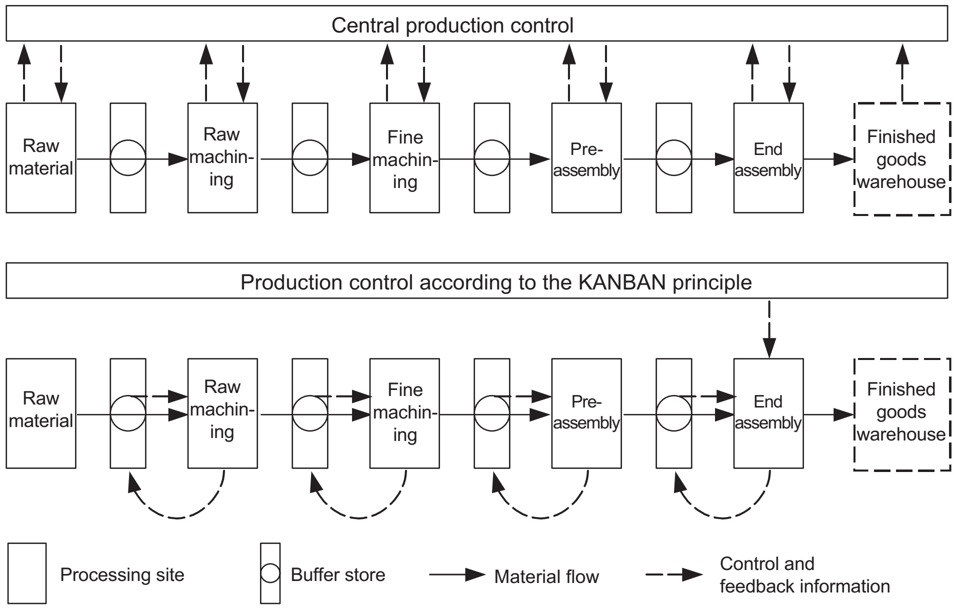


Fig. 4.33 Difference between central and decentralized production control. *Source* Wildemann 1986, p. 40

called the order KANBAN, from which the quantity and the delivery date can be seen. The producer then starts the production of the specified order and arranges the delivery at the requested date in ready-to-install quality. Standardized containers can be used for this purpose, and the material flow can be triggered by the handover of an empty container instead of a card. Since the consumer is responsible for covering his own demand and registers it with the supplier, KANBAN is referred to as the realization of the pull principle.

The following prerequisites should be met for the application of KANBAN systems:

- regular primary demand curve
- flexible production facilities
- low capacity utilization and thus low waiting times before processing
- very short setup times.

The staff of a KANBAN control loop forms a self-regulating work group that is responsible for quality assurance, machine maintenance and material replenishment. The expansion of this decentralized decision-making competence is accompanied by the reduction of the task scope of the central production planning and control system. However, it will generally result in a *combination* of the different planning and control principles. The following tasks can be assigned to the central planning and control instance and complement the decentralized KANBAN control[105]:

- the superior deadline and capacity planning
- the determination of the qualitative product mix, i.e. the determination of the output quantity per part and period
- the creation, issuance and withdrawal of KANBAN cards, as well as the provision of transport containers
- the loading and canceling of orders
- the order progress control, for example by logging the card cycles.

MRP systems and KANBAN systems do not exclude each other in production planning and control. Approaches to combination arise not only from the hierarchy of information processing levels in the PPC system, according to which the tasks are performed centrally at higher planning levels with a higher degree of aggregation of the information to be processed and dezentrally at lower planning and control levels. Approaches also arise from a differentiation of the logistics chain by vertical and horizontal production segmentation.[106] The improved planning and control of demand that facilitates the use of PPC systems is discussed below.

4.6.5 Demand Planning and Control

DRP systems ("Distribution Requirements Planning")[107] are the implementation of the MRP logic for the inventory planning of finished products in distribution warehouses. The aim of DRP is to plan the release dates ("when") and order quantities ("how much") of warehouse replenishments within the distribution channel, in order to satisfy the planned demand and optimize the flow of goods from the central delivery point to the recipient. The triggering moment is the planned orders of the delivery warehouses. DRP thus extends the conventional pull strategy by a push component, by taking into account not only the customer orders but also the planned demand from the system. In the literature, DRP is presented both as a push and a pull system. Thus, with DRP, the product is "pulled" through the distribution channel based on the demand planning of the recipient, rather than being "pushed" into the system from a central planning point. In determining the aggregated primary demand, the planning is no longer taken over by the central delivery point, but by the individual receiving warehouses in the distribution network.

[105] Cf. Wildemann (1986, p. 10).
[106] Cf. Wildemann (2001, pp. 118 ff.).
[107] See also Schulte (2017, pp. 710 ff.).

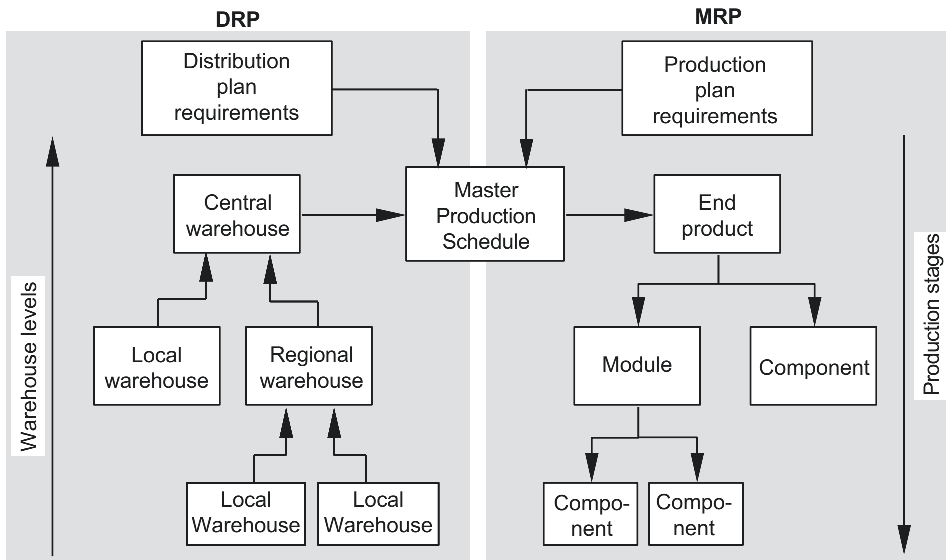


Fig. 4.34 Comparison of the DRP and MRP logic

As can be seen from Fig. 4.34,[108] *DRP follows the reverse path of MRP,* where the gross demand for secondary products was derived from the aggregated size of the primary demand using the bill of materials. DRP now determines, starting from the product demands of local delivery warehouses that are assumed to be known, the aggregated gross demand per finished product at the central warehouse over any stages of regional warehouses. As with MRP, DRP distinguishes between stochastic and deterministic demand. Stochastic demand only exists at the delivery warehouses that are directly connected to the customers. The demand of all upstream warehouses depends on the demand of these warehouses. DRP also uses the elements of MRP, but instead of the disaggregating list of components or "Bills of Material" it uses the distribution list of components or "Bills of Distribution". The "Bills of Distribution" (BOD) contain product-specific information about the distribution structure. The BOD thus provides information on which warehouse makes replenishments for another warehouse. In this way, the dependent demand information of the supplying warehouses can be determined, including the total demand at the central delivery point. Furthermore, the BOD contains information on logistical units, e.g. how many cartons of a product are on a pallet.

Corresponding to the MRP-II system, there is also an extension to the *DRP-II system* ("Distribution Resource Planning" system). The extension of the concept lies in the inclusion and coordination of all resources of the distribution. The concept is extended

[108] For the process of DRP, see also Morgans (1990).

		Demand predictability	
		not predictable	predictable
Possibility, to shift the customer demand	low	Fulfilment of demand by means of reserved equipment and personnel capacity or sales losses	Planned inventories to compensate for fluctuating demand or sales losses
	high	Fulfilment of demand by means of equipment and personnel capacity or storage of demand (by reservation or queues) with non-variable capacity	Demand management through service design, communication, distribution and pricing policies or demand storage and planned inventories to balance fluctuating demand.

Fig. 4.35 Supply-demand management-strategies for services. *Source* Heskett et al. 1990, p. 146

by the component of transport planning and now also takes into account the availability of resources in the medium- to long-term planning.

The DRP system already contains hints for an active influence on the demand by consultations with the decentralized warehouses. The aim is to adjust the demand to the capacities with the aim of smoothing. Such a demand management is also discussed in the literature under the term *demand management* ("Demand Management").[109] The demand can only be influenced if it can be forecasted and if the customers are willing to respond to the influencing measures and change their demand behavior. Otherwise, the supply has to adapt to the demand or there will be demand losses. Figure 4.35 distinguishes four supply-demand situations for services, for which different adaptation or influencing strategies result.

The influence on the demand, which is indicated as a suitable strategy in the situation in the lower right quadrant of Fig. 4.35, can be done by marketing activities to increase the demand with the aim of utilizing surplus capacities or by "demarketing" activities to reduce the demand with the aim of adjusting to bottleneck capacities.[110]

In the upper and lower left quadrants, the provision of capacities (or the build-up of inventories for physical goods) is the appropriate strategy to satisfy the demand. In the lower quadrant, the "storage of demand" by queuing or reservation is also a possible

[109] Cf. Heskett et al. (1990, pp. 146 ff.).

[110] For example, it is well known that airlines control the demand for seats within the framework of "revenue management" to adjust to the seat capacity. See Klein and Steinhardt (2008).

strategy. In the upper right quadrant, all feasible measures of capacity, time and intensity adjustment to the predictable demand fluctuations are possible.

The possibilities of demand management mentioned here form the bridge to the next section. Because demand management also influences the market penetration strategy.

4.7 Interfaces of Logistics Strategies with Procurement and Sales Strategies

In the following, the interface between procurement and sales strategies on the one hand and logistics strategies on the other hand will be examined on the supplier market and the trade market. Both markets are characterized by the type of division of labor between supplier and customer, which was stable for a long time, so that a traditional role behavior of both market participants emerged. However, on both markets, the relationships between supplier and customer in the marketing channel are changing, which are of strategic importance for logistics.

4.7.1 Supplier Industry Market

Supplier companies produce goods for a customer (the buyer company), which is also a producing company. The goods flow into the production of the buyer company, thus serving to satisfy the secondary and tertiary requirements of the buyer. This distinguishes the supplier from the sub-supplier, who produces goods for the primary requirements of his customer, which exceed his capacity limits. Another characteristic of the supplier industry market[111] is a frequently occurring economic power imbalance in favor of the buyer. This is the case when small or medium-sized supplier companies and large buyer companies face each other or when the supplier achieves the predominant share of his turnover with one or a few buyers.

The changes in the *supplier-buyer relationships* are first characterized by the increasing importance of the "pull principle" over the "push principle" for the entire logistics chain. This shifts the logistics control span from the distribution logistics of the supplier in favor of the procurement logistics of the buyer. Another characteristic of the changes in the supplier-buyer relationships is the increasing importance of the cooperation principle over the competition principle. According to the traditional competition principle, the price mechanism alone regulates the relations on the supplier market. The buyer fully exploits his market power with the aim of short-term profit maximization, plays the suppliers off against each other and there are short-term changes of suppliers. According to the cooperation principle, however, a long-term, trustful cooperation between supplier

[111] For the characterization of the supplier industry market, see Backhaus and Voeth (2014, pp. 493 ff.).

and buyer is in the foreground. An intensive exchange of information is the basis of this cooperation. The cost advantages of the established cooperation are shared between supplier and buyer.[112] The pressure for constant innovation at the supplier is maintained by the specification of rationalization successes by the buyer, thus compensating for the negative effect of the reduced short-term competition among the suppliers.

The trend towards long-term cooperation between buyer and supplier at higher levels of integration leads to a change in the *supplier structure*, which can be characterized by a decrease in the number of suppliers and the establishment of supplier pyramids. The supplier structure is largely determined by the *procurement strategies* and the underlying *sourcing concepts*.[113] The supplier structure is mainly characterized by the following procurement strategies of the buyer:

- Outsourcing: By reducing the depth of production, fixed costs are to be reduced and the flexibility towards demand discontinuities is to be increased. In addition, production cost advantages and specific know-how of the suppliers are to be exploited.
- International Sourcing: For products with a high degree of homogeneity, which can be obtained interchangeably from different suppliers ("commodities"), global sourcing is used with the aim of realizing price advantages. Moreover, the "local content" regulations of various countries and the necessity of countertrade in international sales force global sourcing.
- Single Sourcing: For products with a high degree of heterogeneity, which can only be offered by a few suppliers as specialties, sourcing from one supplier is advisable. This way, economic lot sizes can be achieved, the quality assurance can be simplified and the transaction costs can be reduced.
- Modular Sourcing: The goal of reducing transaction costs is also served by the procurement of assembly-intensive, completely assembled modules. The transition to the module supplier leads to the pyramidal structure of the supply chain.
- Just-in-Time Sourcing: The production-synchronous procurement serves the goals of higher flexibility and planning reliability as well as the reduction of the replenishment time, the inventories and the lowering of the administrative effort.

The *portfolio technique* discussed in the treatment of the relationship between corporate overall strategies and logistics can also be applied to the procurement market. For example, in the purchasing portfolio analysis, based on the two classification criteria "contribution to success" and "procurement risk", four procurement situations are distinguished.[114] Strategic procurement items have a high contribution to success and cause

[112] For the cost reduction and profit increase potentials, see Pfohl (2022, pp. 302 ff.).

[113] For procurement strategies see Pfohl and Large (2003); for the sourcing concepts see also Eßig et al. (2013, pp. 107 ff.).

[114] See Large (2013, p. 79).

a high procurement risk. Bottleneck items have a low contribution to success and their market shows a high procurement risk. More pleasant procurement markets are those for leverage items (high contribution to success, low procurement risk) and for non-critical procurement items (low contribution to success, low procurement risk). The resulting strategies have a great influence on the procurement logistics. For example, if the company has a relatively strong position, it is easier to implement its procurement logistics concepts than if the supplier has a dominant position.

However, for the strategic design of logistics, a portfolio is more useful, which is not oriented to the procured materials, but to the suppliers, as they can be influenced more directly in their logistical performance potential. For this purpose, a supplier success potential-portfolio can be created. The supplier success potential portfolio is based on the classification criteria “cost potential” and “revenue potential” of the suppliers. Figure 4.36 shows as an example the supplier success potential portfolio of a mechanical engineering company for the material group machining.

The diameter of the circles represents the purchasing volume of the individual suppliers and thus their quantitative importance. Since the calculation of “cost potential” and “revenue potential” also relies on logistical metrics, such as the quantity accuracy and the delivery reliability of the suppliers, the classification as problem supplier is often due to insufficient logistics potentials.

Another example of a procurement portfolio is the power portfolio shown in Fig. 4.37 with the derived strategic thrusts, which also affect logistical basic issues

The procurement strategies of the buyer are opposed by the the *sales strategies of the supplier*. A key influencing factor for the choice of sales strategy is the product offered.[115] For *“commodities”* the focus of the sales strategy is on the price policy and on the additional services. In the case of additional services, the logistical services for achieving competitive advantages play a major role. If there is only the possibility of adapting to the existing price level within the framework of the price policy, two cost reduction measures are available, among others, with the relocation of the site and the reduction of the production depth, which also have a significant influence on the logistics of the supplier.

For *specialties* the focus of the sales strategy is on adapting to the problems of the buyer in a increased integration of the supplier into the value chain of the buyer and in a long-term contractual securing of the cooperation. In the case of an emancipation of the supplier by developing independent market offers, the focus of the sales strategy is on the technology-driven innovation, which is based on a strong independent research and development activity, and on the multi-level marketing. The latter aims to generate demand for the supplier's products not only from the direct buyer, but also from the downstream markets of the buyer.

[115] Cf. Backhaus and Voeth (2014, pp. 219 ff.).

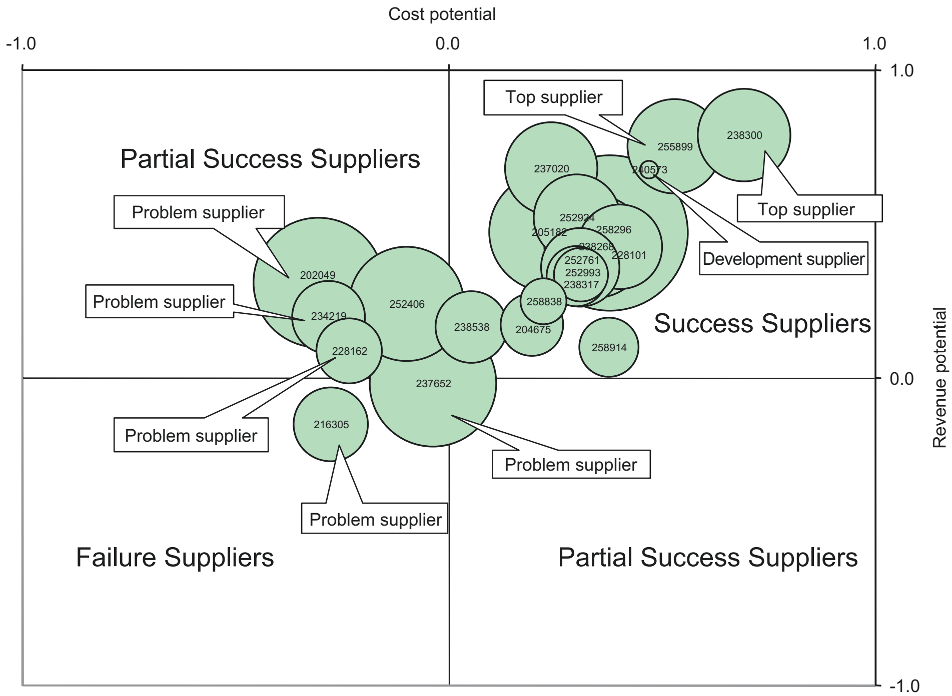


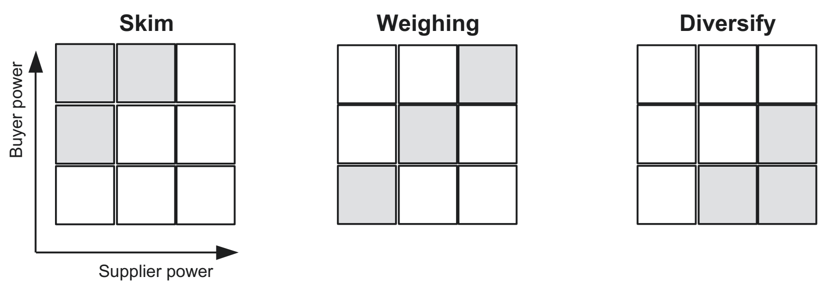
Fig. 4.36 Evaluation of the supplier structure of a mechanical engineering company based on a supplier success potential portfolio. *Source* Large 2013, p. 134

The essential *integral quality* for the increased integration of the supplier into the value chain of the buyer is also referred to as the core problem of supplier marketing. It initially concerns the product quality in the narrow sense, but also the availability quality and the time quality. The availability quality is guaranteed by the logistics of the supplier. The integral time quality refers to the coordination of the service life of the supplier's product with the service life of the primary product of the buyer. The time quality thus influences the task of the spare parts logistics of the supplier.

4.7.2 Trade Market

Trading companies act as intermediaries between manufacturer and end consumer (e.g. retail trade) or between manufacturer and another manufacturer (production-related trade) or between a manufacturer and a trading company (consumer goods wholesale trade). The trade as a whole has its raison d'être in the division of labor performance of service tasks on resale markets. Since the products of the manufacturers are resold in

Strategic thrust



Fundamental Questions			
Quantity	Distribute	Retain or carefully modify	Centralize
Price	Enforce reductions	Bargain opportunistically	Do not overemphasize the topic
Contractual safeguarding	Buy on the spot markets	Both spot market purchases and contract purchases	Secure requirements via contracts
New suppliers	Keep in contact	Selected suppliers	Search hard
Stocks	Keep low	Use stocks as a buffer	Build up inventory buffer
In-house production	Reduce or not start at all	Make selective decisions	Strengthen or start a new
Substitution	Stay in contact	Pursue good opportunities	Seek actively
Value Analysis	Force suppliers	Perform on a selective basis	Run one's own program
Logistics	Minimize costs	Optimize selectively	Build up sufficient stocks

Fig. 4.37 Power portfolio on the procurement market. *Source* Kraljic 1988, p. 491

principle unchanged, one also speaks of intermediate trade. Wholesale and retail traders acquire property rights from the goods and sell them on, as the end consumers wish.[116]

The *manufacturer-trade relations* were formerly characterized by a predominant supply power on the part of the manufacturers.[117] The trade, on the other hand, was largely

[116] Kotler et al. (2017, p. 621).

[117] Cf. Theis (1999, pp. 32 f.).

fragmented and powerless and was regarded by the manufacturers merely as a distributor of the goods. In the 60s of the last century, a concentration process began in the trade, which continues to this day. The original objective was to achieve a better negotiating position vis-à-vis the manufacturers, e.g. to exploit quantity discounts through a central purchasing. However, the merger of individual businesses into large retail chains also necessarily involved an increasing professionalization and improved qualification of the management, so that the trade developed from a passive sales intermediary to an active product and demand designer. This *demand power of the trading companies*, which is based more on quantitative aspects, is further expanded qualitatively by the use of information and communication technologies. The trade has a precise data base by capturing the article, customer and sales data at the "point-of-sale". This improves the decision-making basis. Information that a manufacturer can only obtain through intensive market research activities or a cooperation with the trade, the trade receives so to speak "free of charge". There is accordingly a vertical information incline from the trade in the direction of the manufacturer, which facilitates a shift of the logistical control span from the distribution logistics of the manufacturers to the procurement logistics of the trade. The manufacturers can no longer "push" the goods through the logistics channel, but the trade "pulls" them with its demand power, which ultimately represents the demand power of the consumers. The information advantage enables the trade to design the logistics channel to the manufacturer efficiently.

The strategic developments of trade can be described first of all as a *quantitative change* by a reduction of the number of sales outlets and the number of decision-making points.[118] The reduction of the number of sales outlets results from the trend towards large-scale types of operation. A "law" in trade states that with the increase of the level of economic development of a country, the number of sales outlets per 1000 inhabitants of a country decreases, while at the same time the sales area per 1000 inhabitants increases.[119] The reduction of the number of decision-making points in the trade companies results from the concentration process in trade. A quantitative change in terms of the number of competitors and the number of logistics channels results mainly from the effects of e-commerce on trade. In addition to the problem of threat by novel virtual providers, the traditional trade companies had to develop options for dealing with the new situation. In particular, the question of a multi-channel strategy and its consequences for the systems of procurement and distribution logistics arose.[120]

[118] Cf. Barth et al. (2007, p. 6 ff.) For the development of the trade market see also Seeck et al. (2014, pp. 9 ff.) and for the impact of trends in the business environment of trade on trade logistics see ibid., pp. 33 ff.

[119] Cf. Tietz (1991, p. 173).

[120] See also: Meffert et al. (2019, pp. 593 ff.) To achieve synergy effects, the logistics channels of online trade and the logistics channels of stationary trade can also be partly used jointly. For this purpose, the term "Omnichannel" was coined in the USA. See also Cooke (2014) and Christopher (2016, pp. 64 ff.).

The *qualitative changes* concern the structure of the decision-making processes. They result from the trend towards centralization of decision-making in the organizational structure, the trend towards multipersonal decision-making processes (purchasing committees) and the trend towards the already mentioned improved decision-making basis.

The logistics-relevant objectives underlying the procurement decision are the bundling of goods flows (transport cost- and goods receiving cost reduction), the reduction of inventory (inventory cost reduction), the reduction of space requirements (rent cost reduction, productivity increase), the simplification of processes (cost reduction, time saving, flexibility increase) and the improvement of goods presence (sales increase). At the same time, with the level of economic development of a country, the price awareness in the procurement decision increases.[121] This price awareness is expressed in particular also in the demand for special conditions due to the concentration of procurement and the elimination of distribution logistics services when the trade takes over the procurement logistics.

The trade market is also characterized by a *paradigm shift* in the manufacturer-trade relationship.[122] The manufacturers strive on the one hand for a direct end consumer contact at the "point-of-sale", in order to gain more control over the "demand side". The trade strives on the other hand for a direct influence on the production at the manufacturer, e.g. the production of fresh goods as a core process of the food trade. The distribution logistics of the manufacturers and the procurement logistics of the trade will have to be designed differently for these two approaches. The influence of the manufacturers or the trade on the logistics also becomes clear when three marketing concepts are distinguished with the trade- or manufacturer marketing and the cooperative marketing.

The *trade marketing*[123] is oriented towards the assortment-oriented profiling of the business, the type of operation or the distribution channel. Not the product is the "brand article" of the trade, but the type of operation. Thus, the trade marketing, which represents a range marketing at its core, is fundamentally different from the product-oriented manufacturer marketing, which shapes the sales strategies of the manufacturer.[124] As long as the institutions cooperating in the marketing channel design their marketing relatively independently of each other, one can speak of them practicing an individualistic marketing. The manufacturer marketing can be divided into a *consumer-oriented* and a *trade-oriented manufacturer marketing*. The consumer-oriented marketing is oriented towards the end consumer market downstream of the trade. By influencing the demand on this market, the product offer is pulled through the marketing channel, especially through the trade, which acts as a neutral "agent" of the manufacturers, according to a pull strategy. The trade-oriented marketing is oriented towards the trade market.

[121] Cf. Tietz (1991, p. 173).

[122] Cf. Zentes and Bastian (2010).

[123] Cf. Theis (1999, pp. 25 ff.).

[124] Cf. Barth et al. (2007, pp. 170 ff.).

According to a push strategy, the demand is influenced e.g. by intensive personal selling, by shelf maintenance or by pricing policy, which leads to the listing of the product offer in the trade. The products are thus pushed into the trade by "in-selling measures".

The trade or manufacturer marketing does not take into account that the marketing activities of the vertically upstream and downstream partner are interdependent. The increasing mutual dependence of the logistics systems is shown e.g. in the use of merchandise management systems and the disposal of packaging.[125] The ecological problems in the disposal of packaging and products at the end of their life cycle point in the same direction. The solution of the marketing channel problems therefore increasingly requires the replacement of the individualistic by a *cooperative marketing,* which, if initiated by the manufacturer, is also called *vertical marketing*[126]. An essential component of such marketing concepts is the principle of function optimization, according to which each partner in the marketing channel takes over the functions that he can perform most efficiently. Logistics is one of the essential fields of activity of a cooperative marketing, besides the placement at the "point-of-sale" and the area of merchandising/sales promotion/advertising.

An example of cooperative marketing is the "Efficient Consumer Response" approach (ECR).[127] The goal of ECR is the cooperative optimization of the value chain between manufacturers and retailers of consumer goods. The methods used for this can be divided into three large blocks: ECR basic technologies, supply side strategies and demand side strategies. For the latter, the focus is on "category management" (product group control). This involves a consistent alignment of the product group offerings to the needs of the consumer. For the question of interest here, the component of "Efficient Replenishment" (ER) as the core of the supply side strategy is especially important. This refers to the realization of an efficient and continuous replenishment of goods from the manufacturer to the sales outlets of the trade. A prerequisite for this in the block of ECR basic technologies is the item-specific recording of sales in a merchandise management system using EAN codes and scanner technology. The European Article Number (EAN) enables a uniform and unique identification of goods.

The following three cooperation approaches are characteristic for the ER component:

- Continuous Replenishment (CR): The goal is to optimize the inventory of goods in the trade. With the lowest possible inventory levels, the availability of goods on the shelf should be ensured. Based on current sales and inventory data provided to the supplier, order cycles can be reduced and order quantities can be precisely aligned to the demand.

[125] See also Pfohl (2022, pp. 80 ff., 158 f. and 221 ff.).

[126] See also Meffert et al. (2019, pp. 353 f.).

[127] See for the following Krings (2010, pp. 292 ff.).

- Collaborative Planning Forecasting and Replenishment (CPFR): The goal is to start a cooperative planning and forecasting process between manufacturers and retailers based on a close exchange of information. This is especially important for product launches and sales promotion activities.
- Cross Docking: The goal is to reduce duplication of work in the warehouse of the manufacturer and the warehouse of the trade. Flows of goods from different suppliers are bundled and consolidated at a logistics location—the cross docking center. There is no elaborate loading and unloading or picking. The delivery of goods to the cross docking center is generally already pre-picked for the store to be supplied. The stores are then supplied with the pre-picked packaging units of different suppliers bundled together.

The logistics tasks to be performed between manufacturers and retailers can also be transferred to logistics companies. Their business strategies are discussed below.

4.8 Business Strategies in Logistics Companies

4.8.1 Product-Market Combinations

Defined one the *market share* of a company not in relation to a narrowly defined market niche, but to the total market relevant for the experience curve—this is the market of groups of product or service types, whose offering allows the same experiences to be achieved due to the technology used, the required know-how, etc.—then large market shares can only be achieved by large companies. The experience curve thinking thus pushes companies to grow. However, studies in various industries on the relationship between profitability and market share have shown that profitability can also be high with small market shares.[128] Although there is no clear relationship between profitability and market share, in some industries the U-curve shown in Fig. 4.38 can be detected. According to this, medium market shares form a critical area. This is also plausible. Because medium market shares already require a company size that loses the advantages of small companies (e.g. flexibility), but does not yet have the advantages of large companies (e.g. economies of scale effects).

In accordance with the U-curve, it is predicted that both large and small companies will be successful in the future in the freight transport market.[129] For the freight transport market both in Europe and in the USA, a clear trend towards a supply oligopoly

[128] Cf. Porter (2013, pp. 81 f.) On the role of small and medium-sized logistics companies in the logistics industry, see Pfohl (2021, pp. 290 ff.).

[129] On the development of the freight transport/logistics market, see Pfohl (2003, pp. 22 ff., 2018, pp. 301 ff. and 351 ff.).

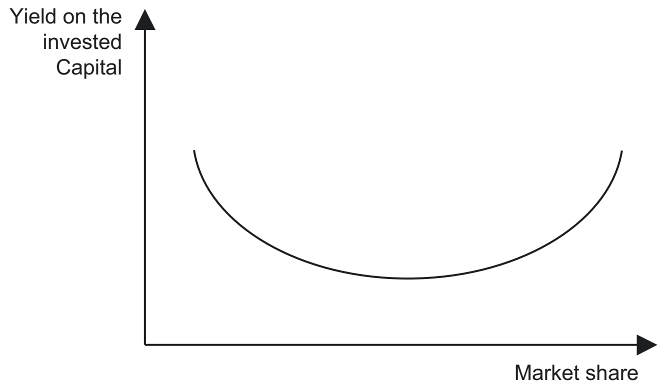


Fig. 4.38 Profitability and market share. *Source* Porter 2013, p. 83

and thus the existence of three to five large companies (so-called “megacarriers”) is predicted, which as generalists cover the entire market with all services across the area. The main reason for the emergence of such large companies is not seen in the associated cost advantage, but in the market advantage of a company that operates multimodally on the market and offers logistics service packages. Small companies will be able to satisfy the shippers' demand in market niches successfully as specialists, or secure their existence as suppliers of partial logistics services for the large generalists.

The business strategies of logistics companies can be detailed by the *business model*.[130] This is characterized by the product-market combination, the configuration of value-adding activities and the revenue mechanism.

By the product-market combination, the offered products or services and the markets addressed by them are concretized. The offer of services in a logistics company can include the realization of goods distribution, logistics consulting—including the development of own IT software, which is then also offered to competing logistics companies—and non-logistics services. The scope of services in the realization of goods distribution ranges from the execution of individual logistics subtasks (e.g. transport) to the planning, execution and control of comprehensive logistics service packages (“Full Service”). The offer of integrated logistics services that corresponds to the logistics system thinking includes various possibilities of differentiation and specialization[131] with regard to the spatial dimension (geographical location and size of the distribution area), the goods dimension (type and quantity of goods to be distributed) and the qualitative dimension (the service level in goods distribution) of the offer.

By the configuration of value-adding activities, it is determined which position the company occupies in the supply chain or value chain. This results in which value-adding

[130] Cf. Trefzger et al. (2010, pp. 1366 ff.).

[131] Cf. Pfohl (2022, pp. 261 ff.).

activities are performed by itself and which are outsourced. The relationships with customers, suppliers and other partners are established.

By the revenue mechanism, the sources of revenue in a business strategy are determined. A distinction can be made here between usage-dependent and usage-independent revenues. For the billing of usage-dependent revenues, the usage duration, the usage quantity or the usage distance can be used as a basis.

From the increasing demand for comprehensive logistics service packages results the offer of *contract logistics*.[132] These integrated service packages are adapted to the individual needs of a shipper and contractually secured for a longer term (multi-year "contract"). In this context, the keywords "*Third Party Logistics Provider*" (3-PL) and *"Fourth Party Logistics Provider"* (4-PL) up to XPL are discussed in literature and practice.[133] A 4-PL is a logistics service provider who, as an outsourcing partner of the shipping industry, integrates complete logistics chains, networks and systems within the framework of supply chain management and is also referred to as "Lead Logistics Provider" or "Control Tower". In contrast to the 4-PL, a 3-PL is understood to be a logistics service provider who provides system services, such as the management of the entire distribution and procurement logistics for an industrial and trading company, using its own network and own handling capacities, i.e. its own logistics "assets".

But even a limitation of the scope of services to a logistics subtask does not necessarily mean that competitive advantages can only be achieved through the price. For example, if customers only order in small quantities and the delivery is made from a regional or central warehouse, then there is a demand for small, time-bound piece goods shipments. This trend has created growing market segments. These include especially the courier, express and parcel services (CEP). Their common feature is a, usually cross-border, standardized service offer for the transport of small, higher-value goods or documents.

All services are characterized by the fact that the providers try to give them clear contours of a brand name.[134] As Fig. 4.39 shows by the example of the truckload industry, there are in any case many business models to adapt the offer profile to the demand profile. A prerequisite for this is a market segmentation that allows a sufficiently accurate determination of the demand profile.

Using market segmentation, markets are to be divided into submarkets with homogeneous demand profiles in order to enable a differentiated or concentrated market approach. For industrial goods markets, a *two-stage market segmentation* is suggested.[135] The first stage, which is relevant for the development of business strategies, is a demand- or prob-

---

[132] Cf. e.g. Schönberger and Bobel (2010, pp. 1072 ff.).

[133] For an overview of the development cf. Pfohl (2003, pp. 29 ff.) For 4-PL see in particular Pfohl et al. (2015). For the "Digital Forwarder", who brings shippers and logistics service providers together on a platform, cf. DHL Customer Solutions & Innovation (2020, p. 46).

[134] See for examples the results of a reader and expert vote at Huss-Verlag GmbH (2020).

[135] For multi-stage market segmentation, see Backhaus and Voeth (2014, pp. 124 ff.).

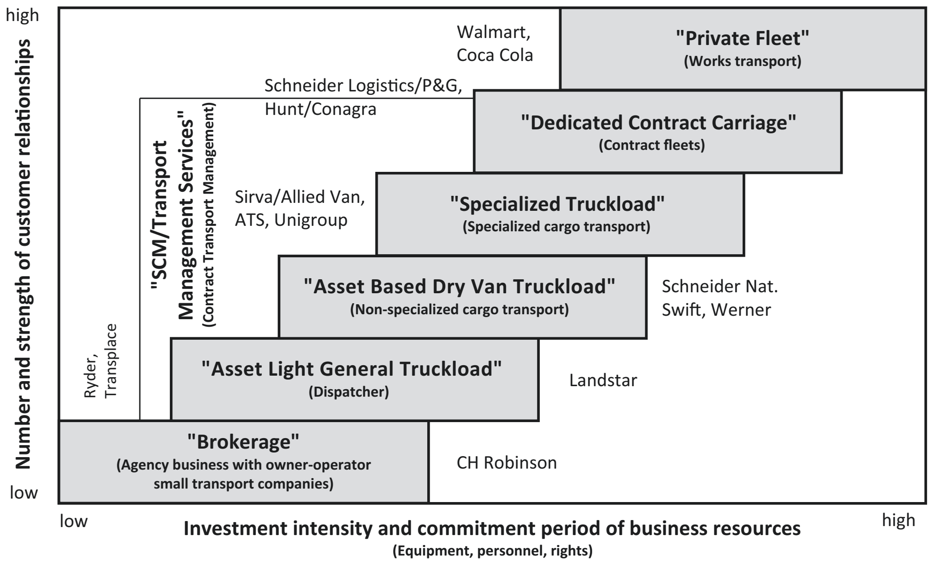


Fig. 4.39 Spectrum of successful business models in the American truckload industry. *Source* Klaus 2010, p. 206

lem-oriented market segmentation.[136] The goods-service matrix in Fig. 4.40 shows how to proceed in this case. The header row breaks down the service requirements into different components. The first column contains a classification of the goods according to the statistics accessible in a country. In the matrix fields, it is to be marked for the types of goods which service components have high, medium and low requirements. If a field is left blank, the corresponding service component is irrelevant for a type of goods. From the matrix, the types of goods with similar requirement profiles can then be grouped into market segments. In this way, "logistical goods families" are formed, consisting of heterogeneous goods that have the same requirements for transport, storage, packaging, etc.

With regard to the marketing mix to be used in a market segment, the service demand (the logistics problem) is the basis for the product policy (performance policy) and contracting policy (conditions policy) to be pursued. For the communication policy and distribution policy, a behavior-oriented market segmentation is to be carried out in a second stage. Based on an analysis of the behavior when purchasing logistical services, the persons involved in the purchasing decision process at the shipper and the information sources they use in the different phases of the decision process are determined.[137] Based on this, homogeneous target groups can be formed, to which the market approach by field service, personal sales and advertising is adapted.

[136] For a detailed discussion, see Zöllner (1990, pp. 80 ff.).

[137] For logistical services, see Pfohl et al. (2003, pp. 216 f., 2022, pp. 259 ff.).

Goods group	Delivery service: Delivery time	Reliability of the workflow	Ready for delivery	Delivery accuracy	Condition of delivery	Order modalities	Delivery modalities	Information of the customer
Chemical products								
Plastic products								
Products of the food industry								
- Meat products								
- Other								
Electrical engineering products								
Paper and cardboard products								
Engineering products								

Fig. 4.40 Goods-service matrix for demand-oriented market segmentation. *Source* Based on the matrix by Kolins 1980, p. 155 and p. 159

4.8.2 Customer Orientation

The legitimacy of a company ultimately results from its ability to solve customer problems (satisfy customer needs). In the case of a logistics company, these are the logistics problems and possibly also the non-logistical problems that have to be solved together with them for the shippers who are potential customers.

The underlying *systems thinking* of the logistics conception corresponds to the requirements that have to be met today for a definition of customer problems. Because on the industrial goods market, there is a general trend to no longer request individual solution components from different providers for a problem, but rather integrated problem solutions from a single source. This applies to both material products and services.[138] The

[138] For system business, see Backhaus and Voeth (2014, pp. 198 and 449 ff.).

risk for the customer at the technical and organizational interfaces in a product or service package is thereby significantly reduced. In the context of logistical services, this is also referred to as "one-stop shopping".

Another starting point for defining customer problems is their *hierarchical structuring*. For a logistics company, ensuring the service level resulting from strategic decisions in the logistics, procurement, production and distribution areas is the primary customer problem (customer problem of the first order), which is characterized by a high degree of permanence and, according to the current state of knowledge, cannot disappear in the foreseeable future. From this, customer problems of lower order are derived in the logistical subsystems of transport, storage, etc. They owe their existence to a specific solution alternative for the primary customer problem. The lower down in the hierarchy the customer problem to be solved by a logistics company is, the greater the risk that it will be rationalized or innovated away by a new solution alternative for the primary customer problem. A logistics company that today may still solve the customer problem "truck transport in full-load traffic from the factory warehouse to the delivery warehouse", which is located far down in the customer problem hierarchy, may lose its market tomorrow due to a new logistics strategy of the customer.

Customer orientation is the basis for the business strategy of the logistics company. However, other influencing factors have to be considered for the selection of such a strategy.

4.8.3 Strategy Choice

A good starting point for choosing a strategy is the competitive analysis of Porter shown in Fig. 4.41. The competitive situation in the logistics industry is determined by the *buyers* and their demand on the one hand. As shown in the characterization of the freight transport market at the beginning of this section, the increasing demand for time-defined services and complete services is particularly important here. On the other hand, the bargaining power and behavior of the *suppliers* are also decisive. Here, special attention must be paid to the outsourcing of individual services by logistics service providers and especially to the business model of the so-called Fourth Party Logistics Provider (4-PL). These service providers have to enter into cooperations due to the lack of their own physical logistics infrastructure and are therefore often confronted with the bargaining power and possibly opportunistic behavior of their suppliers.[139]

Furthermore, the existence *of potential new competitors* is a significant determinant of competition. For example, there are potential competitors in the form of IT system houses or management consultancies with core competencies in the development and implementation of supply chain management tools for specific logistics problem solutions. However, it must be taken into account that these potential market entrants still

---

[139] Cf. Pfohl (2003, pp. 24 ff.).

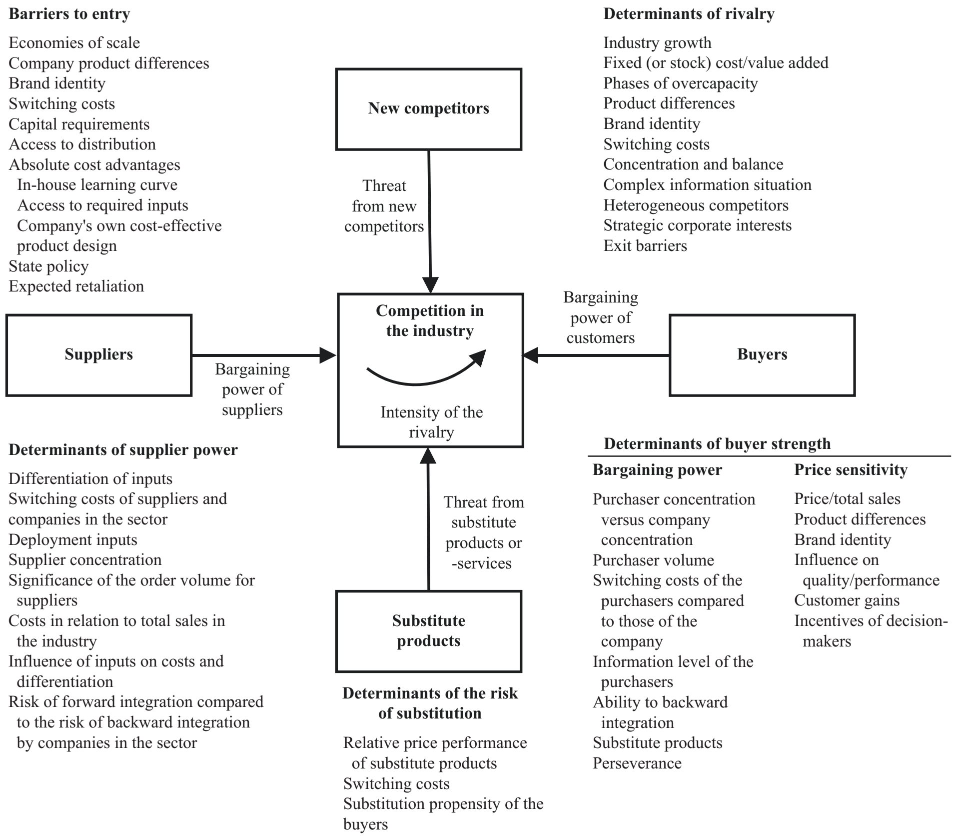


Fig. 4.41 Competitive situation in the market for logistics services. *Source* Porter 2013, p. 32

have to generate the essential physical logistics network through cooperations. Due to long-term market relationships with established service providers, this can in turn represent a relatively high entry barrier for new competitors. With regard to the competition of existing service providers by *substitute products*, the use of real-time information to reduce safety stocks is particularly important. As already explained, the *competition within the industry* is now characterized by considerable consolidation tendencies. The competitive situation is also characterized by the fact that the institutions involved in the value chain complement each other in a division of labor, but can also compete with each other. For example, the wholesale trade is increasingly facing competition from efficient logistics companies in providing logistics and related services. As competitors to logistics and wholesale companies, merchandisers and distributors are particularly important. Merchandisers are service providers who take over all activities related to the placement of the goods in the trade for the manufacturer. These include unpacking, labeling and shelf maintenance. Distributors are usually main suppliers of retail companies, who take over the delivery of certain goods in the overall market or a regional submarket also for the competition on their behalf.

The criteria for the choice of strategy must be concretized in terms of the potential strengths of a logistics company and the threats of market entry. The quality of a business strategy as a product-market combination is mainly determined by the growth potential of the considered market segment, the risk of segment stability and the relative competitive advantage that a logistics company has over the competition in the considered logistics service.[140]

The *growth potential* of a market segment depends first of all on the growth of the industry for which the logistics service is offered. Like the other providers of production goods, the logistics company faces a "derived" demand and must therefore also deal with the sales markets of their customers. Particular difficulties in forecasting the industry development have logistics companies that offer their logistics services to several industries. Because the industry structures can often differ considerably and change fundamentally (e.g. by the emergence of new substitute products and competitors).[141] Since market segments within an industry can grow very differently, the market analysis of the logistics company must not stop at the general industry development, but must extend to the market segments that include their potential customers. If one wants to know the growth potential of a customer, the market analysis must also capture their market share.

The *risk of segment stability* depends, besides general political and economic factors, especially on the threat of market entry by potential competitors, which is determined by the existing entry barriers. These include also the expected retaliation measures of the established providers. The probability of retaliation can be estimated as high if strong retaliation measures were taken against earlier entrants, the market shows slow growth, the established companies have high means for retaliation and they have invested in highly illiquid assets on the market.

In the market for logistics services, basically all entry barriers can exist. However, compared to tangible goods, the creation of entry barriers by protected technologies and performance differentiation is more difficult. Thus, the protection by patents, which primarily target the hardware technology, is of comparatively low importance. But the software technology for planning, controlling and monitoring complex logistics processes that take place within and between companies offers good possibilities for creating entry barriers. Because the production factors personnel and information, which are mainly required for this, can generally only be brought to the necessary quality level slowly in the necessary combination. The performance differentiation by brand names, which is often so successful for tangible goods that the brand name almost becomes a generic term (e.g. Xerox), is more difficult for services, but is becoming increasingly important

[140] For customer potential analysis, see Pfohl et al. (2003).

[141] For the elements of the industry structure (competitive structure) to be analyzed, see Porter (2014, pp. 24 ff.) For the analysis of the industry structure, see also Zöllner (1990, pp. 223 ff.).

for logistics companies. Above all, however, logistics companies, like other service companies, must develop a good reputation for the quality of their offer. “The more abstract and complex the service is, the more urgent is the need and the greater are the chances of developing a “good reputation”, which … acts as an access barrier.”[142]

The *relative competitive advantage*—i.e. the competitive advantage compared to the strongest competitors—for a logistics service depends in particular on the extent to which it matches the strengths of the logistics company. When choosing the service to offer, a logistics company can basically orient itself to the three criteria that designate the coordinates in Fig. 4.42 and that show the potential strengths of the logistics company.[143]

If one summarizes under the criterion *function fulfillment* or customer problem the offered scope of service (the logistics control span to be responsible for by the logistics company, the breadth of the logistics service range) and the service quality (the service level), then the scope of service takes a special position among the starting points for specialization. Because if the shipper increasingly orientates his wishes to the logistics system thinking and demands from the logistics company the solution of complex problems, then a specialization on small sections of the logistics control span is very risky. On the other hand, the solution of complex logistics problems requires, besides often necessary investments in the production factors equipment and information, special strengths in the production factor personnel. Because logistics knowledge among the employees of the logistics company is a prerequisite for the necessary cooperation with the shipper in solving his logistics problems and for offering logistics service packages that are tailored to the shipper's needs.

When specializing in a certain service quality, the offer of the logistics company focuses on goods with special delivery service requirements, such as urgent or care-intensive goods. In addition to the special knowledge for handling such goods among the employees, this often requires the use of a specific technology for service creation. For example, urgent goods require particularly fast communication and transport systems and care-intensive goods require transport vehicles with cooling or air suspension.

Thus, the type of specialization in a certain service quality turns into a specialization in a certain *technology,* if there is a compelling connection between the service quality and the technology. In the past, logistics companies focused on specializing in specific production procedures, e.g. special transport vehicles. However, as explained, this is precisely not the marketing concept as the basis for developing business strategies. Since the customer is generally interested in the result and not in the type of production procedure used, it can also be easily substituted.

[142] Thomas (1983, p. 45).

[143] For an example of a search frame that contains a coordinate “Geographical Spaces” instead of the technology coordinate, see Zöllner (1990, pp. 62 f.) For a “logistics service heptagon” as a search frame, see Cooper et al. (1994, p. 164).

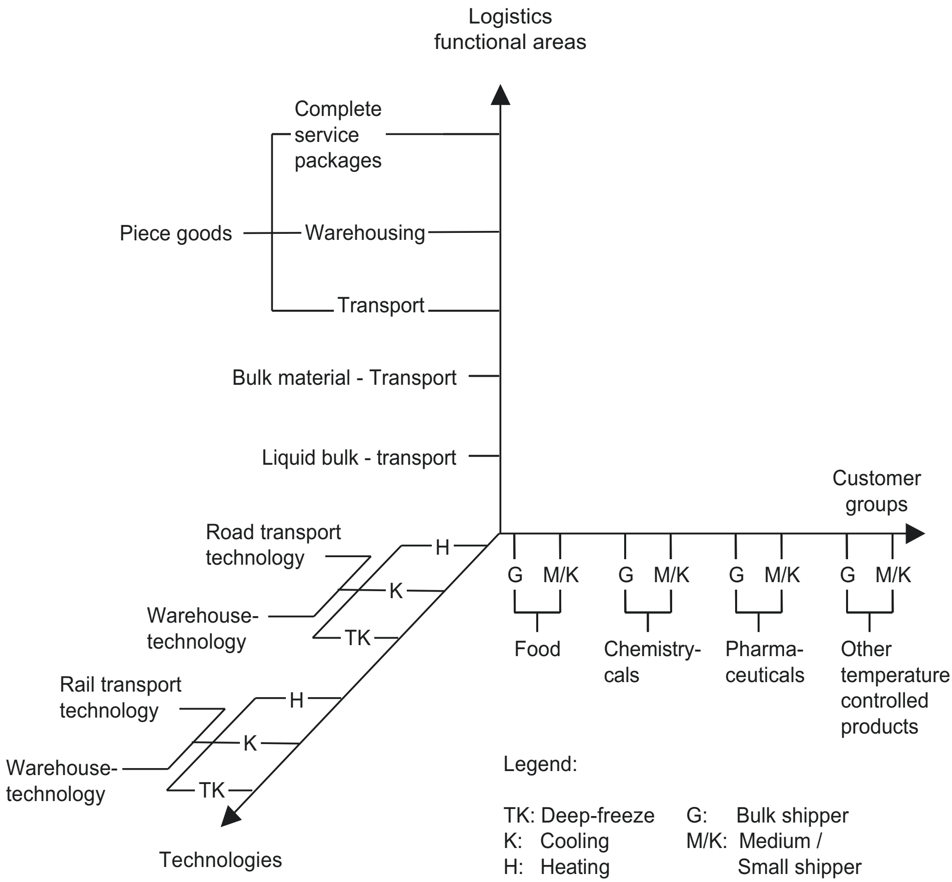


Fig. 4.42 Search frame for logistics services to be offered. *Source* Zöllner 1990, p. 66

When specializing in a certain *customer group*, one can distinguish the target groups of large shippers as well as medium and small shippers. These can operate in different industries. An example of this is the specialization in chemical logistics.[144] Another possibility of specializing in customer groups results for whom logistics service capacities are reserved for. This can be, for example, for individual customers ("dedicated"), for several customers who share capacities ("multi-user") or for a broad customer base ("open").

[144] On this specialization, see Krupp et al. (2013).

4.8.4 Innovation Strategy

For the innovations, three types of innovations are usually distinguished according to the innovation object.[145] These are, on the one hand, *process innovations*, which concern the change or redesign of the material and immaterial processes necessary for the provision of services within or between companies. This is particularly important for those industries in which differentiation by *product innovations* is hardly possible anymore. However, logistics also has significance for supporting product innovations, especially in industries with short product life cycles. Because only a logistics adapted to the product innovations can ensure the short time of market introduction and penetration necessary for the amortization of the research and development expenditures. Product innovations in the form of *service innovations* are also important for the logistics service providers. For their service products, the development trends for product innovations determined for material goods, such as increasing system character and growing complexity, standardization of modules while simultaneously individualizing the product offering, apply in the same way. *Business model innovations* refer to new possibilities of how a company achieves value creation. They arise from changes in the product-market combination, the execution and configuration of the value creation activities or the revenue mechanism. Business model innovations can be made necessary by process and product innovations or arise from them.[146]

For all innovations, it is possible to distinguish between medium-induced *("Technology Push")* and purpose-induced *("Demand Pull") innovations*. However, it is obvious that in logistics, the innovations enabled by technology and demanded by the market often mutually condition each other. The development towards a global and individualized buyer market is only made possible by the innovative integration of the information and goods flow technology.

According to the innovation content, radical and incremental innovations can be distinguished. Through *radical innovations*, products, processes or business models are fundamentally redesigned. *Incremental innovations* concern improvements of the products, processes and business models. The difference can be illustrated with the experience curve. The incremental innovation leads to a faster progress on the experience curve, while the radical innovation leads to a new experience curve. Radical innovations, i.e. innovations with a high degree of novelty, are rarer than incremental innovations, i.e. innovations with low innovation content.[147]

---

[145] Cf. Pfohl et al. (2007a, pp. 19 ff.) and Lampe and Stölzle (2012, pp. 7 ff.) In another approach, the innovation objects “Supply Chain Business Processes”, “Supply Chain Technology” and “Supply Chain Network Structure” are distinguished. Cf. Arlbjorn et al. (2011, pp. 8 ff.).

[146] Cf. Lampe and Stölzle (2012, p. 9); see also Frunzke (2010, pp. 288 f.).

[147] Cf. the empirical study of the generation of innovations in contract logistics relationships by Pfohl et al. (2007b, p. 110).

For logistics service providers, the importance of innovations increases, as the industrial and trading companies increasingly consider the innovation capability of the service providers when outsourcing logistics services.[148] To increase the innovation capability, an increase in the innovation intensity—measured as the sum of the innovation expenditures in relation to the turnover—can lead in the first place.[149] However, the increase in innovation intensity must be accompanied by a professional innovation management.[150]

Due to the necessary integration of the external factor in the service production[151], the greater importance of involving the customer in the innovation management of service providers follows, compared to the innovation management in industrial companies.[152] Both more innovative companies in the shipping industry and more innovative logistics companies show a significantly higher degree of involvement of the partner in the innovation process than the average companies.[153]

The cooperation of the partners in the innovation process is greatly influenced by the role understanding that the partners have of each other in the generation of innovations. An empirical study has shown that the self-image and the external image of the role of the customers and the service providers in the innovation process do not match. For example, the service providers estimate their innovation capability higher than is the case from the customer's point of view.[154]

As *methods* to support the innovation process, the "modular service architecture" and the "service blueprinting" are proposed. "With the development of a modular service architecture, customer-specific logistics services can be provided on the basis of standardized, modular service components following the industrial model."[155] Within the service configuration, the adaptation to the specific requirements of the customer ("customizing") takes place. The service blueprinting serves to visualize the process of providing a service. In particular, a subdivision is made into the sub-processes in which an active (co-)operation of the customer is necessary, and into the sub-processes that are carried out by the service provider alone.[156] Another approach to support the innovation process is the "service engineering".[157] It is assumed here that services can be developed

---

[148] Cf. European Logistics Association and Arthur D. Little (2007, p. 12).

[149] Cf. Wagner (2007, pp. 67 f.).

[150] See in detail Pfohl et al. (2007a, p. 32 ff.) For challenges and design recommendations for an innovation management in logistics, see also Straube (2013, pp. 46 ff.).

[151] See Pfohl (2022, p. 23).

[152] Cf. Göpfert and Hornbostel (2009, p. 173).

[153] Cf. European Logistics Association and Arthur D. Little (2007, p. 21).

[154] Cf. Pfohl et al. (2007b, pp. 113 ff.).

[155] Pfohl et al. (2007a, p. 79).

[156] Cf. ibid., pp. 81 f. For an example of a service blueprint of the order processing, see Engelke (1997, p. 253).

[157] Cf. Elbert and Özsucu (2012, pp. 62 ff.); Preiß (2014).

similarly to goods, taking into account the service-specific characteristics. The methods and tools proven in product development are adapted to the service development in a procedural model.

A special importance for logistics innovations comes from the *start-ups* in the logistics sector.[158] The observation of the start-up market provides information on whether and which new business models work, without having to test them in the company itself.[159] To promote promising innovations, a financial participation in the start-up is also an option.

The implementation of the logistics strategies in industrial, trade and logistics companies requires a correspondingly developed logistics controlling. The controlling concept and the controlling instruments relevant for logistics are discussed in the following section.

References

Aberle G (2009) Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 8., rev. a. ext. ed. Oldenbourg, München

Abrahamsson M (2010) The role of logistics in corporate strategy. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 533–551

Ansoff H (1966) Management-Strategie. Moderne Industrie, München

Ansoff H (1988) The new corporate strategy. John Wiley & Sons, New York

Arlbjorn J, de Haas H, Munksgaard K (2011) Exploring supply chain innovation. Logist Res 3(1):3–18

Ashayeri J, Rongen J (1997) Central distribution in Europe: a multi-criteria approach to location selection. Int J Logist Manag 8(1):97–109

Backhaus K, Voeth M (2014) Industriegütermarketing. Grundlagen des Business-to-Business-Marketings. 10., rev. ed. Vahlen, München

Ballot E, Montreuil B, Meller R (2014) The physical internet. The network of logistics networks. Predit, La Documentation Francaise

Barth K, Hartmann M, Schröder H (2007) Betriebswirtschaftslehre des Handels, 6, rev. ed. Gabler, Wiesbaden

Berbner U (2017) Situationsadäquate Gestaltung des Supply-Chain-Risikomanagements unter Berücksichtigung des Informationstechnologieeinsatzes. Eul, Lohmar-Köln

Bobel T (2009) Logistikorientiertes Management von Events. Grundlagen und Handlungsempfehlungen für die Eventlogistik. Haupt, Bern

Boyd J (2020) Shifting ground. Supply Chain Quarterly 14(Special Issue):35–37

Bretzke W-R (2015) Logistische Netzwerke. 3. ed. Springer, Heidelberg

Christopher M (2010) Enhancing supply chain agility through complexity reduction. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Gabler, Wiesbaden, P 573–583

[158] Cf. Schwemmer (2019a, pp. 9 ff.).

[159] Cf. Schwemmer (2019b, p. 30).

Christopher M (2016) Logistics & Supply Chain Management, 5. ed. Pearson, Harlow
Cooke J (2014) A supply chain redesign for omnichannel success. Supply Chain Q 8(2):34–38
Cooper J, Browne M, Peters M (1994) European logistics – markets, management, strategy, 2. ed. Wiley-Blackwell, Oxford
Corsten H (1998) Von generischen zu hybriden Wettbewerbsstrategien. WISU 27(12):1434–1440
Cushman & Wakefield Healey & Baker (2003) European distribution report. Cushman & Wakefield, London
Darr W (1992) Integrierte Marketing-Logistik. Dt. Universitätsverlag, Wiesbaden
Daugherty P, Stank T, Ellinger A (1998) Leveraging logistics/distribution capabilities: the effect of logistics service on market share. J Bus Logist 19(2):35–51
Delfmann W (1978) Lieferzeitorientierte Distributionsplanung. Duncker & Humblot, Berlin
Delfmann W (2004) Postponement. In: Klaus P, Krieger W (Eds) Gabler Lexikon Logistik, 3. ed. Gabler, Wiesbaden, P 380–381
Delfmann W (2010) Entschleunigung, Entkopplung, Konsolidierung. Ansatzpunkte für einen Perspektivenwechsel in der Logistik. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Gabler, Wiesbaden, P 585–600
Doch St (2009) Logistische Leistungsdifferenzierung im Supply Chain Management. Schriftenreihe Logistik der Technischen Universität Berlin, Berlin
DHL Customer Solutions & Innovation (2020) The Logistics Trend Radar. 5. ed. DHL, Troisdorf
Elbert R, Özsucu Ö (2012) Produkt vs. Prozessorganisation. Innovationsmanagement aus Sicht eines Logistikdienstleisters. In: Stölzle W, Lieb Th (Eds) Business Innovation in der Logistik. Chancen und Herausforderungen für Wissenschaft und Praxis. Gabler, Wiesbaden, P 53–75
Engelke M (1997) Qualität logistischer Dienstleitungen. Operationalisierung von Qualitätsmerkmalen, Qualitätsmanagement, Umweltgerechtigkeit. Erich Schmidt, Berlin
Eßig M, Hofmann E, Stölzle W (2013) Supply chain management. Vahlen, München
European Logistics Association, Arthur D Little (2007) Innovation excellence in logistics. Value creation by innovation. ELA, Brussels
Evers P (1995) Expanding the square root law: an analysis of both safety and cycle stocks. Logist Transp Rev 31(1):1–20
FM Global (2020) FM Global Resilience Index 2020 – Executive Summary. https://fmglobalpublic.hartehanks.com/AssetDisplay?acc=11FM&itemCode=S17062_DEU. Accessed: 3. Sept 2020
Fontius J (2013) Megatrends und ihre Implikationen für die Logistik. Schriftenreihe Logistik der Technischen Universität Berlin, Berlin
Frunzke H (2010) Logistikinnovationen: Logistik als Gegenstand von F&E. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 283–301
Gareis K (2002) Das Konzept Industriepark aus dynamischer Sicht. Theoretische Einführung – empirische Ergebnisse – Gestaltungsempfehlungen. Dt. Universitäts, Wiesbaden
Göpfert I (2009) Die Anwendung der Zukunftsforschung für die Logistik. In: Göpfert I (Ed) Logistik der Zukunft – Logistics for the Future, 5., act. a. enl. ed. Gabler, Wiesbaden, P 39–87
Göpfert I (2013) Logistik: Führungskonzeption und Management von Supply Chains, 3. ed. Vahlen, München
Göpfert I, Hornbostel B (2009) Innovationsmanagement bei Logistikdienstleistern. Theoretische Implikationen und praktische Erkenntnisse. In: Göpfert I (Ed) Logistik der Zukunft – Logistics for the Future, 5., act. a. enl. ed. Gabler, Wiesbaden, P 167–194
Grant D et al (2006) Fundamentals of Logistics Management. European edition. McGraw-Hill, New York
Grothausmann A (2009) Effiziente Supply Chains für eine sichere Versorgung. Logistik für Unternehmen 23(6):51–53

Hall A (1987) Consolidation strategy: inventory, vehicles and terminals. J Bus Logist 8(2):57–73
Häusler P (2002) Auswirkungen der Integration der Logistik auf Unternehmensnetzwerke. Dt. Universitäts, Wiesbaden
Havighorst D (1980) Konzept und Leistungspotential der Marketing-Logistik. Wirtschafts- und Handels, Weinheim
Hayes R, Wheelwright S (1984) Restoring our competitive edge. Competing through manufacturing. Ronald Press, New York
Heinrichmeyer H (1998) Grundlagen der Netzoptimierung. In: Buchholz J, Clausen U, Vastag A (Eds) Handbuch der Verkehrslogistik. Springer, Berlin, P 185–199
Henning R et al (2003) Economies in der Verkehrswirtschaft. In: Merkel H, Bjelicic B, (Eds) Logistik und Verkehrswirtschaft im Wandel. Unternehmensübergreifende Versorgungsnetzwerke verändern die Wirtschaft. Festschrift für Gösta B. Ihde. Vahlen, München, P 399–417
Heskett J, Sasser W Jr, Hart W (1990) Service Breakthroughs. Changing the rules of the game. Ronald Press, New York
Heusler F, Stölzle W, Bachmann H (2006) Supply chain event management – Grundlagen. Funktionen und potentielle Akteure. WiSt 35(1):19–24
Hoppe N, Conzen F (2002) Europäische Distributionsnetzwerke: Voraussetzungen. Projektablauf, Fallbeispiele. Gabler, Wiesbaden
Huss-Verlag GmbH (2020) Beste Logistik Marke 2020: Alle Ergebnisse zur Leser- und Expertenwahl. LH 42 (Sonderpublikation)
Ihde G, Janz O (2000) Gestaltungsprinzipien der Logistik. Wisu 29(3):332–341
Ihde G, Kloster T (2001) Netzeffekte in Logistiksystemen. Logistikmanagement 3(2):25–34
Jordan D (1988) Integrale Logistik im Philips Konzern. In: DGfL (Ed) LOG'88. Technologie, Management, Organisation. Tagungsbericht. DGfL, München, P 43–65
Jüttner U, Peck H, Christopher M (2003) Risk management: outlining an agenda for future research. Int J Logist 6(4):197–210
Kerres H (1991) Kundenorientierte Logistik im Einzelhandel. In: Bäck H (Ed) Europäische Logistik-Dimensionen, 8., Logistik-Dialog. TÜV Media, Köln, P 317–328
Klaus P (2002) Die dritte Bedeutung der Logistik. DVV Media Group, Hamburg
Klaus P (2010) Mächtig, unbeliebt, unprofitabel – und wenig verstanden? Der LKW-Ladungsverkehr in Europa und seine Zukunft. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 191–210
Klein R, Steinhardt C (2008) Revenue Management: Grundlagen und Mathematische Methoden. Springer, Berlin/Heidelberg
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. DGfL, Dortmund, P 215–218
Köhler H (2011) Supply Chain Risiken in Low Cost Country Sourcing. Reduktion von Lieferrisiken in China und der Türkei. Erich Schmidt, Berlin
Kolins R (1980) Launching a motor carrier marketing program. In: Sales & Marketing Council of the American Trucking Associations, I. (Ed) Motor carrier marketing management. Washington DC, P 143–182
Kotler P, Keller K, Opresnik M (2017) Marketing-Management. Konzepte – Instrumente – Unternehmensfallstudien. 15., act. ed. Pearson, Hallbergmoos
Kraljic P (1988) Zukunftsorientierte Beschaffungs- und Versorgungsstrategie als Element der Unternehmensstrategie. In: Henzler H (Ed) Handbuch strategische Führung. Gabler, Wiesbaden, P 477–497
Krings M (2010) Efficient consumer response. Vorläufiger Endpunkt der Entwicklung moderner Supply Chains im Konsumgüterhandel. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 987–1008

Krupp Th, et al (2013) Chemielogistik. Bedeutung, Strukturen, Dynamik. Studie der Bundesvereinigung Logistik (BVL) e. V. DVV Media Group, Hamburg

Lambert D (2014) Supply Chain Management. Process, relationship, performance, 4. ed. Supply Chain Management Institute. Ponte Vedra Beach

Lampe K, Stölzle W (2012) State of the Art von Innovationen in der Logistik. In: Stölzle W, Lieb ThC (Eds) Business Innovation in der Logistik. Chancen und Herausforderungen für Wissenschaft und Praxis. Gabler, Wiesbaden, P 3–28

Large R (2013) Strategisches Beschaffungsmanagement. Eine praxisorientierte Einführung mit Fallstudien, 5., ful. rev. ed. Springer Gabler, Wiesbaden

Lee H (1998) Postponement for mass customization. In: Gattorna I (Ed) Strategic supply chain alignment. Routledge, Vermont, P 77–91

Lendzion H-P (1991) Das Logistik-Konzept der Karstadt AG für die 90er-Jahre. In: Zentes J (Ed) Moderne Distributionskonzepte in der Konsumgüterwirtschaft. Poeschel, Stuttgart, P 35–50

Liebmann H-P (1991) Struktur und Funktionsweise moderner Warenverteilzentren. In: Zentes J (Ed) Moderne Distributionskonzepte in der Konsumgüterwirtschaft. Poeschel, Stuttgart, P 17–32

Lynch D, Keller S, Ozment J (2000) The effects of logistics capabilities and strategy on firm performance. J Bus Logist 21(2):47–67

Meffert H, Burmann C, Kirchgeorg M (2019) Marketing: Grundlagen marktorientierter Unternehmensführung – Konzepte, Instrumente, Praxisbeispiele, 13., rev. a. enl. ed. Gabler, Wiesbaden

Mikus B (2003) Strategisches Logistikmanagement. Ein markt-, prozess- und ressourcenorientiertes Konzept. Dt. Universitäts, Wiesbaden

Morgans L (1990) DRP – a critical link in supply chain management. Focus 9(5):31–34

Müller-Steinfahrt U (2013) Erfolgsfaktor Refurbishing. In: Wimmer T, Hucke S (Eds) Impulse, Ideen, Innovationen, Bd 3, Kongressband. Deutscher Logistik-Kongress. DVV Media Group, Hamburg, P 460–484

Otto A, Kotzab H (2001) Der Beitrag des Supply Chain Management zum Management von Supply Chains – Überlegungen zu einer unpopulären Frage. ZfbF 53(3):157–176

Pagh J, Cooper M (1998) Supply chain postponement and speculation strategies: how to choose the right strategy. J Bus Logist 19(2):13–33

Pawellek G, Schulte H (1987) Logistikgerechte Konstruktion. Auswirkungen der Produktgestaltung auf die Produktionslogistik. ZfL 8(9):35–39

Persson G (1991) Achieving competitiveness through logistics. Int J Logist Manag 2(1):1–11

Pfohl H-Chr (1977) Zur Formulierung einer Lieferservicepolitik. Theoretische Aussagen zum Angebot von Sekundärleistungen als absatzpolitisches Instrument. ZfbF 29(5):239–255

Pfohl H-Chr (1980) Die Logistikkonzeption als Grundlage für ein modernes Marketing von Transport- und Speditionsunternehmen. DBW 40(3):423–434

Pfohl H-Chr (2001) Wertsteigerung durch Innovation in der Logistik. In: Pfohl H-Chr (Ed) Jahrhundert der Logistik. Wertsteigerung des Unternehmens: customer related, glocal, e-based. Erich Schmidt, Berlin, P 187–235

Pfohl H-Chr (2002) Risiken und Chancen: Strategische Analyse in der Supply Chain. In: Pfohl H-Chr (Ed) Risiko- und Chancenmanagement in der Supply Chain: proaktiv – ganzhaltig – nachhaltig. Erich Schmidt, Berlin, P 1–56

Pfohl H-Chr (2003) Entwicklungstendenzen auf dem Markt logistischer Dienstleistungen. In: Pfohl H-Chr (Ed) Güterverkehr. Eine Integrationsaufgabe für die Logistik. Entwicklungen – Auswirkungen – Lösungsmöglichkeiten. Erich Schmidt, Berlin, P 1–44

Pfohl H-Chr (2021) Logistik. In: Pfohl H-Chr (Ed) Betriebswirtschaftslehre der Mittel- und Kleinbetriebe. Größenspezifische Probleme und Möglichkeiten zu ihrer Lösung, 6., rev. ed. Erich Schmidt, Berlin, P 269–299

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. upd. ed. Springer, Berlin/Heidelberg

Pfohl H-Chr, Zöllner W, Weber N (1992) Economies of scale in customer warehouses. Theoretical and empirical analysis. J Bus Logist 13(1):95–124

Pfohl H-Chr, Stölzle W (1997) Planung und Kontrolle. Konzeption, Gestaltung, Implementierung, 2., neubearb. Aufl. Vahlen, München

Pfohl H-Chr, Gareis K, (2000) Die Rolle der Logistik in der Anlaufphase. ZFB 70(11):1189–1214

Pfohl H-Chr, Pfohl P (2000) Postponement in der Supply Chain: Grundlagen und empirische Ergebnisse zur Verbreitung in Westeuropa. In: Hossner R (Ed) Jahrbuch der Logistik 2000. free beratung, Düsseldorf, P 40–45

Pfohl H-Chr, Large R (2003) Beschaffungsstrategien und strategisches Beschaffungsmanagement. In: Boutellier R, Wagner St, Wehrli H (Eds) Handbuch Beschaffung. Strategien, Methoden, Umsetzung. Hanser, München/Wien, P 433–452

Pfohl H-Chr, Gomm M, Hofmann E (2003) Kundenpotenzialanalyse für Logistikdienstleister. Bedarf und Gestaltungsmöglichkeiten für die kundenorientierte Entwicklung. FBIIE 52(5):213–220

Pfohl H-Chr, Frunzke H, Köhler H (2007a) Grundlagen für ein Innovationsmanagement in der Logistik. In: Pfohl H-Chr (Ed) Innovationsmanagement in der Logistik. Gestaltungsansätze und praktische Umsetzung. DVV Media Group, Hamburg, P 16–105

Pfohl H-Chr, Frunzke H, Köhler H (2007b) Innovationsgenerierung in kontraktlogistischen Beziehungen aus Dienstleister- und Kundensicht. In: Pfohl H-Chr (Ed) Innovationsmanagement in der Logistik. Gestaltungsansätze und praktische Umsetzung. DVV Media Group, Hamburg, P 106–164

Pfohl H-Chr, Gallus P, Köhler H (2008) Konzeption des Supply Chain Risikomanagements. In: Pfohl H-Chr (Ed) Sicherheit und Risikomanagement in der Supply Chain. Gestaltungsansätze und praktische Umsetzung. DVV Media Group, Hamburg, P 8–94

Pfohl H-Chr, Köhler H, Thomas D, (2010) State of the art in supply chain risk management research: empirical and conceptual findings and a roadmap for the implementation in practice. Logist Res 2(2):33–44

Pfohl H-Chr, Moraitakis N, (2014) Entwicklung und Herausforderungen in den Supply Chains in Chinas Binnenland. LogRealdirekt 2:14–15

Pfohl H-Chr, Berbner U, Zuber C (2015) Potenziale der 4th Party Logistics. Chancen und Herausforderungen für KMU und Großunternehmen. In: Wolf-Kluthausen H (Ed) Jahrbuch Logistik 2015. free beratung, Korschenbroich, P 34–37

Pfohl H-Chr, Wagner S, Ries A, Berbner U, Witte H, (2015) 4th Party Logistics – Chancen und Herausforderungen. Neue Wege im Logistikmanagement. KPMG, Frankfurt

Pfohl M (2002) Prototypgestützte Lebenszyklusrechnung. Vahlen, München

Porter M (2013) Wettbewerbsstrategie. Methoden zur Analyse von Branchen und Konkurrenten, 12., act. a. enl. ed. Campus, Frankfurt a. M.

Porter M (2014) Wettbewerbsvorteile. Spitzenleistungen erreichen und behaupten, 8. ed. Campus, Frankfurt a. M.

Preiß H (2014) Service Engineering in der Logistik. Die systematische Entwicklung von AIDC-technologiebasierten Mehrwertdienstleistungen. Fraunhofer, Stuttgart

Prockl G (2007) Logistik-Management im Spannungsfeld zwischen wissenschaftlicher Erklärung und praktischer Handlung. Gabler, Wiesbaden

Reiche F, Hofstetter J, Stölzle W (2009) Ereignisorientierte Steuerung von Lieferketten: Nutzen, aktueller Stand der Nutzung und Potentiale. Die St. Galler Supply Chain Event Management-Studie. Cuvillier, Göttingen

Rink R, Kaminski P (1986) Formulation of effective logistics strategies and tactics. Markt 25(3):57–61

Schmidt K-J (1990) Just-in-Time über große Entfernungen. Logistik Spektrum 2(5):103–105

Schneeweiß Ch (2002) Einführung in die Produktionswirtschaft, 8., corr. u. enl. Aufl. Springer, Berlin

Schönberger R, Bobel T (2010) Kontraktlogistik zwischen globalen und regionalen Supply Chains. Der Logistikdienstleister als geostrategischer Intermediär. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 1061–1091

Schuh G, Stölzle W, Straube F (Eds) (2008) Anlaufmanagement in der Automobilindustrie erfolgreich umsetzen. Ein Leitfaden für die Praxis. Springer, Berlin

Schulte C (2017) Logistik. Wege zur Optimierung der Supply Chain, 7., tot. rev. a. enl. Aufl. Vahlen, München

Schwemmer M (2019a) Top 100 in European Transport and Logistics Services 2019/2020. DVV Media Group, Hamburg

Schwemmer M (2019) Logistik-Start-up: Neues Miteinander. VerkersRundschau 27:28–30

Seeck St et al (2014) Logistik im Handel. Strukturen, Erfolgsfaktoren, Trends. Studie der Bundesvereinigung Logistik (BVL) e.V. DVV Media Group, Hamburg

Sharman G (1984) The rediscovery of logistics. HBR 62(5):17–19

Stölzle W (1993) Umweltschutz und Entsorgungslogistik: theoretische Grundlagen mit ersten empirischen Ergebnissen zur innerbetrieblichen Entsorgungslogistik. Erich Schmidt, Berlin

Straube F (Hrsg) (2013) Technologien und Innovationen in der Logistik. Schriftenreihe Logistik der Technischen Universität Berlin, Berlin

Theis H (1999) Handels-Marketing: Analyse- und Planungskonzepte für den Einzelhandel. Dt. Fach, Frankfurt

Thomas D (1983) Strategien in Dienstleistungsunternehmen. Harv Manag 5(2):42–48

Tietz B (1991) Erfolgspotentiale der europäischen Binnenmarktintegration für Industrie, Handel und Logistik-Dienstleister. In: Zentes J (Ed) Moderne Distributionskonzepte in der Konsumgüterwirtschaft. Poeschel, Stuttgart, P 163–182

Trefzger D, Gerdes U-T, Müller F (2010) Innovative Geschäftsmodelle von Logistikdienstleistern in der Kontraktlogistik – Herausforderungen an die Kundenintegration. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 1363–1376

Vahrenkamp R (2007) Logistik. Management und Strategien, 6., rev. a. enl. ed. Oldenbourg, München/Wien

Wagner S (2007) Bestandsaufnahme und Plädoyer für eine Intensivierung des Innovationsmanagements bei Verkehrsdienstleistern. Zeitschrift für Verkehrswissenschaft 78(1):58–70

Wang L, Foerstl K, Zimmermann F (2017) Supply Chain Risk Management in the Automotive Industry: Cross-Functional and Multi-tier Perspectives. In: Abele E, Boltze M, Pfohl H-Chr (Eds) Dynamic and Seamless Integration of Production, Logistics and Traffic. Fundamentals of Interdisciplinary Decision Support. Switzerland, P 119–144

Welge M, Al-Laham A, Eulerich M (2017) Strategisches Management: Grundlagen, Prozess, Implementierung, 7., rev. a. act. ed. Gabler, Wiesbaden

Wildemann H (1986) Just-in-Time-Lösungskonzepte in Deutschland. Harv Manag 8(1):36–48

Wildemann H (1989) Fabrikorganisation: Kundennahe Produktion durch Fertigungssegmentierung. ZfB 59(1):27–54

Wildemann H (1990) Kostengünstiges Variantenmanagement. io. Management-Zeitschrift 59(11):37–41

Wildemann H (2001) Das Just-in-time-Konzept. Produktion und Zulieferung auf Abruf, 5. ed. TCM, München

Williams W, Mahmoodi F (2019) SKU rationalization: Finding the right balance between too many and too few. Supply Chain Quarterly 13(4):32–37

Zäpfel G, Missbauer H (1987) Produktionsplanung und -steuerung für die Fertigungsindustrie. Ein Systemvergleich. ZfB 57:882–899

Zentes J, Bastian J (2010) Der Handel als Hersteller. Neuorientierung der Wertschöpfungsarchitekturen. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, P 969–985

Zhao M, Dröge C, Stank T (2001) The effects of logistics capabilities on firm performance: customer-focused versus information-focused capabilities. J Bus Logist 22(2):91–107

Zibell R (1990) Just-in-time. Philosophie, Grundlagen, Wirtschaftlichkeit. Huss, München

Zinn W, Bowersox D (1988) Planing physical distribution with the principle of postponement. J Bus Logist 9(2):117–136

Zöllner W (1990) Strategische Absatzmarktplanung. Kunden- und Wettbewerbsanalyse für Logistikunternehmen. Springer, Berlin

Logistics Controlling

5

5.1 Controlling Conception as a Frame of Reference for Logistics Planning and Control

5.1.1 Controlling Conception

"The Controlling is … generally understood as a task area for *supporting the management* of the company. However, the scope and content of the tasks for management support vary considerably among the different controlling approaches."[1] However, there is agreement that controlling is more than control, and that "to control" today is clearly interpreted with the cybernetic perspective of directing, steering or regulating processes.[2] The primary functions of controlling are the information and coordination functions. The information function includes providing the management with information for company management. The coordination function includes aligning the division of labor actions of the management in company management with regard to the company's overarching goals.

Figure 5.1 systematizes the forms of Controlling conceptions presented by prominent representatives of controlling. To distinguish them, "direct" and "indirect" controlling goals are used.[3] Direct controlling goals are understood to be the controlling functions mentioned, and indirect controlling goals are the company goals that can affect the technical, economic, social or ecological dimension of the company.

---

[1] Schweitzer and Friedl (1992, p. 141 f.) Emphasis by the author.

[2] Cf. Weber and Schäffer (2020, p. 24).

[3] Cf. Schweitzer and Friedl (1992, p. 147 ff.). For a comparison of different controlling concepts, cf. also Weber and Schäffer (2020, p. 22 ff.); Küpper et al. (2013, p. 19 ff.); Göpfert (2013, p. 35 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_5

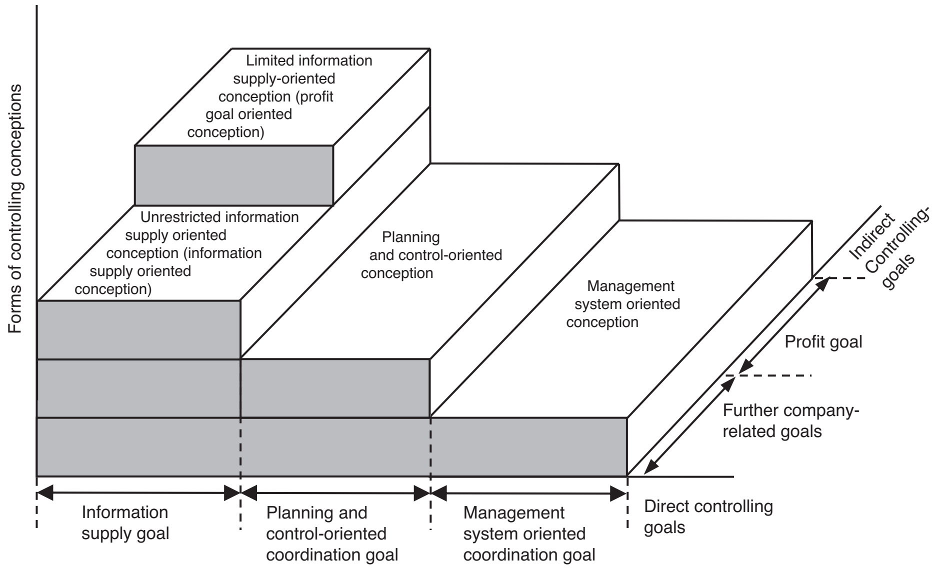


Fig. 5.1 Forms of controlling conceptions. *Source* Based on Schweitzer and Friedl 1992, p. 148

According to the *direct controlling goals*, three conceptions are distinguished. In the information supply-oriented conception, controlling is limited to determining the information needs and offering the corresponding information for the company's management processes. The information must be available to the management in time so that they can still intervene in the processes taking place in the company. In the planning and control-oriented conception, controlling additionally includes the coordination of the planning and control processes, which are prerequisites for the company's management. In the management system-oriented conception, the coordination finally extends to the entire management or management system, which Küpper et al.[4] for example, divide into information system, planning and control system, organization system and personnel management system.

According to the *indirect controlling goals*, two conceptions are distinguished. One conception is limited to fulfilling the information and coordination function of controlling with regard to the company's profit goal. The second conception also includes other company goals, especially ecological goals. In the profit goal-oriented conception, it is additionally distinguished whether the support of the management is limited to the operational and tactical planning and control level, i.e. aligned with the profit goal, or whether it also includes the strategic level, i.e. the profit potential goal.

[4] Küpper et al. (2013, p. 43 ff.).

The focus of controlling is also on the so-called *"operational" controlling,* in which the information and coordination functions relate to the operational and tactical planning and control level. Here, the technical-economic dimensions of the company goals are clearly in the foreground of the consideration. The focus of controlling is thus on the processing of "hard" information. For company management, primarily quantifiable information is provided. The coordination also does not relate evenly to all management subsystems, but the focus is on the coordination of planning, control and information supply. Furthermore, it is characteristic of controlling that it does not include all possibilities of coordination, but is limited to management systems that are coordinated by means of planning.[5]

The following explanations are based on the outlined focal points of the controlling conception. Controlling is understood as a predominantly operational-tactical, planning- and control-determined task area to support the management. A prerequisite for such support is the determination of the information needs in the management. Therefore, it is one of the tasks of controlling to motivate the decision-makers to formulate their information needs as precisely as possible and to clarify whether the corresponding information can be obtained economically. The coordination of the information needs in planning and control with the possibilities of information supply forms an important core of controlling.[6] Horváth[7] formulates the following principles for this:

1. "The recipient orientation of the information must be consistently realized. This means:
   - Only report on variables that can be directly influenced by the recipient.
   - The information must be adapted to the education and knowledge level of the recipient.
   - The information should be limited to steer impulses.
   - The information supply should take place according to demand and just in time.
2. The information supply must be controlled by economic considerations. This means:
   - Transfer prices for information service should be provided.
   - Investments in information services should be based on economic analyses.
3. The self-controlling of the line should be promoted and expanded. This means:
   - Provide tools instead of individual information.
   - Expand the direct retrieval of IT information.
4. Do not request any useless activities for the controlling from the line. This means:
   - All information collection activities that only serve the completeness need of the controlling should be abolished."

[5] Cf. Küpper et al. (2013, p. 33 ff.).

[6] Cf. ibid., p. 214 ff. For the determination of the information needs cf. Horváth et al. (2020, p. 197 ff.).

[7] Horváth (1992, p. 4).

5.1.2 Logistics Controlling

By logistics controlling we mean the execution of controlling tasks in the logistics area of the company. It can be understood as a functional controlling subsystem that serves to support logistics management. The similarity of the thinking inherent in the logistics conception and the controlling conception is often emphasized when the "coordination function of controlling" and the "coordination function of logistics" are stressed. The fundamental difference between logistics and controlling with regard to the coordination aspect, however, lies in the fact that logistics is a cross-sectional function in the operation system, whereas controlling is a cross-sectional function in the management system.[8] The kinship in logistics and controlling thinking is also expressed by Horváth when he calls for the development of an effective and lean controlling that requires the controller to think in processes and to achieve an integrating, cross-functional effect with his instruments.[9]

The function of logistics controlling results from the transfer of the tasks of controlling to the area of logistics, which is why one also speaks of a *specialized controlling*[10]. To work out the tasks and instruments of an area-specific controlling, one proceeds as with corporate controlling from the separation between management and operation system. The operation processes can be systematized according to the phases of research and development, procurement, production and sales, as well as the production factors used, such as material and human labor. The object of an area-specific controlling then results from the transfer of the controlling function to the individual subareas of the operation system. Accordingly, phase- or function-related as well as goods- or factor-related types of sector controlling are distinguished. Often, the subsystems of management are specially developed. Individual operation areas have to be organized, planned and controlled in a specific way. They can have their own cost and performance accounting or their own motivation and incentive systems. By developing such management subsystems for individual areas, specific interdependencies and coordination problems arise. They form the core for the characterization of the tasks of an area-specific controlling. With the transfer of corporate controlling to an area, the area controlling coordinates the management subsystems, e.g. planning and control, within this area. In addition to these coordination tasks, there is a need to integrate the management of an area into the management of the entire company. This results in relationships to corporate controlling. Above all, the respective management subsystems have to be linked with the corresponding systems of the entire company. Thus, accounting systems of the areas have to be integrated into the overall corporate accounting or the area planning into the overall

---

[8] Cf. Küpper et al. (2013, p. 591).

[9] Cf. Horváth (1992, p. 6 f.).

[10] Cf. Horváth et al. (2020, p. 404 ff.) On logistics controlling as specialized controlling cf. Göpfert (2013, p. 56 ff.); Reichmann et al. (2017, p. 411 ff.).

planning. With the focus on one area, interdependencies to the management systems of other areas of the company are out of sight. This gives rise to a third field of tasks for the area controlling, which relates to the coordination between the management subsystems of different areas.

According to the explanations on the different *phases of development of the logistics*, there is no uniform logistics controlling, but rather different manifestations according to these phases.[11] If one sees supply chain management characterized as cross-company logistics management, then supply chain controlling has to support this comprehensive claim of logistics management. The special aspects of supply chain controlling will be discussed in more detail below.

5.1.3 Supply Chain Controlling

There are *two tasks of supply chain controlling (SCC)* to be distinguished.[12] First, it is about supporting the decision for the implementation of supply chain management (SCM). Because investments have to be made in the cross-company relationships. It has to be shown how these investments affect the company goals. Second, the ongoing inter-organizational decision making in supply chain management has to be supported.

A direct transfer of known controlling concepts to SCM is limited insofar as they are oriented internally and thus have to be adapted to the cross-company structures of SCM. In addition, they have to integrate factors that can provide statements about the complexity, quality and intensity of a cross-company cooperation. A supply chain can only function if it is advanced by all partners together. This gives rise to the central requirement for SCC in establishing a common language for all partners of a supply chain. This means a common process understanding as well as a uniform definition of the data and key figures used. Moreover, the controlling of a supply chain should quantify the factors that represent and help steer the way the partners cooperate.

The specific challenge for a *cross-company* SCC is to support a close cooperation of economically and legally independent companies, in order to ensure the continuity of the cooperation. For this, besides the development of a common process understanding of all partners involved in the cooperation, critical bottlenecks of the supply chain have to be identified. For this purpose, for example, a stress and resilience analysis of the members of the supply chain can be conducted.[13] The stress is mainly determined by the dynamics (volatility) of the demand, the complexity of the products, the power distribution between the companies, and the geographical and cultural distance in the supply chain. The resilience depends on the robustness, the economic stability of the companies, and

[11] On the development phases of logistics see Part I, Sect. 2.2.

[12] Cf. Otto and Stölze (2003, p. 4 ff.).

[13] Cf. Weber and Wallenburg (2010, p. 295 ff.).

the level of trust in the supply chain. Based on this analysis, a stress-resilience portfolio of the members in the supply chain can be created. Furthermore, the essential cost, performance and revenue data of the intra-company logistics systems of all partners have to be synchronized and supplemented. The determination of the key figures of a cross-company supply chain requires an intensive exchange of information with partly confidential data. This requires a coordination of the information systems. In addition to the "normal" key figures such as cost, revenue and performance data of a cross-company supply chain, the SCC has to determine key figures for measuring the intensity of the cooperation of the involved partners.

One of the instruments developed especially for this purpose is the so-called "relationship controlling".[14] Its task is, on the one hand, the definition of suitable criteria for the current state of the partnership. This is, on the other hand, connected with the search for possible improvements. For this purpose, regular target/actual comparisons of the previously agreed target specifications are carried out in a cross-company controlling cycle. As a second area, the "trust controlling" is mentioned. Here, for example, in regular surveys of the connected companies, the essential factors for the trust in partnerships can be queried. These are the reliability, the competence, the emotional trust, the vulnerability and the loyalty. If trust deficits are detected, they should be solved as cooperatively as possible.

In the following, the most important *instruments of logistics controlling* will be discussed, which are available for the implementation of the controlling conception in logistics. These are goals and key figures, budgets, cost and performance accounting, the balanced scorecard, the financing, the ecological orientation, audits and the system analysis.

5.2 Goals and Key Figures

5.2.1 Goal Planning

Logistics goals are sub-goals in the *goal hierarchy* of the company and can be seen as means to achieve the company's top goals. The possible contribution of logistics to important company goals was discussed in Part I, Sect. 3.2. A way to support the derivation of logistics goals is to use hierarchically structured key figure systems, in which individual key figures are mathematically or at least logically linked to each other. An example of this are the possibilities of increasing profitability by reducing costs, reducing capital commitment or increasing sales, which were mentioned in Part I, Sect. 3.2.3.

[14] For relationship and trust controlling, see Weber and Wallenburg (2010, p. 300 ff.). See also the measurement of the "soft" factors in the relationship between industrial companies and logistics companies by Vitasek and Maylett (2011).

Another support for the derivation of logistics goals are the *models of logistics management* in Part I, Sect. 2.3, based on which the tasks of logistics management were concretized. The logistics cube shown in Fig. 2.2 illustrates in the flow level which logistics-relevant flows have to be captured by key figures. The functional level shows the link between the logistics goals and other area goals of the company and the possibility of structuring the logistics goal system according to logistical sub-goals for the logistical subsystems differentiated according to the principle of performance. The institutional level shows the possibility of structuring the logistics goal system along the logistics chain, also beyond the own company boundaries. The logistics variables shown in Fig. 2.3 show the possibility of structuring the logistics goal system according to technical, organizational and employee goals, which are sub-goals for the overall logistics goals associated with a specific logistics task. The combination of the logistics production factors shown in Fig. 2.4 shows the possibility of structuring the logistics goal system according to the production factors that have to be used to achieve the logistics service and cost goals.

5.2.2 Key Figure Formation

Logistical key figures serve as *indicators* for measuring the efficiency and effectiveness of logistical systems.[15] They represent empirically observable and measurable facts that describe the logistics goal or goal system as adequately as possible. As already explained in the goal planning, key figures are used to derive and specify quantitatively formulated goals. These are necessary for the planning and control as well as steering of the logistics processes. In addition to the goal-setting function, key figures have an analysis function. For logistics key figures should make the interdependencies between the logistics systems and logistics processes transparent. As problem indicators, key figures promote and support problem recognition. A fast and timely determination of the logistics key figures makes it possible to identify positive and negative developments at an early stage (early detection function) and to contribute to the steering of logistics processes (steering function).

Since many facts in the logistics system can be quantified, the use of key figures is suitable. Therefore, it is not surprising that both in theory many key figures for the logistics area of the company are proposed and in practice key figures are used intensively compared to other company areas.[16] The problem lies in the *selection* of the key figures suitable for a specific company. One can distinguish four basic forms of selection with

[15] Cf. on the following Pfohl and Zöllner (1991, p. 324). On types and functions of key figures, see also Weber and Schäffer (2020, p. 180 ff.) and Küpper et al. (2013, p. 471 ff.).

[16] Cf. the overview by Pfohl and Zöllner (1991, p. 325).

the logical, empirical-theoretical, empirical-inductive and model-based forms.[17] The logical form corresponds to the derivation of subordinate variables by definition-logical relationships and mathematical transformations from upper key figures, as shown in the case of goal planning. In the empirical-theoretical form, one uses theoretical statements about relationships, e.g. from production and cost theory. In the empirical-inductive form, one tries to derive the relevant key figures from the experiential knowledge about the empirical relationships, possibly supported by the use of statistical methods. In the model-based derivation, finally, relationships are mapped in a quantitative model. In various simulation runs, one tries to identify, for example, which variables are particularly important for achieving the goals. Most of the logistics key figure systems proposed in the literature are based on a combination of logical and empirical-inductive derivation.[18] In order for key figures to fulfill their functions in controlling, the following *requirements for the key figure formation* must be met[19]:

- Validity: The key figure must adequately reflect the operational reality. For example, the number of pallets handled by a forklift per hour is a more suitable key figure for measuring productivity than the possibly different number of cartons on the pallets.
- Relevance: Key figures should only reflect decision-relevant information, i.e. information that can discriminate between decision alternatives and that are actually used for decision making.
- Power: A key figure should cover as many facts of a problem area as possible. If, for example, an employee in the goods receipt is responsible for receiving the goods and for putting them away, a key figure for measuring his work productivity must take both activities into account. In addition, a key figure should indicate problems as early as possible.
- Completeness: If different relevant facts cannot be captured with one key figure, several key figures must be formed to fully capture a problem area.
- Comparability: Key figures should be comparable within and between companies and allow comparisons at different points in time. This typically requires a standardization of key figures.
- Compatibility: The information required for the key figure should be obtainable from the existing information systems. Among themselves, key figures should be as linkable as possible to form key figure systems.
- Cost and benefit: The key figure formation has to be efficient. The one-time costs of developing key figures and the ongoing costs of collecting them are to be weighed against their benefit for fulfilling the goal and analysis function.

---

[17] Cf. Küpper et al. (2013, p. 482 ff.).

[18] Cf. Küpper et al. (2013, p. 599).

[19] Cf. NCPDM (1984, p. 42 ff.).

The logistics key figure formation has to include the logistics way of thinking. The new perspective associated with logistics is horizontally oriented towards the order and goods flow and requires key figures that include the dimension of time. The input-output relations based efficiency measurement of logistics systems,[20] in the form of classical business key figures, e.g. productivity or capacity utilization, is thus to be supplemented by the efficiency measurement based on time. This is also confirmed by studies that show that successful companies use *time-based and cross-company* key figures. This enables the measurement and presentation of the value-added contribution of the individual functions and process steps in the entire supply chain. In addition to the aspects mentioned, care must be taken in the formation of key figures that suboptimal island solutions are not provoked by a one-sided orientation towards individual key figures, but that they contribute to the realization of optimal logistics overall systems. For this purpose, it is advisable to link logistics key figures in a key figure system.

The *indicator system* presented below has a hierarchical structure,[21] through which the information needs of the different indicator recipients are satisfied in a specific way. The schematic structure of the indicator system can be seen in Fig. 5.2.

The global or aggregated indicators for the overall logistics system are intended for the logistics management. These indicators are then broken down into their components or indicators are presented that act as influencing factors on the global logistics indicators.

The indicators are systematized according to two dimensions. According to the phase of the goods flow, a distinction is made between procurement logistics, production logistics and distribution logistics and according to logistics activities, the subsystems transport, inventory management (stock management), warehouse, and order processing are distinguished. The indicator systems presented for these subsystems are exemplary for the respective activity area across all logistics phases for the corporate logistics. For the individual phases, the same indicators apply in principle.

The indicators of the matrix fields can be further split if necessary. In Fig. 5.2, a split into two further dimensions is indicated, namely into product sales and customer sales groups. The efficiency of the logistics management is reflected in all indicators of the indicator matrix. Nevertheless, it is desirable to be able to capture the efficiency of the management functions separately. Therefore, an additional indicator system is developed for this purpose.

---

[20] See the approaches to efficiency measurement in Part I, Sect. 3.2.1; cf. also Pfohl and Hoffmann (1984, p. 48 ff.).

[21] The presentation is based closely on Pfohl and Zöllner (1991, p. 325 ff.). For further logistics indicator systems see Hofmann and Nothardt (2009, p. 127 ff.); Weber and Wallenburg (2010, p. 101 ff.); Reichmann et al. (2017, p. 434); Werner (2017, p. 365 ff.).

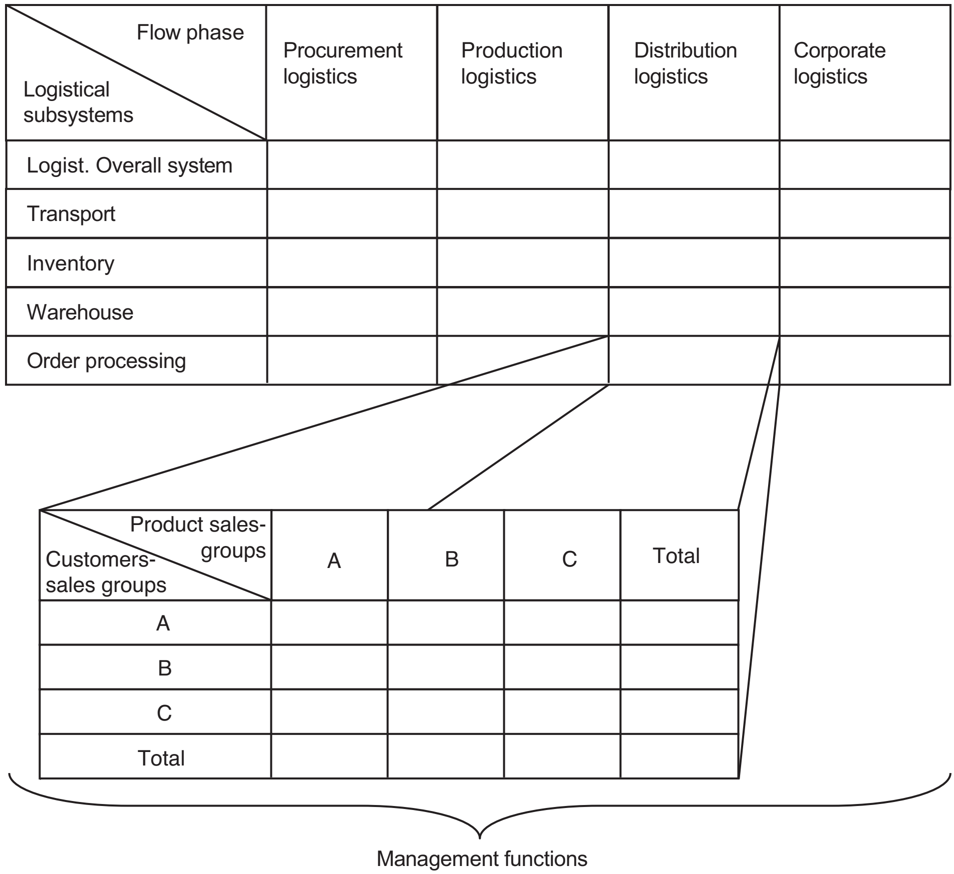


Fig. 5.2 Structure of a logistics indicator system. *Source* With minor changes taken from Pfohl and Zöllner 1991 p. 326

5.2.3 Key Figures for the Overall Logistics System

As peak figures of the performance indicator system for the efficiency of the overall logistics system shown in Fig. 5.3 logistics costs and delivery service are chosen. These cornerstones of the logistics performance indicator system are to be considered together with further key figures from the company, which are in direct relation to the logistics costs and the delivery service. The surrounding key figures are the total costs of the company, the turnover and the capital tied up in fixed or current assets (as far as logistics-induced). The key figures are supplemented by selected ratios between these variables.

The *logistics costs* are to be indicated in their absolute amount and in their allocation to the logistics subsystems transport, inventory, warehouse and order processing as

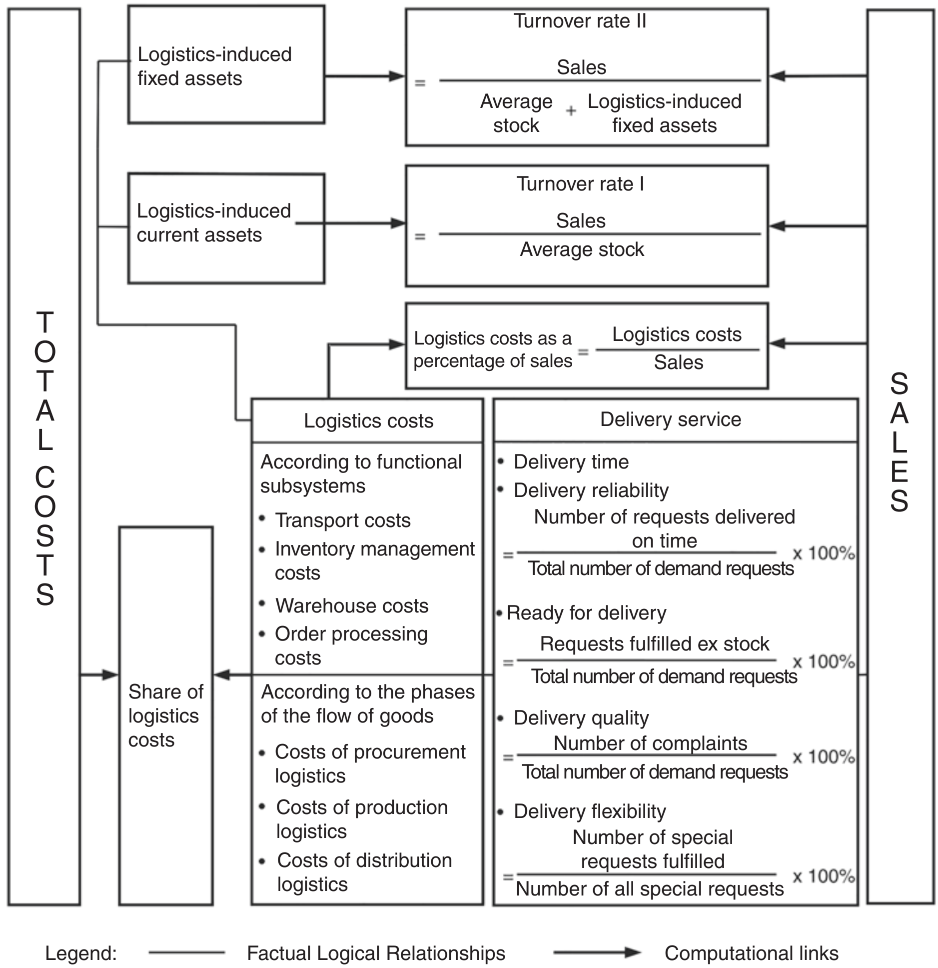


Fig. 5.3 Performance indicator system for the overall logistics system. *Source* With modifications taken from Pfohl and Zöllner 1991, p. 327

well as in the breakdown according to the logistics phases procurement logistics, production logistics and distribution logistics. The phase-related breakdown of the logistics costs then clearly shows where the main focuses of the companies lie with regard to the complexity of the logistics. For example, the phase-related assessment of the logistics costs and the logistics service over time allows statements to be made about the extent to which initiated rationalisation measures have already led to cost reductions. Thus, measures to improve efficiency in procurement logistics can lead to corresponding cost reductions over time while maintaining the defined delivery service. Such measures are the implementation of just-in-time concepts, which tend to increase costs in transport and order processing, but on the other hand are supposed to lead to significant cost savings in inventory and warehouse costs. In this respect, only a logistics cost consideration of all logistics subsystems in procurement logistics allows an adequate control of the logistics costs.

The *delivery service* as the output of the overall logistics system is broken down into the components delivery time, delivery reliability, delivery quality and delivery flexibility. The delivery time refers to the time span between the order placement by the customer and the receipt of the goods. It consists of various time components, which—as far as they can be attributed to the logistics—are taken up again in the performance indicator systems of the logistics subsystems (transport time, order processing time, picking and provision time). The delivery reliability sets the number of on-time delivered demand requests in relation to the total number of demand requests. For the delivery reliability, there are very different definitions in the business literature—as well as for the delivery readiness from stock.[22] For example, a demand request can be defined as an order position or a total order, in quantity or value sizes. Each company will have to choose the definition that best reflects the relationship between the delivery reliability and the expected sales effects. The delivery quality can be measured by the ratio of the number of complaints and the total number of demand requests. For the definition of a demand request, the same spectrum arises as already outlined for the delivery reliability. Under complaints, all complaints regarding the delivery accuracy (by type or quantity of the wrong goods), or the delivery condition (damaged or spoiled goods), but not the delivery time, are to be understood. As an indicator for the delivery flexibility, i.e. the ability of the logistics system to respond to special customer needs, the ratio of the number of fulfilled special requests to the total number of special requests is proposed.

In addition to the logistics costs and the delivery service, the *capital* tied up by the logistics forms another key figure for measuring the efficiency of the overall logistics system. A distinction is made between capital that is tied up in fixed assets (e.g. fleet, warehouse and storage facilities) and capital that is included in current assets (e.g. average inventories valued with prices). In the course of inventory reduction measures, the focus is often on current assets, with the risk that the inventory reductions are "bought" by investments in fixed assets, so that per saldo a lower or even no rationalisation gain remains. Therefore, both asset components should be considered in parallel here.

According to the joint consideration of the logistics-induced current and fixed assets, two different turnover rates are considered. While the turnover rate I refers only to the turnover of the inventory, the turnover rate II provides the turnover of the total capital tied up by the logistics, thereby avoiding a one-sided focus on inventories and showing substitution effects.

[22] Cf. Pfohl (2022, p. 35 ff.).

In addition, selected ratio key figures are set in the performance measurement system, which describe input-output relations or breakdowns of key figures. Based on the key figure "share of logistics costs", the relative change of the logistics costs in relation to the total costs can be tracked in a time series analysis. The key figure "logistics costs per unit of sales" is an indicator for the burden of the revenue with logistics costs. This key figure sets the valued input of the logistics system, i.e. the logistics costs, in relation to the valued output of the system, the sales. A mathematical link between the logistics costs and the delivery service does not lead to a meaningful key figure, so that only the logical connection is pointed out. A numerical relationship between the delivery service level and the delivery service-induced sales[23] can generally also not be determined exactly. Therefore, the key figure "logistics costs per unit of sales" represents perhaps the best practicable indicator for the profitability of the logistics.

5.2.4 Key Figures for the Logistics Subsystem Transport

In the performance indicator system for the logistics subsystem transport shown in Fig. 5.4 four productivity and capacity indicators are formed between the *transport costs* and the capacities provided in relation to them on the one hand and the *quantitative performance* of the transport system on the other hand, which do not require any further explanations due to their clarity.

The productivity of the transport system must not be seen without considering the specific *qualitative performance* of the chosen means of transport. These performance indicators are the transport time (which can vary greatly depending on the mode of transport by air, land or sea), the reliability of the timely and faultless transport and the transport flexibility. These indicators are formed in analogy to the corresponding indicators of the delivery service. The qualitative transport performance represent components or influencing factors of the delivery service.[24] The indicators can be further detailed by individual delivery regions or by individual drivers or carriers (freight forwarders).

5.2.5 Key Figures for the Logistic Subsystem Inventory Management

The performance indicator system for the logistics subsystem inventory management shown in Fig. 5.5 links the inventory holding costs with the inventory holding

[23] See the explanations on the determination of the demand effect of the delivery service in Sect. 4.3.3.

[24] For example, the transport time is part of the delivery time and the transport reliability is an influencing factor for the delivery reliability.

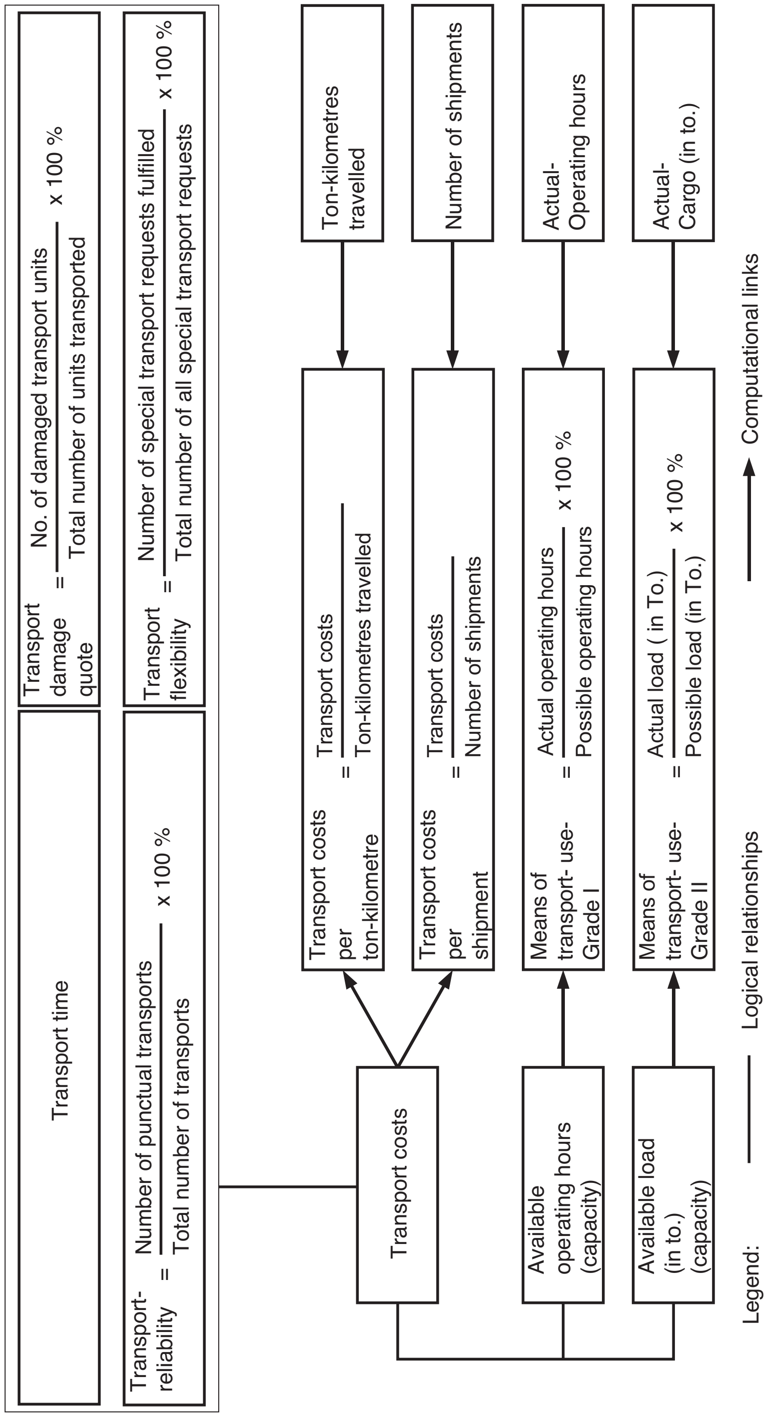


Fig. 5.4 Performance indicator system for the logistics subsystem transport. *Source* Adapted from Pfohl and Zöllner 1991, p. 329

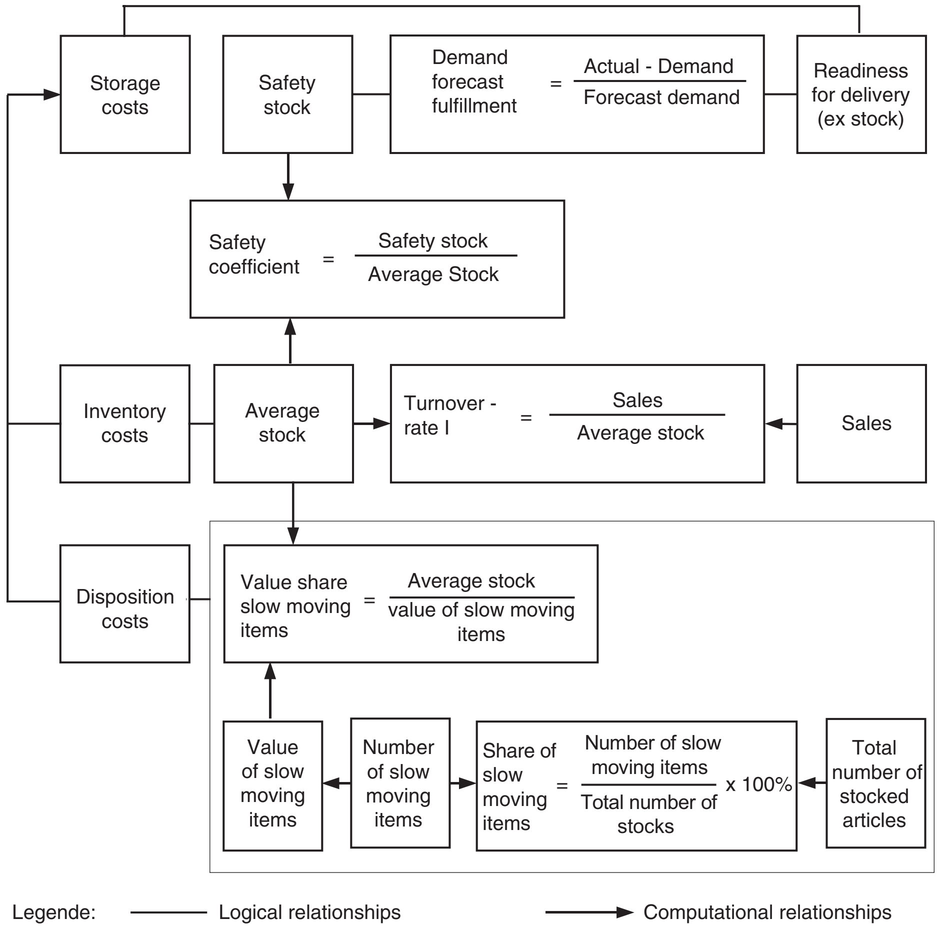


Fig. 5.5 Performance indicator system for the logistics subsystem inventory management. *Source* Adapted from Pfohl and Zöllner 1991, p. 330

performance. The *inventory holding costs* consist of the inventory carrying costs[25] and the disposition costs[26]. The costs of this subsystem are opposed by the *performance* of providing goods in the desired quantity and at a desired time. The central indicator on the performance side is the delivery readiness (from stock), which was introduced in the same form—as well as the turnover and the turnover frequency I—already in the performance indicator system for the logistics overall system. To measure the quality of

[25] Interest for the capital tied up in the stocks, taxes and insurance as well as inventory risk costs, e.g. due to spoilage, damage and shrinkage.

[26] Salaries, costs for disposition systems.

the disposition, the indicators "total number of stocked items", "number of slow movers" (items that have no consumption over a given period of time), "value of slow movers", "share of slow movers" and "value share of slow movers"—in the form defined in Fig. 5.5—are introduced. These indicators can optionally be recorded for individual disposition groups or for individual dispositions. They thus represent a suitable instrument for planning and controlling the disposition activity and serve as a starting point for inventory clearance actions.

In addition to the average *inventory level*, the safety stock is also included in the performance indicator system. The safety coefficient indicates the relative share of the safety stock in the average inventory level and thus shows how much the latter is burdened by the "fixed" safety stock base. In connection with the safety stock resulting from the forecast inaccuracy, the quality of the forecast itself has to be considered, which is measured by the indicator "demand forecast fulfillment". The disposition is responsible for the inventory, but only to the extent that it would arise if the demand forecasts were met. For example, an increased inventory of finished products is not to be attributed to the finished goods and production disposition if the sales forecast could only be met by 50% and the remaining production quantity had to be taken into stock. Likewise, the reason for an unsatisfactory delivery readiness level is not in the disposition if the actual demand exceeds the forecasted demand by far.

5.2.6 Key Figures for the Logistics Subsystem Warehouse

The logistical subsystem warehouse, for which a performance indicator system is shown in Fig. 5.6, can be divided into time-bridging processes, in which the stored goods are at rest, and into movement processes associated with storage (goods receipt, storage, retrieval, picking). As *performance indicators*, the storage capacity, which is defined as the number of available storage spaces, and the storage movements result. The utilization rate of the warehouse corresponds to the percentage of occupied storage spaces to the total number of available storage spaces. At this point, an example should be given of the danger of a one-sided orientation towards the optimization of a key figure, which here would mean the goal of a high utilization rate. An increase in the occupied storage spaces would, on the other hand, result in an increased inventory, so that the company would move away from the overall optimum. All key figures must therefore always be seen in the overall business context.

The performance variables are contrasted on the input side with the *warehouse costs*, which are broken down into their main components personnel costs and capital costs (depreciation, insurance and taxes, maintenance and operating costs). The key figures "average storage space costs" and "average storage movement costs" represent cost allocation rates at the same time.

By jointly considering the key figures "average personnel costs per storage movement" and "average capital costs per storage movement", substitution effects (e.g. human

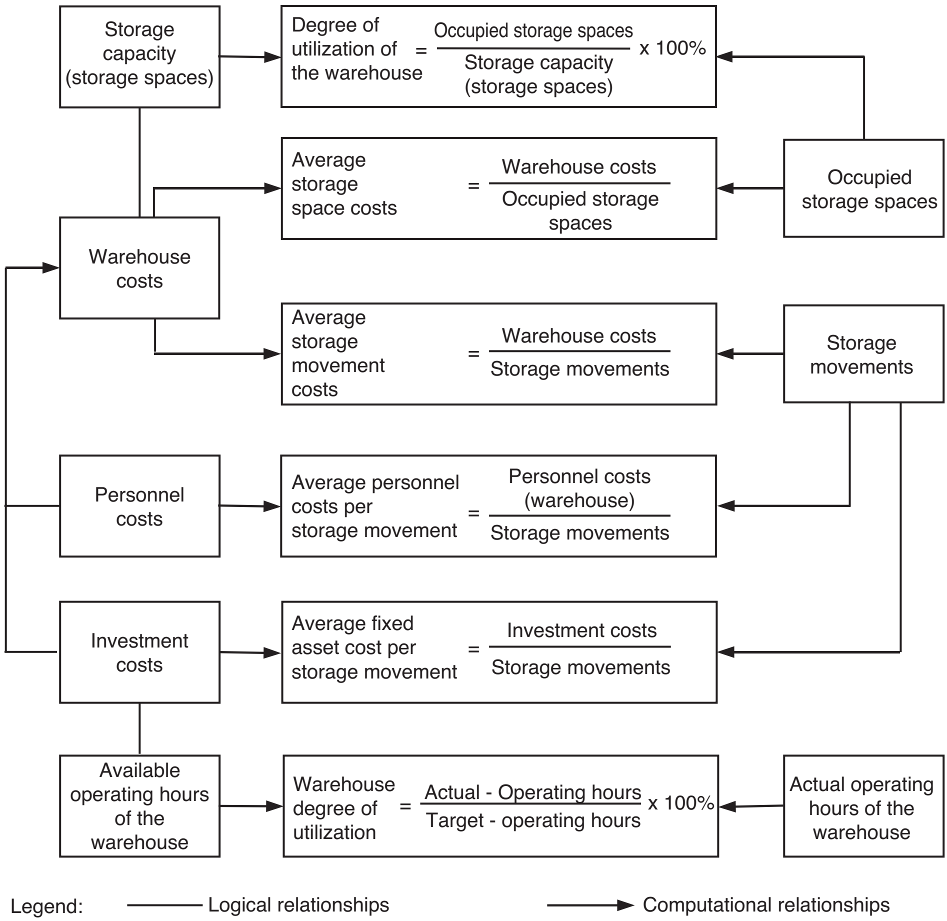


Fig. 5.6 Performace indicator system for the logistics subsystem warehouse. *Source* With modifications taken from Pfohl and Zöllner 1991, p. 331

labor by equipment) can be tracked and checked for their economic efficiency. The utilization rate of the warehouse—which basically results from the availability of the conveying equipment and the computer system used—is determined as a ratio of actual operating hours and target operating hours.

A detailed presentation of the qualitative performance of the warehouse system is omitted. They are part or influencing factor of the delivery service. In principle, they can be set up in analogy to the overall logistical system.

The key figure system presented for the warehouse subsystem can also be transferred to picking and packaging processes by replacing the storage movements with the corresponding activities and the warehouse as a technical facility with picking or packaging facilities.

5.2.7 Key Figures for the Logistics Subsystem Order Processing

The performance of the logistics subsystem order processing consists in processing a number of orders in a varying processing time in operational practice. As quantitative *performance indicators*—as shown in Fig. 5.7—the number of incoming orders and the number of orders processed on time are set up. Key figures for the qualitative performance of the order processing system are, in analogy to the delivery service and the

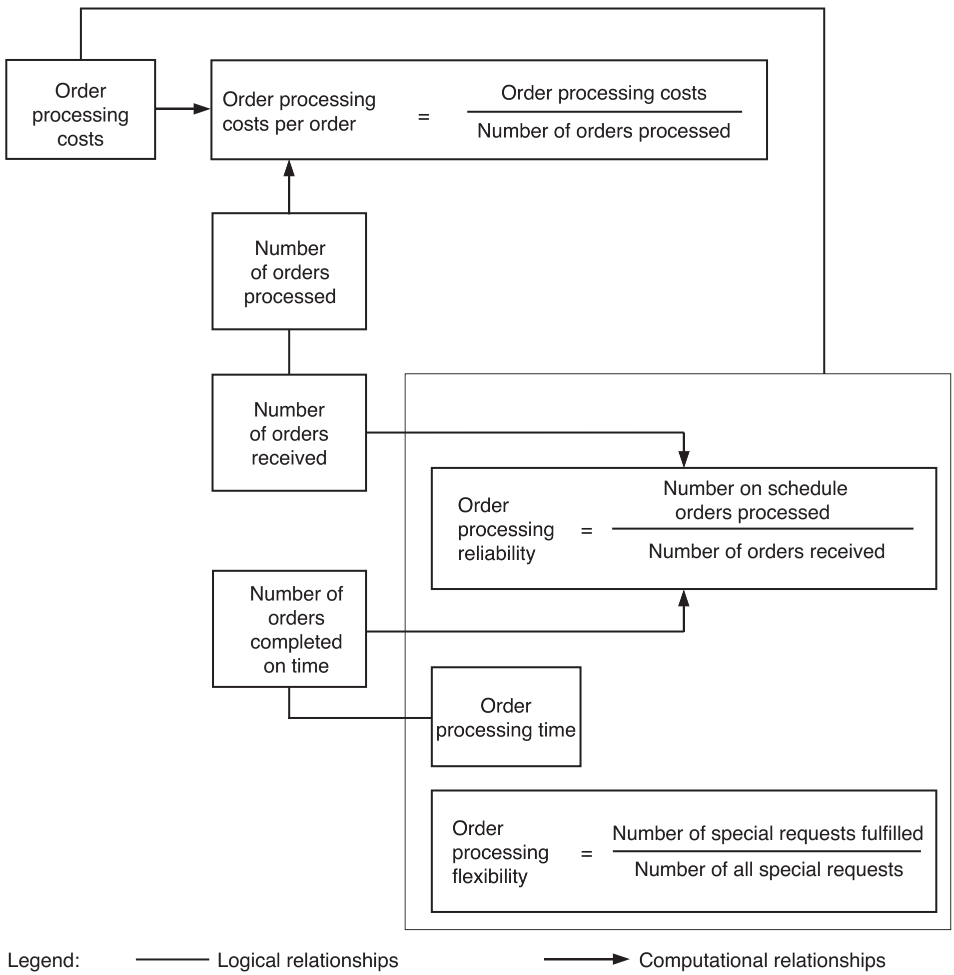


Fig. 5.7 Performance indicator system for the logistics subsystem order processing. *Source* With modifications taken from Pfohl and Zöllner 1991, p. 332

qualitative performance of the transport system, the "order processing time",[27] the "order processing reliability" and the "order processing flexibility".

The link to the *"order processing costs"* is established via the productivity key figure "order processing costs per order".

5.2.8 Key Figures for Logistics Management

To measure the efficiency of logistics management, reference is made to the management functions of personal leadership, organization and planning. The development of special key figures for functions of logistics management represents on the one hand a necessary complement to the key figures for the efficiency of the overall logistical system. On the other hand, it allows for a consideration of the interdependence relationships with other operational areas, especially procurement, production, sales, as well as research and development. It should be ensured that the systems thinking is not only applied to logistics, but that the interfaces to the internal environment at the operational level are also anchored in the key figure system.

Leadership in the sense of personal influence on people has primarily effects on the human resources area of the company.[28] These effects can be expressed by abstract predicates such as cohesion (group cohesion), conflicts, job satisfaction and motivation. These predicates can be operationalized, for example, by the indicators "fluctuation rate", "absenteeism rate", "participation rate suggestion system" and "conflict rate", as shown in Fig. 5.8. These indicators should be recorded for the logistics area as well as for individual subsystems depending on the size of the area and compared with the overall company indicators. For a detailed analysis, the separate recording of the indicators for individual managers is also conceivable.

In the absence of direct criteria, the following are shown as substitute measures that seem suitable for assessing how well the *organization* (structure and process organization) and the *planning* are suitable for supporting or ensuring an efficient flow of logistics processes.

As the central, measurable output of logistics management, the throughput time is chosen, which is understood as the duration that an object needs to pass through the company. The throughput time compared to that of the competition or its change over time shows to what extent the company has succeeded in implementing just-in-time concepts. It is an important influencing factor for other logistics indicators, such as the turnover frequency and the delivery service (delivery flexibility).

[27] That is, the time that elapses from the customer's order placement to the arrival of the documents confirming the delivery at the customer's premises.

[28] See Part IV, Sect. 10.2.

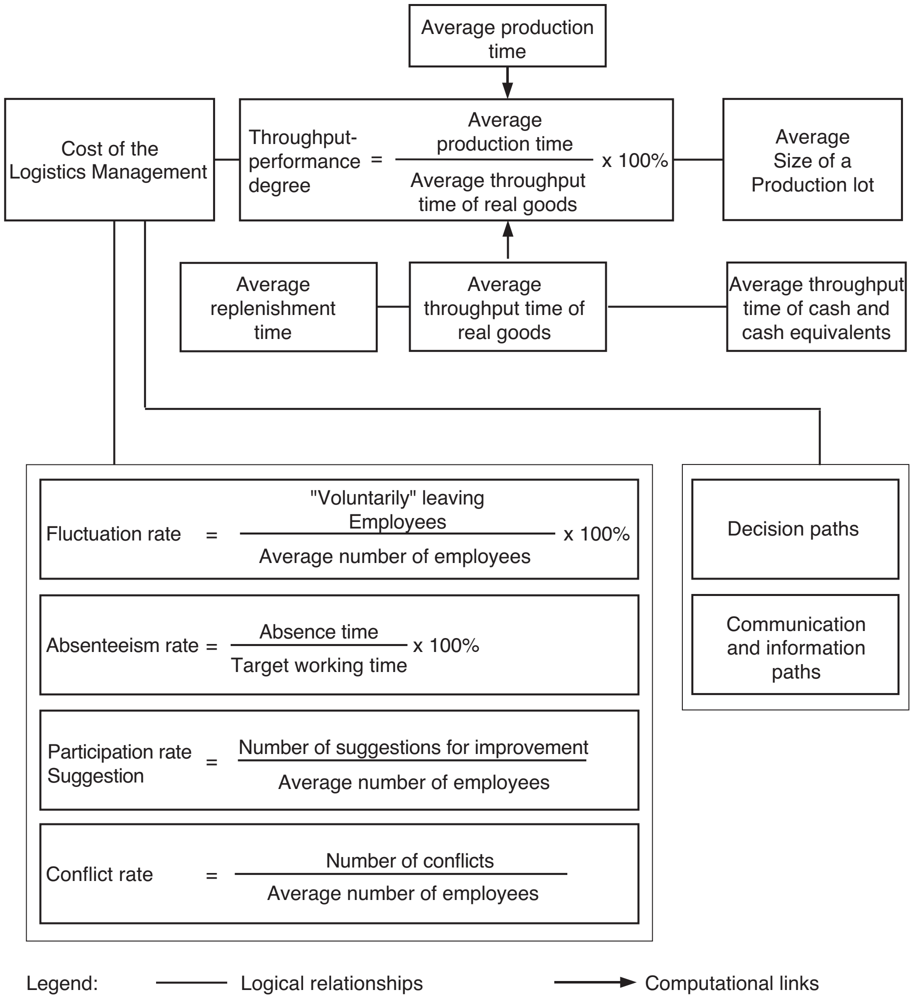


Fig. 5.8 Performance indicator system for functions of logistics management. *Source* Adapted from Pfohl and Zöllner 1991, p. 333

The throughput time refers to two aspects, namely the real goods and the payment flows induced by the exchange of real goods. The average throughput time of the real goods has an impact on the storage capacity to be provided and the flexibility of the production, while the average throughput time of the payment flows (from the payment to the supplier to the payment by the customer) is the size that directly influences the average capital commitment. This issue is discussed under the keyword *"Management of net current assets (working capital)"*. Important indicators in this area are, for example, the age of the inventories, the receivables and liabilities, which determine the so-called "cash-to-cash cycle".[29]

By considering the payment and real goods flows together, a one-sided orientation towards the goods flow should be avoided, in which hours are sometimes negotiated in the delivery, while payment terms and their compliance receive less attention. Ultimately, this means an extension of the logistical conception to other operational subareas (receivables as "stocks").

The assessment of the performance of the management must not result in a one-sided behavioral orientation towards isolated target variables, but must support an orientation of the decisions in logistics and the closely linked operational functions towards an overall optimum. Such conflict fields exist, among others, between the stocks, the capacity utilization, the throughput times and the steering bottlenecks, which is why a parallel consideration of relevant indicators is mandatory. Another approach to taking the conflicts into account is the orientation towards the *value-added curve,* whose area below the curve reflects the capital commitment in the working capital.[30] It thus represents the cost development, for example, of a product over the entire throughput time. From a cost and liquidity point of view, the capital commitment should be minimized with a constant delivery service. Period and company comparisons reveal the extent to which this goal is achieved by measures in procurement, production and distribution logistics.

Of increasing importance for logistics management is the communication of the value contribution of logistics to the corporate management. In this context, the chief financial officer is a particularly important recipient of the relevant information. In general, the value contribution of logistics was discussed in the discussion of the contribution of logistics management to achieving the corporate goals. In particular, reference is again made to the indicator system for measuring the profitability effect of logistics activities in Fig. 3.5 and to the example of a value driver hierarchy for influencing shareholder value in Fig. 3.6 Part I, Sects. 3.2.3 and 3.2.4. Figure 5.9 shows the influence on the cash flow of the "management of the supply chain", which, in addition to the "management of product development" and the "management of customer loyalty", is often regarded as one of the three core business processes. These figures are examples of the way in which logistics management must communicate with top management.

5.2.9 Benchmarking

Key figures facilitate the execution of intra- and inter-company comparisons. Comparisons in turn enable the determination of a deviation from predefined or achievable degrees of goal achievement. Key figure comparisons therefore play an important role in

[29] See Sect. 5.6.2.

[30] See the value-added curve in Fig. 3.1, Part I, Sect. 3.1.1.

Drivers of shareholder value	Supply chain management processes
Acceleration of cash flows	• Reduction of order processing time • Reduction of the cash-to-cash cycle • Reduction of start-up times
Increase in cash flows	• Supply chain process reengineering to minimize costs (e.g. by reducing error rates) • Reduction of net working capital through just-in-time methods • Reduction of tied-up capital through outsourcing of low-value -added activities • Use of market information and forecasts to reduce costs and inventories and to use capacities for high-value products ("yield management")
Risk reduction (volatility of cash flows)	• Increasing switching costs for sales intermediaries through service, incentive and retention programs • Minimization of conflicts with sales intermediaries • Management of competition in and between sales channels • Use of demand-driven flexible production and order processing systems

Fig. 5.9 Drivers of shareholder value through supply chain management processes. *Source* Adapted from Siravastava et al. 1999, p. 168

so-called "benchmarking", whose objective is to align the activities of a company with *world-class standards*.[31] "Benchmarking is a continuous process in which products, services and especially processes and methods of operational functions are compared across several companies. The aim is to reveal the differences to other companies, to identify the causes for the differences and possibilities for improvement, and to determine competitive-oriented target specifications. The comparison is made with companies that excel in the method or process to be examined."[32] Benchmarking thus goes beyond the traditional competitive analysis, in which one remains attached to the industry practices in problem perception and problem solving, thus reducing the risk of operational blindness to a risk of industry blindness.[33]

[31] Cf. on benchmarking Ester (1997, p. 7 ff.); Horváth et al. (2020, p. 222 ff.). On the application of benchmarking in logistics, see Hofmann and Nothardt (2009, p. 93 ff.).

[32] Horváth et al. (2020, p. 222).

[33] Cf. Pfohl and Ester (1999, p. 23).

The forms of benchmarking can be systematized according to the parameters object, target variable and comparison partner. With regard to the object of benchmarking, products were mainly compared in the first benchmarking studies. This was extended by the focus on operational value creation processes to process benchmarking. Strategic issues are also possible objects of comparison.

The target variables are cost, quality, customer satisfaction and time. These are not independent, as quality and time aspects are implicitly contained in customer satisfaction, for example.

As comparison partners, first of all other business units of the same company are possible. In this case, one speaks of an *internal benchmarking*. The advantage here is especially the better access to existing data. However, the perspective is still limited to the own company. In the case of *external benchmarking*, direct competitors (competition-oriented benchmarking) can be used as comparison partners. The problem here is especially the willingness to exchange information openly. Alternatively, comparisons can be made with partial areas of companies from other industries in the form of functional benchmarking and generic benchmarking. Another possibility to circumvent the data exchange problem is anonymous benchmarking.

Figure 5.10 shows the *process steps* for carrying out benchmarking projects, which ideally should be run iteratively in order to use the findings gained in further projects. The first process step, planning, includes the selection and clear delimitation of the object to be examined. When selecting comparison companies, it is important to ensure that there is sufficient similarity in the areas to be examined to allow comparability.

Planning
1. Selection of the comparison object
2. Selection of the comparator company
3. Information collection

Analysis
4. Determination of performance gaps
5. Causes of the performance gaps

Introduction
6. Gaining acceptance
7. Target setting

Enforcement
8. Development of action plans
9. Implementation
10. Control

Fig. 5.10 Process steps of benchmarking. *Source* Taken with minor changes from Ester 1997, p. 25

Companies that excel in the area to be examined because it is a significant factor for the company's success must be found.

The performance gaps identified in the analysis can occur in three forms: negative performance gaps, parity between the companies and positive performance gaps. In particular, the reasons for the negative performance gaps must be examined in detail for the causes of the deviation.

In the introductory phase, target values for the affected business areas are to be defined on the basis of the findings from the analysis. The employees are to be involved in order to create the necessary acceptance for necessary changes.

After the decision for an action plan, the defined measures are to be implemented and controlled. Essential for the implementation is the clear assignment of competencies and responsibilities. As a tool for implementation, for example, the logistics budgets discussed in Sect. 5.4 can be used.

Figure 5.11 shows an example of the indicators that were used in a benchmarking study of warehouses in the USA. The warehouses were classified into five categories based on the observed efficiency values, namely "Urgently needs improvement", "Below average", "Average", "Above average" and "World class". The characteristics for characterizing the warehouses are suitable for capturing the efficiency and effectiveness of a warehouse. The classification of the warehouses according to these characteristics according to the five categories shows where the warehouses have strengths and weaknesses. The benchmarking as a tool of logistics controlling therefore complements very well the system analysis as a tool of logistics controlling discussed in sect. 5.9.

5.3 Balanced Scorecard

5.3.1 Concept of the Balanced Scorecard

The concept of the balanced scorecard (BSC) emerged as a result of the criticism of the one-dimensional financial performance measurement systems in the USA, which are only oriented towards a short-term financial success of the company. Kaplan and Norton[34] developed a concept that complements the traditional financial indicators (financial perspective) with a customer, an internal business process, and a learning and development perspective. With this concept, leading indicators or performance drivers are added to the result indicators. These performance drivers are responsible for the long-term success of the company. Thus, the BSC serves to link the strategic with the operational planning.[35]

[34] Kaplan and Norton (1997).

[35] Cf. Weber and Schäffer (2020, p. 197 ff.) and Horváth et al. (2020, p. 121 ff.).

Ranking Category
1. Urgently needs improvement
2. Below Average
3. Average
4. Above average
5. World Class

Degree of automation

US$ per square foot	Ranking order	Share of warehouses per rank
under $5	5	35 %
$5 - $10	4	35 %
$10 - $15	3	10 %
$15 - $20	2	10 %
more than $20	1	10 %

Highest value: $25/square foot
Lowest value: $1/square foot

Order items per working hour

Order items shipped per hour	Ranking order	Share of warehouses per rank
more than 50	5	5 %
20 – 50	4	5 %
10 – 20	3	25 %
5 – 10	2	50 %
under 5	1	15 %

Highest value: 60 articles per working hour
Lowest value: 1.6 articles per working hour

Storage accuracy

Proportion of incorrectly stored articles	Ranking order	Share of warehouses per rank
under 0.05 %	5	5 %
0.05 – 0.5 %	4	25 %
0.5 – 1.0 %	3	25 %
1.0 – 5.0 %	2	25 %
more than 5.0 %	1	15 %

Best value: 0%
Worst value: 20%

Container per working hour

Container picked per hour	Ranking order	Share of warehouses per rank
more than 250	5	10 %
100 – 250	4	30 %
50 – 100	3	15 %
25 – 50	2	20 %
8 – 25	1	25 %

Highest value: 353 containers per working hour
Lowest value: 8.4 containers per working hour

Period between inbound delivery and storage

Period	Ranking order	Share of warehouses per rank
under 2 hrs.	5	10 %
2 – 8 hrs.	4	15 %
same day	3	15 %
next day	2	50 %
longer	1	5 %

Best value: 0.5 hours
Worst value: 96 hours

Picking accuracy

Percentage of incorrectly picked articles	Ranking order	Share of warehouses per rank
under 0.01 %	5	5 %
0.01 – 0.1 %	4	25 %
0.1 – 0.5 %	3	25 %
0.5 – 1.0 %	2	25 %
1.0 – 5.0 %	1	15 %

Best value: 0 %
Worst value: 11 %

Internal order processing time

Order processing time	Ranking order	Share of warehouses per rank
under 4 Std.	5	15 %
4 – 12 Std.	4	20 %
same day	3	35 %
next day	2	20 %
longer	1	10 %

Best value: 0.5 hours
Worst value: 96 hours

Fig. 5.11 Results of a 1992 benchmarking study conducted in the USA at more than 100 warehouses of 30 companies in 20 different industries. *Source* N. A. 1992, pp. 60–63, retranslated.

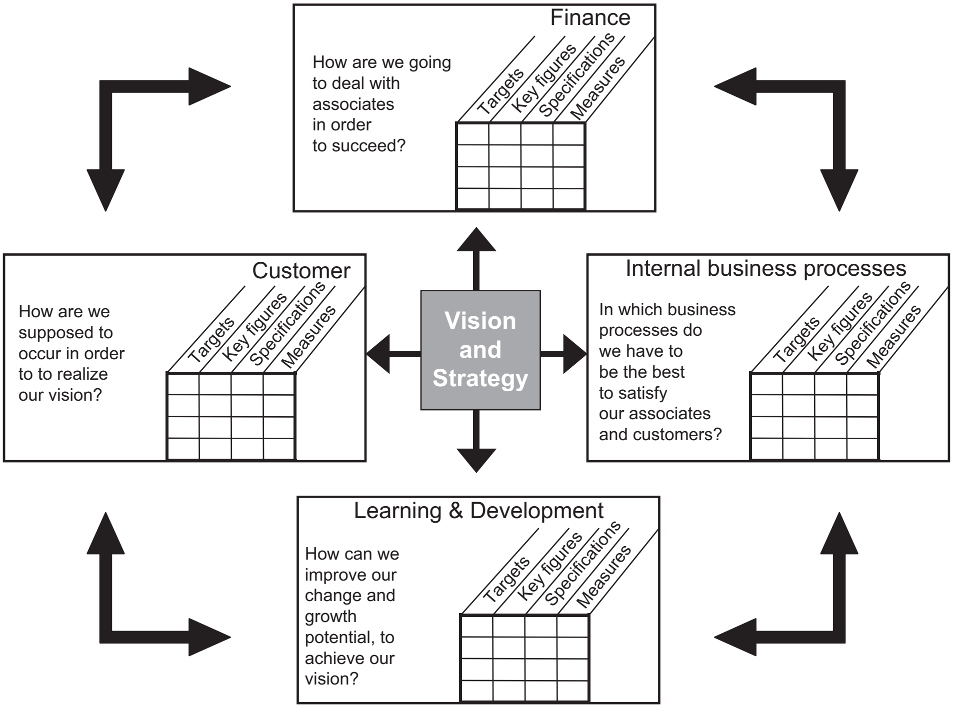


Fig. 5.12 Basic structure of a balanced scorecard. *Source* With minor changes taken from Kaplan and Norton 1997, p. 9

The term BSC contains two essential elements: on the one hand, the *harmony (Balance)* of components, namely strategic and operational indicators, monetary and non-monetary variables, long-term and short-term positions, cost drivers and performance drivers, hard and soft factors, internal and external processes, and past and future performance. On the other hand, it visualizes indicators on a *report card (Scorecard)*. The starting point is the definition of a vision and strategy by the management of the company, which are then transformed into targets, indicators, specifications and measures. The transformation takes place in four perspectives.[36] Figure 5.12 shows the basic structure of a BSC with its four perspectives:

The *financial perspective* shows whether the implementation of the strategy contributes to the improvement of the results. Indicators of this perspective are, for example, the achieved return on equity or the economic value added. The financial indicators have a double role. On the one hand, they define the financial performance that is expected from a strategy. On the other hand, they serve as end goals for the other perspectives of the

[36] See also the four dimensions of the efficiency of a company in Fig. 3.3 in Part I, Sect. 3.2.1.

BSC. Their indicators[37] should generally be linked to the financial goals through cause-effect relationships (causality).

The *customer perspective* reflects the strategic objectives of the company in relation to the customer and market segments that the company wants to address. The *process perspective* has the task of mapping those processes within the operational value creation that are significant for achieving the objectives of the financial and the customer perspective. Indicators of the *learning and development perspective* describe essential elements of the infrastructure that is necessary for the other perspectives. Examples are the qualification of the employees or the performance of the IT systems.

In summary, the following characteristics of the BSC can be identified[38]: It understands itself as a tool for implementing strategies into the daily management action. To this end, it condenses complex strategic aspects into the four perspectives, which focus on the most important management developments of the last years. The market perspective aims at customer satisfaction and customer loyalty management, the process perspective at logistics and process reengineering, and the learning and development perspective at knowledge management and organizational learning. Thus, it achieves in the ideal case an integration and safeguarding of innovative management knowledge.

5.3.2 Application of the Balanced Scorecard in Logistics

The BSC can help to solve the problem of logistics, that the contribution of logistics measures to the success of the company often cannot be adequately expressed in achieved direct and measurable cost reduction effects. By using the BSC, the *value contribution of logistics measures* for the implementation of strategies can be very well described, which lies beyond direct logistics cost reduction, such as the increase of customer satisfaction or in improved adaptability and learning ability of the company towards changed environmental conditions.

The alignment of the BSC to the level of logistics in companies depends on whether logistics is the primary or secondary performance of a company. The former applies to logistics service providers. For them, the corporate strategy simultaneously reflects the logistics strategy. On the other hand, for other companies, the logistics strategy must first be derived from the overall corporate strategy.[39] This can be done either by refining the company-wide BSC to the area of logistics. For this purpose, the overarching corporate scorecard is broken down to the business area of logistics. Therefore, the logistics management has to analyze which activities are influenced by it and in what form. On the

[37] In order to ensure the clarity and manageability of the BSC, it is generally recommended to use no more than five to eight indicators per perspective.

[38] Cf. Weber and Schäffer (2020, p. 397 f.).

[39] See Sect. 4.2.

other hand, logistics processes themselves can represent critical success factors of a company and are thus already included in the process perspective of the corporate scorecard.

With regard to the management of *cross-company logistics networks* or *supply chains*, the use of the BSC is also suitable, but it has to be extended accordingly.[40] The strategies should be openly communicated within the supply chain and target specifications should be formulated for the individual companies (e.g. delivery service levels). Supplier workshops and supplier circles are suggested for the communication of the strategies and the measures to be carried out. To achieve the objectives, action plans must be drawn up and milestones defined. Figure 5.13 shows a possibility of extending the BSC for supply chain management. The four original perspectives of the BSC were supplemented by a fifth perspective of the suppliers. The process perspective was focused on supply chain processes. The relationship level was integrated into the learning and development perspective. Possible key figures for the BSC dimensions (perspectives) are presented.

To meet the increasing importance of value orientation and the clarification of the value contribution of logistics, the ValueScoreCard-concept[41] represents a supplement to the BSC. It enables the integration and implementation of the normative specifications in the company and thus offers a possibility to bring together the levels of action. In accordance with the dimensions of efficiency of a company, value driver hierarchies are established for the financial, technological, ecological and social perspective.

Due to the cross-sectional function of logistics and the field of tension between economic, technological, social and ecological criteria, the ValueScoreCard-concept is suitable e.g. for transport processes in procurement. The value formulation on the ValueScoreCard results from the corporate policy and the corporate strategy. The values concerning the entire company must be operationalized consistently for transport processes in procurement on the ValueScoreCard. The interests of the shareholders are operationalized, for example, in the financial perspective by the net working capital and the procurement and transport costs. The values in the ecological and social perspective take into account, for example, the strategically relevant interests of the public, environmental associations and the state. In the technological perspective, questions of delivery service or logistics quality are particularly important.

To link the identified decision situations with the values on the ValueScoreCard, consistent value driver hierarchies—from the transport to the company level—are formed. Figure 5.14 shows an example of a value driver hierarchy. The financial perspective is represented by the free cash flow.

[40] Cf. Eßig et al. (2013, p. 409 ff.).

[41] Cf. Pfohl and Elbert (2002, p. 63 ff.).

Objective (BSC dimension)	Possible key figures
Relationship level (and learning and development)	
Data Transfer	Digital Links, Shared Data Sets
Organization/Trust	Trust index, cooperation duration
Cooperation	Squeeze-in-time (time required to integrate a supply chain partner)
Continuous improvement	Suggestions for improvement, training rate
Employee satisfaction	Absenteeism/terminations, training per MA
Finance	
Success	Sales, gross profit, EBIT, net profit for the year
Liquidity	Cash flow, cash-to-cash cycle
Profitability	Return On Capital Employed (ROCE)
(Residual)Value	Economic Value Added (EVA)
Stock	Range of coverage, turn rate
Supply chain costs	Capital commitment and transport costs
Customers	
Customer loyalty/satisfaction	Customer loyalty index
Customer complaints	Customer satisfaction index, service level
New customer acquisition	New customer share of sales
Market share	Relative market share, Absolute market share
Order Fulfillment	Order Fulfillment Time
Sales Forecast Accuracy	Forecast Accuracy
Innovation	New product rate
Suppliers	
Quality/Service	Service level, rejection rate, delay rate
Supplier satisfaction	Supplier satisfaction index
Goods receipt productivity	Shipment per day, goods receipt time per shipment
Incoming goods inspection	Incoming goods inspection
Supply Chain Processes	
Capacity utilisation	Capacity utilisation rate and utilisation intensity
Productivity	Stock movement per employee, picks per employee
Access time/cycle time	Time-to-market, total cycle time
Product/process quality	Scrap/rework rate, parts per million
Production Flexibility	Order processing time and reliability, Upside Production Flexibility

Fig. 5.13 Exemplary selection of key figures for an actor-specific supply chain BSC at the overall company or business field level. *Source* Taken from Eßig et al. 2013, p. 411

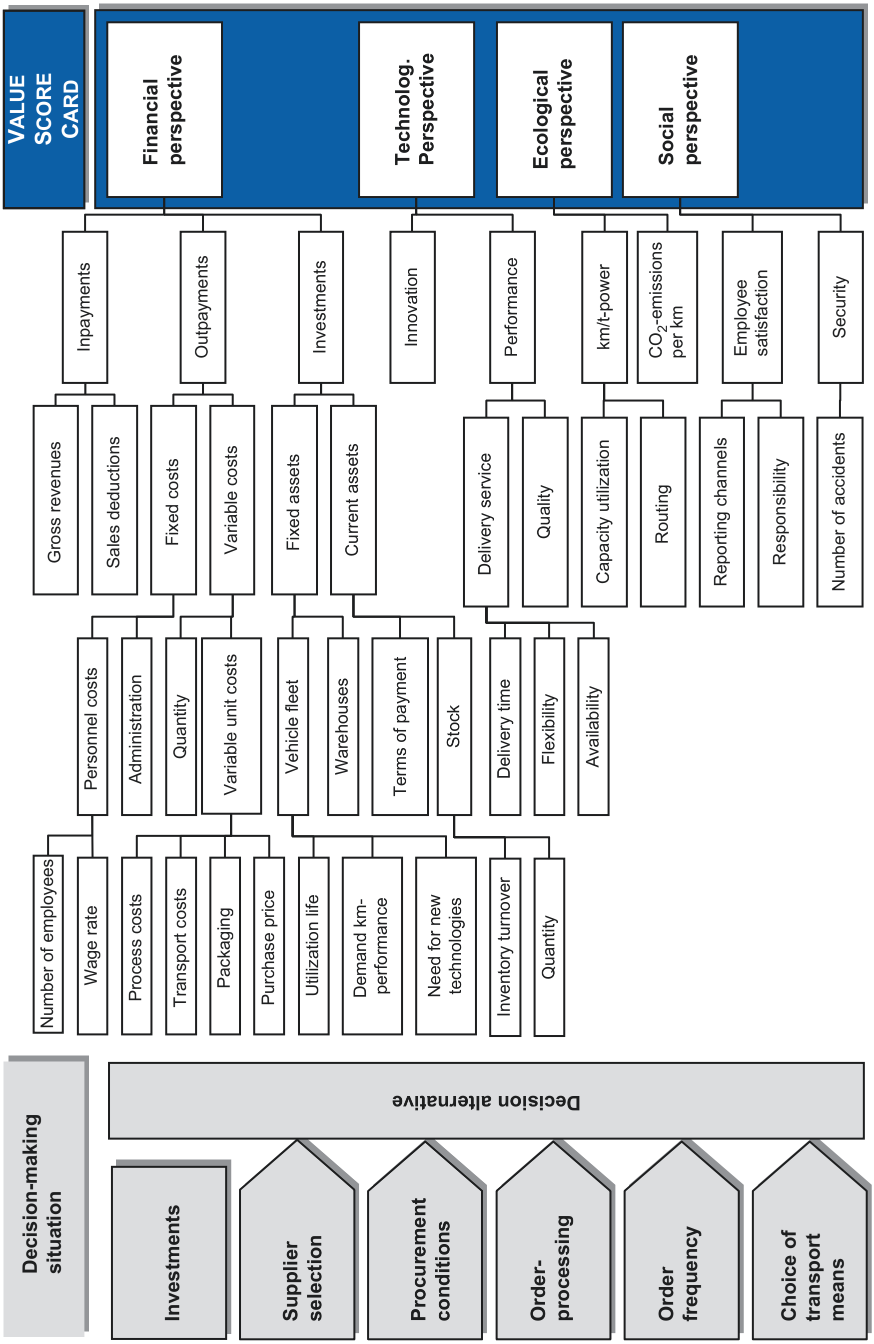


Fig. 5.14 Example of a value driver hierarchy for the design of transport processes in procurement

5.4 Budgets

5.4.1 Budgeting

A budget is generally understood as a plan formulated in *quantitative terms,* which is given to a responsibility area (a decision unit) for a usually one-year planning period within the framework of rigid annual planning. The annual budget, which stands at the interface between tactical and operational planning, is supplemented by rolling monthly planning, in which the planning assumptions are updated and the achievement of the goals set in the annual planning is controlled. According to a narrow definition, a budget is the numerical summary of plans in value or quantity terms, whereby monetary terms are mainly used in business practice. In a broader definition, a budget is understood as the amount of resources that are made available to an organizational unit in a certain period of time to fulfill its tasks.[42] The total budget of a company is differentiated into partial budgets for the various responsibility areas of a company (functional budgets, divisional budgets, project budgets), whereby the resources available to the company are allocated. Thus, budgeting involves resource allocation.

In budget preparation, a distinction can be made between *input- and output-oriented budgeting.* Input-oriented budgeting is the traditional organizational area budgeting, in which only the resources to be used as input in the area are recorded and no reference is made to the goals of this area. Input-oriented budgeting is therefore not a suitable instrument for resource allocation. Because the input variables are not an adequate measure for measuring the performance of a sub-area. Another point of criticism is the continuation character of this type of budgeting. This means that one is strongly oriented towards the empirical variables of the past and that the budget of the previous period has the greatest influence on the budget preparation. In contrast, the goals of the company have the greatest influence on the budget preparation in output-oriented budgeting. Starting from the goal planning, programs, i.e. bundles of measures to achieve the goals, are planned, which is why this type of budgeting is also called program budgeting. From the programs, the resources are finally derived. The resource allocation then takes place on the basis of the programs that are best suited to achieve the goals.

Another distinction in budget preparation is the one according to the dependence on the reference variable in *fixed and flexible budgets.* In the fixed budget, the full costs per cost type are fixed and must be adhered to within narrow limits. In flexible budgets, a division into fixed and variable costs is made and the budget amounts per cost type are specified for different levels of activity. Fixed budgets serve as a control instrument to limit the costs to a predetermined amount. They are applied in areas where the costs do not change depending on the activity, or where the dependence is very difficult to measure. Flexible budgets serve not only as a control, but also as an analysis instrument, since the deviation component of a determined budget deviation attributable to a change in activity can be isolated.

---

[42] Cf. Pfohl and Stölzle (1997, p. 136). For budgeting in general, see Küpper et al. (2013, p. 433 ff.).

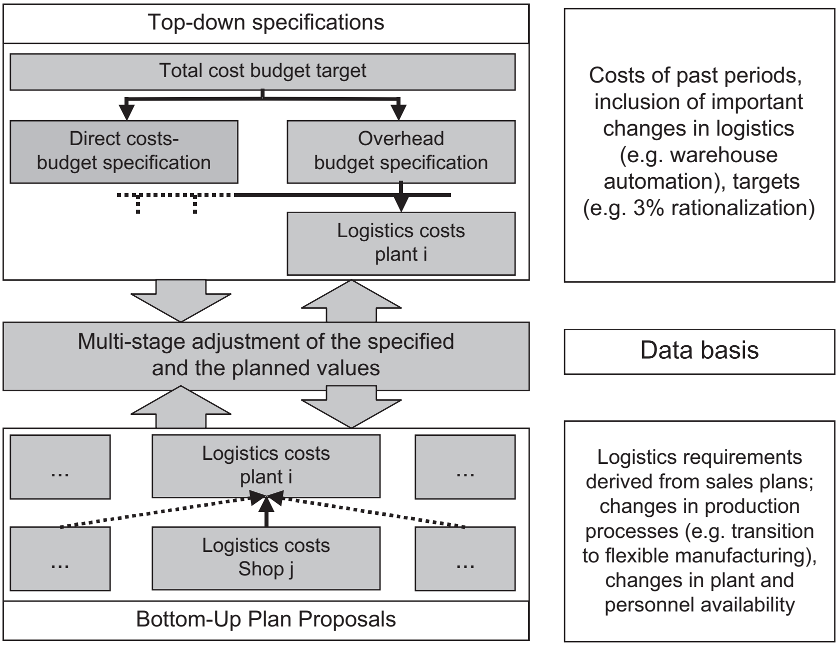


Fig. 5.15 Counter-flow method of logistics budgeting. *Source* With minor changes taken from Weber and Wallenburg 2010, p. 127

Finally, in budget preparation, according to the type of coordination of the plans for different planning levels, the *top-down, bottom-up or counter-flow budgeting* can be distinguished. In top-down budgeting, the partial budgets are derived according to the company hierarchy from the top corporate goals. The budgets are given from top to bottom. In bottom-up budgeting, the total budget is created by gradually summarizing the partial budgets created at lower levels. Counter-flow budgeting is a synthesis of the two other planning methods. It combines the experience and detailed knowledge of the responsible persons on site with the budget expectations of the top management resulting from the overall view of the company.[43]

5.4.2 Logistics Budgeting

The in Fig. 5.15 exemplarily illustrated counter-flow budgeting is the *most widely used method in logistics.*[44] Here, the top-down created budget proposals are compared with the bottom-up determined planning approaches and reconciled in a multi-stage process. This allows an optimal balance between the interests of the entire company and those of the decentralized management levels. Thus, the implementation of the guidelines of the

[43] Cf. Weber and Wallenburg (2010, p. 128).

[44] For logistics budgeting see also in detail Göpfert (2013, p. 354 ff.).

top management can be achieved while taking into account the decision-making competence and the motivation of the individual managers.

Figure 5.16 shows the sequence of the budgeting process for the *transport area*. The required transport performance (the "transport program") results from the planned

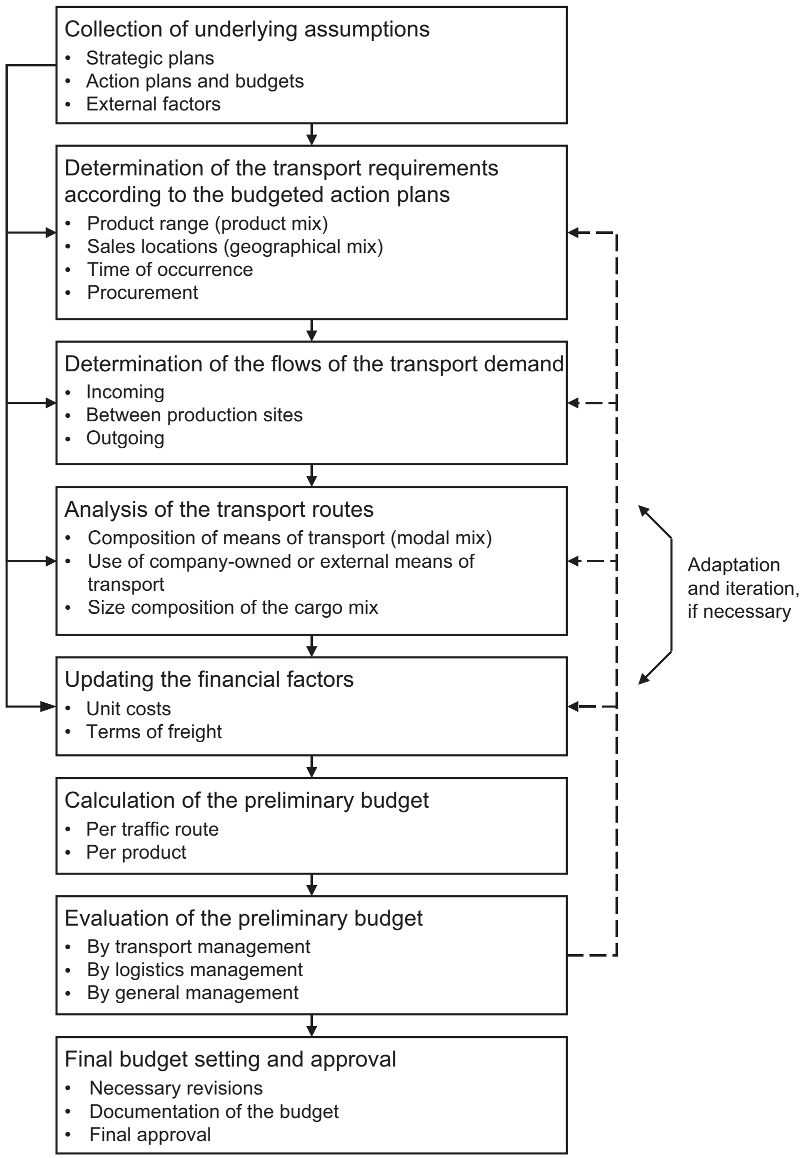


Fig. 5.16 Flow chart of a budgeting process for the transport area. *Source* Based on NCPDM/NAOA 1983, p. 41, retranslated.

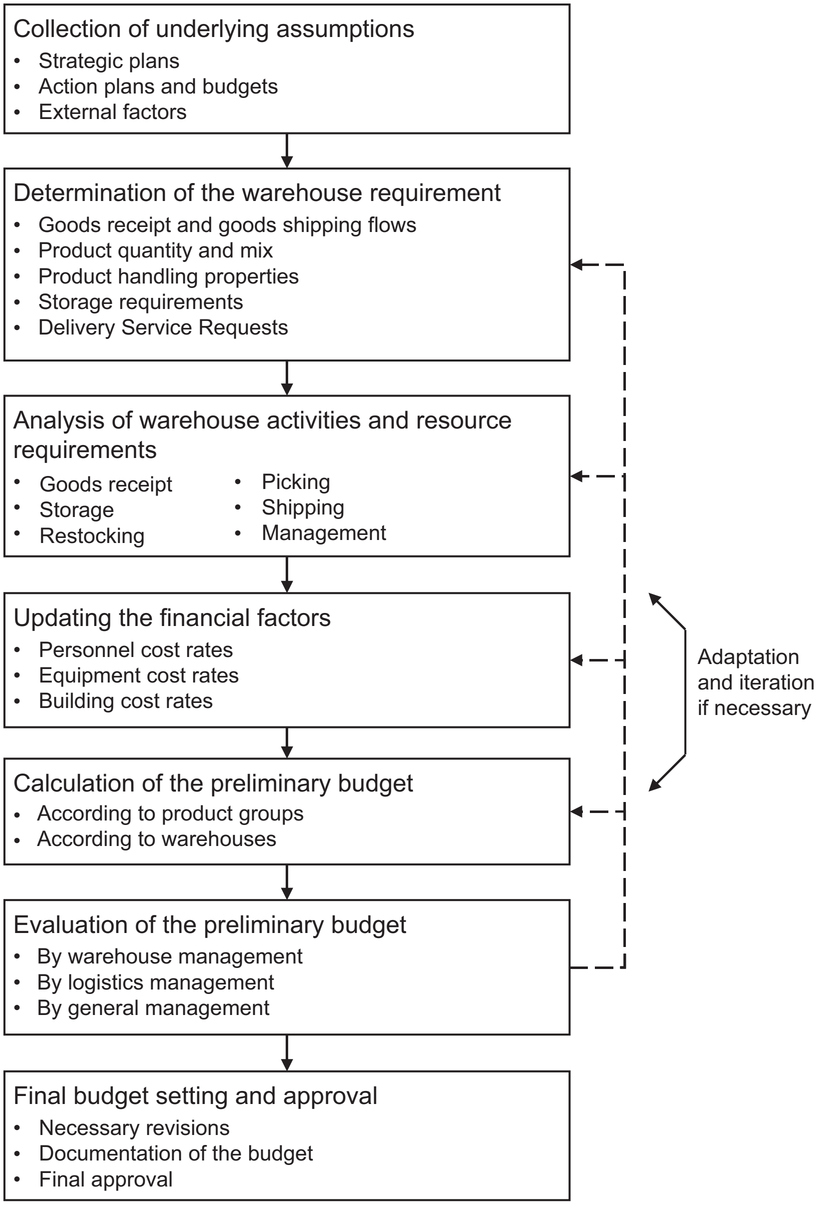


Fig. 5.17 Flow chart of a budgeting process for the warehouse area. *Source* Based on NCPDM/NAOA 1985, p. 119, retranslated.

sales, production and procurement quantities. The basis for this are the action plans and budgets derived from the strategic plans of the corresponding sub-areas of the company as well as external influencing factors such as e.g. environmental protection legislation. Based on these basic data, specific influencing factors regarding special transport requirements, transport quantities, transport execution and transport prices have to be determined for the calculation of the budget.

Figure 5.17 shows in a similar way the sequence of the budgeting process for the *warehouse area.*

5.5 Cost and Performance Accounting

5.5.1 Problems of a Logistics-Oriented Cost and Performance Accounting System

The concepts of cost and performance accounting systems provided by business administration are inadequately aligned to the specific information needs of logistics, as they are primarily production-oriented. In the literature, there are therefore various approaches to developing a logistics-oriented partial cost accounting system, which, however, take into account the specific problems of cost and performance accounting in logistics to varying degrees. These problems and approaches to their handling are discussed below[45]:

1. *Mapping problems:*

Problems of mapping the company's activities in the model of cost and performance accounting can be attributed to the service problem, the diversity problem, the measurement problem and the allocation problem for the logistics area.

Services are more difficult to capture than material goods because of their immaterial nature. A specific tool as a material good can be clearly defined by specifying the material quality, shape, dimensions and tolerances. On the other hand, there can be intensive discussion about the definition of a specific transport as a service. For example, does the waiting time before unloading at the ramp belong to the transport time or does the unloading belong to the provision of the transport service?

Due to the *diversity* of the logistics systems to be represented, many statements on cost and performance accounting only apply to very specific logistics situations.

There are a variety of relevant *measures* for capturing logistics services, such as pallets, tons, hundredweights, pieces, warehouse disposals, shipping orders, goods receipt notifications, delivery time information or freight kilometers. Measures for quantities of goods, time and distance are of equal importance, whereby the quantities of goods are measured in very different ways. The mapping of the services in the manufacturing area,

[45] Cf. Pfohl and Hoffmann (1984, p. 57 ff.).

on the other hand, is essentially based on quantities of goods (usually numbers of pieces or tons) and time information.

The *allocation* of logistics costs is initially complicated by the fact that many logistics activities take place without corresponding payments (e.g. storage operations) and are therefore allocated on the basis of internal budgeting without reference to the market value of the service. In the case of determining internal transfer prices, on the other hand, there are very different possibilities of price setting, which will be discussed in more detail later. Arbitrary cost allocations result mainly from the fact that logistics costs are largely overhead costs. In addition, logistics activities often involve co-production,[46] so that the related cost allocation problem becomes comparatively important. Furthermore, the network character of the provision of logistics services complicates the cost allocation. For example, a number of production logistics activities are performed in so-called "mixed cost centers" together with production activities.[47] The risk of arbitrariness ultimately also exists in the allocation of imputed costs, for example in the determination of the capital commitment costs of the inventory.

2. *Cost object problems:*

As cost object types, the sales services as final cost objects and internal services as intermediate cost objects are usually distinguished. The costs of the intermediate cost objects are recorded in the traditional cost accounting on auxiliary cost centers and allocated to main cost centers by means of methods of internal service allocation. Since logistics in industrial and trading companies provides many service services for other business functions, the associated costs are usually also allocated in this way in practice. The logistics cost object problem, however, is more complex and includes the following two aspects:

On the one hand, in order to assess logistics decision alternatives, their cost and performance effects must be attributable to individual *orders*, so that order-specific characteristics, such as minimum order sizes or surcharges for small quantities in transport planning, can be determined. The relevant costs for different *service components and levels* and the allocability of costs and services to individual *customers* and *regions* form the prerequisite for a differentiated service policy. Also for "tradeoff" analyses, such an extension of the cost object accounting is a basic prerequisite.[48]

On the other hand, for the determination of the operating result and for the product calculation, the allocation of logistics costs and services to *products, product groups* or *areas* is also relevant. Therefore, an alignment of the cost type and cost center accounting to a differentiated logistics cost object accounting is required, which does not exist in a traditional cost and performance accounting.

---

[46] Cf. e.g. Pfohl (2022, p. 264 f.).

[47] An employee operates a machine and takes care of the internal transport for the supply and disposal of the machine.

[48] Cf. Sect. 5.9.2.

3. *Cost theoretical problems:*
The cost theory, which is based on the production theory, deals with the determination of the dependency relationship between the logistics service and the logistics costs in the *cost functions*. So far, there is no closed cost theoretical treatise on the logistics area of industrial and trading companies or to logistics companies. Besides approaches that deal with basic facts of a production and cost theory of services,[49] there are, however, approaches to logistics subareas, for example the discussion of the subproportional increase of the transport costs per object unit with increasing transport distance and increasing transport weight.[50]

A characteristic of logistics cost functions is often their *complexity.* "Thus, the costs of a transport are not only dependent on the quantity transported and the distance (ton-kilometers), but also on the characteristics of the means of transport, the driving style, the route profile, etc. Since individual orders can be transported or stored together, there is often no direct relationship between the respective logistics performance and its costs. Often, the logistics performance is not even the central influencing variable. Moreover, the costs often do not change linearly depending on the performance."[51] In practice of cost and performance accounting, a viable compromise between the practicability of the method for determining the cost function and the accuracy of the representation has to be found to handle the complexity of logistics cost functions. This compromise ultimately is based on an idea of the costs and benefits associated with a logistics orientation of cost and performance accounting.

4. *Cost-benefit problems:*
The implementation of a new cost and performance accounting system requires additional use of personnel, technology and information. However, the benefit of changes in information systems to improve the management's information level is very difficult to capture and companies hardly know anything about the costs caused by the cost and performance accounting.[52]

The *purposes* that one pursues with it are ultimately decisive for the assessment of the cost-benefit problem of cost and performance accounting. There are two main reasons for not exaggerating the requirements for a logistics-oriented cost and performance accounting—in line with a "lean" controlling[53]. These are changes in the planning and control system and the orientation towards the personnel management system.

[49] Cf. Corsten (1999).

[50] Cf. Brauer (1993, p. 38 ff.).

[51] Küpper (1989, p. 58). See also Weber and Wallenburg (2010, p. 43 ff.).

[52] For the efficiency problem of planning and control systems, see Pfohl and Stölzle (1997, p. 180 ff.).

[53] See also the principles of designing the controlling in Sect. 5.1.1.

When aligning the cost and performance accounting to the needs of the planning and control system *(decision-oriented cost and performance accounting)*, it has to be considered that the importance of investment planning increases compared to the cost planning and the importance of strategic planning increases compared to operational planning. The former is due to the fact that due to the advancing automation, the costs of using a plant can only be influenced weakly by the individual cost center manager and the focus of cost influencing shifts to the period of plant design and procurement, i.e. to investment planning, for largely automated processes. During the operation of the plants, performance data on the intended use of the plants (e.g. running times, downtime, quality data) gain more importance than the ongoing planning and control of the costs. The increasing importance of strategic compared to operational planning also speaks against the development of a too differentiated cost and performance accounting, as it cannot meet the information needs at the strategic level.

The alignment of the cost and performance accounting to the needs of the personnel management system *(behavior-oriented cost and performance accounting)* receives far less attention than the one to the needs of the planning and control system, which often leads to a counterproductive, dysfunctional effect of planning and control systems.[54] The behavior-oriented cost and performance accounting is important because modern corporate principles increasingly align with the model of the self-reliant employee and in the formation of partnerships in the supply chain, the price is not determined exclusively by supply and demand, but also by the costs negotiated between the contracting parties. In both cases, a differentiated and causally fair breakdown of the costs is less important. The focus is on the transparency and traceability of the cost determination, so that the accounting system is accepted. Simpler systems will certainly meet these requirements better than complicated systems.

5.5.2 Process Cost Accounting

Due to the flow or process orientation of logistics, it makes sense to propose the process cost accounting as an approach to developing a logistics-oriented cost and performance accounting.[55] The examples for demonstrating the process cost accounting also often come from the logistics area.[56] Despite the advantages to be explained in the following, the spread in practice is rather low, which is due to the necessary implementation effort.[57] Therefore, it is mainly used on a case-by-case basis to support logistic decisions.

---

[54] See Pfohl and Stölzle (1997, p. 264 ff.).

[55] See e.g. Weber and Wallenburg (2010, p. 42); Göpfert (2013, p. 344).

[56] See e.g. Trumpfheller (2002, p. 490 ff.).

[57] See Weber and Wallenburg (2010, p. 314). For the fields of application of process cost accounting, see also Horváth et al. (2020, p. 254 ff.).

Real variables influencing the volume of performances and costs	Influencing variables assumed in traditional material overhead costing
Number of material orders Number of material deliveries Number of material inspections Number of stock placements Number of stock removals Used warehouse space Stock by value	Material quantity Material price
Tendency to overload standard material (high overhead basis despite relatively low resource use)	
Tendency to underload special material (low overhead basis despite relatively high use of resources)	

Fig. 5.18 Deficient performance reference of the surcharge basis material direct costs in the traditional material overhead costing. *Source* With minor changes taken from Warnick 1993, p. 28

Processes or *"Activities"* are transactions that occur in a cost center when performing the tasks assigned to it.[58] For reasons of practicability of process costing, repetitive tasks with comparatively low decision-making leeway are suggested as the area of application. The processes are determined by means of interviews with the cost center managers. In order to take into account the aspect of efficiency, one should focus on operational cost priorities, on operational resources that are used differently by different product types, and on operational resources whose costs are allocated least causally in traditional costing. An example of the poor performance reference of the surcharge basis "material direct costs" in the traditional material overhead costing is shown in Fig. 5.18.

The identification of the real influencing factors of the performance and cost volume, the so-called *process variables, reference variables or cost causes ("Cost Driver")* is the focus of process costing. In contrast to traditional costing, process costing assumes that in addition to capacity utilization, the variety of variants, the product or production process complexity and the order size are cost influencing factors. However, these cost influencing factors have an indirect effect on the cost volume. The process variables, on the other hand, are a direct measure of cost causation. In addition to the proportionality

[58] For the systematics and procedure of process costing, see Lasch (2014, p. 101 ff.); Horváth et al. (2020, p. 254 ff.). For the development of a cross-company process costing, see Winkler (2005, p. 327 ff.).

between the process variable and the resources used (costs incurred), the easy derivability from the available information sources as well as transparency and comprehensibility are cited as requirements for the determination of process variables.

Once the process variables are fixed, the process quantities can be determined by counting as the number of material orders, number of material deliveries, etc. The process quantities also represent a measure of the capacity of a cost center, so that based on planned process quantities for each process, the associated cost types can be planned. Process cost rates can then be determined by dividing the costs allocated to a process by the corresponding process quantities. However, it should be taken into account that in addition to the process quantity-dependent (performance quantity-induced) costs, there are also process quantity-independent (performance quantity-neutral) costs (e.g. department management) that have a fixed cost character and pose corresponding allocation problems.

By summarizing related sub-processes of different cost centers across cost centers, one arrives at the *main processes* as the basis for a process-oriented cost object time and unit accounting. Figure 5.19 shows, using the example of three main processes, the composition of sub-processes with typical associated process variables.

Figure 5.20 shows the summary of sub-processes of different cost centers to the main process “material procurement”.

5.5.3 Capturing Logistics Costs

The capture of logistics costs is carried out in the cost type- and cost center accounting. The basis of a logistics-oriented *cost type accounting* is the differentiation between the costs for the production factors provided or used in the logistics system of a company and the costs for the (purchased) logistics services provided by other companies. Because the coexistence of own production and external procurement (“Make-or-Buy”) of services is typical for the logistics system of a company. In the design of the cost type accounting with regard to the own services, there are hardly any differences to other value-added activities. In the case of external services, however, much more differentiation can be made.[59]

Of particular importance for a logistics-oriented cost type accounting is also the functional cost breakdown, as it allows to differentiate the logistics costs according to the logistics subsystems. If the functional breakdown is taken as the basis of the *cost center accounting*, the functionally differentiated logistics cost types correspond to the cost center costs. Generally, it is suggested to follow the phases of the material flow through the company when forming logistics cost centers. Figure 5.21 gives an example for this.

[59] Cf. for examples with a differentiation in transport, storage and other logistics costs Weber (2002, p. 180 f.).

	Process	Process variable(s)
MP 1	**Place order**	**Order process** **Order item**
SP 1.1	Ordering/calling off goods	Order process
SP 1.2	Select/support suppliers	Number of suppliers Supplier contacts
SP 1.3	Goods receipt	Delivery items
SP 1.4	Putaway	Putaway item
MP 2	**Storing**	**Area load x occupancy time**
MP 3	**Processing sales orders**	**Sales order** **Order item**
SP 3.1	Order processing	Sales order
SP 3.2	Picking	Sales order Order item
SP 3.3	Packing and checking	Customer order Package
SP 3.4	Delivery	Package Ton-kilometer
SP 3.5	Handling complaint	Complaint
SP 3.6	Customer support	Number of customers Support process

MP = Main process SP = Sub-process

Fig. 5.19 Examples of a process hierarchy with typical associated process variables

The transparency of the logistics costs is increased by the establishment of pure logistics cost centers. In the case of mixed cost centers, the logistics cost share can also be relatively accurately recorded by subdividing according to cost places and separately recording the individual activities using the operational data collection. If this is not possible, the costs of the mixed cost center can be approximated by using functional analyses.

For the logistics conception, the total cost thinking is a characteristic feature. The approach of the *Total Cost of Ownership (TCO)* is based on this feature of the logistics conception. The claim of the TCO is to include all relevant costs of the supply chain in

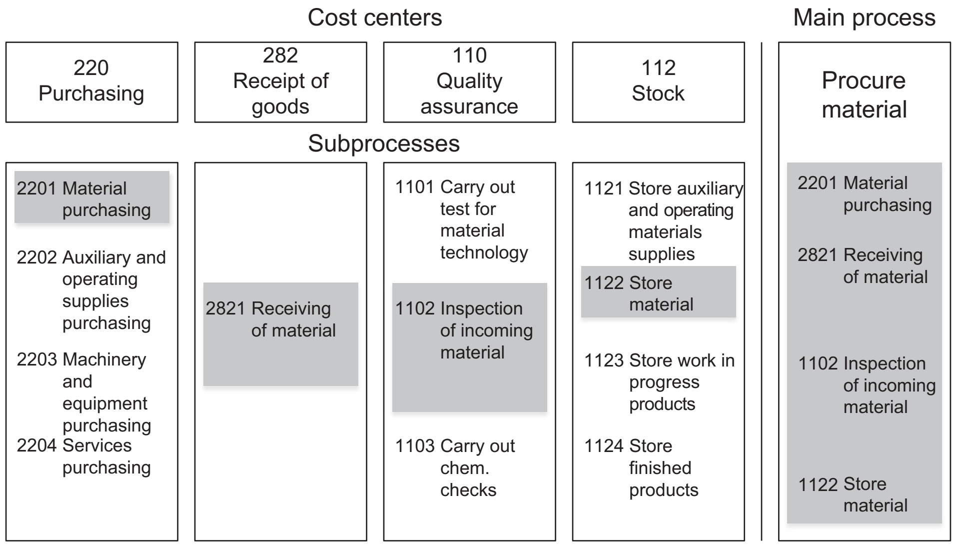


Fig. 5.20 Process analysis of related cost centers. *Source* Coenenberg et al. 2016, p. 166

outsourcing decisions.[60] When selecting a supplier or service provider, additional cost components should be considered in addition to the "purchase price". These costs can arise before and after the purchase decision. Figure 5.22 gives an overview of such costs and points out the advantages and disadvantages of the TCO approach.

5.5.4 Capturing Logistics Performance

Logistics performance has already been discussed in connection with the discussion of the contribution of logistics management to corporate objectives[61] and in connection with the discussion of the objectives and performance indicators of logistics[62]. For what is to be captured and how it is to be assessed as logistics performance depends on the objectives pursued with logistics. Performance is understood as the result of economic activity. Since the reason for an economic activity is a demand to be met, different categories of logistics performance correspond to different categories of demand for logistics activities by the demanders. Based on this consideration, four levels of definition of logistics performance are distinguished in Fig. 5.23, which can be described as poten-

[60] Cf. Eßig et al. (2013, p. 393.)

[61] See Part I, Sect. 3.2.

[62] See Sect. 5.2.

	Cost centers / Cost types, Key figures	Goods receipt	Intracompany Transport	Storage				Outgoing goods				Administration	
								Order picking	Control	Packing	Shipping	Warehouse office	Order processing
1	Personnel costs												
	Wages												
	Salaries												
	Social costs												
	Third-party services												
2	Inventory costs												
	Imputed interest												
	Fracture												
	Shrinkage (inventory)												
	Destruction, returned goods												
	Insurance												
3	Room costs												
	Calculation. Depreciation, rent												
	Energy												
	Maintenance, cleaning												
	Insurance, property tax												
4	Facilities costs												
	Conveyors												
	Stat. facilities												
	Maintenance, servicing												
	Operating and auxiliary supplies												
	Energy												
	Imputed depreciation												
5	Freight costs												
	Distance, area												
	Office expenses												
6	Administration												
	EDP												

Fig. 5.21 Cost center matrix for capturing logistics costs. *Source* Jassmann and Bodenstein 1983, p. 8

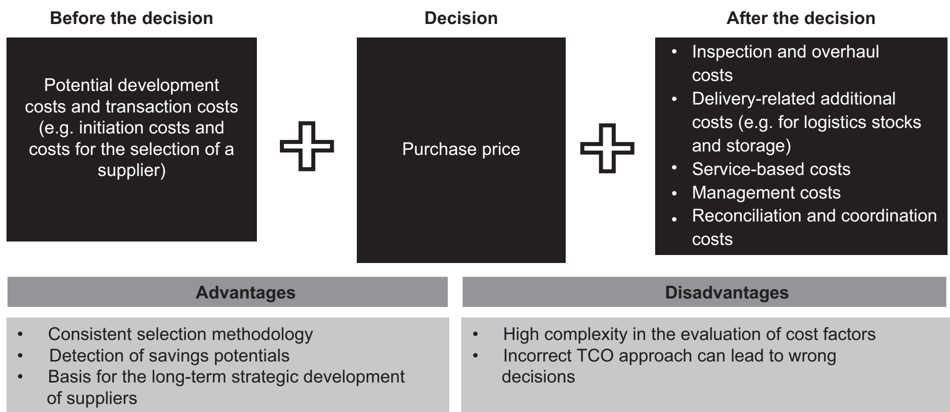


Fig. 5.22 TCO approach at a glance. *Source* Eßig et al. 2013, p. 394

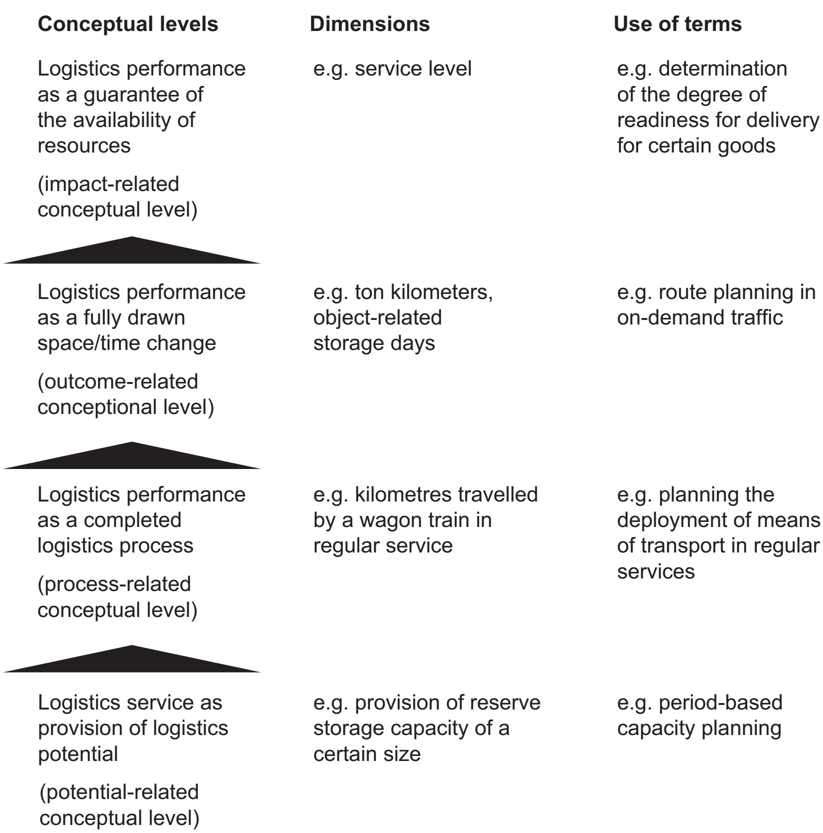


Fig. 5.23 Different perspectives of the concept of logistics performance. *Source* With minor changes taken from Weber 2002, p. 118. See also Weber and Wallenburg 2010, p. 136

tial-, process-, outcome- and impact-related performance. Each of these categories of performance can be regarded as an independent calculation object.

According to the suggestions for cost center formation along the flow of goods and in accordance with the approach of process costing, the establishment of *measurement points along the flow of goods (the logistics chain)* and the associated administrative and dispositional activities is proposed. Starting from the "external" logistics performance to be provided in the market, which can be represented by the various delivery service components, the logistics chain is to be subdivided into sections, for which then the "internal" logistics performance is to be captured at suitable measurement points.[63] The measurement variables for capturing logistics performance are also referred to as "Key Performance Indicators" (KPIs).

5.5.5 Capturing the Logistics Cost-Performance Relations

The steps for capturing the dependency relationships between logistics costs and logistics performance are shown in Fig. 5.24.

While in theory the determination of *cost functions* for capturing the cost and performance relations is the focus, in practice it is about the calculation of logistics performance, i.e. the *allocation of logistics costs to logistics performance.*

The knowledge of the cost-performance relations is a prerequisite for a sound *cost planning*. Figure 5.25 shows an example of the determination of planned costs for different types of performance for different logistics processes, which are provided along the flow of goods through the company. The reference variables are the performance variables that are used for cost planning. In the figure, total (t), variable (v) and fixed (f) costs are distinguished for the planned costs.

An example of the *product costing,* which is extended by logistics-oriented positions, is shown in Fig. 5.26. The basis for such an extension are ideally logistics performance plans, which record for a product across all processing stages, which logistics activities are used.[64] Such logistics performance plans can be created based on bill of materials and operation plans, which have to be supplemented by the recording of logistics workstations. However, the performance plans quickly become complex. In any case, the logistics costs should be allocated to the products as far as possible with their own allocation rates, so that their burden with logistics costs is made transparent.

Which value approach, e.g. individual costs, marginal planned costs or full costs, should be used depends on the question at hand. For short-term decisions, partial cost

[63] See Fig. 5.43 in Sect. 5.9.4 and Zeterberg (1989, p. 9). For a catalog of performance measurement variables in a shipping company and in a logistics service provider, see Weber and Wallenburg (2010, p. 138 ff.).

[64] Cf. Weber and Wallenburg (2010, p. 208 ff.).

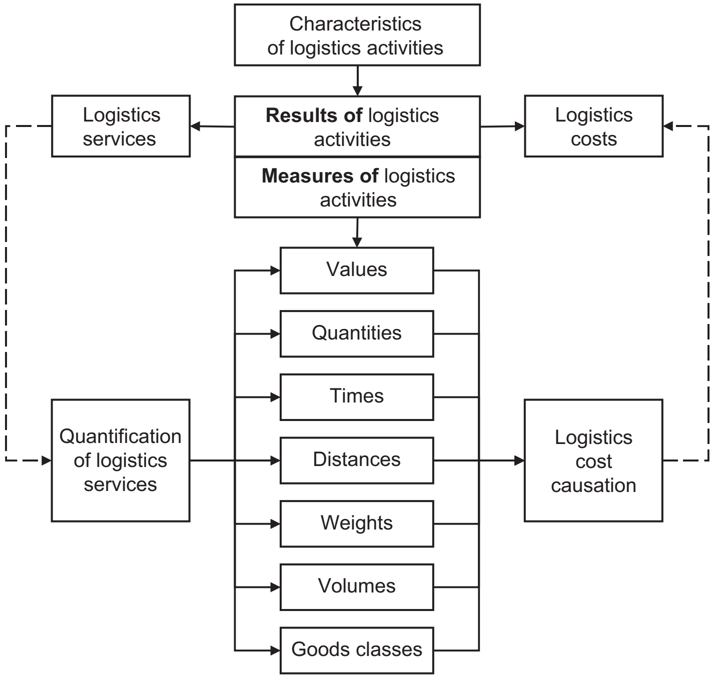


Fig. 5.24 Capturing the logistics cost-performance relations. *Source* With minor changes taken from Reichmann et al. 2017, p. 416

allocation rates are more relevant, while for long-term decisions, full cost allocation rates are more relevant.

Special considerations have to be made when determining allocation rates, if they have the function of *transfer prices (steering prices)* to transfer market-based steering mechanisms to the inside of the company. One distinguishes between market-oriented, cost-oriented or both elements combining transfer prices.[65]

If *market prices* are used, then an internal supplier delivers a service to his internal customer (e.g. central logistics area provides storage service for a division) at the price that he would also have to pay to a commercial supplier (e.g. commercial warehouse operator) on the market. The difficulty is to determine and constantly update "the" market price. Another problem arises when the costs are higher than the market price. Ultimately, it also has to be considered that market prices also contain cost elements, e.g. costs of sales, which do not occur at the internal supplier at all. This is taken into account by an "adjusted" market price, which is set e.g. 15 % below the market price.

For the *cost prices*, the allocation of actual full costs is initially suggested. The disadvantage here is that inefficiencies at the supplier are subsidized by the customer. There

[65] Cf. Küpper et al. (2013, p. 515 ff.).

Logistics area	Logistics performance types	Logistics procedures*	Logistics plan reference values*	Logistics cost types*	Dimen-sions	Plan prices	Planned consumption quantities (per period)	Planned costs (per period)		
								t	v	f
Goods-receipt	Delivered goods in provide qualitatively faultless condition for internal storage/ processing	• Pallets unloaded with forklift	• Number of average pallets to be unloaded per period	• Wage costs	Month	€ Wage/ Month	-------	---	---	---
				• Fuel costs	Litres	€/litre	-------	---	---	---
				• Depreciation	Year	AW/n	-------	---	---	---
				• Interest costs	Year	Interest rate	-------	---	---	---
				• Repair and Maintenance costs	Hour	€/assembler hour	-------	---	---	---
		• Manual goods entry	• Average number of articles to be recorded per pallet	• Wage costs	Month	€ Wage/ Month	-------	---	---	---
		• Random/continuous control	• Average number of articles to be checked per pallet	• Wage costs	Month	€ Wage/ Month	-------	---	---	---
Incoming stock	Time override types of goods to be provided	• Storage of pallets in narrow aisle warehouse	• Average number of stored pallets per period	• Interest costs (on inventories)	Year	Interest rate	-------	---	---	---
				• Interest costs (on capital tied up in storage facilities)	Year	Interest rate	-------	---	---	---
				• Depreciation (on storage facilities)	Year	AW/n	-------	---	---	---
				• Insurance costs	Month	€ premium/ month	-------	---	---	---
				• Energy costs	kWh	€/kWh	-------	---	---	---
Internal transport and handling	Transport and provide (position) certain goods in defined quantities from one location to another location.	• Transport with forklift truck	• Average number of pallets to be transported per period	• Wage costs	Month	€ Wage/ Month	-------	---	---	---
				• Fuel costs	Litres	€/liter	-------	---	---	---
				• Depreciation	Year	AW/n	-------	---	---	---
				• Interest costs	Year	Interest rate	-------	---	---	---
				• Repair and maintenance costs	Hour	€/assembler hour	-------	---	---	---
		• Manual provision of goods	• Average number of pallets to be provided per period	• Wage costs	Month	€ Wage/ Month	-------	---	---	---

Fig. 5.25 Types of logistics performance, logistics processes and logistics planned costs. *Source* With minor changes taken from Reichmann et al. 2017, p. 418 f.

Finished product stock	Time bridging types of goods to be provided	• Storage of pallets in narrow aisle warehouse	• Average number of stored pallets per period	• Interest costs (on inventories)	Year	Interest rate	-------	---	---	---
				• Interest costs (on capital tied up in storage facilities)	Year	Interest rate	-------	---	---	---
				• Depreciation (on storage facilities)	Year	AW/s	-------	---	---	---
				• Insurance costs	Month	€ premium/ month	-------	---	---	---
				• Energy costs	kWh	€/kWh	-------	---	---	---
Picking	Order corresponding provision of certain finished products in defined quantities at certain times	• Manual composition of finished products	• Number of average finished goods to be picked	• Wage costs	Month	€ Wage/ month	-------	---	---	---
		• Manual packing and ready for dispatch	• Average number of finished products to be packaged and made ready for shipment	• Wage costs	Month	€ Wage/ month	-------	---	---	---
				• Packaging material costs	kg	€/kg	-------	---	---	---
Distribution	Finished products to be made available to the recipient by bridging space and time	• Transport by truck	• Average number of pallets to be transported over average km	• Wage costs	Month	€ Wage/ month	-------	---	---	---
				• Fuel costs	Litres	€/litre	-------	---	---	---
				• Depreciation	Month	AW/n	-------	---	---	---
				• Interest costs	Year	Interest rate	-------	---	---	---
				• Car insurance and car tax	Month or Year	€ premium/ month or year	-------	---	---	---
				• Repair and maintenance costs	Hour	€/assembler hour	-------	---	---	---
		• Storage of pallets in the external warehouse	• Average number of pallets to be stored per period	• Interest costs (on inventories)	Year	Interest rate	-------	---	---	---
				• Interest costs (on capital tied up in storage facilities	Year	Interest rate	-------	---	---	---
				• Depreciation (on storage facilities)	Year	AW/s	-------	---	---	---
				• Insurance costs	Month	€ premium/ month	-------	---	---	---
				• Energy costs	kWh	€/kWh	-------	---	---	---

* Only recorded by way of example

Fig. 5.25 (continued)

General cargo	400.00
Packaging and handling costs	35.00
Transport costs	435.00
Acquisition costs	8,000.00
Procurement costs of the material	8,435.00
Storage costs incoming warehouse	515.00
Cost of materials	**8,950.00**
Production costs center A	65,000.00
Transport costs A to B	250.00
Storage costs intermediate storage B	175.00
Transport costs B to C	10.00
Production costs center C	42,000.00
Transport costs B to sales warehouse	1,000.00
Production costs	**117,385.00**
Administrative costs	1,166.00
Storage costs sales warehouse	2,500.00
Packaging and handling costs	1,125.00
Cost price of the product	**122,301.00**

Fig. 5.26 Example of a product costing extended by logistics-oriented positions. *Source* Küpper 1989, p. 58

is no incentive for the supplier to make the processes for service provision more efficient. On the other hand, if planned full costs are allocated, variance analyses can be performed. Of the detected variances, the customer has to bear capacity variances, if the planned service quantity is not used. The supplier, on the other hand, has to bear consumption variances and possibly also price variances, if he has predicted the factor prices incorrectly. A problem with the allocation of planned full costs arises with low capacity utilization of the supplier. The transfer prices are then too high, so that the customer—if this option is provided—obtains the service from a commercial provider, which may contradict the goals of the overall company. This criticism is addressed by the allocation of variable costs or marginal costs. Because if there are excess capacities, the allocation of marginal costs provides an incentive for better capacity utilization. The fixed costs are distributed evenly to all business areas regardless of the service usage. This is perceived as unfair by the areas that use little service.

A *combined transfer price* exists, if a target profit is added to actual or planned full costs. This is appropriate, if with investments in the logistics area a certain "return on investment" is to be achieved. Another form of the combined transfer price is the negotiation of the price between supplier and customer. For example, the fixed costs can be negotiated and the variable costs can be allocated according to the actual amount. The prerequisite for this is that the information base for the price negotiation must be ensured for the negotiating parties. However, subjective elements always enter the negotiation process through the negotiating skills of the participants.

The prices that have to be paid for the cost-causing production factors and the prices that are achieved for the services provided by the company directly influence the financial situation of the company. The financial aspect of the economic dimension of logistics is discussed in the following section.

5.6 Financing

5.6.1 Financial Flow in Logistics

In addition to the flows of goods and information, the financial flows are the third object area of the flow dimension of the logistics cube, which is used as a reference framework for the characterization of the logistics conception and was visualized in Fig. 2.2 in Part I. Here, three, albeit interdependent, approaches to the design of the flow of financial resources can be distinguished, whose main points are shown in Fig. 5.27[66]: Supply Chain Financing ("Supply Chain Finance"), Payment Processes ("Financial Chains") and Taxes/Duties in the Supply Chain ("Supply Chain Tax and Customs"). The financial flow is often also related to the flow of rights, which is not discussed in depth here.

The term "Financial Supply Chain Management" or "Financial Chain Management" became known in connection with software products as an approach to increase the efficiency of the payment processes within the order processing.[67] This financing dimension of logistics is referred to here as *"Payment Processes/Financial Chains"*. By means of electronic data processing, the associated process costs are to be optimized and the transparency of the payment processes between customers, suppliers, financial and logistics service providers are to be increased. This is done by digitizing and automating the processes, whereby a distinction is made between the process of business initiation and the process of business execution. The business initiation includes in particular the verification of the qualifications (e.g. reputation, compliance) and the financial situation (e.g. creditworthiness, payment behavior) of the business partner as well as the price determination (e.g. discount and rebate) and hedging (e.g. insurance and currency fluctuations). The business execution includes in particular the invoicing, the complaint handling and payment.

[66] For the first time, financing was discussed in detail as a new dimension of logistics by a working group of the Bundesvereinigung Logistik e. V. (BVL). See Pfohl et al. (2003).

[67] See also Gomm (2008, p. 64 ff.); Locker and Grosse-Ruyken (2013, p. 163 ff.); Baltes (2015, p. 76 ff.).

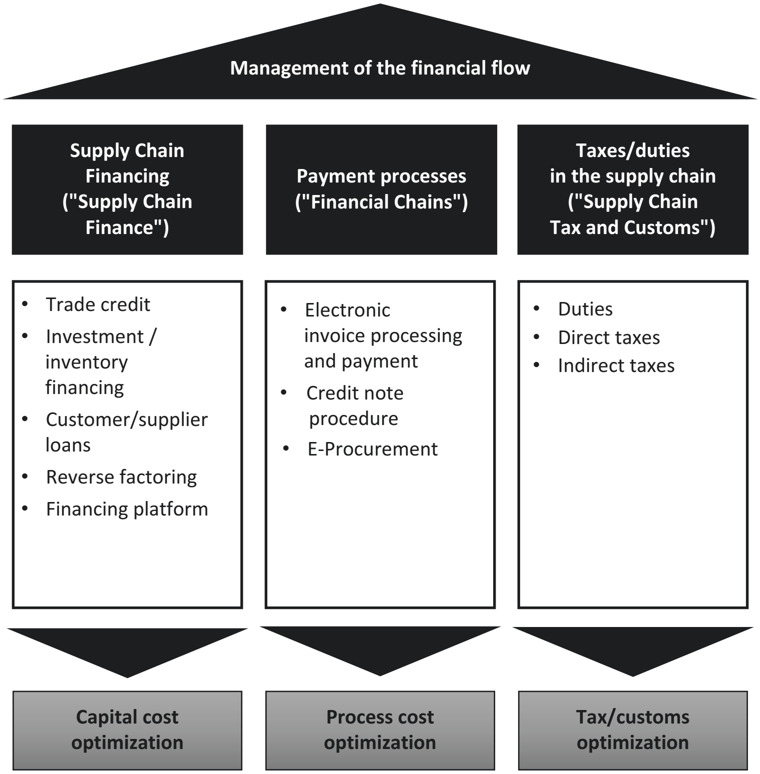


Fig. 5.27 Financing as a dimension of logistics. *Source* Based on Locker and Grosse-Ruyken 2013, p. 149

The main instruments used are the electronic invoice (invoicing and payment) and the electronic credit note procedure. In the credit note procedure, goods and services are settled without receiving an invoice. Instead, the customer issues a credit note to the supplier after receipt of the service. This can be done in the form of a single credit note or in the form of a collective credit note at the end of a certain period.

When designing international logistics systems, but also sometimes when designing national logistics systems (e.g. India), different direct and indirect *taxes as well as the duties in the supply chain* have to be taken into account for cross-border flows of goods. An example of the influence of taxes is the tax optimization by centralizing purchasing and logistics functions in a "principal company", which is located in a country with low tax burden.[68] The principal company is the owner of the purchased goods and the inventory and controls the production and logistics in the country companies. An essential role

[68] See Locker and Grosse-Ruyken (2013, p. 173 ff.).

for the tax optimization is played by the internal transfer prices between the subsidiaries of multinational companies.[69]

An example of the influence of duties is the exploitation of differentially high duties when exporting a final product and the modules from which the final product is to be assembled.[70] If, for example, the sum of the duties for importing the parts from which a final product is assembled is lower than the duty for the final product, then it makes sense to import the parts and not the final product. However, this only applies if the higher logistics costs associated with importing the parts do not cancel out the duty advantage.

In the following, the concept of supply chain financing will be discussed in more detail because of its special importance for logistics controlling.

5.6.2 Supply Chain Financing ("Supply Chain Finance")

The term "supply chain financing" ("supply chain finance") or less frequently also "supply finance" refers to the cross-company optimization of the financing of the objects to be financed in a supply chain. The goal is to *reduce the capital costs* in the supply chain.[71] Figure 5.28 shows the extension of the "classic" logistics management by supply chain financing in supply chain management. The increase of the financial aspects in supply chain management emphasizes the financial perspective that the capital employed in a forward-looking view must at least earn a risk-adjusted return in the market comparison. Based on the inter-organizational approach in supply chain management, supply chain financing can be defined as follows: "Supply chain financing is about saving capital costs by better mutual coordination of financing or by completely new financing concepts in the supply chain—possibly combined with a changed role and task distribution—which none of the involved partners can realize alone."[72]

The amount of capital costs is determined by the three dimensions of financing volume, financing duration and interest rate, as the *financing cube* in Fig. 5.29 shows. The interest rate depends on the volume and duration of the financing. The volume and duration of the financing depend on the net working capital and the logistics real estate and mobile assets to be financed. In addition to the original actors of the supply chain, supplier, logistics service provider and customer of a company under consideration ("Original Equipment Manufacturer / OEM"), new actors enter the scene to perform financing tasks in the supply chain, such as banks, financial intermediaries, investors and insurers.

---

[69] See also Holtbrügge and Welge (2015), p. 415 ff. For tax optimization in the supply chain see also Jespersen and Skjott-Larsen (2005, p. 62 ff.).

[70] See also n. A. (2006, p. 66 f.).

[71] Cf. Gomm (2008, p. 82 ff.); Locker and Grosse-Ruyken (2013, p. 152 ff.); Yahsi (2017, p. 87 ff.). Specifically on "working capital" see also Hofmann et al. (2011).

[72] Gomm (2008), p. 82.

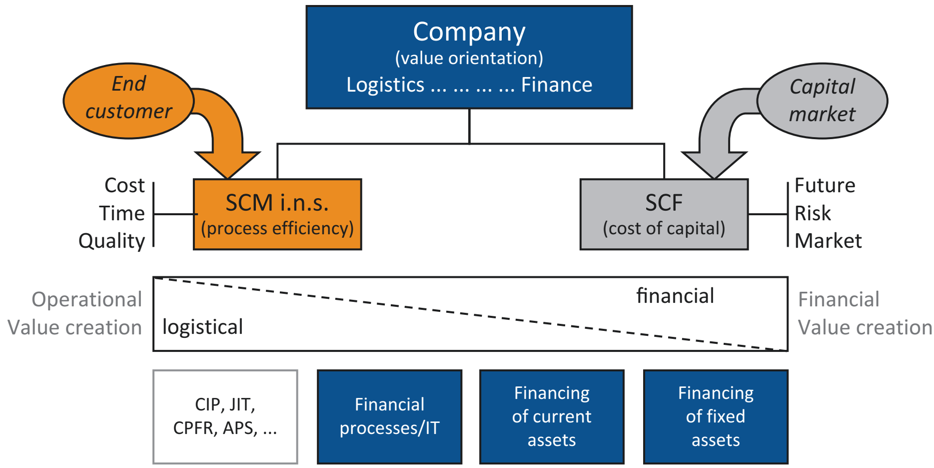


Fig. 5.28 Classification of supply chain financing in supply chain management. *Source* Gomm 2008, p. 83

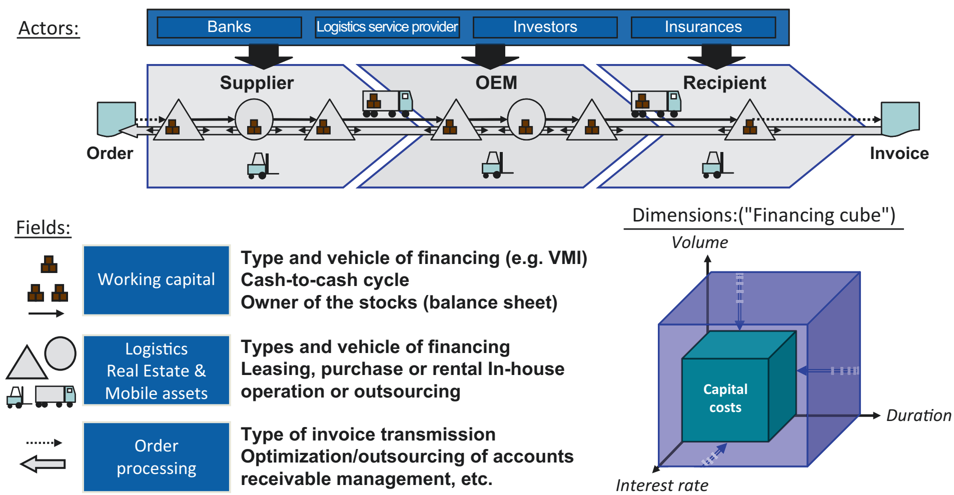


Fig. 5.29 Actors, financing areas and dimensions of supply chain financing. *Source* Adapted from Gomm 2008, p. 105 and p. 132

There are three reasons for possible benefits of supply chain financing that lead to lower capital costs. First, the entry of new actors in the supply chain can lead to a more efficient *inter-organizational division of labor*. For example, one can combine the competence of investors in raising capital, building and renting real estate with the competence of logistics service providers. The logistics service provider rents a warehouse from the investor and operates it as part of outsourcing for an industrial or trading company. Second, one can exploit the fact that actors have more *knowledge* about their partners than other actors due to their position in the supply chain. For example, an industrial company can offer its supplier better financing conditions than a bank due to its in-depth knowledge of the supplier. Third, one can take advantage of the fact that actors in the supply chain have lower *refinancing costs* than their business partners due to their good credit rating and pass them on to their business partners. An example of this is "reverse factoring".[73] A company with a high credit rating signs a contract with a bank ("factor"). The bank pays the supplier after a few days minus a discount, which is based on the financing conditions of the company with the high credit rating. The company then pays the invoice amount to the bank after a contractually agreed period.

Cost and performance accounting and supply chain financing are instruments of logistics controlling that are aimed at achieving the economic goals of the company. Additional instruments are required if the indirect controlling goals listed in Fig. 5.1 also include ecological goals. The problems associated with this are discussed in the following section.

5.7 Ecological Orientation

5.7.1 Accounting and Environment

In addition to the problem of setting up a cost and performance accounting system for the subsystem of disposal logistics[74], the relationship between accounting and environment is initially characterized by the effort to *internalize external effects* of an environmental nature.[75] External effects are impacts of individual economic measures on third parties that are not taken into account in individual economic decisions. To the extent that it is possible, for example, to transform originally external costs into internal company costs, the ecological dimension of the company is given more consideration in the decisions that are based on information from the internal accounting system. Among the internalization procedures that are based on the polluter-pays principle, four groups can be distinguished[76]:

[73] Cf. Locker and Grosse-Ruyken (2013, p. 156 f.); Baltes (2015, p. 323). A study by the Federal Association of Factoring for Small and Medium-Sized Enterprises from 2019 shows a strong growth of reverse factoring in recent years. Cf. Grupp (2020).

[74] Cf. Stölzle (1993, p. 181 ff.)

[75] Cf. Aberle (2009, p. 574 ff.); Pfohl (2022, p. 317 ff.). For an overview of information tools for ecologically oriented corporate management, see Wehberg (1997, p. 84 ff.).

[76] Cf. Aberle (2009, p. 579 ff.).

- Governmental prohibitions and commands: Examples of these are the setting of pollutant emission limits or the landing ban for noise-intensive aircraft.
- Tax or fee solutions: Examples of these are the vehicle tax or the payment of a toll for the use of the highway.
- Politically predetermined environmental standards: Taking into account the marginal avoidance costs, the polluter should check whether it is cheaper to pay a fee or to take emission-reducing measures, for example by installing a filter.
- Certificate solution: The state distributes or auctions tradable and well-defined emission rights. By purchasing emission rights from other companies, a company can increase the environmental burden.

A model for determining the external costs caused by logistics is shown in Fig. 5.30.

Another approach to giving more consideration to the ecological dimension of the company is the *direct recording and subsequent evaluation* of the external effects in addition to the cost and performance accounting. The tools available for this purpose are not as well developed as the controlling tools previously discussed for the economic assessment. The standards according to ISO 14001 as well as the EU Eco-Audit Regulation (EMAS) serve as the basis for the environmental management systems applied in practice.[77]

To record and evaluate the environmental impacts, approaches to an *ecological orientation of controlling* ("Green Controlling") are increasingly presented.[78] In the context of the present discussion, the life cycle assessment will be presented as a possibility for the ecological assessment of logistics systems. The basis for this is the recording and evaluation of environmental impacts of logistics processes.[79]

5.7.2 Life Cycle Assessment

A concept for assessing the environmental impact, which is also suitable for the ecological recording and evaluation of logistical processes, is the life cycle assessment. An example of this is the following *concept of ecological balance sheet.*[80] The starting point of this life cycle assessment is the execution of *material- and energy balance sheet* on the three levels of analysis of the operating balance sheet, process balance sheet and product balance sheet, as well as the substance analysis on a fourth level of analysis.

---

[77] See von Ahsen (2006, p. 26 ff.); Günther (2008, p. 76 ff.).

[78] See Günther (2008, p. 226 ff.); Berlin et al. (2014).; Horváth et al. (2020, p. 409 ff.).

[79] For a systematic overview of the influencing factors on environmental impacts of logistic processes, see Engelke (1997, p. 133).

[80] Cf. Hallay (1990); for an overview of further approaches summarized under the term "life cycle assessment" cf. Günther (2008, p. 285 ff.). The English term is "Life Cycle Assessment". Cf. Topic and Biedermann (2019).

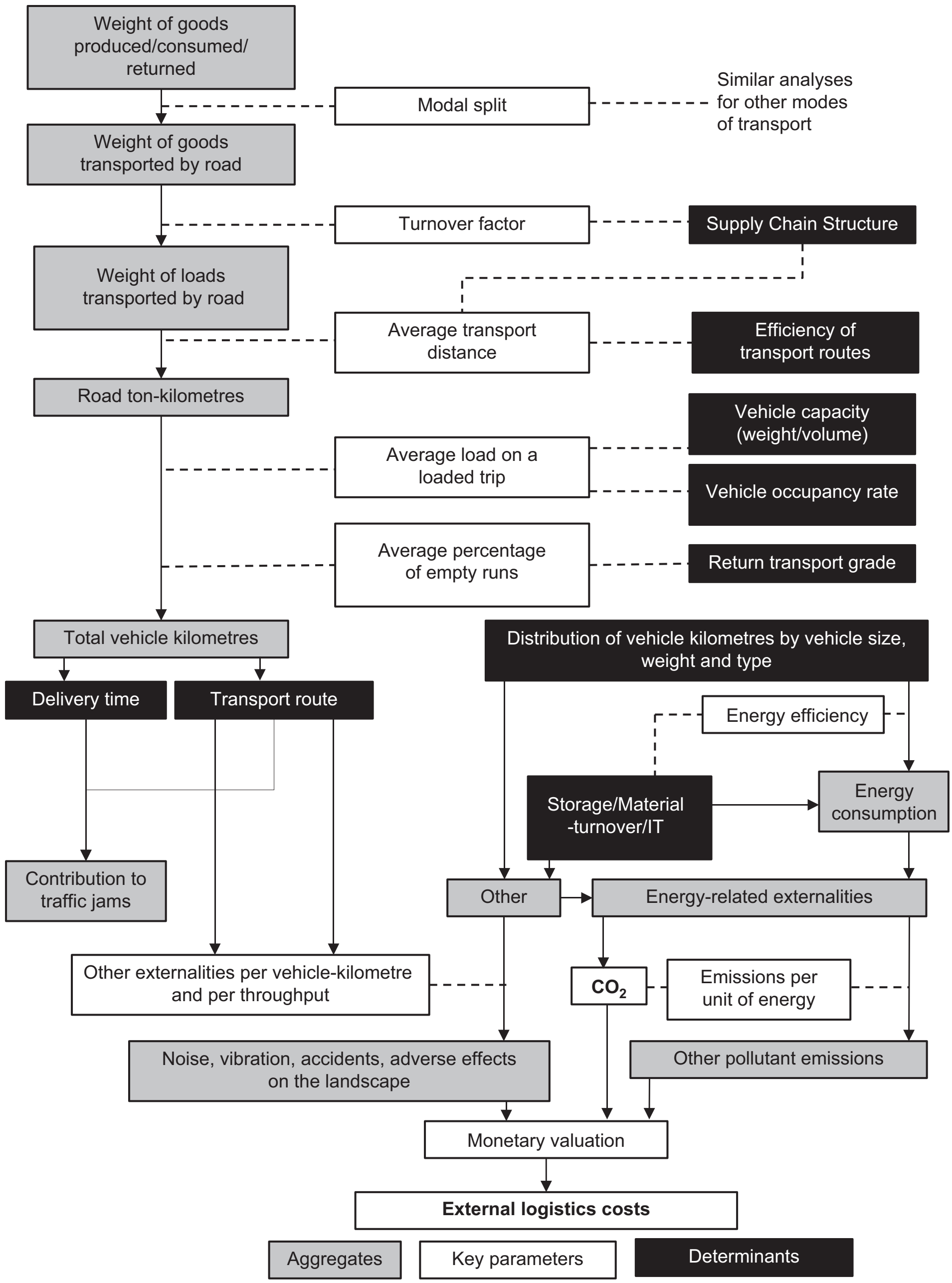


Fig. 5.30 Model for determining the external logistics costs. *Source* McKinnon 2012, p. 20, retranslated

In the *operating balance sheet* a quantitative overview of the environmental impacts of an operation is provided, whereby the operation is regarded as a "black box". The analysis can be carried out on several levels of aggregation, whereby the accuracy of verification increases with increasing detail. The *process balance sheet* records the environmental impact of the processes taking place in the operation. Also in this balance sheet, the accuracy of verification increases with increasing level of detail by breaking down a process into sub-processes. The *product balance sheet* provides a comprehensive view of the environmental impact of a product over its entire life cycle. The *substance analysis* covers all environmental aspects of the operation that are not covered by the material and energy balance sheets on the other three levels of analysis. These include, for example, permanent, operational environmental uses caused by land use, development and landscape interventions.[81]

Using this four-stage approach, material and energy turnover, transformation processes, resulting products, material and non-material emissions, as well as structural interventions can be systematically recorded. If the material and energetic description of the quantitative results on the respective levels of analysis is not sufficient, an attempt should be made to illustrate the environmental impacts by using ecological evaluation approaches. In contrast to other approaches of ecological balance sheets, these evaluation methods are only used as a supplement. The basic approach is to consider the recorded numerical data in physical units without methodical transformation processes, which supports the clarity and clear structure of the concept.

The distinction between operation, process and product in the life cycle assessment is very conducive to the ecological recording and evaluation of logistical processes. In addition to the production processes, the logistics processes have the greatest environmental impact in the processes taking place in the plant. The thinking in material and energy balance sheets with the physical measurement variables corresponds to the analysis of logistical system interrelationships using the process analysis in logistics controlling. However, the environmental impacts due to material- and energy balance sheets are more difficult to record than in production processes, because in logistics processes no physical product changes in the sense of processing occur. This ecological process analysis in logistics can be supplemented by the substance analysis, in order to collect and evaluate the ecological environmental impacts that are not covered by the material and energy balance sheets. The product balance sheet is important for logistics when waste management problems for products and packaging have to be solved.

A special importance with regard to the environmental impacts caused by logistics is attributed to transport, for which the preparation of process balance sheets is therefore very important. This is due to the fact that this process causes a variety of negative environmental impacts, such as noise, emissions and consumption of fossil energy sources, on the one hand. On the other hand, transport is very much in the public perception. To meet these challenges, the transport processes are increasingly analyzed with regard to

[81] Cf. Ewers (1993, p. 42 ff.).

their environmental impacts, in order to expand the offer with ecology-oriented logistics chains. One possibility to determine the status quo is the creation of *ecological profiles* for the logistics chains to be analyzed. Such a profile for the transport of paper is shown in Fig. 5.31. Due to the emission of carbon dioxide, which is considered to be particularly significant for the climate effect, this is highlighted as CO_2-footprint ("Carbon Footprint").

The survey to determine such a profile is carried out by the executing companies along the transport chain using questionnaires. They contain information on the type of transport vehicle used, the transport route, the quantity of goods and the emissions. On the basis of these profiles, environmentally oriented weaknesses can be specifically identified, in order to derive improvement potentials. In addition to the direct effects, an improvement of the environmental image of the respective companies is also expected.

Due to the increasing importance of the ecological dimension of logistics, this should also be included in the logistics audit to be discussed in the next section.

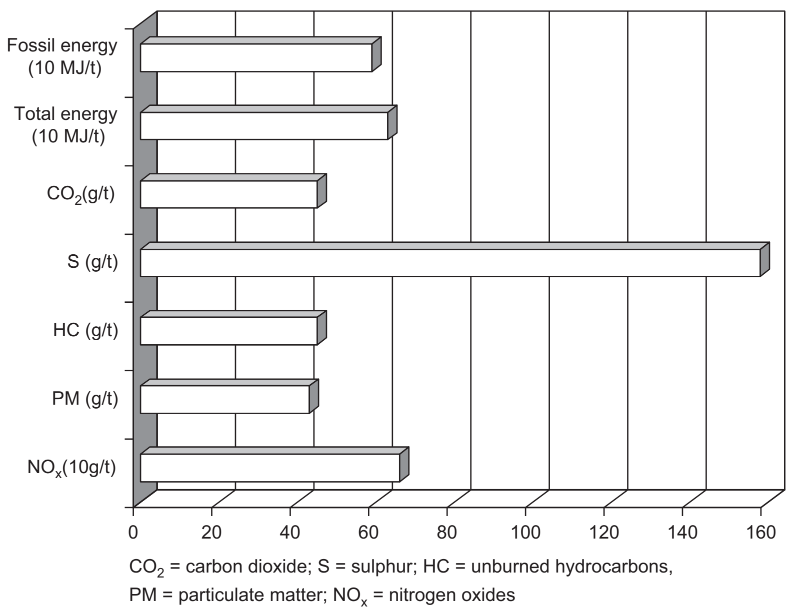


Fig. 5.31 Ecological profile for the logistics chain Hyltebruk—London. *Source* Pfohl and Engelke 1997, p. 382

5.8 Auditing

5.8.1 Auditing/Review

The term audit or auditing comes from the Anglo-American language area and can be translated as review or revision. It is a systematic comparison of the target and actual situation with subsequent judgment formation and communication. A special feature of the audit and at the same time a criterion for distinguishing it from the control is that the audit is conceived as a *case-by-case review of a system from the outside*, while the control is a system-internal, continuous process.[82]

The definition shows that there is no "the" audit. The audit has rather developed into a versatile instrument.[83] Originally, it was used exclusively for the retrospective review of the financial and accounting system for appropriateness, correctness and reliability ("Financial Auditing"), while today it is also seen as a forward-looking review of the operational activities with the aim of system improvement ("Operational Auditing" or "Management Auditing")[84].

An essential feature for differentiating the audits is the origin of the auditor, i.e. the person who performs the review. He or she can come from an internal or external unit from the perspective of the audited institution. Since an audit, by definition, is a review of a system from the outside, it must be ensured that the auditor—even if he or she belongs to an internal unit—is a process-independent employee. In the case of an external unit, it must be distinguished whether a neutral institution (e.g. in Germany the TÜV—Technical Inspection Association—or an auditing firm) or the potential or actual partner in the value creation process (e.g. a customer, a supplier, a bank, an insurance company) handles the audit.

So far, the following *types of audits* have been established:

- Financial audit (auditing), i.e. the review of the correctness of the annual financial statements and the tax situation
- Quality audit, i.e. the review of the effectiveness of the quality assurance system or the quality assurance elements, which are usually based on the standard system DIN ISO 9000 ff. or in the area of the German automotive industry on the VDA-6 series
- Environmental audit (eco-audit), i.e. the review of environmental regulations to determine the environmental liability risks, the examination of compliance with legal

[82] See the distinction between control and revision by Horváth et al. (2020, p. 503 f.).

[83] See e.g. Pfohl and Stölzle (1997, p. 132 f.); Stölzle (2008, p. 1108 ff.).

[84] In operational auditing, the focus is on the operational activities of the company, i.e. it is evaluated whether the "things are done right" (efficiency). In contrast, management auditing focuses on the corporate policy and strategic dimension of the company, i.e. it is assessed whether the "right things are done" (effectiveness).

limits for pollutant concentration on company premises or the review of the environmental management system to identify risk potentials based on the EU regulation on environmental management (EMAS) and environmental auditing or the DIN ISO 14000 series.

- Due Diligence Audit: Due diligence can generally be understood as a systematic analysis and evaluation of a company or a company function, with the aim of improving the quality of decision making for various occasions.[85] A frequently mentioned occasion in this context is a company acquisition. Another occasion can be, for example, the outsourcing of logistics. The due diligence then covers various fields of review, such as strategic audit, human resources audit, market audit, etc.

After determining the form of an audit, the question arises as to the activities involved in conducting an audit. The following therefore outlines the methodology of auditing.

5.8.2 Methodology of Auditing

With regard to the methodology, it is necessary to distinguish whether the results of the entrepreneurial activity or the activities that lead to these results are examined. The first case, which will not be discussed further here, is called *single-case audit or result-oriented auditing* and the second case as *system audit or process-oriented auditing*.[86]

The core point of any audit, regardless of the methodology, is a *target-actual comparison*. Here, the target state is compared with the actual state of an audit object. The target state describes the state in which the audit object should be according to its planning. The actual state, on the other hand, refers to the state in which the audit object actually is.

In the system audit, the target state of the audit objects is first determined during the audit execution, then the actual state is collected and compared with the target state, and finally the target state is evaluated and improvement suggestions are developed. This evaluation of the target state reflects the expectations of the management or a dominant company in the corporate environment (e.g. in the case of a logistics audit, the expectation of the company dominating the logistics chain). In this "ideal concept", the audit objectives or criteria come into play.

An audit thus involves not only a comparison of the target state with the actual state, but also a test of compatibility with the ideal concept. In this test, it must be taken into

[85] Cf. Hofmann and Nothardt (2009, p. 11 ff.).

[86] Cf. Horváth et al. (2020, p. 508 f.). The system audit deals with the comprehensive examination of entire systems with the objective of system improvement. Typical areas of application of the system audit are corporate planning, profitability analysis, investment calculation, logistics, purchasing, sales, production, research and development, etc. For a process system of auditing, see Stölzle (2008, p. 1112).

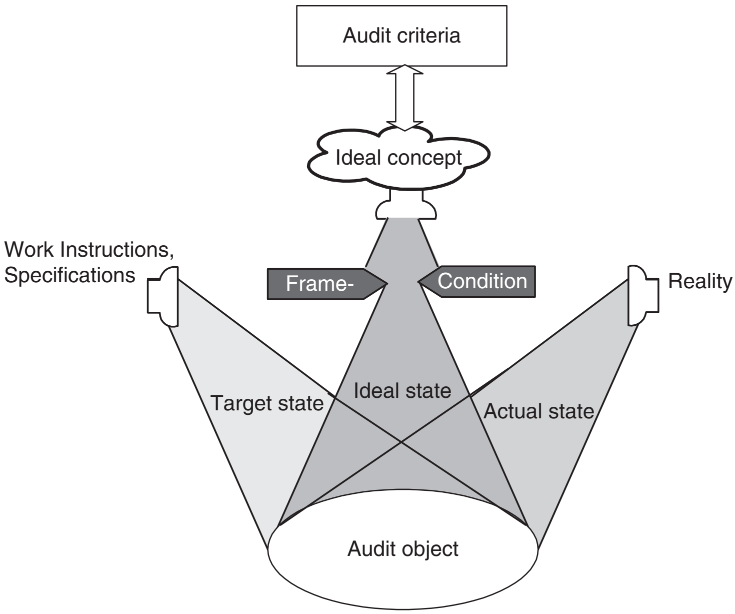


Fig. 5.32 Perspectives of an audit object. *Source* Pfohl et al. 1999, p. 8

account that the area to be audited is subject to certain framework conditions, which affect the implementation of the ideal concept.

Since the target-actual comparison corresponds to a comparison of states, it seems reasonable to also map the test of compatibility to a comparison of states. For this purpose, one or more possible ideal states are derived from the ideal concept limited by the framework conditions for each audit object.[87] There are therefore three perspectives for an audit object, which are shown in Fig. 5.32.

The following example is intended to illustrate the significance of these *audit perspectives*: The audit object to be examined is the ordering process in procurement. The target state of the process results from the corresponding work instruction. According to this, a reorder is made when the inventory falls below a certain quantity. The auditor can determine the actual state based on the orders and the inventory accounting. The comparison of the target state with the actual state shows whether the work instructions have been followed. The goal of the audit is to identify potential for cost reduction. The ideal concept aims to keep the inventories as minimal as possible without endangering the supply of production. From the examination of the framework conditions (e.g. the

[87] To derive the ideal states, it is advisable to use the system states referred to as “best practice”. In the presence of a benchmarking—see Sect. 5.2.9—the findings from the comparison about an optimal system design are also helpful in deriving the ideal states.

replenishment times, the reliability of the suppliers), an ideal state for the ordering process results, which either coincides with the target or actual state or not.

The advantage of determining ideal states is that the compatibility of the target or actual state with the ideal concept can be easily checked by a comparison of the states and therefore the result of the audit is relatively objective. The disadvantages are that the determination of ideal states can be costly and that the opinions on how the audit objects should be designed to achieve the audit objectives may differ. Furthermore, there is a risk that by defining certain ideal states, other states that can also be described as ideal are not taken into account. Moreover, it should be noted that not the state of an audit object, but the combination of states of different audit objects may be decisive for the ideal concept.

5.8.3 Areas of Application of Logistics Audits

A logistics audit is a systematic and independent examination to investigate the design of the logistics system.[88] An overview of the possibilities for designing logistics audits is given by Fig. 5.33. As *audit objective* or *criterion*, the determination of logistics performance indicators can be specified first. In this case, the audit serves as an instrument for preparing decisions, e.g. for outsourcing projects. Furthermore, as an audit objective or criterion, the compliance with laws, regulations and requirements can also be considered (e.g. for the handling of hazardous substances). Another possible audit objective is the compliance with goals that contain specifications for logistics costs and/or performance. These goals are either—derived from the corporate goals—set by the corporate management or imposed by a dominant market partner or agreed upon by several companies within the framework of a cooperation.

Possible *audit objects* are the entire logistics system, specific logistics subsystems (e.g. the inventory management), logistics processes (e.g. the order data transmission), interfaces or technical procedures in the field of logistics (e.g. the packaging technology). If the audit object is the entire logistics system, differentiation criteria must be applied to form manageable audit objects.

For the *audit occasions*, a distinction can be made between whether the audit is self-initiated or imposed by the contractual partner within the framework of a contract initiation or fulfillment (e.g. for the establishment of a long-term delivery relationship or an inter-organizational network).

The *audit results* range from the documentation and evaluation of the performance or efficiency of the logistics to the planning of corrective measures. The documentation of the audit results also has a positive effect on the liability issue, as e.g. in the case of

[88] On logistics audits see Friedl (1997); Pfohl et al. (1999); Stölzle (2008); Hofmann and Nothardt (2009, p. 61 ff.).

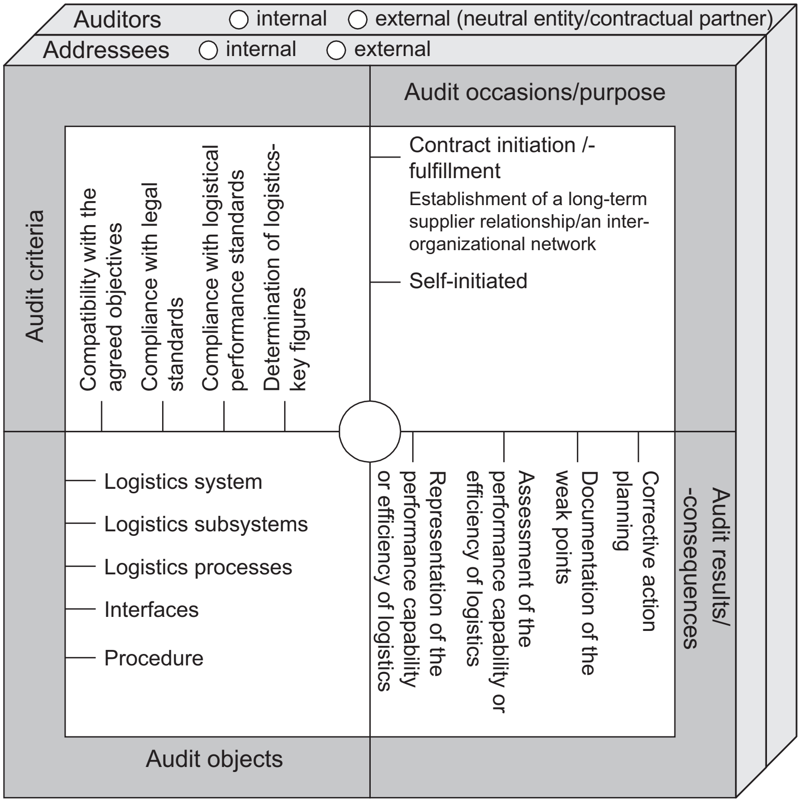


Fig. 5.33 Categories for systematizing logistics audits. *Source* Based on Janzen 1996, p. 137

forwarding services, the burden of proof in cases of the accusation of "gross organizational negligence" is facilitated.[89]

Two cases have to be distinguished with regard to liability.[90] If the proof according to DIN ISO 9000 is required by the supplier on the basis of legal regulations—in the so-called "regulated" area—then this is a mandatory prerequisite. If, on the other hand, only the contract law is the basis of mutual business relations—in the so-called "unregulated" area—then the opinions of the experts are very different. In this context, an investigation by the German Federal Court of Justice on product liability is interesting, according to which companies have to prove at least 24 criteria of the safety of their activities and organizations in order to be legally secured. DIN ISO 9001-9004, however, only require 12 criteria.[91]

[89] See Brands et al. (1991, p. 190 f.).

[90] See Bläsing (1992, p. 19 f.).

[91] See Griepentrog (1992, p. 81).

5.8.4 Operationalization

But logistics subsystems also have to be further broken down for analysis. For this purpose, a decomposition into *processes* is suitable, because first, performance can be adequately measured based on processes and second, the process orientation is an immanent way of thinking of the logistics conception. As a result of this decomposition, a large number of processes emerge as audit objects. To identify the relevant processes from the totality of all processes, a survey of the processes along the process chain is recommended. The chosen level of detail is measured by the trade-off between the accuracy of the analysis, the cost-effectiveness of the investigation and the requirements for transferability to different organizational units.[92] However, for the investigation it is not sufficient to evaluate only the processes. Furthermore, the interaction of the processes has to be considered. Therefore, the *interfaces* between the processes are included in the investigation.

The investigation of the processes and interfaces with regard to the fulfillment of the audit criteria requires their operationalization. For this purpose, the investigation of the efficiency of the processes and interfaces can be subdivided, for example, according to the four characteristic groups of technology, personnel, organization and task.[93]

For each characteristic group, *process characteristics* can be derived, which have to be examined in more detail in the course of the investigation. The selection of the process characteristics for a process or an interface is largely influenced by the objective of the investigation. The objective "determination of process costs" leads, for example, to the derivation of cost criteria as process characteristics. Process characteristics for the characteristic group of personnel are, for example, the ability to perform, the willingness to perform, the capacity and the costs, while for the characteristic group of task, process characteristics such as the aspiration level and the time requirement can be specified.

A process characteristic can be measured by *indicators*. Here, a special emphasis has to be placed on the measurability, since only in this way a quasi-objective investigation is possible. For the process characteristic of performance of the characteristic group of personnel, for example, the indicators of level of education or information supply can be used. Here, too, it applies that the selection of the indicators is influenced by the objective of the investigation. Only those indicators that have a direct or indirect relationship to the achievement of the objective are to be used for the investigation. The measurability of process characteristics also plays an important role in the system analysis, which will be discussed in the following.

---

[92] See also the concretization of logistics-specific analysis and evaluation situations by Hofmann and Nothardt (2009, p. 209 ff.).

[93] See also Fig. 2.3 in Part I, Sect. 2.3.2.

5.9 System Analysis

5.9.1 Weakness and Cause Analysis

Basis of the system analysis is the weakness analysis, which identifies problems, and the cause analysis, which creates the prerequisite for finding solutions. *Logistical weaknesses* or *problems* can be defined as a deviation (discrepancy) between the current or forecasted state and a desired state of the logistics system.[94] Indications of existing or possibly future problems are provided by the problem indicators. These include the deviations determined in comparison to the set logistics goals. On the other hand, indicators that usually occur in the form of changes and point to strengths and weaknesses of the logistics area in the company and to opportunities and threats in its business environment belong to them. However, these problem indicators are only symptoms of a problem. The solution of the problem requires the knowledge of the problem causes.

If one starts from the goals of a company and the approach to achieve them, then the problems in a company can ultimately be traced back to two *sources of problems* or *fields of causes*, namely unsuitable goals and inadequate performance (used resources) to achieve the goals:

- Causes for unsuitable goals: The causes can lie on the one hand in the fact that the conditions for achieving the goals have changed. Examples for this are new legal regulations for the transport of hazardous goods or the revision of sales forecasts. On the other hand, the causes can also lie in unreasonable relations of the target specifications to the available resources. For example, the level of demand is not adjusted to the existing logistics know-how.[95]
- Causes for inadequate performance: On the one hand, other goals can be pursued with the resources used, which leads to a waste of resources. For example, the storage system is suboptimized instead of designing the storage in view of the entire logistics system. On the other hand, the inadequate performance can result from a too low level of performance, which has to be overcome by an increased qualitative or quantitative use of resources. An example for this is the transition from a manual to an automatic picking.

Figure 5.34 shows typical problem symptoms in the *warehouse*. A complete as possible recording of the symptoms serves to identify the problem by the problem description. In the problem analysis, on the other hand, one tries to understand the problem by

[94] On the concept of problem, see Pfohl and Stölzle (1997, p. 56 ff.).

[95] See also the development phases of logistics management in Part I, Sect. 2.2.

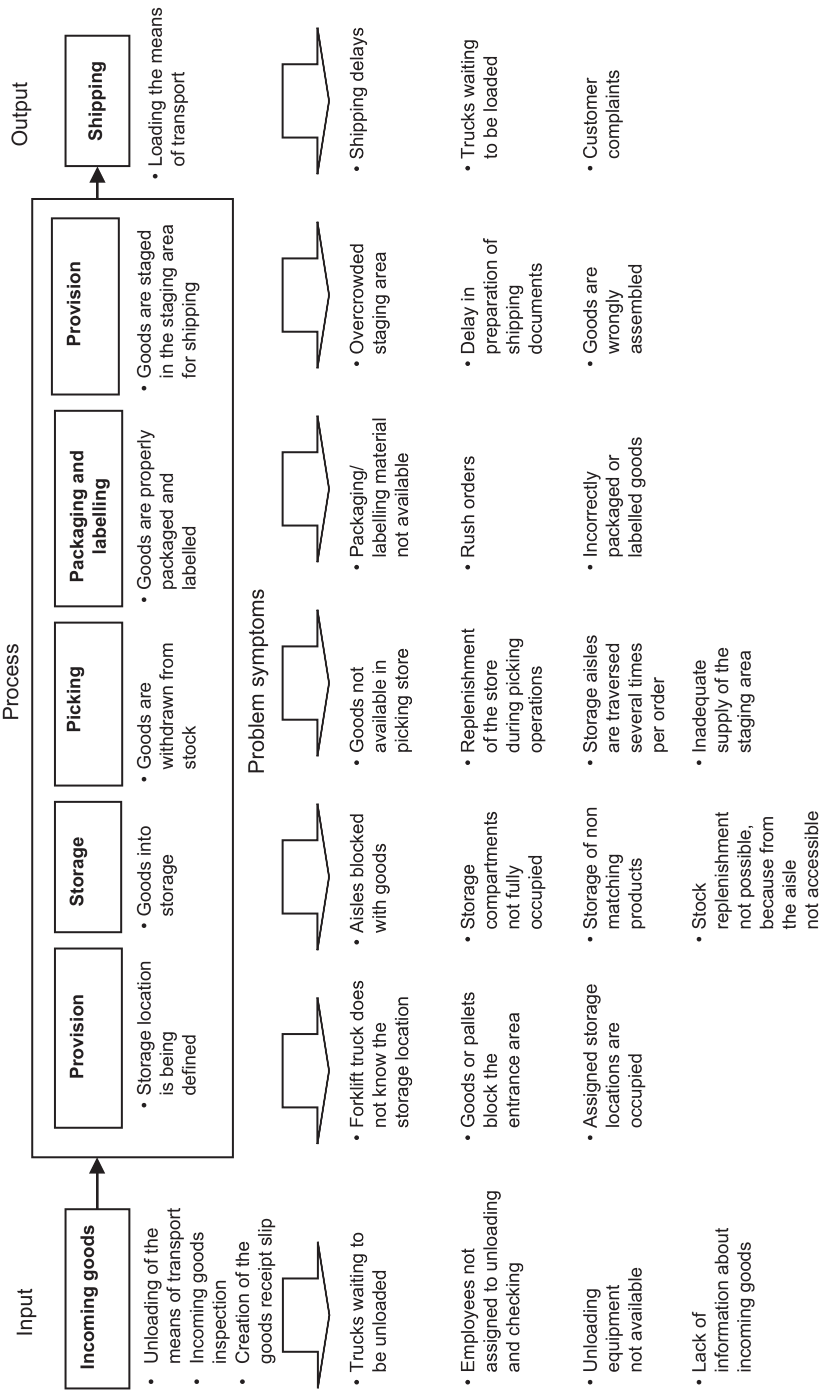


Fig. 5.34 Problem symptoms in the warehouse. *Source* Tyndall 1984, p. 231, retranslated.

analyzing possible causes. Figure 5.35 shows an assignment of weak points in the *delivery service* to logistical subsystems, in which the causes are to be sought.[96]

If one follows the hypothesis frequently represented in the literature that problems arise due to some changes, then in the cause analysis one looks for changes in the possible influencing factors of the symptoms.[97] Among the instruments and methods available for this purpose, the analysis using the key figure systems, which have already been presented as an important instrument of logistics controlling, is particularly important.

Another example is the analysis of the causes of *inventory and receivables increases.* They can ultimately be traced back to the four possibilities

- unbalanced structure of inventories and receivables,
- reducible time delays,
- insufficient planning and control information and
- inefficient decision rules.[98]

To balance the structure of inventories and receivables, one possibility is to clean up the product range. This includes the reduction of slow-moving items and the centralization of inventories. With regard to spare parts, the sale, reworking or scrapping can be considered. On the other hand, the specifications of the materials should be standardized as far as possible. With regard to receivables management, the payment terms should be simplified and possibly the bank account system should be realigned.

To reduce the time delays, the individual production stages should be analyzed in detail. Time gains in receivables management are mainly achieved by accelerating the invoicing process, by switching to faster means of payment and by specifying a due date on the invoice. Another possibility is to shorten the grace periods in the dunning process.

Starting points for improving the planning and control information for inventory management are, in addition to increasing the accuracy of sales planning, also providing detailed information on payment due dates and payment habits. Also, key figures, such as time without movement or the ratio of inventory level to safety stock, contribute to improving the quality of inventory information.

With regard to the decision rules, cumulative safety stocks should be reduced first. Further possibilities are to reduce lot sizes by fully including all inventory costs and to update the planning assumptions for procurement.

A method that combines the cause analysis with the impact analysis, which will be discussed in the following, is the *cause-effect diagram* (fishbone diagram, Ishikawa diagram). Figure 5.36 shows such a diagram using the example of the throughput time deviation. The arrows indicate possible causes for the throughput time deviation.

---

[96] Cf. also Kleer (1991, p. 82 f.), where the influence of the logistical subsystems on the delivery service components is outlined.

[97] Cf. Pfohl and Stölzle (1997, p. 57).

[98] Cf. Meyersiek (1981, p. 78 f.).

Order processing and configuration Long order processing time (from order entry to order configuration) Long order configuration (from the beginning to the end of the order configuration) Insufficient order progress information (poor order tracking) Insufficient order status information (poor shipping tracking) Late invoicing Missing, duplicate or incorrect billing Errors in sales master data (salesman, branch, territory) Non-compliance with special instructions Lack of information about delivery delays (if shipment is delayed) Broker error Name or address error Unclear or confusing forms Other	Inventory planning and control Too many incomplete deliveries (ordered quantity will not be delivered completely) High failure rates (one or more of the ordered product types are not available) Insufficient readiness to deliver (promised goods cannot be delivered) Wrongly delivered goods Inadequate product labelling Frequent shortages Spoilt goods Obsolete goods Backorders Inability to combine several orders Inadequate reserve stocks (for new product launches, competition tests and promotions) High minimum order quantity (required order size is too large) No maximum order quantity (allowed order size is too small) Inflexible order quantities Other
Transport and traffic Long delivery time Insufficient complaint settlement Damaged goods (Crushed, Bent, Damaged corners, Dented, Perforated, Curved, Damp, Dirty, Other) Lost goods Poor route planning Inefficient scheduling Inability to expedite transport Inefficient order tracking Failure to follow special instructions Inadequate transport equipment Insufficient number of vehicles Problems with the transport company Errors in freight invoicing Errors in the consignment note Other	Warehouse and goods handling Wrong goods group Wrong goods quantity Inadequate facilities and/ or service regarding: Cooling Heating Manufacturing Assembly Processing Permanent lack of storage space Temporary storage space shortages Other Late or delayed delivery Defective product labelling Incorrect container type Delay in dispatch of shipping documents Damaged goods delivered from the factory Unsuitable packaging Other

Fig. 5.35 Assignment of weak points in the delivery service to logistical subsystems as cause fields. *Source* Based on Wagner 1977, p. 160 f., retranslated.

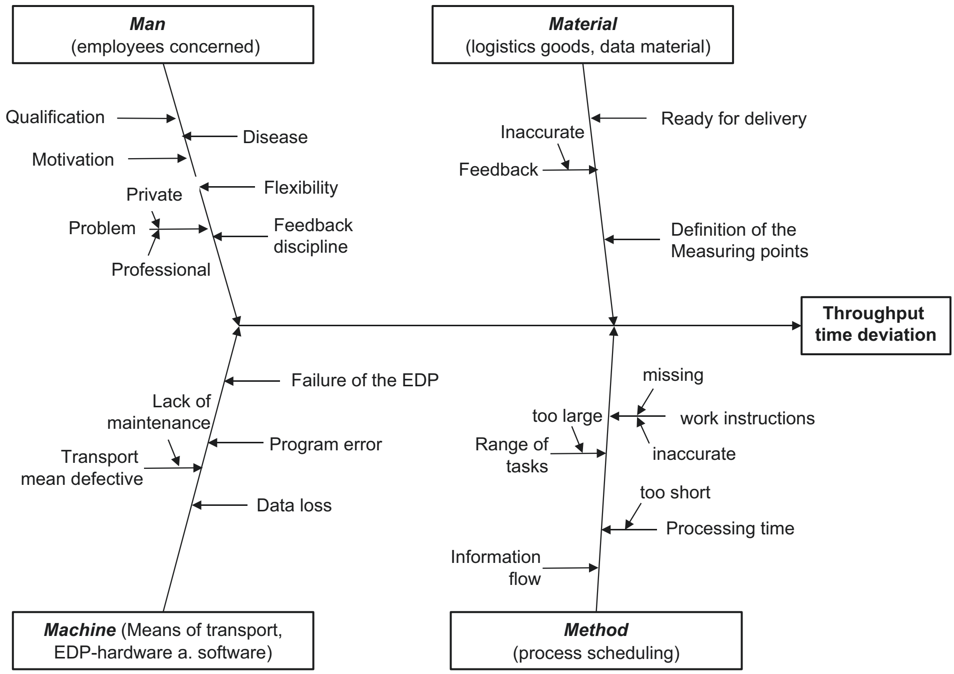


Fig. 5.36 Cause-effect diagram for throughput time deviations. *Source* Engelke 1997, p. 273

5.9.2 Impact Analysis

For the assessment of the solution alternatives for a problem, an analysis of the effects of these alternatives is required. The consideration of *goal conflicts* in logistics decisions is an essential concern of the logistics conception characterized by systems thinking. Goal conflicts occur as cost-cost conflicts or as cost-performance conflicts and are typical for logistics decisions. They are captured by the analysis of the effects of logistics decision alternatives. In the Anglo-Saxon literature, this is referred to as *"Tradeoffs"* and means the competing goal effects of alternative ways of providing logistics services that are captured by means of comparative calculations. The logistics cube shown in Fig. 2.2 in Part I, Sect. 2.3.1 can serve to systematize logistics goal conflicts. They can therefore exist at the interfaces between different logistics functions or these functions and other business functions, between different institutions, i.e. organizational units or companies that cooperate in the logistics channel or have an interest in providing logistics services, and also between different flows in the logistics channel, e.g. between information and goods flows.

A first step to determine the effects of logistics decisions is a *qualitative "tradeoff analysis"*. An attempt to fully capture logistics system interrelationships can consist of creating an interdependency matrix, in which the effects of logistics decision alternatives on the

Costs / Design dimension measures	1	2	3	4	5	6	7	8
Transport costs								
Supply of the distribution warehouses	–				–	–		
Delivery to customers	+	–	–		–	–		
a) Commercial Freight	+							
b) Vehicle fleet								
Handling costs								
Delivering company	–	–		–			–	
Customer				–				
a) Capital costs for equipment				+				
b) Labor costs				–				
c) consumables and supplies				+				
Storage costs								
Factory Warehouse						–		
Delivery warehouse -	–		+			+	–	–
Customer Stock -	–		–			–		–
Stock tied up in the transp.	–				–			
a) cost of capital			+					
b) Obsolete			+					
c) wastage and spoilage				–	–			
d) Insurance and taxes							–	
Warehouse costs								
Delivery warehouse	–		+			+		
Customer warehouse	–		–			–		
a) Own operation							–	
b) External operation							+	
Packaging costs								
Delivering company		–		–	+			
Unpacking at the customer	–			–	+			
Order processing costs								
Delivering company	+	–						+
Customer	+							+
Losses on sales due to lack of delivery service:	–	+	–		–	–		–

Cost conflicts: + = Costs increased by design measure
– = Costs reduced by design measure

Fig. 5.37 Examples of the effects of distribution logistics design measures on the interdependent costs. *Source* Based on Glaskowsky Jr et al. 1992, p. 548 f.

target variables are recorded. Figure 5.37 gives an example of such a matrix, in which the cost conflicts that occur in typical measures for designing logistics systems are indicated. In addition to the changes in the logistics costs of the delivering company, those of the customer are also recorded. The following eight design measures are examined[99]:

[99] Cf. Heskett et al. (1992, p. 547 ff.), where a total of twelve measures are analyzed. For another "tradeoff" matrix, see Pfohl and Hoffmann (1984, p. 52). For a detailed presentation of the mutual dependencies of logistics subsystems using matrices, see Künzer (1978, p. 41 ff.).

1. Use of particularly fast means of transport for the delivery of customers (in connection with a reduction of the number of delivery warehouses and a review of the communication possibilities).
2. Reduction of the number of orders to be processed by increasing the minimum order size.
3. Increase of the number of delivery warehouses to shorten the delivery time.
4. Introduction of logistical units, e.g. in the form of pallets.
5. Improvement in the protective function of the packaging.
6. Establishment of delivery warehouses as “mixing points”, where the goods ordered by the customer, which are produced in different factories, are combined and delivered as one shipment.
7. Use of commercial (third-party operated) delivery warehouses.
8. Use of faster communication means for order transmission and computer-aided methods of order processing.

The objectives can also relate to the logistics quality. Specific approaches to service quality are discussed below.

5.9.3 Analysis of Logistics Quality

A possible approach to operationalize the analysis of logistics quality is to distinguish between the *potential quality, process quality* and *outcome quality* of the service.[100] The potential quality covers all person-related, material-related and organizational prerequisites for service provision of the service provider. This includes, for example, the appearance of the staff as well as the equipment and condition of technical facilities. The process-related quality characteristics refer to the quality of the service creation activities. These include, for example, the error-free acceptance, processing and forwarding of information or the quick response to a change in customer requirements. The outcome quality of services indicates the degree of achievement of the set performance goals. This includes in particular the components of the delivery service, such as the condition of the delivery, the adherence to deadlines or the delivery accuracy.

Due to the importance of the delivery service for the perception of the quality of logistics services, this aspect is discussed in more detail below. A good conceptual framework for the delivery service analysis is provided by the conceptual *model of*

[100] This distinction is based on the approaches to measuring service quality, which can be transferred to logistics services. Cf. Engelke (1997, p. 108 ff.) See also the concept of logistics performance in Fig. 5.23.

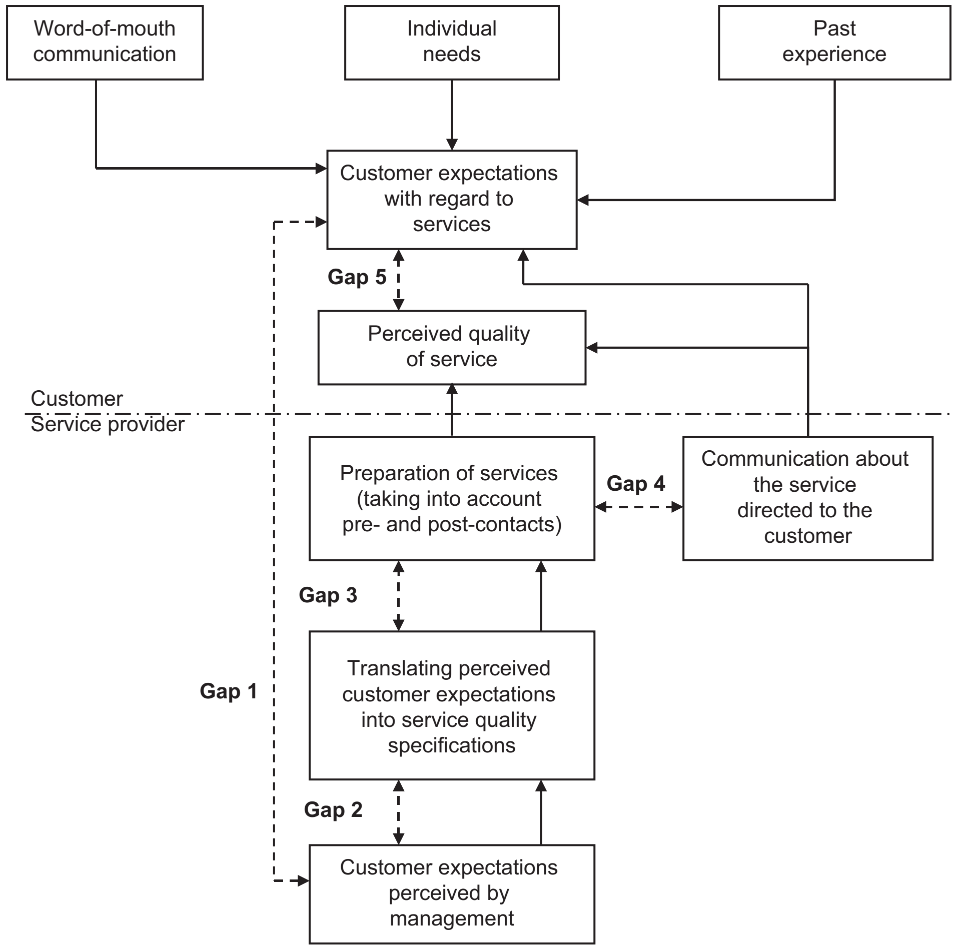


Fig. 5.38 Basic conceptual model of service quality. *Source* With minor modifications taken from Zeithaml et al. 1995, p. 135

service quality, which is shown in Fig. 5.38.[101] This model was developed on the basis of personal interviews and a comprehensive case study at service companies. It reveals various discrepancies or breaks ("gap") in the relationship between customer and service provider, which ultimately result in the customer expectations or customer requirements regarding the services not matching the quality of the perceived service *("Gap 5")*. The discrepancy will be greater the greater the sum of the other gaps is. In Fig. 5.39 the

[101] Cf. Zeithaml et al. (1995). For another "gap" model specifically for delivery time quality, see Kumar and Sharman (1992).

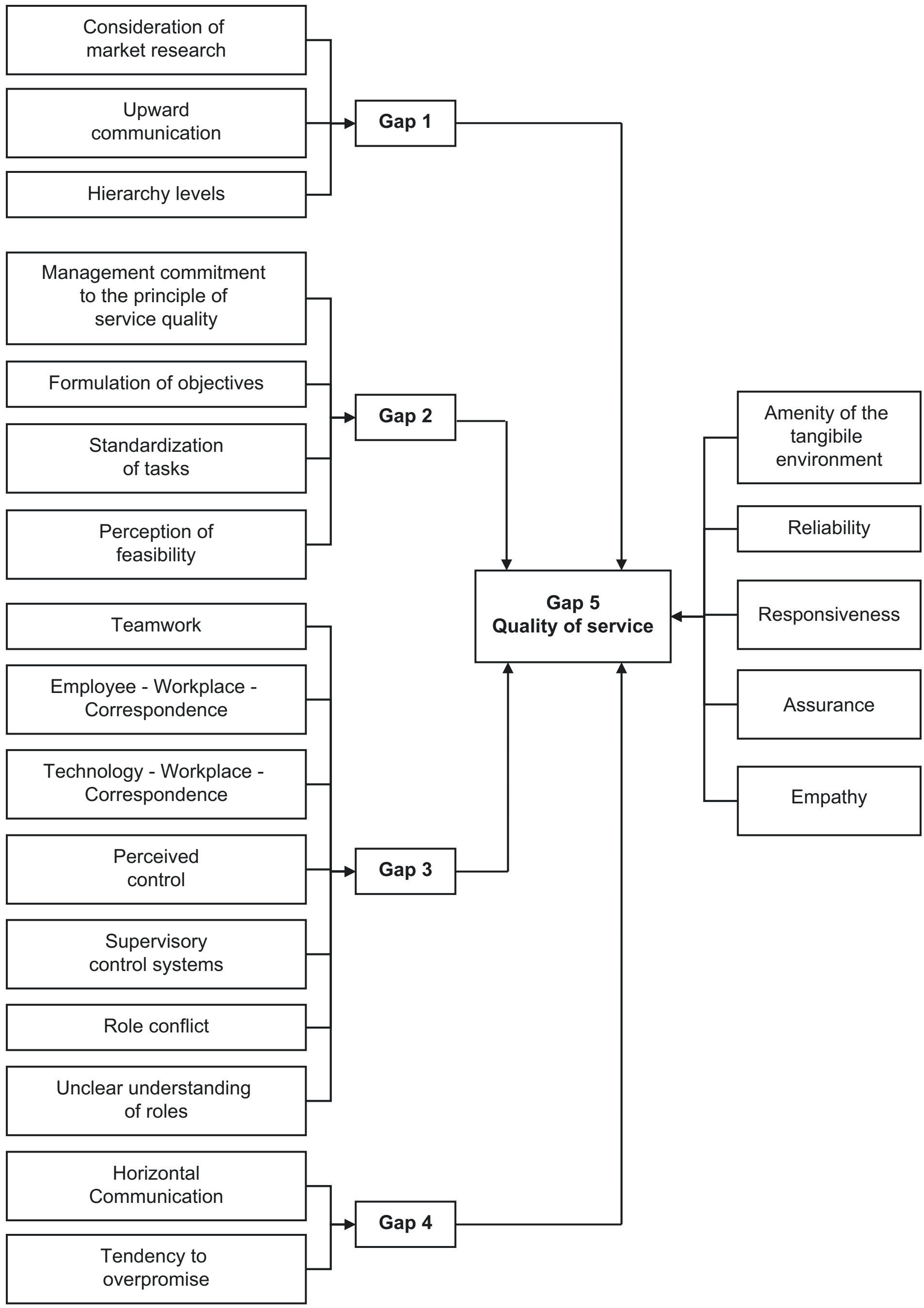


Fig. 5.39 Extended model of service quality. *Source* With minor modifications taken from Zeithaml et al. 1995, p. 155

influencing factors of these gaps are summarized. The model can also be used for weakness and cause analysis.

"Gap 1" is the discrepancy between the actual customer expectations and the customer expectations perceived by the management. The customer expectations depend on the customer's needs, the customer's past experiences with service quality, the word-of-mouth communication of the customer with other people who have experiences with service quality, and the communication of the company with the customer about service quality. "Gap 1" will be greater the less market research is taken into account in the company, the less communication from bottom to top in the corporate hierarchy takes place and the greater the number of levels of the corporate hierarchy is.

"Gap 2" is the discrepancy between the customer expectations perceived by the management and their implementation in quality-specific target values for the specification of service quality. This discrepancy will be greater the less the management is committed to quality thinking, the less attention is paid to the formulation of objectives in connection with service quality, the less the tasks for providing the service are standardized and the less the managers consider the fulfillment of customer expectations as feasible.

"Gap 3" is the discrepancy between the target values (specifications) of service quality and the service actually provided. It will be greater the less the employees feel organizationally committed to teamwork, the less the qualification of the employees matches the tasks to be performed, the less the technology used matches the tasks to be performed, the less the employees with customer contact are allowed to perform their tasks independently, the less the outcome controls of the employees with customer contact are supplemented by behavioral controls, the more role conflicts the employees with customer contact are exposed to at the interface between the company and the customer and the less clearly these employees understand the role they have to perform.

"Gap 4" is the discrepancy between the service provided and the information communicated to the customer about this service in the communication policy of the marketing. This discrepancy will be greater the less communication takes place between the employees who perform these communication tasks and the employees who have to create the service, and the greater the tendency to exaggerated promises is.

"Gap 5" serves as a measure for the service quality. If the service expected (target value) and perceived (actual value) by the customer match or the actual value exceeds the target value, then there is a good service quality. If the actual value is below the target value, the service quality is not satisfactory.

The customer's assessment is based on the evaluation of five *dimensions of service quality.* These are the material surrogates ("Tangibles") of the service (e.g. condition and cleanliness of the delivering truck), the reliability ("Reliability") of the service promise (e.g. delivery reliability), the willingness to perform or the reactivity ("Responsiveness") of the provider (e.g. short-term response to an inquiry about delivery capability), the service competence ("Assurance") of the provider (e.g. advising the customer on solving his logistical problems) and the empathy ("Empathy") for the individual customer situation combined with the willingness to take care of the customer problems. These dimensions

How important is ...		
Criterion	un-important	very important
	1	7
Order processing	○ ○ ○ ○ ○ ○ ○	
Flexibility (ability to respond to special requests)	○ ○ ○ ○ ○ ○ ○	
Readiness for delivery (availability)	○ ○ ○ ○ ○ ○ ○	
Delivery accuracy (exactness of type / quantity, correct location, ...)	○ ○ ○ ○ ○ ○ ○	
Delivery time (duration from order placement to delivery)	○ ○ ○ ○ ○ ○ ○	
Information interface	○ ○ ○ ○ ○ ○ ○	
Delivery reliability (compliance with delivery commitments)	○ ○ ○ ○ ○ ○ ○	
Problem solving (quick remedy for questions, complaints, ...)	○ ○ ○ ○ ○ ○ ○	
Repurchase of goods (returns, packaging returns, ...)	○ ○ ○ ○ ○ ○ ○	
Other		
....	○ ○ ○ ○ ○ ○ ○	
....	○ ○ ○ ○ ○ ○ ○	

Fig. 5.40 Likert scale for assessing the importance of delivery service components

are measured using a standardized questionnaire, whereby the expected and perceived values are each recorded on a Likert scale. A critical point to be made about this way of measuring service quality is that customers tend to inflate their expectations when they do not have to consider any restrictions when expressing them.

There are many methods for measuring customer satisfaction.[102] In the following, selected methods for measuring customer satisfaction with the delivery service are discussed. Simpler than measuring service quality as the difference between expected target and perceived actual values on a Likert double scale is the *direct assessment of service quality* by the customer on a simple Likert scale. Usually, five- or seven-point scales are used, whereby it is not yet clear how the different verbal descriptions of the extreme points (e.g. much better than expected—much worse than expected or excellent—very bad) affect the result of the study. Figure 5.40 shows a seven-point Likert scale for determining the importance of delivery service components. Similarly, a Likert scale can also be used to determine the assessment of satisfaction with the quality of delivery service components. Permissible measures and procedures for evaluating such data collected on ordinal scales are the median, the percentile, the rank correlation and the sign test.

A widely used approach to delivery service analysis due to the good computer support is the *conjoint analysis*, in which the customer does not evaluate individual delivery ser-

[102] See Homburg (2011) for this.

vice components, but the combination of several components, i.e. a delivery service mix. This allows to determine the partial utility of the individual delivery service components with different delivery service levels, the total utility of the delivery service and the relative importance of the delivery service components with respect to the total utility.

Another method for obtaining information about the quality of the offered delivery service is the *critical incident method*. Here, the customers are asked by means of open questions about particularly positive or negative experiences in connection with the ordering and delivery of a product. Based on the problem list generated in this way, the customers are then asked to rate the supplier according to the frequency of occurrence and the annoyance of the problem as well as the effectiveness of the management to handle the problem.

An alternative to the survey as a data collection method, on which the approaches presented so far in the delivery service analysis are based, is first the *secondary statistical evaluation* of existing information. This method requires that there is information material available in a company that can be evaluated with regard to the delivery service at all, e.g. information about changes in order intake after a change in delivery time while keeping all other instruments of the marketing policy constant. This is likely to be the reason why this method fails in general.

Another alternative is the *field experiment*. In such an experiment, the supplier changes, for example, his delivery time in a submarket and observes the customer's reaction to this change. For fear of losing customers in the course of the experiment due to a deterioration of the delivery service level, companies will very rarely decide to conduct a field experiment.

A final alternative is the *simulation,* i.e. the computer experiment. The simulation has the advantage that one can play through any number of delivery service levels to determine their impact on demand. However, the creation of such a simulation model requires a precise knowledge of the criteria on which the customer's reaction to delivery service changes depends.

5.9.4 Process Analysis

The delivery service as a measure of the logistical service quality is the result of the logistical service creation process. The production of a certain service quality requires a corresponding quality in the sub-processes of the service creation. Such a *process-oriented quality understanding,* according to which the quality is not only controlled into a good at the end of the service creation process, but is produced in partial steps from the beginning of this process, is a characteristic of a modern quality management.[103] The earlier a defect is detected in the process of service creation, the lower are the defect elimination costs. In the production of material goods, one speaks of the "tenfold rule

[103] See Part IV, Sect. 11.1.

Sub-process	Probability of an error-free sub-process (example)	Cumulative probability
• The customer recognizes the need correctly	99 %	99 %
• The customer communicates correctly with the supplier	99 %	98 %
• The supplier understands exactly the needs of the customer	99 %	97 %
• The supplier has the product available	95 %	92 %
• The supplier picks correctly and creates error-free shipping documents	99 %	91 %
• The supplier sends the order on time	99 %	90 %
• The forwarder delivers the order on time	98 %	89 %
• The customer receives the goods undamaged	99 %	88 %
• The customer registers and stores the goods correctly	99 %	87 %
• The customer receives the correct invoice and pays it	98 %	85 %
	Overall probability of an error-free overall logistics process	**85 %**

Fig. 5.41 Effect of quality defects in logistic sub-processes on the quality of the overall process. *Source* Byrne and Markham 1991, p. 166, retranslated.

of defect costs", according to which the defect elimination costs of an undetected defect increase tenfold from the stage of planning and development, to the stage of work preparation, to the stage of production and finally to the stage of arrival of the good at the customer.[104] The importance of a process-oriented quality understanding is also shown by the fact that due to the multiplicative linkage of the probability of occurrence of quality defects in the sub-processes, the probability of occurrence of quality defects in the output of the service creation process, e.g. in the delivery service, is much higher than one initially assumes. Figure 5.41 shows an example of how quality defects in parts of the logistics process affect the overall quality of the logistics process.

[104] Cf. Brands et al. (1991, p. 189).

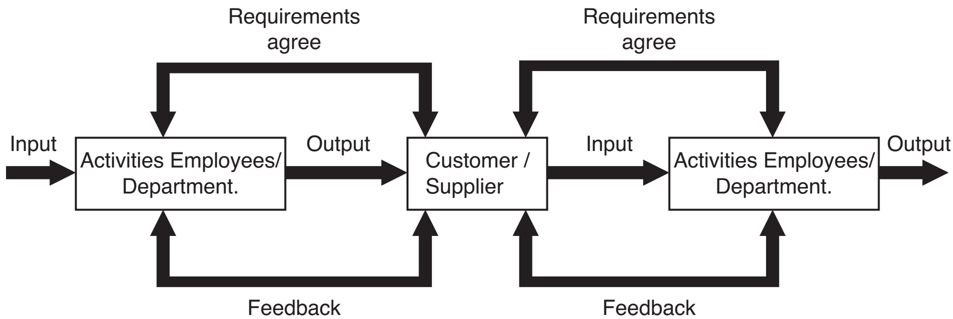


Fig. 5.42 Basic diagram of the process flow. *Source* Striening 1992, p. 159

The process analysis is based on the definition of the process as a series of activities with measurable input, measurable value creation and measurable output.[105] Figure 5.42 shows the basic process flow, whereby the terms “customer” and “supplier” are to be interpreted both internally and externally to the company. Through the *customer-supplier relationship,* i.e. the addressee linkage, the performance characteristics are determined, by which the performance result generated by the activities can be measured. Input and output can be both goods and information.

The process analysis based on the definition of sub-processes, which are linked by customer-supplier relationships, allows the detailed recording of the activity contents and sequences and the measurement of the performances of these activities with special attention to the interfaces. An illustrative scheme is the logistics chain shown in Fig. 5.43 with 13 measurement points. This measurement is of particular importance for the process costing discussed in Sect. 5.5.2 .

Another approach to process analysis is provided by the *value analysis*. The focus of the value analysis is the determination of the functions that have to be fulfilled by a sub-process and the search for possibilities of function fulfillment that cause the lowest possible costs.[106]

In logistics controlling, there are a variety of models that simplify and thus make transparent the complex business processes. Mostly, these are so-called descriptive models, such as the basic diagram of the process flow in Fig. 5.42. The typical models to support the decision making are discussed in the following section.

[105] Cf. Striening (1992, p. 158).

[106] On the concept of value analysis and its use in the field of logistics, see Jehle (1992).

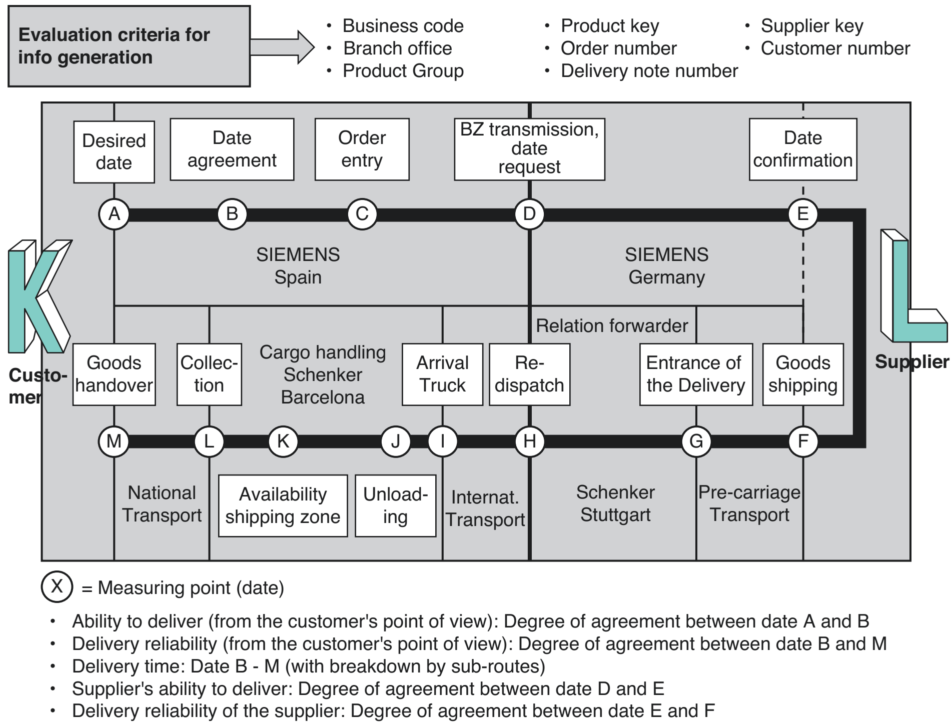


Fig. 5.43 LOGIC—Graph: Measurement points using the example of direct customer delivery via relation forwarder. *Source* With minor modifications taken from Kiesel 1996, p. 65

References

Aberle G (2009) Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 8., rev. a. ext. ed. De Gruyter, München

Baltes G (2015) New perspectives on supply and distribution chain financing: case studies from China and Europe. Eul, Lohmar Köln

Berlin S, Buscher M, Pütter JM (2014) Ökologieorientierte Unternehmenssteuerung mittelständischer Unternehmen: von der Umweltstrategie zu einem ökologieorientierten Betriebswesen – dargestellt anhand von Logistikdienstleistern. IPRI-Praxis, Stuttgart

Bläsing P (1992) Über die ISO-Norm zum Total Quality Management. Beschaffung aktuell 20(4):18–22

Brands H et al (1991) Leitfaden zur Qualitätssicherung in der Spedition. Der Spediteur 39(6):187–194

Brauer KM (1993) Betriebswirtschaftslehre des Verkehrs. 2. Teil: Leistungsbereitschaft der Verkehrsbetriebe, 2., unchang. ed. De Gruyter, Berlin

Byrne P, Markham W (1991) Improving quality and productivity in the logistics process Achieving customer satisfaction breakthroughs. Study prepared for the CLM. Council of Logistics Management, Oak Brook

Coenenberg A, Fischer T, Günther T (2016) Kostenrechnung und Kostenanalyse, 9., rev. ed. Schäffer-Poeschel, Stuttgart

Corsten H (1999) Wettbewerbsfaktor Dienstleistung: produktion von Dienstleistungen – Produktion als Dienstleistung. Vahlen, München

Engelke M (1997) Qualität logistischer Dienstleitungen. Operationalisierung von Qualitätsmerkmalen, Qualitätsmanagement, Umweltgerechtigkeit. Schmidt, Berlin

Eßig M, Hofmann E, Stölzle W (2013) Supply chain management. Vahlen, München

Ester B (1997) Benchmarks für die Ersatzteillogistik. Schmidt, Berlin

Ewers HJ (1993) Der Weg der Vernunft in der Verkehrspolitik. In: Pfohl H-Chr (Ed) Ökologische Herausforderungen an die Logistik in den 90er-Jahren. Schmidt, Berlin, S 39–56

Friedl B (1997) Logistikaudit. In: Bloech J, Ihde GB (Ed) Vahlens Großes Logistiklexikon. Beck, Vahlen, München, S 560–562

Glaskowsky N Jr, Hudson D, Ivie R (1992) Business Logistics, 3. ed. The Ronald Press Company, New York

Gomm M (2008) Supply Chain Finanzierung. Optimierung der Finanzflüsse in Wertschöpfungsketten. Schmidt, Berlin

Göpfert I (2013) Logistik: Führungskonzeption und Management von Supply Chains, 3. ed. Vahlen, München

Griepentrog H (1992) Zertifizierung, Durchbruch oder Feigenblatt. In: Little A (Ed) Management von Spitzenqualität. Gabler, Wiesbaden, S 77–82

Grupp M (2020) Factoring als Finanzierungsmodell für die Industrie – Zahlungsziel: ein Tag. Beschaffung aktuell 38(3):32–33

Günther E (2008) Ökologieorientiertes Management Um-(weltorientiert) Denken in der BWL. Lucius & Lucius, Stuttgart

Hallay H (1990) Die Ökobilanz – Ein betriebliches Informationssystem. Schriftenreihe des Instituts für ökologische Wirtschaftsforschung Nr 27/89. Berlin

Heskett JL, Glaskowsky Jr NA, Ivie RM (1992) Business logistics. Physical distribution and materials management, 4. ed. Ronald Press Company, New York

Hofmann E, Nothardt F (2009) Logistics Due Diligence. Analyse – Bewertung – Anlässe – Checklisten. Springer, Berlin

Hofmann E et al (2011) Ways out of the working capital trap. Empowering self-financing growth through modern supply chain management. Springer, Heidelberg

Holtbrügge D, Welge MK (2015) Internationales Management. Theorien, Funktionen, Fallstudien, 6., compl. rev. ed. Schäffer-Poeschel, Stuttgart

Homburg C (Hrsg) (2011) Kundenzufriedenheit. Konzept – Methoden – Erfahrungen, 8., rev. ed. Gabler, Wiesbaden

Horváth P (1992) Effektives und schlankes Controlling. Herausforderungen an den Controller. In: Horváth P (Ed) Effektives und schlankes Controlling. Schäffer-Poeschel, Stuttgart, S 1–9

Horváth P, Gleich R, Seiter M (2020) Controlling, 14., compl. rev. ed. Vahlen, München

Janzen H (1996) Ökologisches Controlling im Dienste von Umwelt- und Risikomanagement. Schäffer-Poeschel, Stuttgart

Jassmann H, Bodenstein W (1983) Steuerung von Kosten und Leistung. In: Baumgarten H et al (Eds) RKW-Handbuch Logistik. E. Schmidt, Berlin, S. Kennziffer 1620, 6. Lfg. V/83, S 1–27

Jehle E (1992) Value-Management (Wertanalyse) als Instrument des Logistik-Controlling. In: Männel W (Ed) Logistik-Controlling. Sonderheft 1/92 der Kostenrechnungspraxis, Gabler, Wiesbaden, S 68–75

Jespersen B, Skjott-Larsen T (2005) Supply chain management: in theory and practice. Copenhagen Business School Press, Copenhagen

Kaplan R, Norton D (1997) The balanced scorecard. Strategien erfolgreich umsetzen. Schäffer-Poeschel, Stuttgart

Kiesel J (1996) Performance Measurement in der Logistik am Beispiel der Siemens AG. In: Pfohl H-Chr (Ed) Integrative Instrumente der Logistik. Informationsverknüpfung-Prozeßgestaltung-Leistungsmessung-Synchronisation. Schmidt, Berlin, S 55–82

Kleer M (1991) Effiziente Gestaltung des Logistikkanals mittels Kooperation zwischen Hersteller und Logistikunternehmen – Theoretische Überlegungen und empirische Befunde. Schmidt, Berlin

Kumar A, Sharman G (1992) We love your product – but where is it? McKinsey Q 29(1):24–44

Künzer L (Hrsg) (1978) Marketing-Logistik. Transportkette. 24 der Schriftenreihe der Studiengesellschaft für den Kombinierten Verkehr e. V. Frankfurt a. M.

Küpper H-U (1989) Grundzüge der logistikorientierten Kosten- und Leistungsrechnung. Logistik Spektrum 1(3):56–59

Küpper H-U et al (2013) Controlling. Konzeption, Aufgaben und Instrumente, 6., rev. ed. Schäffer-Poeschel, Stuttgart

Lasch R (2014) Strategisches und operatives Logistikmanagement: Prozesse. Springer Gabler, Wiesbaden

Locker A, Grosse-Ruyken PT (2013) Chefsache Finanzen in Einkauf und Supply Chain. Mit Strategie-, Performance- und Risikokonzepten Millionenwerte schaffen. Springer Fachmedien, Wiesbaden

McKinnon A (2012) Environmental sustainability. A new priority for logistics managers. In: McKinnon A, Browne M, Whiteing A (Eds) Green logistics: improving the environmental sustainability of logistics, 2nd edn. Kogan Page, London, S 3–29

Meyersiek D (1981) Rationalisierungs-Reserven im Umlaufvermögen. Millionen auf Lager. Manager Magazin 6:76–81

NCPDM (1984) Measuring and improving productivity in physical distribution 1984. Prepared by A.T. Kearney. National Couincil of Physical Distribution Management. Seller: ThriftBooks-Chicago, Oak Brook

NCPDM/NAOA (Hrsg) (1983) Transportation accounting & control. Guidelines for distribution and financial management. Prepared by Ernst & Whinney and Cleveland Consulting Associates. Oak Brook

NCPDM/NAOA (Hrsg) (1985) Transportation accounting & control. Guidelines for distribution and financial management. Prepared by Ernst & Whinney and Cleveland Consulting Associates. Oak Brook

n. A. (1992) How to Benchmark Warehouse Operations. Distribution 91(1992)9:60–64.

n. A. (2006) Zoll-Management: Katz und Maus. McK Wissen 5(16):64–69

Otto A, Stölze W (2003) Thesen zum Stand des Supply Chain Controlling. In: Stölze W, Otto A (Eds) Supply Chain Controlling in Theorie und Praxis. Aktuelle Konzepte und Unternehmensbeispiele. Gabler, Wiesbaden, S 1–23

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. upd. ed. Springer, Berlin

Pfohl H-Chr, Elbert R (2002) Wertorientierte Gestaltung von Transportvorgängen mittels dynamischer Werttreiberhierarchien. Logistik Management 4(3):63–74

Pfohl H-Chr, Engelke M (1997) Der Papierkonzern STORA erstellt umweltorientierte Transportprofile. Int Verkehrswesen 49(7–8):380–382

Pfohl H-Chr, Ester B (1999) Benchmarking for spare parts logistics. BIJ 6(1):22–39

Pfohl H-Chr, Hoffmann H (1984) Logistik-Controlling. In: Albach H (Ed) Unternehmensführung und Logistik. Ergänzungsheft 2/84 der ZfB. Gabler, Wiesbaden, S 42–70

Pfohl H-Chr, Stölzle W (1997) Planung und Kontrolle. Konzeption, Gestaltung, Implementierung, 2., rev. ed. Vahlen, München

Pfohl H-Chr, Zöllner W (1991) Effizienzmessung der Logistik. DBW 51(3):323–339
Pfohl H-Chr, Gareis K, Stölzle W (1999) Logistikaudit – Einsatz für die Lieferantenauswahl und –entwicklung. Logistikmanagement 1(1):5–19
Pfohl H-Chr, Elbert R, Hofmann E (2003) Management der "finanziellen" Supply Chain: Charakterisierung – Aufgabenbereiche – Interdependenzen. In: Bundesvereinigung Logistik (BVL) e. V. (Ed) Finanzierung – eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Schmidt, Berlin, S 1–64
Reichmann T, Kißler M, Baumöl U (2017) Controlling mit Kennzahlen. Die systemgestützte Controlling-Konzeption. 9., rev. a. ext. ed. Vahlen, München
Schweitzer M, Friedl B (1992) Beitrag zu einer umfassenden Controlling-Konzeption. In: Spremann K, Zur E (Eds) Controlling. Grundlagen, Informationssysteme, Anwendungen. Gabler, Wiesbaden, S 141–167
Siravastava R, Shervani T, Fahey L (1999) Marketing, business processes, and shareholder value: an organizationally embedded view of marketing activities and the discipline of marketing. J Mark 63(Sonderausgabe):168–179
Stölzle W (1993) Umweltschutz und Entsorgungslogistik: theoretische Grundlagen mit ersten empirischen Ergebnissen zur innerbetrieblichen Entsorgungslogistik. Schmidt, Berlin
Stölzle W (2008) Logistik-Audits. In: Arnold D et al (Eds) Handbuch Logistik, 3., rev. ed. Springer, Berlin, S 1108–1115
Striening H-D (1992) Qualität im indirekten Bereich durch Prozeß-Management. In: Zink K (Ed) Qualität als Managementaufgabe (Total quality management), 2., rev. ed. Moderne Industrie. Landsberg am Lech, S 153–184
Topic M, Biedermann H (2019) Life Cycle Assessment zur Entscheidungsunterstützung bei der Gestaltung, Verbesserung und Optimierung von Produkten und Produktionsprozessen. In: Biedermann H, Vorbach St, Posch W (Eds) Industrial Life Cycle Management: Innovation durch Lebenszyklusdenken. Augsburg München, S 74–86
Trumpfheller M (2002) Implementierung der Prozesskostenrechnung zur Steuerung der Logistik in der Automobilindustrie. In: Stölzle W, Gareis K (Eds) Integrative Management- und Logistikkonzepte. Gabler, Wiesbaden, S 473–508
Tyndall GR (1984) Improving the management of distribution with financial information. In: Gallagher P (Ed) Logistics. Change and synthesis. Results and proceedings of the logistics resource forum 1984. Leaseway Transportation Corp., o. O. S 215–234
Vitasek K, Maylett TM (2011) A hard look at the soft side of performance. Supply Chain Q 5(4):26–32
von Ahsen A (2006) Integriertes Qualitäts- und Umweltmanagement. Mehrdimensionale Modellierung und Umsetzung in der deutschen Automobilindustrie. DUV, Wiesbaden
Wagner W (1977) Formalization of the customer service function in distribution. IJPD & MM 7(3):159–175
Warnick B (1993) Kosten- und Leistungsrechnung als Instrument des Leistungs- und Ressourcencontrolling. Kostenrechnungspraxis Sonderheft 1:25–35
Weber J (2002) Logistikkostenrechnung. Kosten-, Leistungs- und Erlösinformationen zur erfolgsorientierten Steuerung der Logistik, 2., compl. rev. a. ext. ed. Berlin
Weber J, Schäffer U (2020) Einführung in das Controlling, 16., rev. a. act. ed. Schäffer-Poeschel, Stuttgart
Weber J, Wallenburg CM (2010) Logistik- und Supply Chain Controlling, 6., compl. rev. ed. Schäffer-Poeschel, Stuttgart
Wehberg G (1997) Ökologieorientiertes Logistikmanagement. Ein evolutionstheoretischer Ansatz. Wiesbaden

Werner H (2017) Supply Chain Management: Grundlagen, Strategien, Instrumente und Controlling. Deutscher Universitätsverlag, Wiesbaden

Winkler H (2005) Konzept und Einsatzmöglichkeiten des Supply Chain Controlling. Am Beispiel einer Virtuellen Supply Chain Organisation (VISCO). Deutscher Universitätsverlag, Wiesbaden

Yahsi B (2017) Financial Supply Chain Management: Erfolgsfaktoren der Gestaltung von Finanznetzwerken. Diss. Technical University of Darmstadt

Zeithaml V, Berry L, Parasuraman A (1995) Kommunikations- und Kontrollprozesse bei der Erstellung von Dienstleistungsqualität. In: Bruhn M, Stauss B (Eds) Dienstleistungsqualität. Gabler, Wiesbaden, S 131–160

Zeterberg U (1989) Ziele und Aufgaben des Logistik-Controlling. In: Baumgarten H et al (Eds) RKW-Handbuch Logistik. Schmidt, Berlin, S. Kennziffer 1540; S 1–20

6 Logistics and Model-Based Decision Making

6.1 Modeling of Logistics Systems

6.1.1 Model and Reality

Models are *simplified representations* of reality.[1] Humans create such simplifications because reality is too complex for the relatively limited capacity of human information perception and processing.

In order to reduce the complex facts of reality to their relevant basic structures, a real system is transformed into a model in an abstracting, simplifying way in the process of modeling or model building. Depending on the building blocks from which a model is created, one distinguishes iconic (e.g. scaled-down representation of a high-bay warehouse using Lego bricks), analog (e.g. the representation of inventory levels in the logistics chain in the form of a hydraulic system) and symbolic models. The latter are by far the most important models in business administration, whereby mathematics is used as the model language to capture the interesting properties of the elements of the real system to be depicted and the relationships between them.

How the modeling is integrated into the *process of model-based decision making* is shown in Fig. 6.1. In a first phase, which can be called the first structuring level or problem definition, the problem is verbally defined. This results in a conceptual model, in which the elements of the real problem situation that are considered essential with their properties and the relationships between them are verbally mapped. In a second phase, which can be called the second structuring level or model building in the narrow sense, the verbal formulations are transferred into the mathematical language of the formal

[1] Cf. Pfohl and Stölzle (1997, p. 52 f.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_6

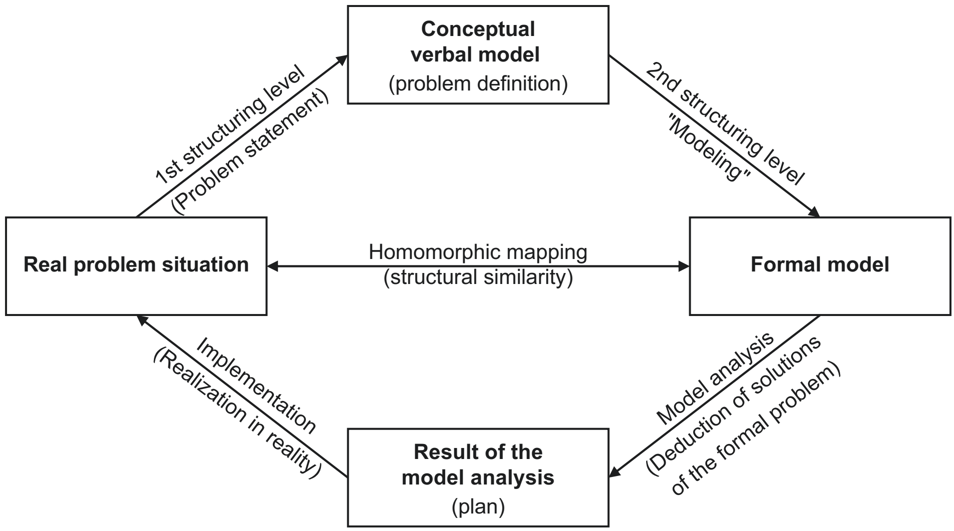


Fig. 6.1 Phases in the process of model-based decision making

model. The result is a homomorphic representation of the real problem situation, in which the basic structure of the problem is reflected. The necessary problem simplification leads only to a structural similarity between the real problem and the model and not to a structural identity (isomorphic model). In a third phase, which can be called model analysis, solutions for the formal problem are derived using quantitative methods. The selected solution as the result of the model analysis is the plan for the solution of the real problem. The implementation of this plan into reality takes place in a fourth phase, which can be called implementation. It leads to the solution of the real problem.

6.1.2 Model Types

The model types represent another possibility to classify models besides the type of model building.[2] According to this, *descriptive models* have the weakest informative value. They depict empirically observable relationships without explaining them. The statements have only descriptive character. Causal relationships are depicted by *explanatory models* (causal models). They contain cause-effect relationships between independent and dependent variables, i.e. the dependent, endogenous variable is causally explained by the independent instrumental variable. A reversal of the perspective leads to

[2] Cf. Pfohl and Stölzle (1997, p. 52 f.) see also Arnold et al. (2008, p. 36 f.) for the classification of models.

a *forecasting model,* i.e. from alternative courses of action for the independent variables, the effects on the dependent variables can be predicted ("what-if" query). *Decision models* are distinguished from the ones described so far by the fact that they contain not only the relations between the elements but also target relations. They are intended to derive action rules that prescribe specific behaviors for achieving the objectives. In contrast to "what-if" queries, decision models perform the evaluation and selection of action alternatives themselves.

6.1.3 Data Problems

The for logistics models required data cannot be easily retrieved in the required quantity and quality in business practice. The collection and processing of the data is often a very *time- and cost-intensive problem* and can affect the efficiency of the model support in the decision preparation.

At the center of the data collection in the form of state and movement variables are the item and order structure as well as the way of order processing and the related goods flows. *State variables* describe the time-related state of a logistics system. Typical state variables for the item data are, for example, item number, description, dimension, weight, inventory, packaging or loading aid assignment. For the order data, they are, for example, inflows and outflows per position, order date, order number, order type, position number, item number of the order positions and shipping method. From these variables, further state data can be determined using calculation and aggregation methods. Such item data are, for example, item group, range per item group or safety stock. Aggregated order data are, for example, weight per order, volume or loading meter or positions per order as well as number of withdrawals. *Movement variables* are time-related and describe processes occurring in the logistics system. For the item data, these include, for example, the storage and retrieval per unit of time, for the order data, for example, number per unit of time, volume per unit of time or shipping units per unit of time.

A particularly serious problem regarding the data quality for the use of logistics models is the determination of the *decision-relevant costs*. Because the allocation of costs to decision alternatives generally influences the determination of the optimal alternative more than any measures to change the model, for example, to be able to map more complex relationships. An example of this is the model-based determination of the optimal order quantity.[3] Decision-relevant are the variable costs of procurement and storage with the order quantity. Since these costs are often not directly available, the easier to determine average costs are also used as a substitute in the order quantity model. How-

[3] Cf. Pfohl (2022, p. 97). The importance of data quality for inventory management is demonstrated by Glock (2020).

ever, this can lead to significant deviations from the optimal order quantity determined with the decision-relevant costs. Significant deviations occur when the proportions of fixed costs to the average costs of procurement and to the average costs of storage differ greatly from each other, or when the fixed costs are taken into account for one of the two types of costs, but not for the other. Compared to high fixed cost shares in the procurement costs, the calculation of the optimal order quantity using average costs leads to larger order quantities, lower order frequency and higher inventory levels.

The principle of allocating decision-relevant costs can be easily illustrated using the example of the decision on the transport variant to be chosen:

- *Full cost comparison*: For the new planning of a company or for the decision on replacement investments, as well as for full utilization of the company's own transport capacities also for expansion investments, full cost calculations must be carried out for the external transport problems. For example, the full costs of using the transport service from forwarding companies and the full costs of an own fleet are compared.
- *Full cost-marginal cost comparison*: This cost comparison is always appropriate when, in the case of an increase in transport volume, the decision has to be made whether existing transport capacities are additionally utilized or whether new transport means are used. Based on a full cost-marginal cost comparison, it must be clarified, for example, whether with an increased transport volume, with an existing rail connection and own freight cars, free capacities of the freight cars are utilized or whether the use of new trucks to be purchased is considered. In this case, the full costs of the new trucks to be purchased would have to be compared with the marginal costs of the increased utilization of the company's own freight car capacities.
- *Marginal cost comparison*: The marginal cost comparison is used when different own transport means with free capacities are available, and an increase in transport volume is to be allocated to the most cost-effective transport means. The transport means with the lowest marginal costs for the additional transport volume is the most cost-effective.

The solution of the data problem is a necessary prerequisite for the efficient use of models for decision support. The selection of a suitable model should be both problem- and method-oriented.

6.2 Problem-Oriented View of Logistics Models

A classification of formal logistics models—hereafter called logistics models—can be done problem-oriented and method-oriented. The problem-oriented classification is done according to typical logistics problems. Despite the diversity of logistics problems, there are three types of models that are based on sophisticated theories and represent pioneering modeling concepts for logistics systems: The graph model, the operation model and the system dynamics model.

In the *graph model*, the logistics system is mapped in its spatial structure as a graph, which is determined by a set of distinguished points (nodes) and connections between the points (edges).[4] Between the nodes, goods and information flow (movable elements), whereby capacity constraints have to be considered when occupying nodes and edges. Storage processes enable a temporal change of goods and information. Goods and information flows can be brokenup or consolidated at points. There are various interdependencies between extraction, goods transformation and goods provision processes. The following elements, whose typical characteristics are summarized in Fig. 6.2, can be distinguished in physical goods flow systems:

Fixed, technical elements (also called facilities):

- Sources and sinks, which generate demand or supply for a spatial and/or temporal change of goods
- Storage elements, which decouple goods flows and change movable elements temporally in a targeted way
- Queueing elements, which absorb movable elements in case of randomly occurring disturbances or delays
- Branching elements, which merge or split flows (collecting and distributing elements)
- passive connection elements, which establish connections between the aforementioned elements (tracks, roads, etc.)
- active connection elements, which realize the transformation process of goods (vehicles, conveying and handling equipment)
- information gathering elements, which identify movable elements
- information transmitting elements, which are responsible for the spatial change of information
- information processing elements, which transform information according to given rules
- information storing elements, which store information
- information displaying elements, which present information visually or acoustically about and for the process flows.

Movable elements (also called activators):

- Goods
- Information
- The active connection elements can also be regarded as movable elements, if they, and not the individual goods, are the subject of the control of the flows.

[4] Cf. Lucke (2001, p. 33 ff.).

Elements	Qualitative characteristics	Quantitative characteristics
Movable elements (activators)	• Variety • Rank • Compatibility	• Dimensions • Quantity
Sources and sinks	• Accessibility • Working regime	• Location coordinates • Volume and demand
Storage elements Queueing elements	• Accessibility • Handling sequence	• Capacity (absorption capacity)
Branching elements	• How it works	• Occupied time
Passive connection elements	• Sequence change option on the element	• Dimensions of the connections • Load capacity
Active connection elements	• How it works • Workspace • Admission/delivery capability • Suitability	• Dimensions • Loading capability • Movement parameters
Information gathering elements	• Measured variables • Form of information gathering	• Capture capability • Dimensions
Information transmitting elements	• Transmission principle • Terminals	• Transmission speed
Information processing elements	• DP-scope of functions	• Processing speed • Dimensions
Information storage elements	• Storage medium	• Storage capacity • Access time
Information display elements	• Output medium	• Dissolving capability • Dimensions

Fig. 6.2 Elements of logistics systems as a basis for graph models. *Source* Adapted from Lucke 2001, p. 37

Typical questions, whose answer the graph model supports, are the optimal arrangement of the nodes, the maximum flow or the shortest path through the network represented by the graph.

The *operation model* (queueing model) is shown in its basic structure (system structure) in Fig. 6.3. From the sources, objects arrive in the form of customers or orders at a operation station. If the operation station is already occupied, they queue up in front of it in the form of a queue. After the operating, the objects leave the system at the sinks. Sources and sinks are the interface points of the considered logistics system with the environment. Three processes characterize the operation model, namely the arrival, stay and operating process of the objects. For each of these sub-processes, there are quantities (system parameters) that specify them exactly. System structure and system parameters

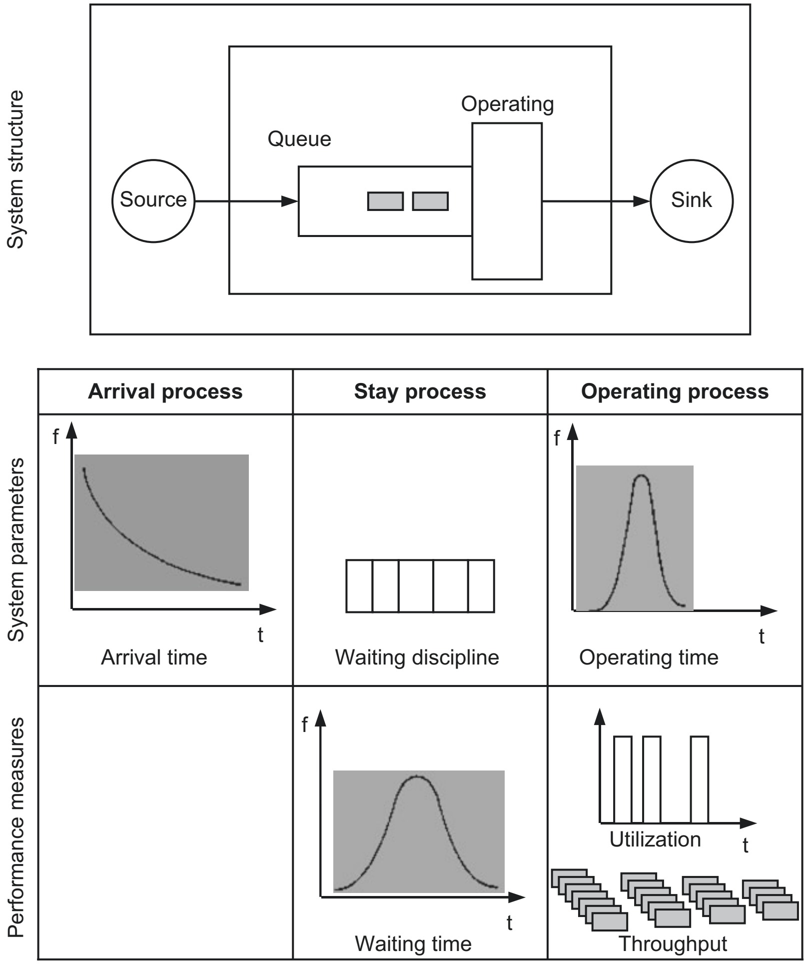


Fig. 6.3 Structure of a operation model

determine the system behavior, which can be described by performance measures. Usually, the parameters of the arrival and operating process are known and performance measures for the stay process, e.g. the waiting time, are to be determined from them.

Graph- and service model can be used as a complement to the analysis of logistical problems, as the example shown in Fig. 6.4 illustrates.[5] Six machine workstations are supplied and disposed of by an electric overhead conveyor system, whereby each workstation is both a source and a sink of the transport system.

[5] Cf. Großeschallau (1984, p. 8 f.).

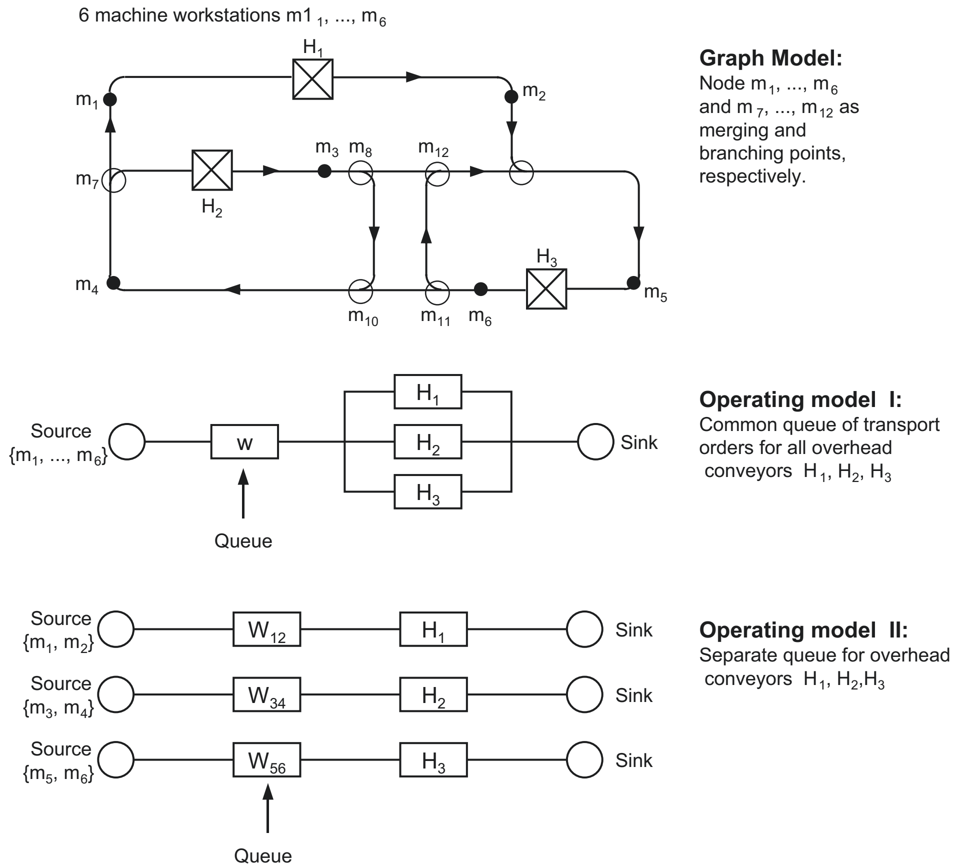


Fig. 6.4 Example of the representation of a material flow system in the graph and operation model. *Source* Großeschallau 1984, p. 8

For the optimal control of the overhead conveyor systems, the structure of the rail system is of interest. The machine workstations as well as the merging, branching and crossing elements can be represented as nodes and the connecting sections as edges of a graph. Then, for example, the shortest paths between the workstations can be calculated.

For the dimensioning of the buffer capacities behind the workstations, on the other hand, the average waiting time of a transport order is of interest. The machine workstations can be regarded as sources of transport orders and the overhead conveyors as operation stations. Then, the waiting times can be calculated for known interarrival time distributions and operating time durations by the overhead conveyors. Since the waiting time and the queue length depend on each other, the required buffer capacity can be calculated.

The *System Dynamics model* developed by Forrester is used to analyze the behavior complex of dynamic systems.[6] In the business application of the model, the companies are depicted as a system of feedback loops, in which the business functions are captured and simulated. The analysis is carried out dynamically in the System Dynamics model, because time-dependent behavioral reactions are taken into account. Social systems are considered as information feedback systems, whereby the feedback loop is the central structural component in the focus of analyses and syntheses. The System Dynamics model allows to depict essential characteristics of the structure of logistics systems and thus to simulate typical behavior patterns for logistics systems. The main variable types of these logistics models are stocks and flows. Stocks of goods, materials or information are time-dependent states that result from ongoing activities, such as procurement or production processes. The control of the activities is mainly based on information about goals and states. In the various system processes, delays and amplifications occur, which influence the temporal course of the system variables. According to the System Dynamics law, for example, the demand fluctuation increases with each order transmission, if the original demand (final demand) is passed on through a series of inventory buffers, whereby a decision to replenish the inventory is made in each inventory buffer. This phenomenon, also known as the "Forrester effect", contributes to the so-called "bullwhip effect" (whiplash effect)[7]. Due to the higher variance of the orders to the suppliers compared to the variance of the sales to the customers, there is a distortion of the demand. This manifests itself in strong fluctuations of the inventory levels on the upstream value-added stages.

The main cause is the lack of transparency of the actual demand of the customers, which leads to misinterpretations regarding the future needs. Furthermore, as a consequence, high inventories of semi-finished and finished products in the supply chain as well as tendentially overcapacities occur. At the same time, however, temporary delivery difficulties arise. Model-based analyses can help to clarify the underlying coordination problems at the interfaces.

In addition to the three basic types of logistics models presented, there are a multitude of logistical problems that are suitable for representation in logistics models. The field of logistics can even be regarded as the *traditional area of application* for the quantitative model analyses of *Operations Research*. Particular attention was paid to the requirement and lot size planning, the location planning and the transport planning.[8] In transport planning, the term "Milk Run" summarizes tour planning systems that are designed as a round trip in analogy to the formerly common collection of milk.

---

[6] Cf. Campuzano and Mula (2011).

[7] For an overview of the causes of this effect, see Schulte (2017, p. 24 f.).

[8] Cf. Domschke and Drexel (1996); Domschke and Scholl (2010).

6.3 Method-Oriented View of Logistics Models

The method-oriented classification is based on the different quantitative methods for deriving solutions in the model analysis. A method is defined as an ordered procedure or process specification for achieving a goal.[9] In the classification of solution methods for deriving solutions for a formal problem in the context of model analysis, a distinction is made between exact and inexact methods.[10] *Exact methods* are those in which there is no doubt about the content or the order of the steps to be taken to find a solution. The finding of the optimal solution or the arbitrary approximation to the optimal solution is guaranteed by exact methods. They are therefore also called optimization methods. *Inexact methods* are those in which the optimal solution or the approximation to it is not guaranteed, because heuristics are used to derive solutions, which are based on empirical knowledge, analogies and plausible assumptions. They are therefore also called heuristic solution methods. The *simulation method*, which means a purposeful experimentation with models in the context of model analysis, can include both exact and inexact methods. Optimization methods, heuristic solution methods and simulation methods can be used in the model analysis of logistics models. The models are then accordingly called optimization models, heuristic models or simulation models.

6.3.1 Optimization Models

Optimization models are basically always applicable when well-structured decision problems are to be represented in the formal model. A problem is called well-structured when the number of action alternatives is known for a decision situation, quantitative information about their effects is available, clearly formulated goals exist and there is a practicable solution algorithm.

The simplest optimization method is the complete enumeration of the solution alternatives. The best one can then be determined by comparison. For example, if a customer can be supplied from three different warehouses and only the transport costs from the warehouse to the customer are to be considered in the decision about the assignment of the customer to a warehouse, the alternative with the minimal costs can be easily determined by comparing the three alternatives. For more complex problems, methods of mathematical programming, such as linear or nonlinear programming, integer programming, dynamic programming or stochastic programming, are to be applied.

The most obvious *advantage*[11] is the guaranteed finding of the best solution of a problem or the arbitrary approximation to it. One does not have to worry about possibly not

[9] Cf. Pfohl and Stölzle (1997, p. 127 f.).

[10] For method-oriented modeling of logistics systems, see also Arnold (2008, p. 428).

[11] Cf. Klein and Scholl (2012, p. 460 f.).

having considered a relevant decision alternative. Meanwhile, more complex problems can also be optimally solved with the various forms of mathematical programming. Due to the possibility of taking into account, for example, all kinds of costs (fixed or variable, linear or nonlinear) and constraints of various kinds for the available production factors, the "trade-offs" in the logistics system can be captured simultaneously and thus the optimal solution can be determined. Another advantage is the very efficient decision support by the optimization model. Because the optimization methods generate all possible solution alternatives and select the best one, without the model user having to invest time in the solution process. A final advantage is also that one is sure to always use the optimal solutions when comparing the solutions for variations in the problem formulation in the context of a sensitivity analysis.

The biggest *disadvantage* of optimization models is that they cannot be applied when logistics problems become too complex due to their combinatorial nature.[12] A good example of this are tour planning problems, where a large number of vehicles have to visit a large number of customers, while a large number of constraints (e.g. predefined time windows for delivery at the customers) have to be considered. Another disadvantage is the "black box syndrome" of the model user. Since many logistics managers do not have a deeper knowledge of mathematical programming, they do not understand the process of selecting the optimal alternative and distrust the optimization model. If too many simplifying assumptions are made in the formulation of the logistics model to reduce the complexity and to be able to apply optimization methods for model analysis, a disadvantage is finally that the optimal solution is too unrealistic to be implemented.

6.3.2 Heuristic Models

Poorly-structured problems, in which, unlike well-structured problems, e.g. clear goal criteria are missing or not all contexts are known, can be mapped using heuristic models. Heuristic methods include a number of heuristic principles that support the search for a solution to a problem. This is usually done by reducing the number of potential solution alternatives. This shortens the time to find a satisfactory solution, but prevents the guarantee of finding the optimal solution. The performance of heuristic models depends crucially on the quality of the heuristic principles. However, it is difficult to determine this quality, as the principles are generally very problem-specific and a comparison with other methods of model analysis is hardly possible in the practical case. The following are some examples of heuristic principles in logistics models[13]:

[12] Cf. Herrmann (2010, p. 71).

[13] Cf. Ballou (1998, p. 504 ff.).

Network planning

- Locations of distribution warehouses are mainly in or near demand centers.
- Customers who should be supplied directly from the factory warehouse and not indirectly via distribution warehouses are those who buy whole carloads.
- A product should be delivered via a distribution warehouse if the difference between the costs of warehouse supply and the costs of delivering to the customer justifies the additional costs of the warehouse.
- When expanding a network, the distribution warehouse that causes the greatest cost savings should be added.
- The most expensive customers in terms of delivery costs are those who buy small quantities and are located at the end of a delivery tour.
- Products that are suitable for Just-in-Time delivery are those where the fluctuations in demand and replenishment time are low.

Tour planning

- Customers who are close to each other (stops, unloading points) are grouped into clusters until the capacity of the delivery vehicle is exhausted. Then the formation of the next cluster begins. Collection trips are often referred to as "Milk Run".
- According to the "Savings" heuristic, each customer to be supplied is initially assigned a delivery vehicle. For each customer, there is therefore a separate tour. Then, two customers are combined into one tour, where the greatest saving in transport distance is achieved. This process is repeated until the capacity of a delivery vehicle is exhausted.
- When determining the order in which the customers assigned to a delivery vehicle are to be approached, the shape of the drop should be followed and the crossing of tours should be avoided.

Planning of storage locations for items in the warehouse[14]

- The higher the withdrawal frequency of items is, the closer they should be stored to the shipping place.
- The larger the volume of the sales unit of items is, the further away they should be stored from the shipping place.
- The lower volume-per-order indices of items are, the closer they should be stored to the shipping place.

[14] Cf. Pfohl (2022, p. 120 ff.).

6.3.3 Simulation Models

Simulation models are based on a special method of experimentation, in which the behavior of systems is described by means of a quantitatively formulated model, taking into account the time factor—such as in the system dynamics model.[15] By changing the parameters or variables that are important for the model, the system is captured in different states by means of simulation. Each alternative state of the system can thus be explicitly represented. The results of the alternatives can then be compared. A simulation model can therefore not generate an optimal solution alternative. It is rather used in the form of so-called "what-if" forecasting models to show the consequences of individual alternatives given by the decision maker. The simulation results generated on the basis of test runs then allow the decision maker to select the most favorable alternative with regard to his or her goals.

In a simulation model of a logistics system, the transactions occurring in the system over a certain period of time, such as order transmission or delivery of goods, are described. The *advantage* of the simulation model lies firstly in the fact that the demand causing these transactions can be represented stochastically and that the decision rules affecting the transactions can be realistically incorporated into the model. Furthermore, it is possible to break down the costs and capture them by means of several different fixed and variable, linear and nonlinear cost functions. In this way, unrealistic assumptions in the construction of the model are much less necessary compared to the models based on other solution methods. Reality can be depicted with much more detail than in the other models and then analyzed by means of performing a large number of alternative calculations.

The *disadvantage* of applying the simulation methods lies in the fact that the necessary analysis of the logistics system requires a great deal of effort and that the procurement of the necessary data is usually very difficult. For very complex systems, simulating all possible alternatives as a basis for determining the most favorable alternative may prove to be impossible.

Simulation models have a very broad *range of applications* in logistics.[16] Typical applications are in the planning of logistics networks and channels, in the planning of delivery service levels, and in the planning of inventory or operating resources capacities. The model analysis here not only refers to the logistics costs, but also to the

[15] Cf. Rose and März (2011, p. 13 f.).

[16] Cf. Eley (2012, p. 129 f.) A stress test with a simulation model regarding the resilience of supply chains is proposed by Simchi-Levi and Simchi-Levi (2020). Testing automated systems of intralogistics with a simulation model, in which the real system is mapped as a digital twin, supports their start-up commissioning. The replication of such systems is called emulation and is regulated by the VDI guideline 4497. See Bös and Schmidt (2020) for this.

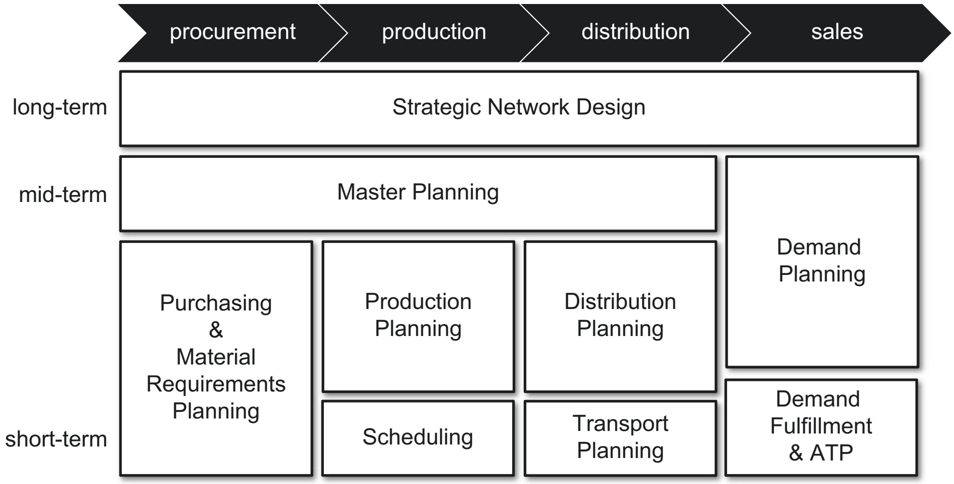


Fig. 6.5 Task spectrum of Advanced Planning Systems. *Source* Meyr et al. 2015, p. 100

relationships between service and costs as well as to the impact of logistics system alternatives on the profit.

A modular system for various simulation tasks and techniques for supply chains and logistics tasks, transport and warehousing, as well as manufacturing and production is AnyLogic.[17] On the company's website, a number of application examples (e.g. in the area of route planning, warehousing) can be tried out online.

In the development of the use of simulation models in logistics, four trends can be identified. According to the increasing importance of cross-functional and cross-company logistics systems, more comprehensive, integrative models are developed. Due to the greater performance of the decentralized computers available to the logistics managers, simulation models are used more frequently and regularly. This use also occurs not only for planning purposes, but also to support decisions in the ongoing operation of the logistics system, i.e. to steer logistics processes. Furthermore, simulation models are increasingly used in the training and further education of logisticians to promote the understanding of the logistics system interrelationships.

[17] https://www.anylogic.de

6.4 Interdisciplinary Model Building

As value creation networks become more global and complex, companies need to be able to master their network of international suppliers and sub-suppliers as well as their globally distributed production sites and markets. In order to manage the interplay of production, logistics and transport with its complex interfaces, extensive planning and control systems are already used today. To prevent the problem that a suboptimal overall performance of the supply chain is achieved by the isolated optimization of individual areas, an interdisciplinary model building and decision support is necessary. Interdisciplinary means both the company-wide integration of the different functions of procurement, production, sales and the cross-company involvement of the different actors in the supply chain, industrial, trade and logistics companies as well as public authorities. A first approach to this are Advanced Planning Systems (APS).

6.4.1 Advanced Planning Systems (Top-Down Approach)

Advanced Planning Systems are hierarchically structured, following the top-down approach of model building. They complement the PPS and ERP systems, to support the cross-location and cross-company planning, control and monitoring of the value chain. The basic structures of the various software solutions offered on the market can be traced back to a basic model.[18] Through a modular structure, they offer an integrative support of the cross-company planning and control. Fig. 6.5 shows the task spectrum of APS.

The *strategic network planning* ("Strategic Network Design") determines the configuration of the supply chain and thus sets the foundations for the other planning modules. This includes the determination of production and sales program, material program, locations of production and storage facilities, the distribution and procurement structure, as well as the strategic cooperations. The planning problem is characterized by the linkage of spatial and temporal aspects. The planning quality of the strategic network planning has a significant influence on the planning quality of the subordinate planning levels. Therefore, it is advisable to include expert knowledge through qualitative research methods, such as brainstorming or discussion rounds, in the modeling, in order to create a balance between the necessary realism and a manageable model complexity.[19]

The *demand planning* ("Demand Planning") forecasts the demanded product quantities and the required safety stocks to ensure a defined service level. Of particular importance is the measurement and monitoring of the forecast quality as well as the selection

[18] Cf. Meyr et al. (2015, p. 99 ff.) For the forms of cross-company planning in general, see Pfohl (2003).

[19] Cf. Meyr et al. (2015, p. 117).

of an adequate forecasting method and the parameter estimation. The results of the forecast are provided to the other APS modules in aggregated form.

In the network-related *master production program planning* (“Master Planning”), the coordinated procurement, production and distribution quantities are determined, taking into account the capacity demand and supply with the objective of minimizing total costs. The network-related master production planning fulfills important coordination tasks through its central control in the hierarchical planning system of the APS. For the purposeful alignment of the subordinate sub-plans, it is necessary to pay special attention to the possible sources of error in the model building. This is especially true for the aggregation of the data.

The *material requirements planning* (“Purchasing & Material Requirements Planning”) supports decentralized planning tasks, such as e.g.

- the supplier selection
- the program- and consumption-driven material disposition
- the order quantity planning
- the planning of material safety stocks
- the order triggering (e.g. in the case of “Vendor Managed Inventory” (VMI)).

The *production rough planning* (“Production Planning”) determines feasible company-related production plans on the basis of the data from the master production program planning as well as situation-dependent and -independent data from the other planning modules. These form the basis of the *production fine planning* (“Scheduling”), which includes the machine occupancy planning.

The *distribution planning* (“Distribution Planning”) supports the planning of the allocation of final product quantities and thus the coordination of production plan and demand. As a result, it provides information about the medium-term expected transport flows and storage quantities in the corresponding time windows and regions. The goal is to minimize the storage and transport costs.

The specifications from the modules material requirements planning and distribution planning are used in the module *transport planning* (“Transport Planning”) to generate the transport plans. This includes the use of transport means, the composition of the load and the determination of the transport route. The delivery dates of the customer orders and the completion dates of the production orders are to be included as influencing factors.

The *customer order acceptance* (“Demand Fulfillment & ATP”) is based essentially on the supply chain related availability assurance and guarantee (“Available-to-Promise” (ATP), “Capable-to-Promise” (CTP)). The inclusion of the available final products and the already planned production orders allows the determination and assurance of a delivery date for the customer order. A distinction can be made between the confirmation of the desired date and, if this is not achievable, the determination of the earliest possible delivery date.

Despite the coverage of numerous fields of activity by the matrix shown in Fig. 6.5, the APS described in the literature only cover a subset of the planning tasks within the framework of supply chain management. The potential for improvement through the APS lies in particular in the improved cross-company cooperation. This is enabled by a common access to a uniform data set (data integration) and the rough coordination of the decentralized sub-plans. In addition, the APS increase the transparency of the logistics and production network and thus enable the acceleration of the data flows and the control, so that administrative processes can be rationalized.

A prerequisite for the use of APS is a hierarchical production planning.[20] It is based on a structuring of the overall problem into subproblems that are connected by super- and subordinate relationships. There is a concretization of the higher-level subplans by the lower-level subplans. By forming subproblems, the complexity of the problems to be solved at the individual planning levels should be reduced, which enables the use of formal problem-solving techniques. However, this also involves aggregation and coordination problems. This results from the fact that the problem scope and the degree of aggregation of the information used differ at the individual levels. It can be observed that the aggregation error increases with increasing aggregation and can thus lead to suboptimal and inadmissible solutions of the planning problem.

6.4.2 Activity-Oriented Decision Support Systems (Bottom-Up Approach)

Activity-oriented decision support systems are based on the analysis of decisions that affect the activities in the supply chain, thus following the bottom-up approach of model building.[21] The decisions are made by the various actors in the supply chain. To reduce complexity in model building, the financial and rights flows are neglected and the focus is on the goods and information flows. The *actors* are industrial and trading companies, logistics companies and the public sector. The decisions made by these actors concern the procurement, production, distribution and logistics activities of the companies as well as the transport policy activities of the public sector.[22]

The focus of the interdisciplinary model building is first the analysis of the *cause-effect relationships* between the decisions of the actors. For this purpose, explanatory models are needed to capture the effects of, for example, a transport policy decision to introduce a truck toll on the decisions of the other actors.[23] Then, the *goals* of the actors

[20] Cf. Stadtler (2015, p. 24 ff.).

[21] Cf. Acatech (2012, p. 30 f.) For the modeling of mobility decisions of typical household groups depending on activity programs, cf. Kuhnimhof (2007, p. 31 ff.).

[22] Cf. Pfohl et al. (2013). See in detail on such decision support systems Abele et al. (2017).

[23] Cf. Rühl et al. (2013).

and the goal relationships have to be captured. In particular, this involves identifying conflicts between the goals of the actors. To reduce complexity, a decision typology has to be developed, according to which the cause-effect relationships and goals can be classified. In the decision models used decentrally by the various actors, the effects of the decision of one actor on the decisions of the other actors can then be taken into account.

The difficulty here lies in the heterogeneity of the types of models that are used in the individual subdisciplines. Models have to be checked for their mutual compatibility and adapted if necessary. Particular challenges are often different conceptions, structure and terminology of the models as well as the complex causal relationships. A very big hurdle in interdisciplinary modeling is the so-called micro-meso-macro gap. The data required by the model, the goal systems and the decision models of the individual actors differ at different decision levels. A regionally producing company at the micro level usually pursues very different goals compared to a regional logistics service provider (meso level) or even to those of a nationwide transport planner (macro level).[24]

References

Abele E, Boltze M, Pfohl H-Chr (Eds) (2017) Dynamic and seamless integration of production, logistics and traffic. Fundamentals of interdisciplinary decision support. Switzerland

Acatech (2012) Menschen und Güter bewegen. Integrative Entwicklung von Mobilität und Logistik für mehr Lebensqualität und Wohlstand. Acatech POSITION, Berlin

Arnold D et al (Eds) (2008) Handbuch der Logistik, 3., new. rev. ed. Springer, Heidelberg

Ballou R (1998) Business logistics management. Planning, organizing and controlling the supply chain, 4. ed. Prentice Hall, London

Bös M, Schmidt T (2020) Die neue VDI-Richtlinie Emulation. Logistik Unternehmen 34(6–7):44–47

Campuzano F, Mula J (2011) Supply chain simulation: a system approach for improving performance. London

Domschke W, Drexl A (1996) Logistik: Standorte, 4., rev. a. ext. ed. Oldenbourg, München

Domschke W, Scholl A (2010) Logistik: Rundreisen und Touren, 5., rev. a. act. ed. Oldenbourg, München

Eley M (2012) Simulation in der Logistik: Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges „Plant Simulation". Springer Gabler, Heidelberg

Friedrich M (2011) Verkehrsmodelle. Qualität und Quantität in Verkehrsmodellen und Prognosen. In: Deutsche Verkehrswissenschaftliche Gesellschaft e. V. (Ed) Ansprüche einer mobilen Gesellschaft an ein verlässliches Verkehrssystem. Deutsche Verkehrswiss. Gesellsch., Berlin, S 199–206

Glock C (2020) Zahlt sich Datenqualität aus? LH 42(3):38–39

Großeschallau W (1984) Materialflußrechnung. Modelle und Verfahren zur Analyse und Berechnung von Materialflußsystemen. Springer, Berlin

[24] See, for example, the requirements for transport models (transport demand and transport flow models) at the macro level in Friedrich (2011).

Herrmann J (2010) Supply chain scheduling, 1. ed. Gabler, Bielefeld

Klein R, Scholl A (2012) Planung und Entscheidung: Konzepte, Modelle und Methoden einer modernen betriebswissenschaftlichen Entscheidungsanalyse, 2. ed. Vahlen, München

Kuhnimhof T (2007) Längsschnittmodellierung der Verkehrsnachfrage zur Abbildung multimodalen Verhaltens. Institut für Verkehrswesen Universität Karlsruhe, Karlsruhe

Lucke H-J (2001) Systemtheoretische Grundlagen der Logistik. In: Krampe HH (Ed) Grundlagen der Logistik: Einführung in Theorie und Praxis logistischer Systeme, 2., tot. new. rev. a. rev. ed. Huss, München

Meyr H, Wagner M, Rohde J (2015) Structure of advanced planning systems. In: Stadtler H, Kilger C (Eds) Supply chain management and advanced planning: concepts, models, software, and case studies, 5. ed. Springer, Berlin, S 99–106

Pfohl H-Chr (2003) Unternehmensübergreifende Planung in der Supply Chain. In: Horváth P, Gleich R (Eds) Neugestaltung der Unternehmensplanung. Innovative Konzepte und erfolgreiche Praxislösungen. Schäffer-Poeschel, Stuttgart, S 51–68

Pfohl H-Chr (2022) Logistics Systems: Busniess Fundamentals, 9., rev. a. act. ed. Springer, Berlin

Pfohl H-Chr, Stölzle W (1997) Planung und Kontrolle. Konzeption, Gestaltung, Implementierung, 2., rev. ed. Vahlen, München

Pfohl H-Chr, Ehrenhöfer M, Zuber C (2013) Dynamic and seamless integration of production, logistics and traffic/transport (DYNAMO PLV). Challenges of an interdisciplinary research project. J Econ Manag 11:81–95

Rose O, März L (2011) Simulation. In: März L et al (Eds) Simulation und Optimierung in Produktion und Logistik: praxisorientierter Leitfaden mit Fallbeispielen. Springer, Berlin Heidelberg

Rühl F et al (2013) Assessing the impacts of HGV tolls on transport logistics. In: World Conference on Transportation Research Society (Ed) Selected proceedings of the 13th world conference on transport research society. WCTR, Rio de Janeiro, S 1–13

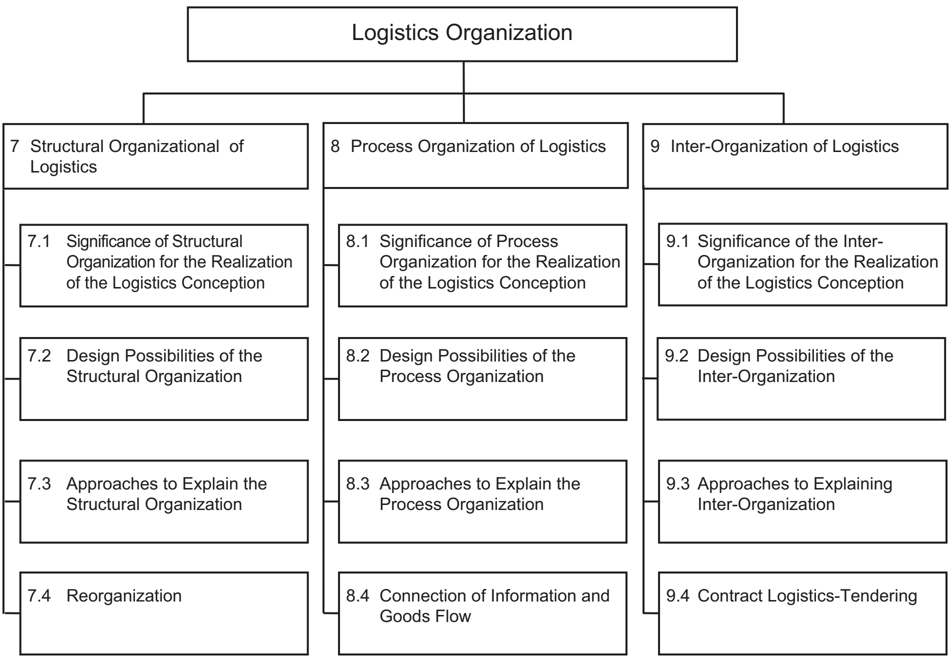
Schulte C (2017) Logistik. Wege zur Optimierung der Supply Chain, 7., tot. rev. a. ext. ed. Vahlen, München

Simchi-Levi D, Simchi-Levi E (2020) We need a stress test for critical supply chain. HBR. https://hbr.org/2020/04/we-need-a-stress-test-for-critical-supply-chains. 13th March 2023

Stadtler H (2015) Supply chain management – an overview. In: Stadtler H, Kilger C (Eds) Supply chain management and advanced planning. Concepts, models, software and case studies, 5. ed. Springer, Heidelberg, S 3–28

Part III

Logistics Organization



The organization problem can be broken down into the sub-problems of differentiation and Integration. The organizational problem of differentiation refers to the breakdown of tasks to exploit division of labor and specialisation. The coordination of these divided tasks with regard to the fulfilment of the overall task of one or more enterprises is called the organizational problem of integration. In some cases, the term coordination is used instead of integration. In the German-speaking world, the management function of the organization is traditionally divided into the two areas of the structural organization and the process organisation. Within the framework of the structural organizational, tasks, competencies and responsibilities are assigned to individual positions and larger organizational units. The process organization has the task of organizing procedures (processes). The objects of order in the process organization are primarily activities, sequences and time requirements. In relation to the logistics subsystem, this results in the logistics structure organization and the logistics process organization as sub-functions of logistics management. Originally, the organizational structure and the process organization were only focused on the internal design of a company. However, the process-oriented view of logistics also requires the design of cross-company mesologistic systems.[1] Therefore, the organization of cross-company systems and the processes taking place within them (inter-organisation) is also part of the object of the organization.

[1] For the institutional delineation of logistics systems, see Pfohl (2022, p. 13 ff.).

Structural Organization of Logistics

7

7.1 Significance of Structural Organization for the Realization of the Logistics Conception

7.1.1 Centralization—Decentralization

If one puts the *institutional dimension* of logistics in the foreground, then logistics is understood as an *organizational subarea* of the company, which can be designed by means of a corresponding logistics management. This part of logistics management in the sense of an active organizational design, which focuses on the management of division of labor and coordination, shall be understood in the following as the management function logistics structural organization.

The requirements for the type of organizational implementation of logistics and thus for a conforming logistics organizational structure can be derived directly from the logistics conception and specifically from the systems thinking.[1] The basic idea for this is that logistical tasks can only be fulfilled efficiently if all the processes and their interdependencies required for this are considered as a whole. Only in this way can optimal overall solutions be found and coordination problems be solved.

First of all, *goal conflicts between different areas* can be avoided if logistical tasks are combined in one area. Goal conflicts arise because the different functional areas have different interests and thus pursue different goals. In particular, by combining logistical tasks of different functional areas in one organizational unit in the sense of total cost

[1] See for the following Pfohl and Large (1998, p. 91 ff.); Pfohl (2022, p. 233 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_7

thinking, the risk can be reduced that cost savings in one organizational area lead to cost increases in another.

By reducing *interfaces*, transaction costs are also reduced, as coordination and negotiation processes between different departments involved in the logistical service creation are minimized. In general, communication problems between departments are avoided, which have a negative impact on the time required for logistical processes and the flexibility of logistics systems. Another problem of distributing logistical tasks to different organizational units is *internal conflicts*, as logistics, e.g. within production planning and control, is only understood as a supporting activity.

From the systems thinking of the logistics conception the basic thesis can be derived that the coordination is facilitated by the concentration of the logistical tasks in a specialized organizational unit. This leads to the demand for a *high degree of centralization* of logistics and puts the question of centralization versus decentralization of logistics in the center of interest.

The *counter-thesis* to the centralization thesis is that the necessary coordination of the organizational units entrusted with the fulfillment of logistical tasks, especially in the case of small companies, can be achieved without organizational integration. As a substitute for a central organizational structure, the use of a comprehensive coordination instrumentarium as well as measures of secondary organization can serve. Overall, this is intended to promote thinking in cross-departmental processes beyond function-oriented boundaries. The coordination instruments can be subdivided into coordination by personal instructions, coordination by self-coordination, coordination by standardization and coordination by corporate culture.[2] The secondary organization includes all hierarchy-complementary and hierarchy-crossing organizational structures.[3] This includes in particular the formation of committees and working groups.

7.1.2 Function—Process

By increasing the consolidation of logistics tasks in functionally specialized organizational units for logistics, which are anchored in the corporate hierarchy as equally as possible with the other functionally specialized organizational units, the realization of the logistics conception in the company shall be supported. The *function-oriented organization* of logistics is contrasted with a *process-oriented organization* of logistics with the spread of a process-oriented corporate management. The process-oriented organizational

[2] Cf. Schulte-Zurhausen (2014, p. 236 ff.); see also Pfohl (2022, p. 235 f.). The instruments of coordination by plans and programs listed there belong to coordination by standardization.

[3] Cf. Schulte-Zurhausen (2014, p. 306 ff.).

model is designed to be "cross-functional".[4] In this form of organization, the functional specialization and division of labor are abandoned in favor of a consolidation of all tasks that have to be fulfilled for the execution of a business process derived from the corporate strategy, e.g. order fulfillment or product creation process. The process-oriented cooperating employees pursue together a corporate principle formulated as a logistical guiding principle, use and share the logistical know-how collected (learned) in the company, have access to the same information base throughout the process and apply the same rules and procedures for process design. The dissolution of an organizational unit logistics that encompasses all logistics tasks and reports directly to the management and its transfer into a process organization is sometimes seen as a sign of a particularly advanced and "mature" logistics.[5]

7.1.3 Hybrid Organizational Units (Mixed Forms)

The starting point of the following considerations is the insight gained from the study of successful companies that one-sided characteristic expressions of the features that characterize management have a negative impact on the achievement of corporate success. For example, in a dynamic environment, the corporate development of companies is considered to be endangered, in which the characteristic expressions of the 7-S management model—with the management features strategy, structure, systems, style, core staff, special knowledge and self-understanding of the company—show extreme values, as shown in Fig. 7.1.[6] Transferred to the organization of logistics, this means that it is not about the decision "either" centralization "or" decentralization or "either" functional orientation "or" process orientation. A successful realization of the logistics conception is supported by a "both and" organizational form. The reason for this is provided by the plausible hypothesis that in dynamic environments, e.g. with regard to functional and process orientation, only companies are successful that can react quickly and flexibly to customer wishes on the one hand due to the process orientation and can learn on the other hand due to the functional orientation. Because learning takes place in the company in functionally specialized organizational units. The following section deals with design possibilities of the organizational structure that are based on the hybrid organizational model.[7]

---

[4] Cf. Gaitanides (2007, p. 54).

[5] See also the comparison of a "functions" logistics and a logistics as "management of flow systems" by Klaus (1998, p. 62 f.).

[6] Cf. Pascale (1990, p. 36 ff.). who refers to this connection as the "Fit/Split" paradox.

[7] A trend towards such forms of a hybrid logistics organization can also be seen in corporate practice. See Part I, Sect. 2.2.3.

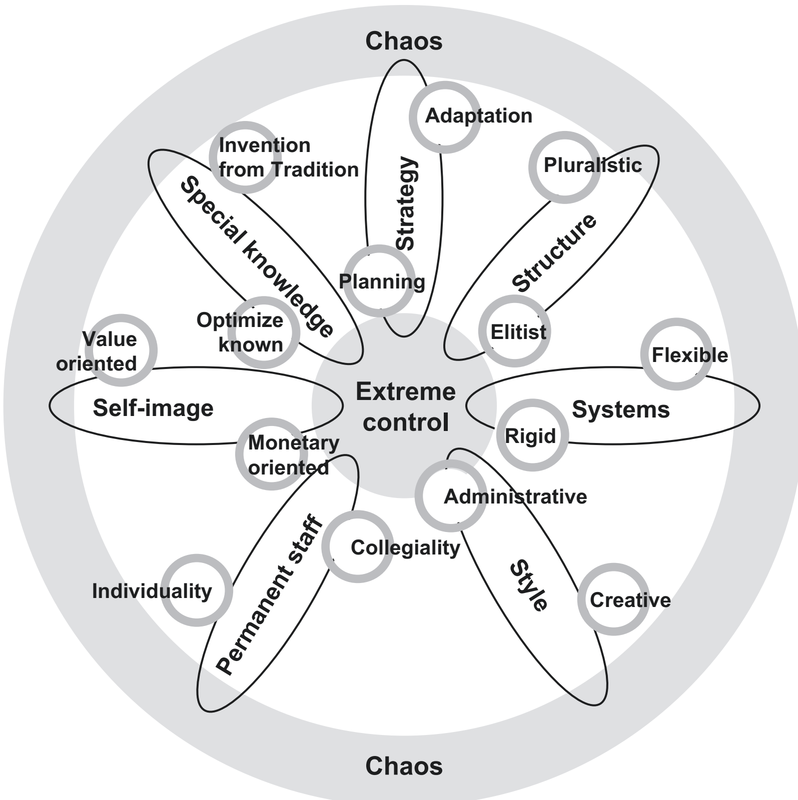


Fig. 7.1 Endangerment of corporate development due to one-sided characteristic expression in the 7-S management model. *Source* Pascale 1990, p. 86

7.2 Design Possibilities of the Structural Organization

7.2.1 Hybrid Logistics: Centralized/Decentralized

As hybrid forms, all organizational models can be described in which the logistics tasks are distributed to a central logistics department and to other organizational units—decentralized logistics departments or other departments with a different focus of tasks.

If "lean structures" are the guiding principle of the company, central areas are suspected of having "put on too much fat" and should actually be abolished as "water heads".[8] In many companies, the pendulum then swings in the direction of decentralization, only to swing back in the direction of centralization at some point. Only a few

[8] Cf. Krüger and von Werder (1995, p. 6 ff.).

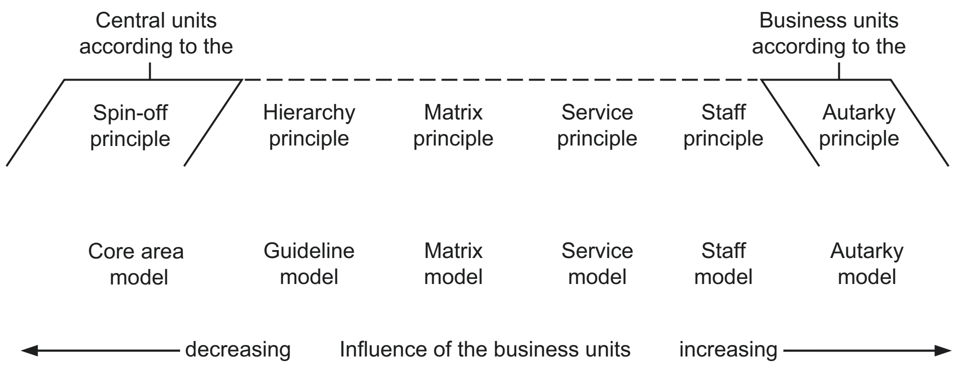


Fig. 7.2 Types of central areas or center concepts. *Source* Krüger and Werder 1995, p. 8

companies apparently manage to find the right balance between centralization and decentralization.[9] In the direction of centralization, *center concepts* for partial function organization are discussed.[10] A center is an organizational unit that performs tasks across areas in order to leverage synergies across the company. The center is responsible for a specific service and provides it for several internal customers. In the center organization, four design components can be distinguished: configuration, motivation, location and institution.

The *configuration* is about the distribution of competencies between a centrally anchored center and the decentralized operational units. Based on a comprehensive theoretical and empirical study, the six concrete organizational models shown in Fig. 7.2 on the continuum of centralization and decentralization can be distinguished,[11] which can also be applied to centers in principle and are up for discussion for the organization of the partial function "logistics".

In the core area model, the function is completely outsourced from the decentralized operational business unit and anchored only in the permanent central organizational unit. The core area decides and realizes alone. In the extreme core area variant, there is no organizationally defined communication between the centralized and decentralized organizational unit. In the moderate variant, however, an information and know-how exchange is organizationally provided.

[9] Cf. Ghoshal and Mintzberg (1994, p. 8).

[10] For the following cf. Krüger et al. (2007, p. 4 ff.). Basically, two types of organization can be distinguished with the corporate center and the shared service center. Corporate centers are responsible for sovereign tasks such as auditing. In contrast, the shared service center focuses on the provision of services. The logistics organization thus concerns the organizational type "shared service center".

[11] Cf. Krüger and von Werder (1995, p. 8 ff.). For the possibilities of central and decentralized integration of logistics, see also Pfohl (2022, p. 237 ff.).

The guideline model provides for the anchoring of the functional tasks in several permanent organizational units, some of which are located centrally and some decentrally. The central guideline area is solely authorized to make basic decisions on the functional tasks and has the authority to issue instructions to the organizational units in the decentralized operational business units that are involved in the functional tasks. The decentralized organizational units can therefore only make detailed decisions on the implementation of the decisions of the central unit within the framework of specifications.

In the matrix model, the subtasks of a function under consideration are anchored both decentrally in the business units in the form of operational matrix units and in a central matrix unit. These organizational units are only jointly authorized to make decisions, which is why one or more decision committees have to be set up for self-coordination. The matrix committee is staffed with members of the organizational units and makes guideline decisions, within which the operational units can act.

In the service model, different competencies are assigned to the centralized and decentralized organizational units. The functional tasks are subdivided into decisions on the “whether”, “what” and “how”. The business units are responsible for the decision on the “whether” and “what”. They issue corresponding orders to the central service unit, which then decides on the “how” of order fulfillment.

In contrast, in the staff model, the central staff is not entrusted with the fulfillment of business unit orders, but rather takes on tasks of decision preparation. The central staff serves as informational and methodological support for the decentralized organizational units in the operational business units.

In the autonomy model, a centralized organizational unit for taking over any functional tasks is completely dispensed with. The functional tasks under consideration are fully institutionalized in the individual operational units and the business units are authorized to make decisions and carry out the tasks.

The autonomy model is suitable when it comes to strengthening the independence of the business units and giving them responsible leeway. The time and cost of internal coordination should be avoided. On the other hand, the core area model is recommended when critical interdependencies regarding the subfunctions under consideration have to be coordinated sustainably and the cross-sectional interests of the entire company have to be preserved. The guideline model is suitable when, on the one hand, uniform principles of task fulfillment should be enforced throughout the company and, on the other hand, certain leeway for the operational business units should be opened up within the framework of the specifications. The advantages of the matrix model lie in the balanced coordination of interdependent actions. The special advantage of the service model “lies in the possibility of achieving pooling effects by organizationally combining potentials with a simultaneously strong, self-responsible position of the business areas.”[12]

[12] Krüger and von Werder (1995, p. 15).

The design component *Motivation* concerns the incentive systems that are to be aligned with the measurement of the performance of a center. The incentive systems known from the organization of divisional business units can be transferred to the center organization of functional subareas. “As performance indicators, input variables such as costs (cost center) or budget compliance (budget center), output variables such as sales (revenue center) or service level agreements (result center) or input/output relations such as profit (profit center) are possible.”[13]

The design component *Location* concerns the center location. Because a center does not have to be located at the headquarters of a company, which is especially important for the organization of internationally active companies. Other locations could have advantages such as lower labor costs or advantages due to the professional skills of the staff.[14]

The design component *Institution* concerns the formal-factual consolidation of the center. In particular, the legal form of the center plays a role. The legal independence can on the one hand underline the independence of the center. On the other hand, it can prepare the possibility of a “spin-off”.

7.2.2 Hybrid Logistics: Function/Process

Another form of hybrid logistics is the combination of *function- and process-oriented organization* of logistics. The fundamental innovation of the concept of a process-oriented organization of logistics is the reversal of the design guidelines of the classical organizational approach. This follows the “top-down” approach and first forms subtasks that are delegated to a function. This in turn forms subtasks and delegates them until the subtasks have reached a volume that can be handled by a task holder himself (structural organization). Only at the end of this task structuring is the cross-functional design of the processes (process organization). The process orientation follows the “bottom-up” approach in the formation of positions. Based on the organizational principle of process segmentation, processes are subdivided into operations. After analyzing the quantity and processing time of the operations, they are grouped together and assigned to positions. The difference to the classical approach is that positions are only formed on the basis of integrated activity complexes.[15]

According to the *process idea*, the processes dominate the structure: Instead of “Process Follows Structure” it is “Structure Follows Process”. As far as possible, continuous

---

[13] Krüger et al. (2007, p. 5).

[14] See also the takeover of “strategic mandates” in multinational companies by Holtbrügge and Welge (2015, pp. 154 ff.).

[15] Cf. Gaitanides (2007, p. 32 and on the process organization as a hybrid coordination form p. 74 ff.). See also “From function to process orientation” by Schulte-Zurhausen (2014, p. 47 ff.).

processes without interfaces should be designed between the procurement and sales markets. The overall process is subdivided into distinguishable consecutive process modules (value creation phases) that can be understood as customer-supplier relationships and in which an output is generated from an input using predefined processes.[16]

In the sense of a corporate management oriented to the principle of *"both"*—*"and"*, the processual organization is not a substitute for the functional organization. Processes are only another dimension of organizational design, and it depends on the balance between functional and process organization. The functional organization "enables employees to develop functional loyalty and gives them orientation and behavioral stability"; moreover, it promotes "the development of functional expertise, which is urgently needed for qualified problem solving and innovation processes."[17] The process organization enables the customer orientation of the entire company and promotes the cross-functional cooperation, which is essential for error-free, timely and cost-effective satisfaction of customer needs.

As early as 1988, the well-known Peter F. Drucker, known for his accurate management visions, expressed the opinion that the "information-based organizational form" of the future with its flat hierarchy will be characterized by the interaction of functional organizational units and value creation process-oriented, team-like structured organizational units. "Traditional departments will serve as guardians of standards, as centers for training and the assignment of specialists; they won't be where the work gets done. That will happen largely in task-focused teams."[18] Also the first protagonists of a "lean production" Womack and Jones emphasize the necessity of a new cooperation between function- and process-oriented organizational units.[19] While the value creation processes are carried out by cross-functional groups, the functions take on the role of learning centers ("schools") and innovation centers for developing "best-practice" procedures. The cooperation in project groups and a planned job rotation can contribute significantly to handling the conflict between function and process.

7.2.3 Hybrid Logistics: Primary/Secondary Organization

In addition to the primary organization discussed so far, the *secondary organization* of logistics has a special significance. Organizational units that perform special tasks for a limited time and stand alongside the primary position and department structure form the secondary organization of a company. Since these organizational units are often interdisciplinary, they can eliminate weaknesses of the primary organization and overcome inter-

[16] See also the remarks on process analysis in terms of controlling in Part II, Sect. 5.9.4.

[17] von Eiff (1994, p. 368).

[18] Drucker (1988, p. 47).

[19] Womack and Jones (1994, p. 99 ff.).

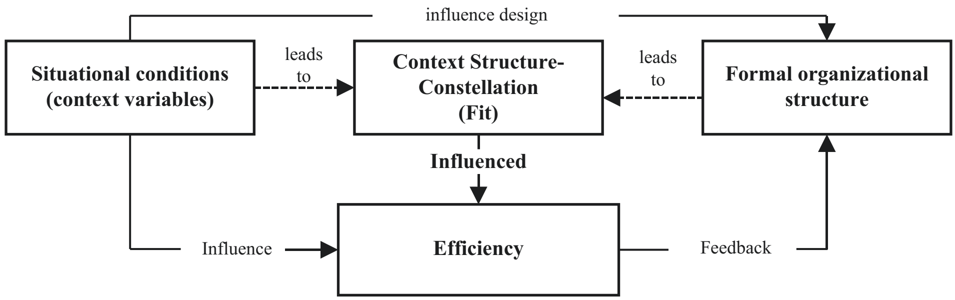


Fig. 7.3 Basic model of the situational approach. Taken from Gallus 2011, p. 115 based on Kieser 2006, p. 218

face problems. In addition to committees, e.g. production planning committee composed of employees from production, logistics and purchasing, the organizational units of the secondary organization include project teams. By means of logistics teams, employees from other functional areas can be involved in solving logistical problems. This also strengthens the long-term relationships with other functional areas. For example, when introducing a reusable container system, buyers and production control staff can provide important impulses and help with the implementation of the found solution. Especially solutions for the realization of supply chain management concepts, e.g. the introduction of advanced planning systems, require the coordination of activities in all functional areas and at upstream and downstream companies. Here, too, cross-functional and cross-company teams can be a significant help.[20]

In summary, the following characteristics of the *organizational alignment of excellent companies* can be identified[21]:

1. The transfer of decision-making authority along with the execution competence and the associated information corresponds to the cross-sectional character of the logistics tasks.
2. The transformation of the organizational structure takes place from a functional to a process orientation. However, this does not mean neglecting the functional excellence. Rather, it is important to align the functional capabilities with the maximum achievable overall goal and to combine them with the process orientation.
3. The changes in the organization are accompanied by an organizational learning and a knowledge transfer in the company. Through this learning process, barriers to change can be reduced and the attitude and skills of the employees can be shaped accordingly.

[20] Cf. Stock (2003, p. 217 ff.).

[21] Cf. Pfohl (1999, p. 173 f.).

4. The flexibility for changes in the organization is an essential prerequisite to be able to meet the constantly changing requirements of the environment and the changing understanding of logistics.
5. The formation of interdisciplinary teams for tasks from the field of logistics takes place in order to take into account the cross-sectional character of logistics.
6. The loyalty of the employees becomes a prerequisite for success in the time of organizational change; because due to constantly changing career paths, employees often feel insecure.
7. The reorganization of logistics is accompanied by a redesign of the information systems in order to provide the information needed to coordinate the process organization.
8. The business processes increasingly detach themselves from the existing formal organizational structure and relate more and more to virtual networks in the organization.

The theoretical approaches presented in the following section can contribute to the justification of this organizational design of the logistics organization.

7.3 Approaches to Explain the Structural Organization

The question of the right or even optimal logistics organization for a specific company is hardly answerable, as it ultimately depends on a multitude of different factors. Nevertheless, there is no lack of attempts in the literature to determine the determinants of organizational structures of logistics.[22] In addition to the situational approach, the approach of the strategy-conform logistics organization will be used here because of its importance for the strategy discussion in Part I and II.

7.3.1 Situational Approach of Organization Theory

The *basic idea* of the situational or "contingency" approach is the dependence of the kind of an efficient organizational structure on the framework conditions of organizational design. This relationship is shown in Fig. 7.3. The situation determines the formal organizational structure, which in turn affects the behavior of the organizational members and thus the efficiency of the organization. The situational conditions (context variables) can be subdivided into internal company variables and external environmental variables. "Structures with the highest possible profit potential are then found when there

[22] See for the following explanations Pfohl and Large (1998, p. 97 ff.).

is a “fit” between the context and design or structural variables (congruence-efficiency hypothesis).”[23]

If one transfers these basic thoughts to the organizational design of logistics, the first step is to identify those *situational conditions* that determine the form of integration of logistics into the organizational structure of companies. In a second step, the success effects of certain structures in certain situations are then to be examined. In the literature, the explanation of the integration of logistics into the organizational structure using the situational approach has been repeatedly suggested.[24] With regard to the progress in knowledge achieved, three stages can be distinguished: The naming of possible influencing factors, the formulation and justification of plausible hypotheses, and finally the empirical testing of these hypotheses.

Influencing factors of the organizational expression can be found with reference to American sources already in the first German-language publications on business logistics and have been repeatedly cited since then. Taking these works into account, the following situational conditions can be mentioned[25]:

- Complexity and dynamics of the environmental conditions
- Scope and homogeneity of the company's product program
- Structure of the production system and especially the production technology
- Structure of the distribution system and especially the warehouse structure
- Level of logistics costs
- Level of required delivery service level
- Number of logistics decisions
- Number of distinguishable logistics decision fields
- Size of the company
- Number of plants and warehouses
- Industry
- Corporate culture
- Quantity and quality of information required
- Strength of material and product flows
- Degree of interdependence between logistics subareas
- Level of demand of the logistics task
- Degree of information of the employees about the logistics conception
- Level of capital intensity of the logistics technology.

[23] Gallus 2011, p. 115).

[24] See in particular Pfohl and Zöllner (1987). For a complementation of the situational approach by a configurational approach in the organization of logistics, see Klaas (2002); Gallus (2011, p. 117 ff.). The configurational approach additionally requires a “fit” between the design variables.

[25] See Pfohl and Large (1998, p. 97 f.) and the literature noted there.

The potential influencing factors mentioned are a colorful collection of merely plausible factors. At best, they are based on transfers from general organization theory. Nevertheless, often in the literature, in connection with the mention of influencing factors, *plausible hypotheses* about the influence of these factors on the form of logistics organization, especially on the degree of centralization, were also formulated directly[26]:

- With increasing complexity and dynamics of environmental relations, related to the logistical tasks to be fulfilled, the tendency to organize these tasks together increases.
- With increasing homogeneity of products and markets, the tendency to organize these tasks together increases.
- With a growing share of workshop production and order production, the tendency to combine logistical tasks within a materials management department increases.
- With increasing complexity of information and goods flow, the tendency to organize logistical tasks together increases.

However, it must be critically noted that despite an increasing complexity of the economy, no increase in the share of central organizational forms can be observed, but—as shown—the hybrid forms seem to gain in popularity. Possibly, the changes in products and markets, which are rather characterized by a decreasing homogeneity, have a counteracting effect. In conclusion, it can be stated that the *empirical verification* of such hypotheses based on appropriate modern methods of multivariate analysis is still pending today.

In addition to this criticism of the state of situational logistics organization research, however, also *fundamental points of criticism* of the situational approach of organization theory can be raised. First, the situational approach is mechanistic in its basic design. There is little room for the creative element of organization. A stronger consideration of goals and strategies in the design of logistics organization can be achieved by combining the situational approach with the approach of strategy-conform logistics organization.

7.3.2 Approach of Strategy-Conform Logistics Organization

The design of an appropriate organizational structure of logistics can also be understood as a consequence of strategic considerations. In principle, this follows the well-known thesis “Structure Follows Strategy” by Chandler.[27] The organizational design of logistics is thus oriented to the chosen competitive strategy of a company.

---

[26] Cf. Pfohl and Zöllner (1987, p. 4 ff.).

[27] Chandler (1962).

This basic idea follows the approach of strategy-conform logistics organization. It combines *two models of organization theory* and concretizes them for the area of logistics: the decision-logical approach of organization theory by Frese and the concept of competitive strategies by Porter.[28] The following concretizes this approach for the logistics organization.

From the *decision-logical approach*, the basic thesis is adopted that in any form of organizational structure of a company, due to the chosen division of labor, interfaces inevitably arise. The resulting "information deficits" impair the decision quality and result in autonomy costs, which can serve as an indicator for the efficiency of the chosen organizational structure. Since interfaces can be overcome most easily within a department, it is suggested to integrate the success-relevant interfaces in one department, whereby the success-relevance of an interface is generally determined by the pursued competitive strategy.

By integrating success-relevant interfaces in an organizational unit "logistics", the efficiency—especially the coordination efficiency—of the organizational structure can be increased. The market, process, resource and delegation efficiency are derived as decision-relevant criteria of coordination efficiency. By this step, however, the situation of a multiple objective setting arises in the organizational design, which requires the introduction of a weighting factor. Since a strategy-conform logistics organization is sought and precisely the success-critical interfaces are to be integrated, the chosen competitive strategy is also of central importance in the case of logistics as the standard for the importance of the efficiency criteria mentioned.

For this purpose, the generic *competitive strategies according to Porter* can be used. When pursuing a cost leadership strategy, the resource and procurement market efficiency are considered dominant, which would particularly suit concentrated organizational units, such as a comprehensive logistics department or a department that follows the concept of integrated materials management, i.e. includes purchasing. On the other hand, if a differentiation strategy is pursued, the sales market and process efficiency are in the foreground. However, which design alternative promises the greatest efficiency in this case depends largely on the area where the differentiation is sought, which makes design recommendations difficult.

The approach of strategy-conform logistics organization could be supported by a first empirical study based on personal interviews with representatives of 30 West German automotive suppliers.[29] However, a further verification based on appropriate samples is still pending.

---

[28] The following is based on Pieper (1995, p. 42 ff. and p. 138 ff.). For the decision-logical approach see Frese (2005, p. 201 ff.). For the concept of competitive strategies see Part II, Sect. 4.2.1.

[29] Cf. Pieper (1995, p. 145 ff.).

Based on the design hints that can be derived from the theories, the active design of the division of labor and coordination of logistics requires a goal-oriented reorganization process. The following section therefore deals with the reorganization of logistics.

7.4 Reorganization

If the organization as the activity of organizing is in the focus, then questions of *organizational planning,—implementation and -control,* i.e. the design and change of the organizational structure, gain importance. Since organizational structures can only rarely be designed for completely new companies, the practical organizational work presents itself as the management of reorganization. The organization is thus regarded as an influenceable internal design variable, which can serve, in addition to the task, the technology and the employees, to fulfill logistical tasks more efficiently.[30]

7.4.1 Causes of Reorganization

„Business changes are today in almost all industries more the rule than the exception. In business practice, it can also be observed that the intervals between profound changes in companies are becoming increasingly shorter."[31] The causes of change and thus the drivers of reorganization are extremely diverse. The causes that trigger the *change of logistics* were for many years the subject of the annually repeated studies of the Ohio State University in the USA. The five most important causes are based on the study from the year 2002[32]:

- Financial effects of logistics management
- Supply Chain Integration
- Internationalization
- Information technology
- Management of change.

[30] See Part I, Sect. 2.3.2.

[31] Stock-Homburg (2007, p. 796).

[32] Cf. Ginter and Lalonde (2002, p. 15) and Lalonde and Ginter (2008, p. 15). In the study of 2008, only „management of change" was replaced by „management of energy and transportation costs". See also the following statements Pfohl (1999, p. 204 ff.). as well as generally the drivers of logistics management in Part I, Sect. 1.3. See also independently of logistics the influencing factors of changes at the corporate level by Stock-Homburg (2007, p. 802 ff.).

It is remarkable at first that in this study the *management of change* itself is mentioned as an influencing factor of logistics development. The further development of logistics is thus dependent on the extent to which companies succeed in adapting their structures and processes to the changes in the environment or even proactively accompany and promote the developments in advance by organizational changes.

The *financial effects of logistics* are increasingly given attention as a cause for a reorganization of logistics.[33] This also emphasizes the organizational interface between the financial and the logistics management. Conceivable is an expansion of the responsibility for inventories and the „cash-to-cash cycle“ and thus an increase of the scope of tasks of logistics in the sense of a management of the net working capital. The management of the „cash-to-cash cycle“ includes, in addition to the design of inventory ranges, also questions of the design of payment terms. However, this interface management is also possible within the secondary organization by forming cross-functional committees.

The *supply chain integration* is also mentioned as a central cause. The supply chain management leads first to an increased need for coordination of internal areas. This affects, for example, the interface between logistics and production. Whether this interface is internalized organizationally, however, is open, since the pure process-oriented coordination is also possible. Against an expansion of the logistics tasks with regard to production in the primary organization speak especially new interfaces in the production area. As already mentioned in the management of net working capital, secondary organizational measures are suggested. In addition, the supply chain management leads to cross-company coordination, which will be discussed in more detail in the section on inter-organizational logistics.

The *information technology* is always an important cause of reorganization. The information and communication technology have on the one hand created possibilities for the extensive decentralization of logistical activities. On the other hand, modern information technologies, especially in connection with supply chain management concepts, enable the central control of various operational areas by a comparatively small central unit.

A great importance is attributed to the *internationalization* as a cause of the reorganization of logistics. Due to a progressive internationalization, new logistics tasks arise in the areas of internationally coordinated inventory management, the planning and execution of cross-border transports and the export packaging. These tasks require a coordinated fulfillment and therefore speak for a central organization. On the other hand, with increasing internationalization, investments are also made in host countries. This creates new logistics tasks that have to be fulfilled locally, i.e. decentrally, in the plants and branches. An increasing internationalization should therefore overall lead to the transition to hybrid organizational forms.

[33] See also the importance of the financial perspective on the contribution of logistics to the corporate goals of profitability or corporate value in Part I, Sect. 3.2, and on supply chain financing in Part II, Sect. 5.6.

In addition to these general occasions for reorganization, which apply to an entire industry or even the entire economy, *concrete occasions for reorganization* can be cited in a company. Examples of this are the introduction of supply chain management concepts, which lead to the dissolution of traditional logistics departments and the emergence of hybrid systems with cross-functional responsibility for logistics and production processes.[34] Another individual occasion for reorganizing logistics can be the need for integration of new parts of the company. The integration measures to be carried out also include the unification or at least coordination of the organizational structure.[35] As a final example of concrete occasions, outsourcing of operational logistics tasks, e.g. fleet management, can be mentioned. This reduces the scope of tasks of logistics. The remaining allocation and control of external transports can then be carried out by a central logistics or another organizational unit, e.g. purchasing.

Considering the diversity of the occasions for reorganization, this underlines the statement made at the beginning that the phases of organizational change represent normal states of an organization.

7.4.2 Change Strategies

The reorganization process can be conceptually divided into two successive phases. First, the *phase of concept design* is passed through, which comprises as essential elements the design, evaluation and selection of new organizational patterns. As a starting point, the organizational models of logistics derived in Sect. 7.2 can serve, which have to be adapted according to the company-specific conditions. This is followed by the *phase of implementation*, which can be further divided into the two sections of introduction and enforcement. With the implementation, the integration of the new logistics structures into the overall organizational structure of the company is to be accomplished.[36]

The problems that can be expected in the reorganization depend largely on the *intensity of the change*. A radical and a rather gradual (continuous) approach can be distinguished.[37] In the narrower sense, reorganization refers to those cases where the organizational change goes beyond a continuous development and requires profound and holistic cuts in the existing structure. The reorganization can follow three different change strategies[38]:

[34] Cf. Min (2001, p. 382 ff.).

[35] Cf. Pfohl and Hofmann (2003, p. 326 f.).

[36] Cf. Pfohl et al. (1989, p. 221). For the phase models, see also Stock-Homburg (7.2007, p. 801 ff.).

[37] Cf. Stock-Homburg (2007, p. 797 ff.).

[38] Cf. Krüger (1994, p. 364 and the layer model of transformation p. 358 ff.); Pfohl (1995, p. 199 f.).

- Reorganization as *management of factual issues* (factual-rational dimension of change): This perspective assumes a rational behavior of those affected. They also accept a profound reorganization, as long as they are convinced of the efficiency of the new solution. The change strategy therefore primarily includes tasks of information and education.
- Reorganization as *management of states of mind* (value-cultural dimension of change): This addresses the level of socio-cultural values. A comprehensive reorganization must be accompanied by a constant influence on the attitudes of those affected from this perspective.
- Reorganization as *influence management* (political-behavioral dimension of change): This strategy focuses on power and coercion strategies.

Concrete reorganization projects require the parallel use of all these strategies. Above all, it cannot be expected that reorganization processes can be carried out solely on the factual-rational level.

According to the different *degree of participation* of those affected by the reorganization process, two contrasting models of implementation can be distinguished. In the strategy of the “bomb drop”, new concepts of logistics organization are implemented without the involvement of the affected departments and abruptly by using power. This is intended to reduce reorganization barriers, which already have an effect during the planning of the new logistics organization. An example of this is the imminent loss of influence and decision-making authority of other functional areas. The counter-model is the early involvement of all those affected and the search for a solution based largely on consensus. However, there is especially the risk that the reorganization process gets entangled in collective decision processes and loses momentum early. On the other hand, personal barriers can be reduced in a collective design process, which increases the chance of successful implementation.

One approach to implementing new organizational patterns of logistics is the *promoter-opponent model*.[39] The basic idea of the promoter-opponent model is the existence of supporters of the reorganization (promoters) and opponents of the change (opponents). According to this model, reorganizations have a good chance of success if power promoters (sanction power) and expert promoters (expert power) join forces to form a so-called promoter team. In the case of logistics reorganization, a member of the management board could take on the role of the power promoter and a technically qualified logistician the role of the expert promoter.

Especially in the case of profound organizational change, e.g. the creation of a central logistics unit, which is associated with the extraction and integration of partial functions from other functional areas, it can be advantageous to provide intermediate stages in a *multi-stage reorganization process*. These transition strategies are especially useful when

[39] Cf. on this and the multi-stage reorganization process Pfohl (1995, p. 201 ff.).

the complexity of the change measures is high and significant barriers to reorganization are expected. In addition to personal barriers, resource-related and temporal barriers can also play a role. Transition strategies can reduce the risk of reorganization. On the other hand, however, it should be noted that they increase the time required for the change.

7.4.3 Theses on a Successful Reorganization Process

Based on a research project on the *investigation of reorganization processes* in the medium-sized automotive supplier industry, the following theses on a successful reorganization process can be derived[40]:

- The reorganization-friendly mood of the second hierarchy level is of central importance for achieving the objectives. Their diverse possibilities of resistance and the priority of their own interests over those of the company make it necessary to take away their fear of personal disadvantages that they associate with the logistics reorganization. To this end, the uncertainties about their further career path and their position in the company must be resolved as early as possible.
- Depending on the social legislation of a country, the role of the employee representation is important. The early involvement of the employee representation, e.g. the works council in Germany, can create a reorganization-promoting "spirit of departure" through employee participation.
- The training activities for the lower hierarchy levels are often too low. Therefore, there is a need for training both to overcome qualification and motivation barriers. These trainings should address basic logistics knowledge; because this promotes the overcoming of the traditional thought patterns of this employee group. It is also important to convey the logistics conception and modern process-oriented approaches, such as supply chain management.
- Compared to the pure cooperation of internal managers, the integration of external consultants has an accelerating effect on the implementation process. In addition to the reorganization-related methodological knowledge, the company also benefits from the expertise of the consultants, which in turn benefits the degree of goal achievement. As another source of information for system design, the companies should use the possible experience advantage of their customers and the logistics service providers.
- When filling the position of the logistics manager, the search for external experts has paid off, who can take over the pending tasks without prejudice. To confer a corresponding power position in the company, the logistics organizational unit should be located (at least) on the second hierarchy level in the company and be granted a con-

[40] Cf. Pfohl (1995, p. 217 ff.). For the effects of changes at the corporate level in general, cf. Stock-Homburg (2007, p. 811 ff.).

sulting or even veto right for important interface tasks (e.g. conclusion of long-term delivery contracts, sales price formation, product development etc.).

- The formation of a new logistics organizational structure requires, according to the model of the variables to be influenced, the adaptation of important techniques and employee variables. While a logistics-oriented control and remuneration system can influence the employee behavior in a goal-oriented way, the management needs a correspondingly developed logistics controlling for the success-oriented logistics control.
- The dangers lying in the grown organizational structure for a reorganization process must be recognized in time. Because this organizational structure is often a pronounced reorganization obstacle. For example, the reduction of an area of responsibility and the limitation of competencies for a member of the company is usually associated with great acceptance problems.
- By carefully creating personality profiles, potential opponents can be identified in advance in connection with the forecast of possible reorganization consequences. If their power position is reorganization-threatening, either their intensive involvement in the reorganization process or their transfer or even dismissal is required.
- The support of the management is indispensable for the implementation success. This not only accelerates the implementation progress, but also prevents the initiation of reorganization-inhibiting conflicts by powerful opponents. The starting point of any reorganization projects should therefore be the conviction of the management of the necessity of the reorganization.

If we summarize these theses again, it becomes clear that the implementation of reorganization processes in logistics is a complex and costly undertaking, which is quite associated with the risk of failure. However, it also became clear that without proactive adaptation of the logistics organizational structure to the economic, technical and social requirements, an efficient design of logistics is not possible in the long term.

References

Chandler A (1962) Strategy and structure. Chapters in the history of the industrial enterprise. Cambridge, London

Drucker P (1988) The coming of new organization. HBR 66(1):45–53

Frese E (2005) Grundlagen der Organisation. Entscheidungsorientiertes Konzept der Organisationsgestaltung, 9. ed. Gabler, Wiesbaden

Gaitanides M (2007) Prozessorganisation. Entwicklung, Ansätze und Programme des Managements von Geschäftsprozessen, 2., compl. rev. ed. Vahlen, München

Gallus P (2011) Effiziente Organisationsformen im Regionalflugsegment von Netzwerk-Carriern. Eul, Lohmar Köln

Ghoshal S, Mintzberg H (1994) Diversification and diversifact. Calif Manag Rev 37(1):8–27

Ginter J, Lalonde B (2002) The Ohio State University survey of career patterns in logistics: profile 2002. CLM, Oak Brook

Holtbrügge D, Welge M (2015) Internationales Management. Theorien, Funktionen, Fallstudien, 6., compl. rev. ed. Schäffer-Poeschel, Stuttgart
Kieser A (2006) Der situative Ansatz. In: Kieser A, Ebers M (Eds) Organisationstheorien, 6. ed. Kohlhammer, Stuttgart, P 215–245
Klaas T (2002) Logistik-Organisation. Ein konfigurationstheoretischer Ansatz zur logistikorientierten Organisationsgestaltung. Deutscher Universitäts-Verlag, Wiesbaden
Klaus P (1998) Jenseits einer Funktionslogistik: der Prozeßansatz. In: Isermann, H (Ed) Logistik. Gestaltung von Logistiksystemen, 2., rev. a. ext. ed. Moderne Industrie, Landsberg/Lech 1998, P 61–78
Krüger W (1994) Organisation der Unternehmung, 3., impr. ed. Kohlhammer, Stuttgart
Krüger W/v, Werder A, (1995) Zentralbereiche als Auslaufmodell? Gestaltungsmuster und Entwicklungstrends der Organisation von Teilfunktionen in der Unternehmungspraxis. Zeitschrift für Organisation 64(1):6–17
Krüger W/v, Werder A, Grundei J, (2007) Center-Konzepte: Strategieorientierte Organisation von Unternehmensfunktionen. Zeitschrift für Organisation 76(1):4–11
Lalonde B, Ginter J (2008) The Ohio State University 2008 survey of career patterns in logistics. CLM, Oak Brook
Min S (2001) Inter-functional coordination in supply chain management. Journal of Business Logistics. 22(2):1–25
Pascale R (1990) Managing on the edge. How the smartest companies use conflict to stay ahead. Simon & Schuster, New York
Pfohl H-Chr (1995) Reorganisation der Logistik – Konzepte und Umsetzung effizienter Strukturen. In: Pfohl H-Chr (Ed) Organisationsgestaltung in der Logistik. Kundenorientiert – prozeßorientiert – lernfähig. Erich Schmidt, Berlin, P 177–224
Pfohl H-Chr (1999) Ständiger Wandel. Änderung der Organisations- und Personalstruktur als Voraussetzung zur Logistikexzellenz. In: Pfohl H-Chr (Ed) Logistik 2000plus. Visionen, Märkte, Ressourcen. Erich Schmidt, Berlin, P 167–220
Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. act. ed. Springer, Berlin
Pfohl H-Chr, Hofmann E (2003) Integration akquirierter Unternehmen aus Sicht der Logistik. In: Wurl H (Ed) Industrielles Beteiligungscontrolling. Schäffer-Poeschel, Stuttgart, P 303–335
Pfohl H-Chr, Large R (1998) Eingliederung der Logistik in die Aufbauorganisation von Unternehmen. In: Isermann H (Ed) Logistik. Gestaltung von Logistiksystemen, 2., rev. a. enl. ed. Moderne Industrie, Landsberg/Lech, P 91–105
Pfohl H-Chr, Zöllner W (1987) Organization for logistics: the contingency approach. Int J Phys Distrib Mater Manag 17(1):3–16
Pfohl H-Chr, Linn N, Kunz T (1989) Zum Problem der Unabhängigkeit der Erfolgsdeterminanten von Reorganisationsprozessen. J für Betriebswirtschaft 39(4):220–243
Pieper C (1995) Strategieorientierte Organisation der Logistikfunktion. Konzeption und empirische Untersuchung in der Automobilzulieferindustrie. Huss, München
Schulte-Zurhausen M (2014) Organisation, 6., rev. a. act. ed. Vahlen, München
Stock R (2003) Steuerung von Dienstleistungsnetzwerken durch interorganisationale Teams. Wiesbaden. In Bruhn M, Stauss B (Eds) Dienstleistungsnetzwerke. Gabler, Wiesbaden, P 215–228
Stock-Homburg R (2007) Nichts ist so konstant wie die Veränderung: Ein Überblick über 16 Jahre empirische Change Management-Forschung. ZfB 77(7/8):795–861
von Eiff W (1994) Geschäftsprozessmanagement. Integration von Lean Management-Kultur und Business Process Reengineering. ZfO 36(6):364–371
Womack J, Jones D (1994) From lean production to lean enterprise. HBR 72(2):93–103

Process Organization of Logistics

8

8.1 Significance of Process Organization for the Realization of the Logistics Conception

8.1.1 Process Thinking in the Logistics Conception

The explanations on the organizational structure have shown the limits of the traditional structure-oriented organization and emphasized the necessity of a process orientation. The process orientation of the logistics organizational structure shows the importance of the process organization of logistics. The task of the process organization of logistics can also be derived directly from the systems thinking of the logistics conception. Between the elements of a logistics system there are relationships that can be interpreted as processes in a flow-oriented way. If one concentrates the systems thinking on these relationships, it emerges as process thinking.

A process consists of a sequence of actions. Processes are therefore spatio-temporal events, which in turn makes the importance of the process organization for logistics clear. This perspective emphasizes the dimension of time over the dimension of capacity of the logistics system. From the characterization of processes as sequences of actions, the objects of arrangement and thus the *design variables of the logistics process organization* become clear.[1] At the center of the process organization are the individual activities that have to be performed to fulfill a logistics task. Fundamental for the process organization of logistics is therefore the analysis of logistics work processes.[2] In addition to operational execution activities of logistics, this also includes activities of logistics

[1] Cf. Large (2013, p. 284 f.).

[2] Cf. Küpper and Helber (2004, p. 29 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_8

management. Although often the sequence of logistics activities is mandatory due to logical connections, there are also possibilities for design regarding the sequence. A well-known example for this is the organization of delivery tours. The individual activities can be assigned time requirements as well as time points, in the sense of start and end dates. The process organization therefore has a direct impact on the service components of delivery time and delivery reliability. This already addresses the core fields of the process organization. In addition, operational facilities and other resources can be assigned to the individual activities. Likewise, responsibilities for individual activities or process sections can be defined within the framework of the process organization.

A common argument against the process organization is that process organizational measures cement processes and thus limit companies and individual employees in their *flexibility*. Against this view, two traditional arguments can be made. First, according to the regulatory need, different levels of process organization are possible. One can distinguish, for example, four levels with increasing degree of standardization: framework programming, module programming, branched routine programming and rigid routine programming.[3] Process organization is therefore not synonymous with a fixed regulation of processes. Moreover, the so-called substitution principle of organization shows that only in cases where there is a high degree of similarity and repetition, the case-by-case external or self-control is replaced by a predefined process organization.[4]

With regard to the cross-company process organization, empirical studies on excellent logistics have shown that the inter-organizational interfaces of logistics systems are most flexible when the processes are standardized and predefined routines are followed diligently.[5] This is because logistics processes can be so diverse that a precise prior coordination is indispensable in order not to lose control over the processes. Think in this regard of the interactions of logistics service providers with their hundreds or thousands of customers in different countries. It is then necessary to create routinized processes for the complex interactions. Not individual, case-by-case regulations are needed, but the flexible handling of the complex processes is generally regulated. Flexibility becomes routine. This also eliminates the need for intervention by managers who have to be involved in individual solutions in exceptional cases, which leads to an overload of the management technique "management by exception"[6].

[3] Cf. Ulrich and Fluri (1995, p. 192).

[4] Cf. Schulte-Zurhausen (2014, p. 243).

[5] Cf. The Global Logistics Research Team (1995, p. 165 ff.).

[6] See Part IV, Sect. 10.3.2.

8.1.2 Critical Success Processes

In the design of the process organization, it is important to identify the “important” or “critical” processes with regard to the company’s success or the logistics. This can be done at different levels of aggregation, either at the company level, at the level of individual business areas or for specific functions. In general, indications of the critical processes can be derived from the following *criteria*[7]:

- High importance for problem solving or satisfaction of external or internal customers
- High cost intensity
- High capital commitment
- High importance for the safety of production
- Long process duration
- New or different solutions are known
- New technologies can be used.

A prerequisite for applying these criteria is the *process identification,* i.e. the determination and delimitation of the processes that are necessary for the creation of a market performance.[8] To develop such a framework for the relevant processes of a company, two approaches are distinguished. The general or deductive approach assumes that there are a number of differentiable framework processes that can be identified in any company. These processes, for which Fig. 8.1 gives an example, are then to be configured company-specifically. The singular or inductive approach starts from the specific situation of a company and determines the processes required for satisfying the customer benefit. Both approaches can be combined by concretizing the deductively determined ideal-typical framework processes by inductive process identification. In this way, a general framework, which is especially necessary for the cross-company connection of the processes in a logistics chain, is maintained.

The identification of the most important processes is the starting point for their design. The following section will discuss design options for the process organization.[9]

[7] Cf. Krüger (1994, p. 121 f.).

[8] See also Hagen and Felder (2006, p. 30 ff.); Gaitanides (2007, p. 55 f. and 149 ff.).

[9] See as an example the order processing process at Pfohl (2022, p. 69 ff.).

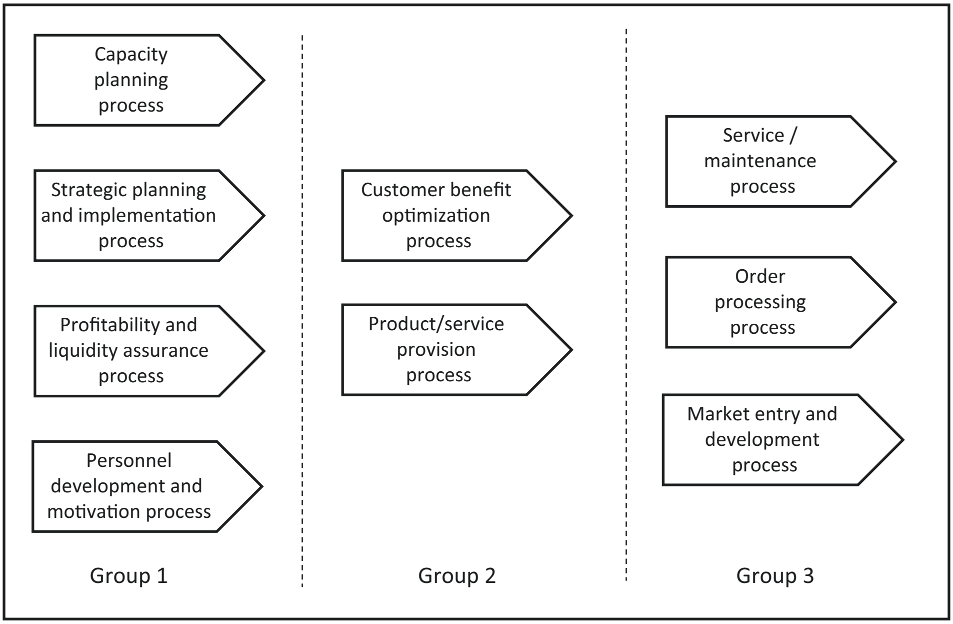


Fig. 8.1 General ideal-typical identification of framework processes. *Source* Gaitanides 2007, p. 151

8.2 Design Possibilities for the Process Organization

8.2.1 Design Concepts

As already indicated, it is necessary to distinguish whether processes have to be designed for completely new processes, or whether existing processes can be used. In the second case, new alternatives can be generated by variation and improvement of the existing ones. The following basic possibilities can be distinguished (see also Fig. 8.2):

- Omitting: Non-value-adding processes are omitted. For example, the transfer of the customer order to the supplier's order form is omitted by having the customer use the supplier's order form.
- Adding: To reduce the risk of payment default, a credit check is performed.
- Combining: Several sub-processes of order processing, for which different employees were previously responsible, are performed by one employee with the help of information technology.
- Splitting: Due to the necessary knowledge of the importance of customers, the determination of payment terms is transferred to an employee from marketing.

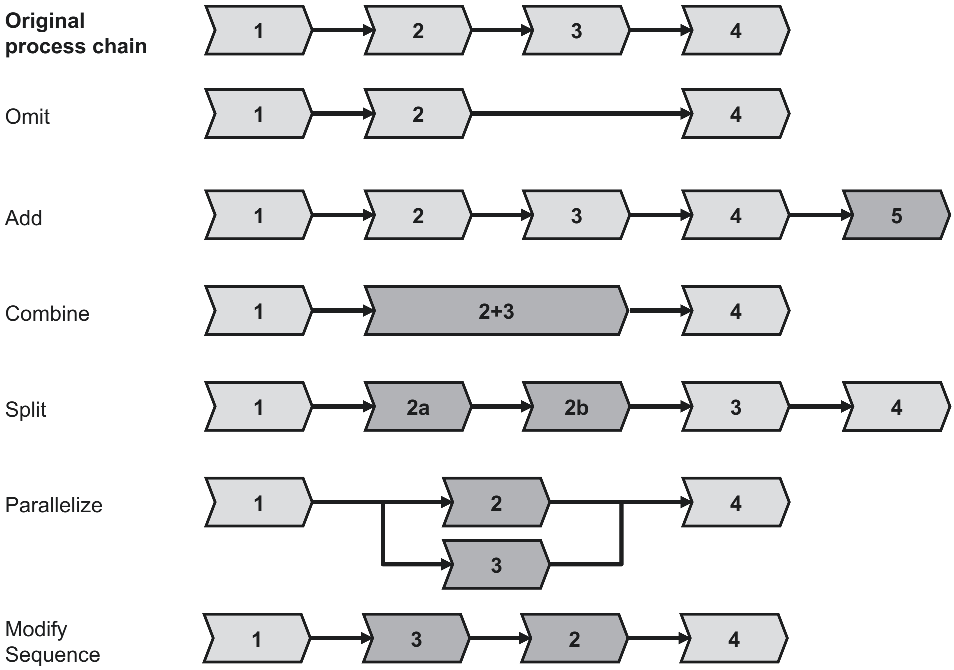


Fig. 8.2 Possibilities of process optimization. *Source* Vahs 2019, p. 250

- Parallelizing: In the case of pre-invoicing, the invoice is created in parallel to the processes of compiling the order.
- Modifying the sequence: Checking the availability of an item from the supplier by the customer before the order is transmitted.

In the case of *new design of processes*, it is often attempted to adopt *proven processes*. As role models, sister companies of one's own group, but also other companies, especially competitors with similar process problems, can serve. In the past, the automotive industry was often attributed a model function in Germany. An example of this is the attempt to adopt processes of JiT delivery by other industries. However, the different conditions and resource endowments in different industries were often neglected. A systematic approach to comparing and adopting proven processes is benchmarking.[10] When using comprehensive planning and control systems, the design framework for new processes is also often limited, as existing processes in the system have to be built on.

[10] See Part II, Sect. 5.2.9.

<table>
<tr><th>Basic functions
Information flow</th><th colspan="6">Implementation options</th></tr>
<tr><td>Capturing of the customer order</td><td colspan="2">manually</td><td colspan="2">manual with automatic support</td><td colspan="2">automatic</td></tr>
<tr><td>Processing of the customer order</td><td colspan="2">Customer order as individual order</td><td colspan="2">Splitting customer orders into individual orders</td><td colspan="2">Customer orders as order groups</td></tr>
<tr><td rowspan="2">Passing on the picking order</td><td colspan="3">paperless</td><td colspan="3">paper-bound</td></tr>
<tr><td colspan="3">each position individually</td><td colspan="3">several positions at the same time</td></tr>
<tr><td rowspan="2">Confirming of picking</td><td colspan="2">each withdrawal unit single</td><td colspan="2">each position individually</td><td colspan="2">several positions at the same time</td></tr>
<tr><td colspan="2">manually</td><td colspan="2">manual with automatic support</td><td colspan="2">automatic</td></tr>
</table>

Fig. 8.3 Alternative realization possibilities for the information flow in picking systems. *Source* Jünemann and Schmidt 2000, p. 221

However, these approaches are basically not creative and are based on existing processes. *New and unique processes,* which can form potential for success in the sense of the resource-oriented approach of strategic management then, can only be generated by creative designs. To generate new process designs or to vary existing processes, various creativity techniques can be used,[11] which often rely on group dynamic effects. Examples of this are brainstorming and card technique. Individual creativity techniques, such as the use of morphologies, can also be helpful. By using morphological boxes, different solution alternatives for a specific sequence of actions can be combined.

8.2.2 Example of Picking

An example of an application of morphologies is picking. Figure 8.3 shows a morphological box for the information flow in picking processes. It shows the *four basic functions of the information flow* in picking, namely capturing and processing the customer order, passing on the picking order and confirming the picking, with the respec-

[11] Cf. Pfohl and Stölzle (1997, p. 153 ff.).

tive design options. A fundamental decision relates to the degree of automation. Here, a distinction is made between manual or automatic and the corresponding mixed forms. Furthermore, a distinction can be made between the individual processing and the consolidation of orders or positions in the information flow.

In addition to the possibilities for realizing the information flow shown in Fig. 8.3, there are further variation possibilities in the design of the material flow. The following *basic functions of the material flow* to be fulfilled can be distinguished[12]:

- Movement of goods for provision
  - Provision
  - Movement of the picker to the provision
  - Withdrawal of goods by the picker
  - Transport of the withdrawal unit to the delivery
  - Delivery of the withdrawal unit
  - Transport of the picking unit to the delivery
  - Delivery of the picking unit
- Return transport of the broken loading unit.

As "pickers", both persons and technical devices or picking machines (picking robots) can be considered. A fundamental choice also exists for these basic functions with regard to the degree of automation with the characteristics *manual, mechanized* or *automated.* Manual processes are carried out completely by humans. In mechanized processes, technical aids are used for support. Automated processes only require human intervention for starting and stopping or for part of the control tasks.

Another common decision concerns the type of provision. Here, the principles *"goods to man"* and *"man to goods"* can be distinguished. In the first case, the goods are transported to the provision point by means of conveyor systems and removed there. In the second case, the picker has to go to the goods or to different provision points. For this purpose, a variety of technical aids have been developed. In practice, combinations of different principles can also be found. For example, a *two-stage picking* is possible, in which mechanized picking is carried out according to the principle of "man to goods" in the first stage. In the second stage, the individual partial orders are automatically consolidated into customer orders.[13] The variety of possible manifestations is hardly limited by the numerous choices, so that depending on the delivery service requirements and the type of goods, different systems are implemented in practice.

[12] Cf. Jünemann and Schmidt (2000, p. 212). See also Schulte (2017, p. 264 et seq.) for the design of picking systems.

[13] Cf. for this and other examples Jünemann and Schmidt (2000, p. 217 et seq.).

Fig. 8.4 Basic form of the SCOR model 2013. *Source* Supply-Chain Council

8.3 Approaches to Explain the Process Organization

As a basis for the development of explanatory models, a descriptive description model will be presented here. Subsequently, the influencing factors of process organizational facts relevant for a theory of process organization will be discussed.

8.3.1 SCOR Description Model of Logistics Processes

The "Supply Chain Operations Reference" (SCOR) model shown in Fig. 8.4 is a description of the logistics processes from the user's perspective. A *reference model* is a deductively developed model that abstracts from the company-specific characteristics of the processes. A reference model is intended to support the modeling in a company on the basis of a uniform terminology. The following requirements must be met by reference models[14]: correctness (accurate representation of reality), semantic unambiguity, completeness, comprehensibility, complexity reduction, verifiability, adaptability, combinability. Such a model offers a standardized way to analyze, improve and implement logistics processes. The "*Supply Chain Council*" (SCC), an organization in which companies worldwide cooperate, developed such a model, which is accessible to all companies.[15] The model is based on the five basic processes:

- Planning ("Plan")
- Sourcing ("Source")
- Making ("Make")
- Delivering ("Deliver")
- Returning ("Return").

[14] Cf. Lasch (2014, p. 126 f.).

[15] The statements refer to SCOR Version 10.

Using these process building blocks, the process chains of different industries can be modeled. Here, three types of processes are distinguished. The *execution processes* include all activities for order handling in a broad sense or order processing. These include the above-mentioned processes of sourcing, making, delivering and returning. The *planning processes* describe the preparatory activities for future material, information and value flows. As a third category, the *enabling processes* are named. They serve the preparation and design of the supply chain. This includes, for example, the selection of suppliers, which then serves as the basis for the execution processes.

The SCOR model assumes a hierarchical structure. On the highest level, the entire supply chain is described. This includes, for example, the locations and the essential processes or a segmentation of the main suppliers and customers. The processes are divided into sub-processes on level 2 and shown in their interconnection. Level 2 thus represents a refinement of the overall configuration. It illustrates potential problems in the form of open interfaces, different control mechanisms or duplicate activities. Level 3 serves to document the individual process categories and steps, as well as the associated input and output information. The highest level of detail is reached on level 4. It does not contain any reference content, but gives the companies applying the model the possibility to include their own content such as work instructions and flow diagrams.

Another feature of the SCOR model is the provision of key performance indicators for the mapping of the supply chain. These include in particular the:

- Supply chain delivery reliability (“Supply Chain Delivery Reliability”)
- Supply chain responsiveness (“Supply Chain Responsiveness”)
- Flexibility of the supply chain (“Supply Chain Flexibility”)
- Supply chain cost (“Supply Chain Cost”)
- Efficiency of asset management in the supply chain (“Supply Chain Asset Management Efficiency”).

The main benefit of the model lies in the determination of a common definition of the key performance indicators for the partners in the supply chain. This facilitates the identification of weaknesses and thus the cross-company optimization. At the same time, the key performance indicators can serve as a basis for benchmarking.[16]

8.3.2 Factors Influencing the Process Organization

As a basis for a theory of process organization, the factors influencing process organizational facts must first be identified.[17] On the basis of such a classification, comparative or

[16] See Part II, Sect. 5.2.9.

[17] For the following, see Küpper and Helber (2004, p. 7 ff.).

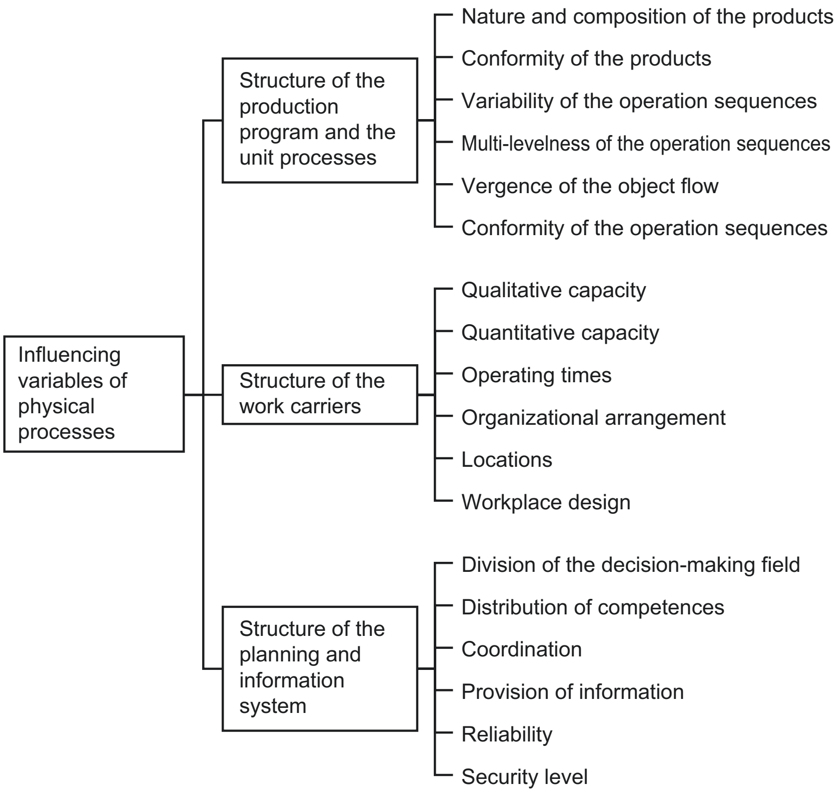


Fig. 8.5 Factors influencing the process organization of physical processes. *Source* Based on Küpper 1982, p. 81

quantitative statements can then be formulated as hypotheses that establish the relationships between process organizational questions and the influencing factors or the goals. To derive a comprehensive theory, these individual hypotheses would have to be linked to form a comprehensive system of statements.

The factors influencing the process organization are particularly the structure of the production program and the unit processes, the structure of the work carriers, and the structure of the planning and information system. An overview of the individual aspects is given in Fig. 8.5.

With regard to the structure of the *production program*, the conformity between the products is an important criterion. Here, a distinction is made between the types of mass, batch, series, and single item production.[18] The composition of the production program

[18] See Pfohl (2022, p. 188 f.).

determines the extent to which questions of lot size problems have to be considered. They are especially relevant for batch and series production.

The structure of the *unit processes* describes the number, type, and sequence of operations that have to be performed to complete a product. Essential influencing factors are the multistage and conformity of the operation sequences as well as the vergence of the object flow. The vergence type describes the necessity for combining and/or splitting materials in the production of a good. For example, in a smooth object flow, the product is formed from a single material, while in a regrouping object flow, several materials are used and several product types are produced at the same time.[19] The vergence thus describes the objects of the unit processes, while the multistage and conformity of the operation sequences refer to the activities. If unit processes contain similar activities, they can be performed by the same work carriers.

The structure of the *work carriers* is therefore another important factor influencing the process organization. In addition to the qualitative and quantitative capacity, the maximum availability is also determined by the operating time. For employees, this results, for example, from the agreed working time arrangements. Operating resources can be limited in their operating time by maintenance or repair measures. The organizational arrangement and the locations of the plants, but also of the departments and individual work carriers, are closely related. Both influence the possible unit and transport processes.[20] The workplace design has a particular impact on the quality of work and job satisfaction.

In addition to the components of the physical processes in the company described so far, the process organization also depends on structural features of the decision processes. Therefore, the *planning and information system* must be included in the analysis. In general, the decision field is divided according to functions (e.g., procurement, production) or objects (product groups). The sub-plans can then be further differentiated according to their time horizon, the degree of precision, and the dimensions considered (quantities, values). The distribution of competencies indicates the extent to which there is a centralization or decentralization of planning and decision-making competencies. In the coordination between the planning objects, a basic distinction can be made between the simultaneous and successive approach. The simultaneous planning allows for the highest possible integration, but is associated with high requirements for the planning models used. In the successive planning, the knowledge and willingness to participate of the decentralized planners can also be better utilized.

[19] Other vergence types are convergent and divergent. See also Küpper and Helber (2004, p. 9).

[20] For the basic types of production organization workshop and flow production, see Part II, Sect. 4.6.3.

The information system has the particular task of providing the required information in a timely and quality manner. Because this directly influences the quality of the process organizational decisions. Only by providing the information reliably can the adaptability required by the process organization be implemented. Because of the importance for the process organization, the information and communication technology will be discussed in more detail in the next section.

8.4 Unification of Information and Goods Flow

8.4.1 Overcoming Interfaces

The developments in the field of information and communication technology (ICT) are in a close mutual relationship with logistics. On the one hand, logistics is one of the most important operational fields of application and, with its increasing requirements, is a driver for further developments in the field of ICT. On the other hand, new technological possibilities form the basis for the development of new concepts in logistics. One such new technology is the cyber-physical system, which leads to a connection of information and goods flow and thus has a great impact on the process organization.

A major problem of the process organization is the overcoming of interfaces, which hinder an efficient and effective design of the processes. *Interfaces*[21] exist both in the goods flow, e.g. in combined transport, and in the information flow, e.g. between the different stations of the order processing. Furthermore, there are interfaces between the information and goods flow, e.g. the triggering of the picking activities in the warehouse by an internal order. Another interface is the human-machine interface, e.g. the information from the malfunction of a storage and retrieval machine to an employee with the corresponding decision-making authority.

Cyber-physical systems (CPS) are an approach to overcoming such interfaces, as they close the media gap between the virtual and real world. CPS… "are objects, devices, buildings, vehicles, but also production facilities, logistics components, etc., that contain embedded systems that are made communicable. These systems can communicate via the Internet and use Internet services. Cyber-physical systems can directly capture their environment with their corresponding sensors, evaluate, store and act on the physical world with the help of actuators using globally available data and services."[22] CPS are the basic technology of the fourth industrial revolution ("Industry 4.0").

CPS have been discussed under the term "Internet of Things" in logistics since the turn of the millennium.[23] The term originated in connection with RFID-based tracking

[21] See Pfohl (2022, p. 286).

[22] Bauernhansl (2014, p. 15 f.).

[23] Cf. ten Hompel and Henke (2014, p. 615 ff.).

of goods in the logistics chain.[24] This enables a unique identification of the goods in real time and thus creates transparency about the processes taking place. The *networking* through the Internet of Things is complemented by the networking with the Internet of Services, e.g. “Software-as-a-Service” or “Business-Process-as-a-Service”,[25] and the Internet of People, e.g. social networks. The basis for this are CPS platforms.[26] In addition to such networking, the *decentralized self-control* is a fundamental idea of Industry 4.0.[27] The aim is to enable the delegation of decision-making to local logistics units. For example, a sea freight container should be able to plan its own route and arrange its own transport as an active participant in the logistical process. For this purpose, intelligence must be shifted to the containers or, in production, to the workpiece carriers, or less frequently to the products themselves. The decentralization can also be supported for the human as the decision-maker, if the human-machine interface is bridged by mobile tablet computers that can be integrated into networks in various ways.[28]

Three main factors drive the development of CPS.[29] First, according to the still valid “Moore’s Law”, the computing power doubles every 18 months. Second, according to the “Law of Metcalfe”, the benefit of a communication network increases with the square of the number of its participants. Third, decentralization is an approach to managing complex systems.

The technical prerequisites for the development of CPS have been available for years and they are constantly being further developed in their technical maturity. These are embedded systems, automatic identification systems, and broadband wireless networks.[30] The first two will be briefly discussed below.[31]

8.4.2 Technical Requirement

Embedded systems refer to devices that are integrated in a technical context. They perform monitoring, control and regulation functions. They are an essential element in *communication networks.* Machine-to-Machine (M2M) communication is the keyword for

[24] Cf. Schlick et al. (2014, p. 57 f.).

[25] Cf. Coyle and Ruamsook (2014, p. 24).

[26] Cf. Bauernhansl (2014, p. 16).

[27] Cf. Redelberg (2014, p. 1).

[28] This is also referred to as the “assisted operator”. Cf. Schlick et al. (2014, p. 63).

[29] Cf. Bauernhansl (2014, p. 17 f.).

[30] Cf. Schlick et al. (2014, p. 59).

[31] For the third technique, see the explanations on the external communication infrastructure and technology by Pfohl (2022, p. 330 ff.).

networking, which is an important component of Industry 4.0.[32] M2M generally means the automatic data transmission between technical devices of different kinds. M2M solutions are already used today in fleet management, in the control and monitoring of production processes or in shipment tracking in transport and logistics.

M2M systems are characterized by three basic components:

1. Data endpoint (DEP)—e.g. a truck to be monitored
2. Communication networks
   a) Mobile communication (e.g. GSM, SMS, LTE)
   b) Wired (e.g. fixed network, DSL, Ethernet)
   c) Other (e.g. Bluetooth, RFID, W-LAN)
3. Data integration point (DIP)—e.g. a server that monitors the engine condition of the truck

The data endpoint is a transmitter that is linked to a terminal device (usually an embedded system). Within a closed network, there can be numerous data endpoints and the associated terminal devices. Using the DEP, the machines exchange data with the data integration point (DIP) via a communication network, which is often connected to a central server. The DIP, unlike the numerous DEPs, is usually only found once in an M2M application. The information does not flow exclusively in the direction of the center. Communication between the individual DEPs is also possible. The entire data transmission can take place via a mobile network, for example. For instance, a plant sends an error message directly by SMS to a selected group of engineers.

Under the umbrella term *identification systems*, various techniques can be summarized. For mass articles, barcode systems are currently mainly used. A gaining alternative is the so-called “Radio-Frequency Identification” (RFID). Here, the information is transmitted by electromagnetic fields. The advantages of the transponders, which are either equipped with a fixed memory (“Read-Only”) or freely writable (“Read/Write”), can be summarized as follows[33]:

- Several transponders can be read out simultaneously (bulk detection)
- Susceptibility to interference is low even under extreme external conditions (humidity, dirt, etc.)
- Readability is given even without direct line of sight, i.e. a position-independent identification of goods is possible
- Transponders are characterized by a high service life
- Storage of information is possible with a much lower space requirement compared to the barcode.

[32] Cf. Emmerson (2010); Wu et al. (2011).

[33] Cf. Rohwedder (2002, p. 444).

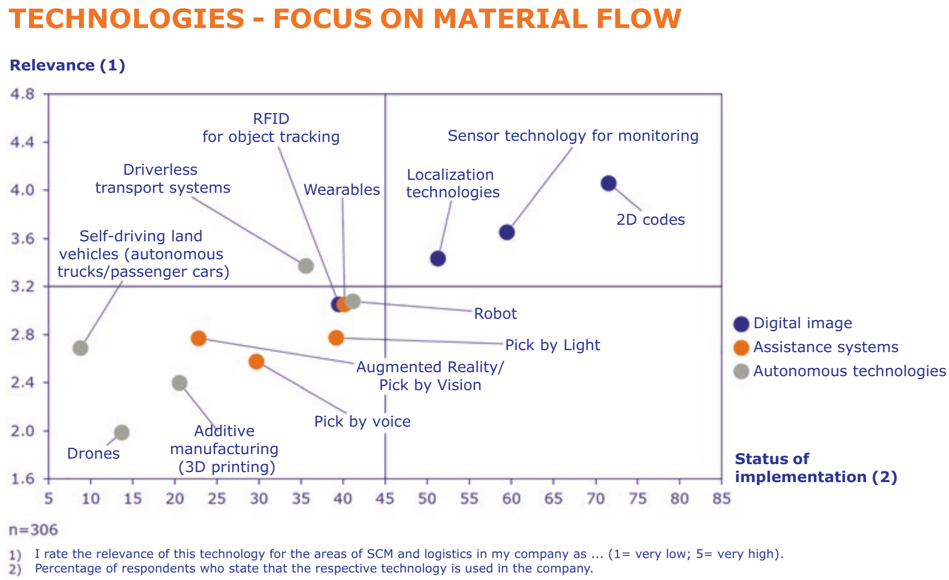


Fig. 8.6 Relevance and implementation status of technologies—focus on material flow. *Source* Kersten et al. 2020, p. 14

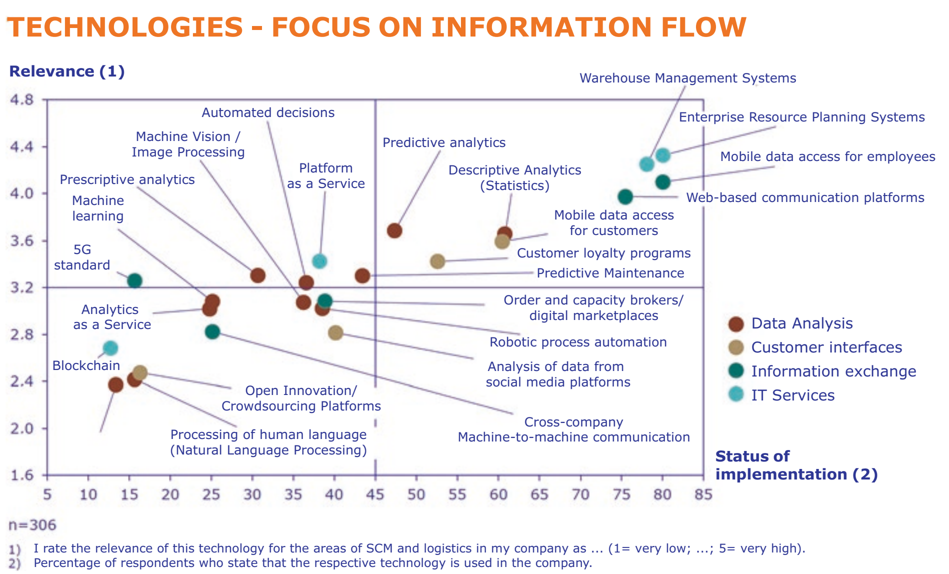


Fig. 8.7 Relevance and implementation status of technologies—focus on information flow. *Source* Kersten et al. 2020, p. 15

The factors that hinder the use of RFID are the associated investment costs and the installation effort for the conversion from the barcode technology as well as the lack of standardization and data protection.[34] An alternative with lower energy consumption is BLE (Bluetooth Low Energy).[35]

To take advantage of such technologies, coordinated action by the actors involved in the logistics chain is indispensable. In every company, logistics management has to deal with the possibilities of digital technologies. Because digital transformation is a feature of logistics excellence.[36] Here, the assessment of the relevance of the technologies by the management is of great importance. The Figs. 8.6 and 8.7 show the assessment of the relevance and the current state of implementation according to a study by the German Federal Association of Logistics in industry, trade and logistics services in 2020.[37] It turns out that relevance and implementation status do not always correspond. An international study by Gartner Inc. shows that the relevance of digital technologies and the capabilities for implementation in their companies are rated higher by the top management ("C-level") than by the middle management. Possibly, the top management overestimates the potentials of the technologies and their own abilities for implementation.[38]

The potentials of digital technologies can often only be exploited if they are implemented across companies. The inter-organizational issues related to this are discussed in the following section.

References

Bauernhansl Th (2014) Die Vierte Industrielle Revolution – Der Weg in ein wertschaffendes Produktionsparadigma. In: Bauernhansl T, ten Hompel M, Vogel-Heuser B (Eds) Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Springer Vieweg, Wiesbaden, pp 5–35

Coyle JJ, Ruamsook K (2014) Game-chaining trends and supply chain's "new normal". Supply Chain Q 8(4):22–29

DHL Customer Solutions & Innovation (2020a) Next-generation wireless in logistics. DHL, Troisdorf

DHL Customer Solutions & Innovation (2020b) The logistics trend radar. 5th edn. DHL, Troisdorf

Emmerson B (2010) M2M: the internet of 50 billion devices. Win-Win Mag 1:19–22

[34] Cf. Pater and Seidl (2007, p. 37). For the implementation process of RFID, see Hansen and Gilbert (2008, p. 178 ff.).

[35] For a comparison of RFID and BLE, see DHL (2020a, p. 15 ff.).

[36] See Part I, Sect. 3.3.2.

[37] See also DHL Customer Solutions & Innovation (2020b); Kearney (2020, p. 57 ff.).

[38] Cf. Klappich (2020). See also Part III, Sect. 7.4. Because digital technologies can also be a reason for reorganization in the company.

Gaitanides M (2007) Prozessorganisation. Entwicklung, Ansätze und Programme des Managements von Geschäftsprozessen, 2., compl. rev. ed. Vahlen, München

Hagen N, Felder M (2006) Prozessstandardisierung. In: Hagen N et al (Eds) Prozessmanagement in der Wertschöpfungskette. Haupt, Bern/Stuttgart/Wien, pp 23–49

Hansen W-R, Gillert F (2008) RFID for optimization of business processes. Wiley, Chichester

Jünemann R, Schmidt T (2000) Materialflußsysteme. Systemtechnische Grundlagen, 2nd edn. Springer, Berlin

Kearney (2020) CSCMP's Annual State of Logistics Report. Study Council of Supply Chain Management Professionals. CSCMP, Oak Brook, IL

Kersten W et al (2020) Trends und Strategien in Logistik und Supply Chain Management: Entwicklungen und Perspektiven einer nachhaltigen und digitalen Transformation. Studie der Bundesvereinigung Logistik. BVL.digital, Bremen

Klappich D (2020) The digital disconnect. Supply Chain Q 14(Special Issue):43–45

Krüger W (1994) Organisation der Unternehmung, 3, impr. ed. Kohlhammer, Stuttgart

Küpper H-U (1982) Ablauforganisation. Gabler, Stuttgart

Küpper H-U, Helber S (2004) Ablauforganisation in Produktion und Logistik, 3., rev. a. enl. ed. Schäffer-Poeschel, Stuttgart

Large R (2013) Strategisches Beschaffungsmanagement. Eine praxisorientierte Einführung mit Fallstudien, 5. compl. rev. ed. Springer Gabler, Wiesbaden

Lasch R (2014) Strategisches und operatives Logistikmanagement: Prozesse. Springer Gabler, Wiesbaden

Pater H-G, Seidl P (2007) Der RFID-Markt aus Sicht der Anwender und Anbieter. In: Bullinger H-J, ten Hompel M (Eds) Internet der Dinge. Springer, Berlin, pp 19–38

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. act. ed. Springer, Berlin

Pfohl H-Chr, Stölzle W (1997) Planung und Kontrolle. Konzeption, Gestaltung, Implementierung, 2., rev. ed. Vahlen, München

Redelberg J (2014) Industrie 4.0 im Kontext Logistik – Connected Supply Chains. https://www.de.capgemini-consulting.com/blog/digital-transformation-blog/2014/08/industrie-40-im-kontext-logistik-connected-supply-chains. Accessed 12 Juni 2015

Rohweder D (2002) IT-Potenziale zur Gestaltung der Auftragsabwicklung in der Konsumgüterindustrie. In: Stölzle W, Gareis K (Eds) Integrative Management- und Logistikkonzepte. Gabler, Wiesbaden, pp 429–450

Schlick J et al (2014) Industrie 4.0 in der praktischen Anwendung. In: Bauernhansl T, ten Hompel M, Vogel-Heuser B (Eds) Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Springer Vieweg, Wiesbaden, pp 57–84

Schulte Chr (2017) Logistik. Wege zur Optimierung der Supply Chain, 7., compl. rev. a. enl. ed. Vahlen, München

Schulte-Zurhausen M (2014) Organisation, 6., rev. a. act. ed. Vahlen, München

Supply Chain Council (2013) Supply chain SCOR framework. https://www.apics.org/sites/apics-supply-chain-council/frameworks/scor. Accessed 25 Jan 2016

ten Hompel M, Henke M (2014) Logistik 4.0. In: Bauernhansl Th, ten Hompel M, Vogel-Heuser B (eds) Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Springer Vieweg, Wiesbaden, pp 615–624

The Global Logistics Research Team at Michigan State University (1995) World class logistics: the challenge of managing continous change. CLM, Oak Brook, IL

Ulrich P, Fluri E (1995) Management. Eine konzentrierte Einführung, 7., impr. ed. Haupt, Bern

Vahs D (2019) Organisation: ein Lehr- und Managementbuch, 10., rev. ed. Schäffer-Poeschel, Stuttgart

Wu G et al (2011) M2M: from mobile to embedded internet. IEEE Commun Mag 49(4):36–43

Inter-Organization of Logistics

9

9.1 Significance of Inter-Organization for the Realization of the Logistics Conception

9.1.1 Inter-Organizational Thinking

In the approaches to thinking that are characteristic for the *logistics conception* of system orientation, flow- or process orientation and cross-functional orientation, the design of the logistics chain in the form of inter-organizational logistics systems is included.[1] Because systems thinking demands a perspective that does not end at the legal-organizational boundaries of a company, but strives for optimal solutions with regard to logistics overall systems. The flow or process thinking is based on a reduction of the mutual decoupling or separation of the sections in the logistics chain by inventories and sees the basis of a transparent and fast flow of goods along the logistics chain in the informational linkage of all members of the logistics chain.

The cross-functional thinking serves not only to avoid efficiency-reducing conflicts between areas of a company due to the prevailing departmental egoisms, but also to avoid such conflicts between companies that arise from short-term competitive thinking.[2]

Already in 1973 Heskett[3] stated that the inter-organizational design of cross-company logistics systems offers much greater possibilities of cost reduction, performance improvement and the development of logistics potentials compared to purely

[1] For the basics of inter-organization of logistics see Pfohl (2022, p. 285 ff.).

[2] For the causes of conflicts in inter-organizational cooperation see Howaldt and Ellerkmann (2011, p. 29 f.).

[3] Heskett (1973, p. 123 ff.); see also Heskett et al. (1992, p. 735).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_9

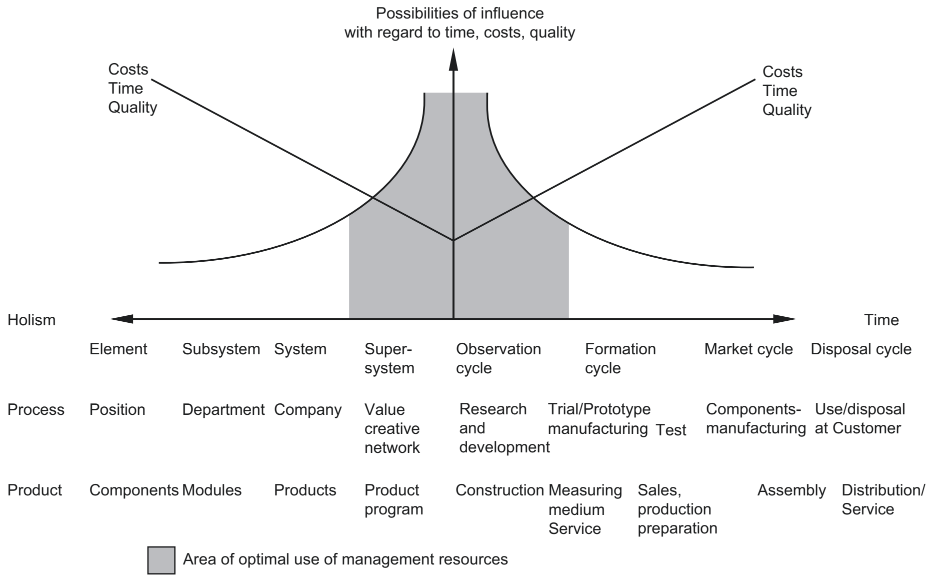


Fig. 9.1 Area of optimal use of management resources according to the fundamental principle of effective and efficient design. *Source* Pfeiffer and Weiß 1994, p. 36

technological and intra-organizational changes of logistics systems. He sees a development in the *maturity of logistics analysis* starting from the intra-organizational logistics total cost analysis, over the intra-organizational logistics profit analysis to the inter-organizational cost and profit analysis. Also in the later research in the field of supply chain management, the dissolution of company boundaries is discussed and the network is considered as the object of planning and control.[4]

The consideration of cross-company logistics systems is also contained in the *fundamental principle of effective and efficient design* of value creation networks: "The more fundamental and holistic and the earlier the management in the life cycle of a product or production process or more generally of a project thinks and acts, the greater are the effectiveness and efficiency of the influencing measures with regard to the optimization variables time, cost and quality and the lower are the costs and the times of the influence."[5] The super system listed in Fig. 9.1 from the point of view of holism also includes cross-company logistics systems consisting of the logistics systems or logistics subsystems of a company, its suppliers and customers as well as its logistics service providers.

[4] See on this Cox et al. (2001, p. 31 f.); Burgess et al. (2006, p. 716).

[5] Pfeiffer and Weiß (1994, p. 181).

In accordance with this fundamental principle, it is also demanded that the *"business reengineering",*[6] an approach to fundamentally rethink and radically redesign companies or essential business processes, not limit the view to the individual company, but apply it to the totality of the companies involved in the value creation for a customer, especially to the logistics chain. The essential characteristics of business reengineering are the process orientation, the improvement by orders of magnitude, the break with existing rules and the creative use of information technology. The process orientation frees the view for new, cross-functional and cross-company problem solutions. Ambitious plans are supposed to lead to innovative problem solutions and to improvements in quantum leaps. For this, a break with old rules is always necessary, which define, for example, the type of division of labor within and between companies or the roles to be perceived by companies of different industries and sectors. In this context, each company should take over the process activities that it can perform best due to its specific strengths.

9.1.2 Competitive Advantages

These *strengths* are expressed above all in the ability of the company to exploit "Economies of Scale" (scale advantages), "Economies of Scope" (synergy advantages), "Economies of Arbitrage" (price advantages), "Economies of Structure" (change advantages) and "Economies of Speed" (speed advantages) in the performance processes to solve the customer problems (satisfy the customer needs).[7] The importance of these "Economies" for achieving competitive advantages can change over time. For example, it can be observed that the synergies have gained significantly in importance compared to the economies of scale.

Scale advantages lead to competitive advantages due to lower unit costs by combining and increasing identical processes that are possible with large quantities. However, due to differentiation, such large quantities can be achieved less and less. This also applies to upstream production stages, as companies are striving to shift the decoupling points as far as possible in the direction of the customer as a result of the application of the postponement strategy, in order to exploit economies of scale and the delayed cost increase in the value chain as well as "risk pooling".[8]

Scope advantages (synergy effects) lead to lower unit costs by combining different processes through the joint use of production factors. This is possible when a complete rivalry between the individual uses does not occur. Economies of scope due to non-rivalrously usable resources can be perceived especially in market-oriented value creation

[6] See Hammer and Champy (1993, p. 48 and 66 f.).

[7] See also the development of logistics target variables at Pfohl (2022, p. 47 ff.).

[8] Cf. Part II Sect. 4.4.4.

stages, e.g. in consulting, tendering, sales, provision, shipping, technical customer service or spare parts supply.

Price advantages lead to lower unit costs due to lower prices for the production factors. These can be, for example, lower wages, lower interest rates or lower land prices, but also lower taxes.

To achieve competitive advantages due to economies of scale, scope and price effects, it is often appropriate to reduce the depth of production. Because a supplier who supplies several customers with one product will be more likely to realize economies of scale despite the described change in performance profile. Likewise, he will be able to achieve economies of scope more easily, as he perceives the outsourced value creation stages closer to the market than the outsourcing company. Likewise, price advantages can be achieved by suppliers if they have their location in countries that have the corresponding advantages. However, the information- and transportation costs in connecting the companies cooperating in the logistics chain must not become so large that the cost advantage of the inter-company division of labor is consumed again. In addition, the exchange of information and goods must take place so quickly that the customer needs can be satisfied in the required time.

Change advantages result from the fact that companies can adapt to new technology and market structures by changing the organizational and personnel structure. Here, too, a lower depth of production can prove to be advantageous. Because the contracts with suppliers can generally be changed more easily than existing intra-organizational structures and employment contracts.

The consideration of the *speed advantages* remains critical. The already mentioned need for a short-term response to customer needs shows the importance of the ability to achieve speed advantages in order to increase competitiveness. The pressure for speed requires a cross-company cooperation of all companies working together in the logistics chain. The acceleration of the overall process in the logistics chain requires a stronger linkage of the information and material flows not only intra-organizationally between the different areas in the company, but also inter-organizationally between the companies. To ensure the competitiveness of cross-company logistics systems, special attention must be paid to the harmonization of the information interfaces.

In the context of these considerations, it is also important to point out the relationship between the *environmental conditions* and the *organizational form* in the development of a company. As can be seen from Fig. 9.2, the inter-organizational network, which is temporary even if it is long-term, is the appropriate organizational form for the turbulent, complex and uncertain business environmental conditions that are typical for many companies today. An example of this is the current development of the industry structure in the aviation industry. Eighty percent of the components of an Airbus passenger jet are supplied by external suppliers. These are supposed to "act more flexibly, supply

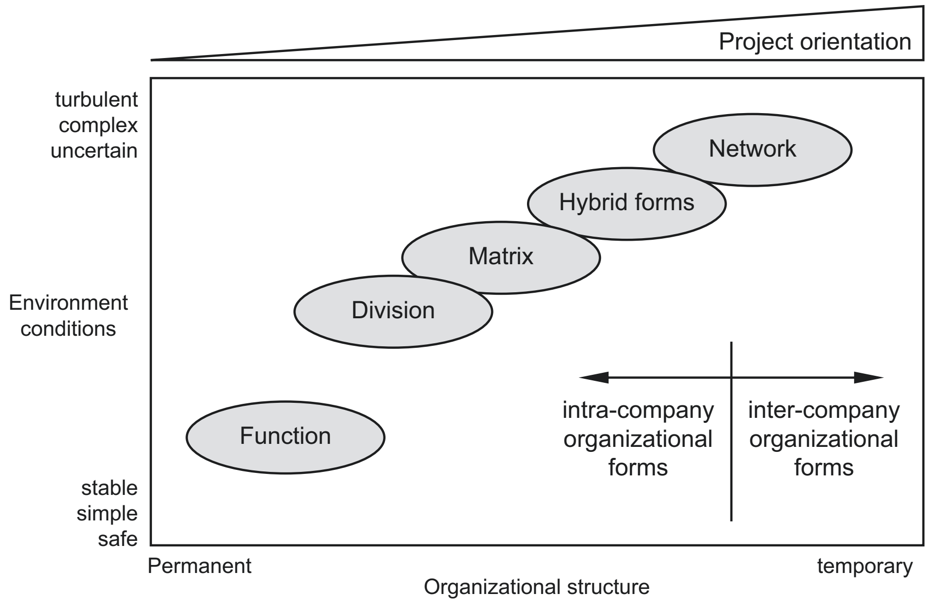


Fig. 9.2 Relationship between business environmental conditions and organizational structure of a company. *Source* With minor changes taken from Roventa 1991, p. 406

the new Airbus productions in China and the USA, bear more development risk—and become cheaper."[9] Airbus expects agility and efficiency from the industry reorganization, to maintain or expand market shares. In an interview, Airbus board member Günter Butschek explains with regard to the size and inter-organizational structures of suppliers: "Reliable deliveries are not a question of the size of the companies. This has to do with the process and quality capability. When it comes to transferring development tasks to partners in the supplier industry, however, size does play a role. Especially with regard to the global character of our development and production, I consider it desirable that smaller companies in the supplier industry join forces to form larger and more robust alliances. There has already been some progress, but I still see potential."[10] The reduction of the depth of production of the aircraft manufacturer thus has direct consequences for the supplier companies, for whom the network increasingly represents a strategic necessity.

[9] Fasse (2013, p. 1).

[10] Wenzel (2012). The need to exploit this potential is underlined by the crisis of the aviation industry due to the Corona pandemic.

9.2 Design Possibilities of the Inter-Organization

From the perspective of logistics management, the various characteristics of different forms of cooperation[11] are less interesting than the management of the cooperation and especially the management of the inter-organizational logistics systems that result from the cooperation. In this context, two management tasks can be isolated: the emergence management and the relationship management. Before going into more detail on these, the basic relationship patterns and structural features of networks are presented. The relationship patterns show the advantages of the type of cooperation based on the associated risks and opportunities. The structural features of networks characterize networks with regard to inter-organizational properties that are relevant for the cooperation management.

9.2.1 Relationship Patterns in Networks

Figure 9.3 illustrates the possible relationship patterns. Depending on the intensity of the dependence of the organizations on each other and the degree of behavioral uncertainty in the inter-organizational relationships, four conceivable constellations arise. The concrete manifestations range from the short-term business relationship based on market coordination to a very close, long-term cooperation in the form of a strategic value creation network.[12]

Factors that influence the dependence of the partners are, for example, historical, economic, technological or political aspects. Factors that influence the risk of a partnership are, for example, based on the competencies of the partners, contractual arrangements, trust between the partners or political developments.

The *strategic cooperation* is particularly suitable for situations in which the exchange of services is characterized by a high regularity and the specificity of the services to be provided is high. This is due to the fact that compared to a short-term market relationship, on the one hand, lower transaction or coordination costs can be expected and, on the other hand, synergies can be exploited. Although risks could result from the dependence, they do not weigh heavily, because the reciprocity of the dependency relationship reduces the risk of opportunistic behavior. This must also be seen in the context that only in the case of a “win-win” situation, which brings advantages for both partners, the cooperation at the strategic level makes sense.

Less close is the *tactical cooperation.* There are relationships with a number of suppliers and the focus is mainly on process improvements and quality enhancements. As already apparent from the classification in the matrix, this class of relationships is

[11] See Pfohl (2022, p. 290 ff.). See also Killich (2011, p. 13 ff.) on forms of cooperation in general.

[12] Cf. Cousins (2013, p. 98 ff.).

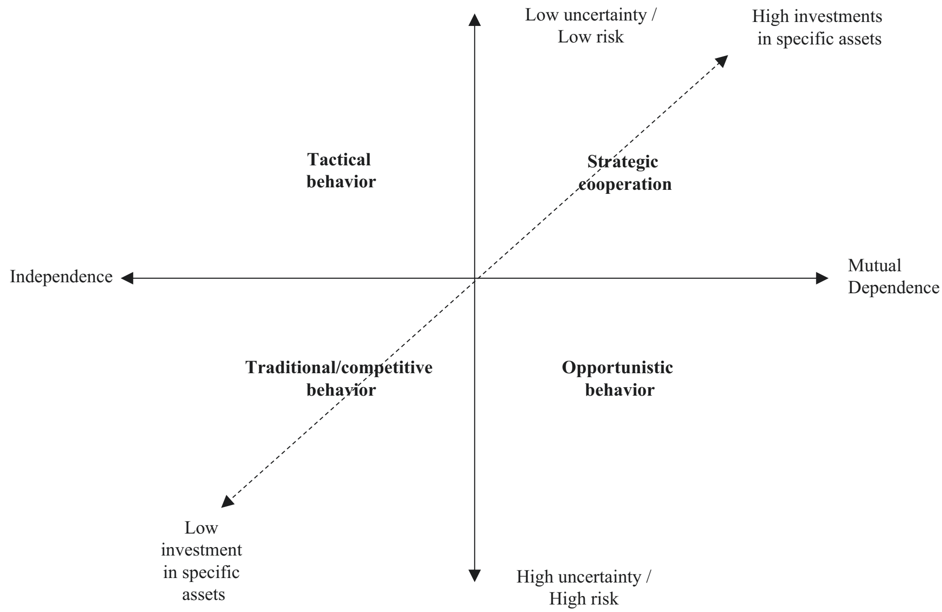


Fig. 9.3 Inter-organizational relationship patterns. *Source* Cousins 2013, p. 100, retranslated

considered to be favorable in terms of risk. This is because the behavior of the counterpart is predictable, and there is a low dependence.

The opposite is the case in the case of unilateral dependence, where the threat of *opportunistic behavior* entails much greater risks. If one of the cooperation partners has a high dominance, there is a danger that the dominant position will be exploited to the disadvantage of the partner. However, there are numerous strategies to deal with this situation and to create tolerance on the part of the dependent partner, so that he does not constantly look for opportunities to leave the relationship.[13]

In the case of *traditional/competitive behavior*, the avoidance of behavioral risks also entails the loss of opportunities. For example, while the traditional procurement pursues the goal of price minimization, suppliers are prevented from planning and building capacities in the long term and developing innovative proposals by deliberately short-term contract design. As a result, potentials remain unused or corresponding activities are returned to the procuring company in the form of higher purchase prices. Also negative repercussions as a result of playing out procurement power can be quality losses

[13] Cousins, for example, describes that a possible strategy of the dominant company is to use its own dominance only in strategically important exceptional cases, in order to maintain the tolerance of the partner in principle: Cousins (2013, p. 99 f.).

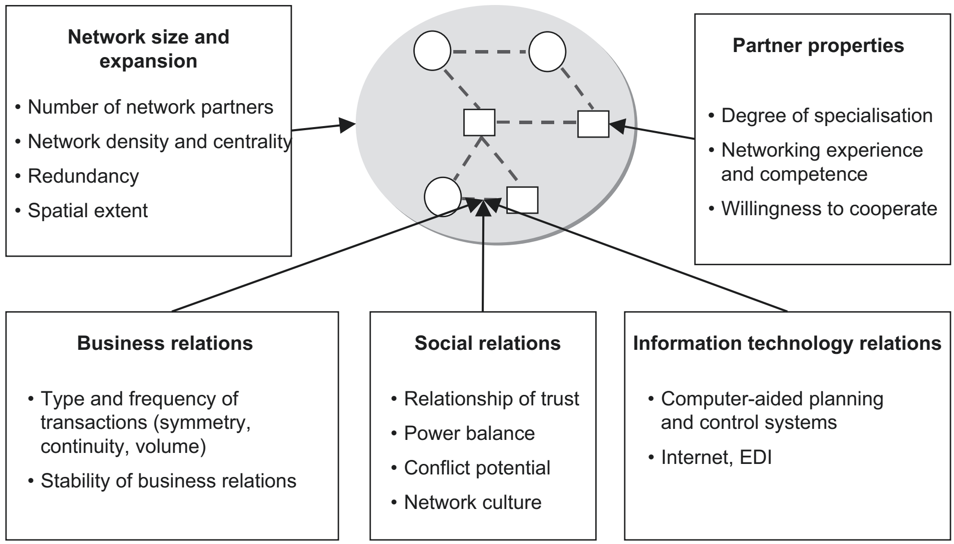


Fig. 9.4 Structural characteristics of networks. *Source* Adapted from Pfohl 2001, p. 37

or deteriorations in delivery service. Such cooperations usually exist in non-technology-intensive areas.

9.2.2 Structural Features of Networks

Cooperation and coordination do not only refer to a single business relationship, but also to the totality of all companies to be integrated in the supply chain, whereby the intensity of the business relationships can vary. [14] An overview of all existing relationships in a network and their influencing factors, which together form the structural characteristics of networks, is given in Fig. 9.4.

In the distribution of network tasks, a concentration of the network partners on their respective *core competencies* is sought. Each partner should therefore take over the function that he can perform best of all network partners. In order to create the performance readiness of the network, an efficient linkage of the core competencies of the network partners is required. The *collective competencies,* which are also referred to as

[14] See also the different levels of interface management in the network strategic decision "Integration—Loose Coupling" in Part II, Sect. 4.4.6. The following explanations are based on Pfohl (2001, p. 36 ff.). See also another breakdown of the structural characteristics in the form of structural variables of network organizations by Yahsi (2017, p. 56 ff.).

complementarity competencies, include, for example, logistics, coordination and communication competence. Logistics thus has the task of connecting and coordinating the value-added activities distributed spatially and temporally to different network partners.

The coupling of the network partners specialized in fulfilling certain functions within a production network is achieved by an appropriate design of the network relationships, which in turn depend on the network size and extent as well as the partner characteristics. Here, three types of network relationships can be distinguished.[15]

The *business relationships* include on the one hand the concrete time-limited transactions that take place between the network partners. On the other hand, they also include the resulting long-term business relationships that last beyond interruption periods of discontinuous transactions. The basis for the emergence of long-term business relationships is the existence of *social relationships,* which are understood as lasting, usually trustful relationships between more than two persons. They are bound to specific individuals, unlike business relationships. *Information technology relationships* finally link the network partners by means of inter-organizational information and communication systems. Business, social and information technology relationship networks rarely correspond to each other. For example, only a part of the business and social relationships are usually supported by information technology.

The marketability (market success) of networks is based on cooperation prerequisites, which are shown in Fig. 9.5. A prerequisite for cooperation in a network is especially a *transparency* between the partners regarding the processes affected by the networking, which must be supported by comprehensive *communication*[16] . Equally important, however, are *trust*[17] and detailed agreements between the parties involved. Trust is one of the most important prerequisites for successful cooperation in the network, as sensitive internal information is also shared in the course of the extensive data exchange between the partners. At the same time, the companies involved in the network also have business relationships with other companies outside the network. These "external" companies, however, can also be competitors of the company that provided the confidential information or its know-how. Confidential information includes, for example, future needs or technical details that are exchanged in the context of outsourcing.

Closely related to the prerequisites for marketability of networks that have been discussed so far is the design of the *leadership,*[18] which can have significance in two respects. On the one hand, it is about the *distribution of leadership competence* between

[15] For another breakdown of business relationships, see Schönsleben (2011, p. 35 ff.).

[16] For communication in inter-organizational relationships, see e.g. Palmatier et al. (2007, p. 175 ff.). For transparency in inter-organizational relationships, see e.g. Dyer and Singh (1998, p. 666).

[17] For trust in inter-organizational relationships, see e.g. Dahm and Thorenz (2010).

[18] On leadership in networks, see e.g. Sydow (2010, p. 359 ff.).

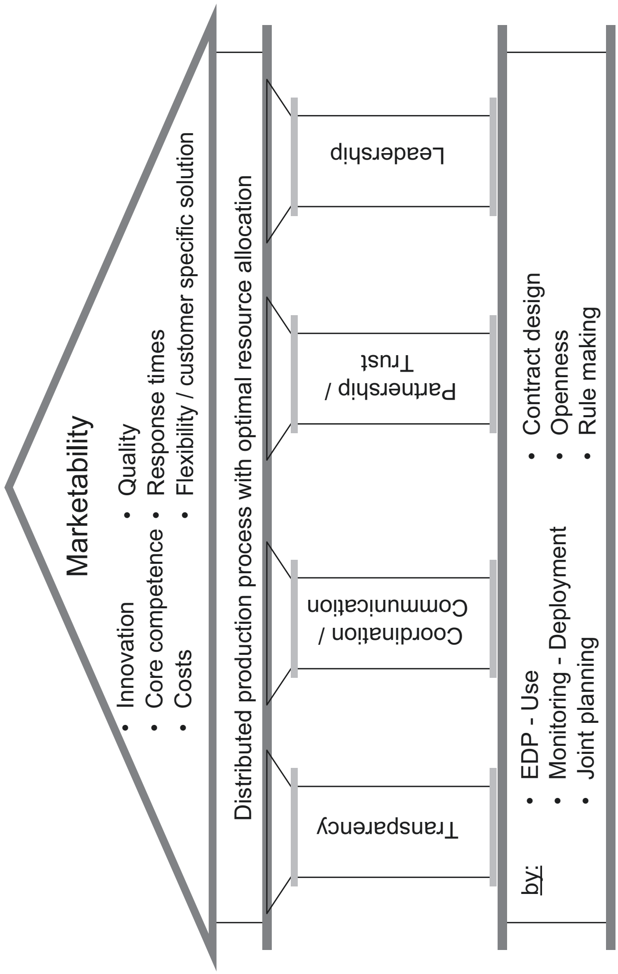


Fig. 9.5 Cooperation prerequisites. *Source* Adapted from Lutz 2000, p.

the individual companies in the inter-organizational performance creation system.[19] There is little clarity so far on the question of who should take over the control of a network. Various problem areas hinder a central control concept.[20] On the one hand, the implementation of appropriate IT solutions has not progressed far enough to enable the complete integration of the cross-company planning and control of performance processes. In addition, there are still general acceptance problems for the cross-company integration in many companies. It is recognized that the type of exercise of power also has a lasting influence on the functionality of the network.[21] A certain degree of exercise of power promotes the development and implementation of the cross-company overall strategy. However, forced coordination can lead to partners leaving the network at the first opportunity. As a final point, the enormous complexity of value creation networks should be mentioned, which is why a leadership and action autonomy in the form of distributed leadership is preferred here for risk considerations.[22]

The second perspective of leadership in networks concerns the *leadership in the narrower sense,* namely the personal influence of employees by superiors.[23] The superiors of the logistics employees working at the interfaces in production networks must use their leadership behavior to ensure that the task fulfillment distributed among several network partners is coordinated sensibly. In addition, the employees should be motivated to promote the further development of the network relationships. For example, incentives for stronger cooperation between purchasing and logistics employees also promote cooperation with suppliers.[24] Since a uniform influence on the individual employees of the different network partners using network-wide applied leadership instruments is hardly possible, the focus must be on a suitable adaptation of the internal leadership technique and style. For example, social conflicts between employees of different network partners often cannot be solved using the conflict management methods applied internally. An escalation of the conflict to a common hierarchical superior is not possible in networks. Consequently, cross-company conflict management methods must be agreed upon between the network partners.

The fulfillment of the prerequisites for cooperation is largely based on the design of the *information flow.* In contrast to the classical delivery relationship, the information flow in networks is much more extensive and open. Data are, depending on the agreement,

[19] See also the different types of networks, in which the leadership competence is distributed differently, in Pfohl (2001, p. 38 ff.) and Pfohl (2022, p. 301 f.).

[20] An overview of this is shown by Burgess et al. (2006, p. 703 ff.).

[21] See also the creation of supplier portfolios taking into account the dominance of specific partners in Schönsleben (2011, p. 90 f.).

[22] Cf. Göpfert (2009, p. 121 f.). See also the assignment of complexity to the levels of the supply chain (“balancing of complexity”) in Klaus (2005, p. 372 f.).

[23] See also Part IV, Sect. 10.2. See also Sydow (2010, p. 359 ff.).

[24] Cf. the results of an empirical study by Pfohl and Moraitakis (2021).

automatically exchanged and circulated in the network between the partners using system support. Therefore, precise regulations on the scope of data exchange must exist with corresponding agreements, i.e. which information should be exchanged and how it may be used.[25] Possible are e.g. confidentiality clauses with appropriate sanctions. With regard to the amount of data, an inspection or limitation of the data stocks is also possible.

Furthermore, agreements must exist regarding the bindingness[26] of the exchanged data. For example, it is questionable to what extent a purchase obligation exists with regard to manufactured parts based on transmitted planned requirements, or how the risk is distributed between the parties. The frequency of data exchange is also important. In order to ensure the most accurate information possible, a frequent data exchange should be aimed for.

The definition of rules of the game as the basis for fulfilling the conditions of cooperation includes in particular the *organizational design of logistics*. It concerns the definition of the cross-company material and information flow processes, the assignment of the logistics tasks to the network partners and the definition of coordination mechanisms for the goal-oriented alignment of the individual logistics activities. The cross-company logistics tasks can be summarized and assigned to the network partners according to the known criteria of organizational task analysis and synthesis in order to exploit the advantages of division of labor.[27] The putting together of all logistics activities that are required for the provision of a specific product or product group at the receiving point can be useful if the value creation processes in the network differ significantly for individual product groups. This leads to the development of differentiated logistics systems for different product groups, which differ, for example, in terms of the delivery form (conventional delivery, "ship-to-stock", "ship-to-line", "line-to-line"). Regardless of the type of aggregation of logistics subtasks, it must be checked whether they can be transferred to specialized logistics service providers.

As a result of the assignment of logistics areas of responsibility to different organizational units of the network, there is a need for coordination of these network partners. Apart from the decoupling of the network partners by creating buffer stocks, the *standardization* for logistics variables in advance of a transaction offers the possibility to keep the coordination effort low. For example, time windows for the delivery of goods are agreed upon, which reduces the need for coordination regarding the adjustment of the delivery time only in exceptional situations. Of importance here is whether these are bilateral or network-wide standards. Network-wide standards have the advantage of ena-

[25] See also the initiative for an "Industrial Data Space" in Germany, which provides an information technology architecture for safeguarding data sovereignty. "It represents a virtual data space, in which the data remains with the data owner until it is needed by a trusted business partner." Otto et al. (2018, p. 113).

[26] Killich defines the bindingness as a characteristic of cooperation. Killich (2011, p. 18 ff.).

[27] See also Sect. 7.2.

bling a changing cooperation of different partners without much coordination effort, as a simple coupling of the logistics systems of the partners is possible. The choice of suitable coordination mechanisms to cover the remaining coordination needs depends on the degree of the three types of relationships in the network. Coordination by self-alignment as a person-oriented coordination instrument, for example, takes place predominantly through horizontal communication between the network partners, for which close social contacts between the employees of the network partners are conducive. Often, institutionalized committees in the form of cross-company teams or working groups are formed for this purpose. For coordination by plans, well-developed information technology relationships are advantageous. An example of this is the automatic transmission of planning data on production quantities to the supplier within the framework of a delivery call-off system. Such coordination problems must be taken into account already at the selection of the network partners at the beginning of a cooperation decision process.

9.2.3 Emergence Management

The emergence management[28] has the task of establishing the cooperation and creating the logistics systems required at the beginning. To do this, it is necessary to convince all involved partners of the *advantages of cooperation*. The partners will recognize the advantages of cooperation if, in the sense of the incentive-contribution theory, the potential or already received incentives for participating in a cooperation are higher than the contributions to be made. Incentives arise when the potential partners expect positive effects on their goals that they could not achieve alone.[29]

The *cooperation decision process* can be represented by means of the phase scheme shown in Fig. 9.6.[30] At this point, the two phases of evaluation and selection and the contract negotiation and cooperation agreement are of particular interest. The tasks of the *evaluation and selection* differ depending on the type of cooperation partners to be involved.

If a *cooperation with suppliers* is to be used to build an inter-organizational logistics system, then the management tasks largely correspond to those of strategic supplier selection.[31] Compared to the traditional, more object-oriented, operational supplier selection, the supplier's capabilities come more into focus. In particular, his logistics perfor-

[28] See also Howaldt and Ellerkmann (2011, p. 23 ff.).

[29] See Pfohl (2022, p. 294 f.), where the term "cooperation willingness" is introduced. See also the possibility of contractually stipulated "revenue sharing" of the cooperation partners in Elbert et al. (2017).

[30] See also the functions of network management—selection, allocation, evaluation and regulation—according to Sydow and Möllering (2015, p. 194 ff.).

[31] See also Large (2013, p. 162 ff.).

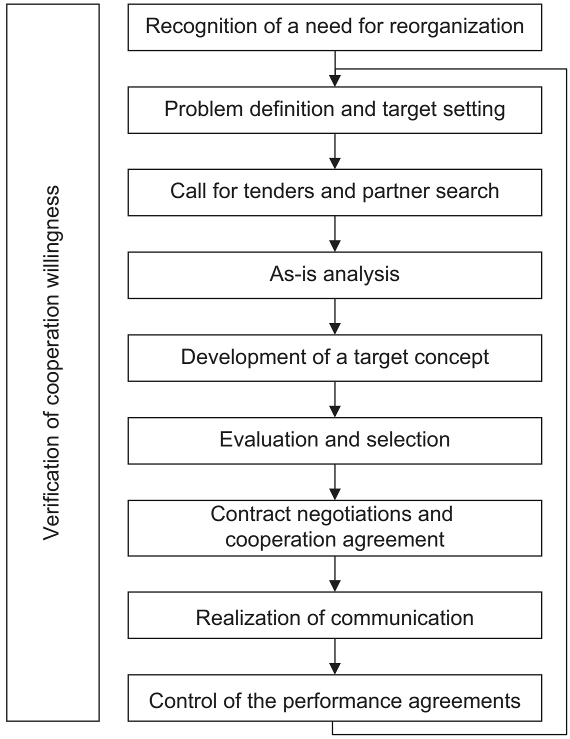


Fig. 9.6 Phase scheme of the cooperation decision process. *Source* Kleer 1991, p. 108

mance must be intensively checked. Certificates of the supplier, but also own audits can be used as tools for this purpose.[32] The cooperation ability and willingness must also be carefully checked by negotiation talks. The actual selection decision process follows the processes of organizational purchasing behavior that are extensively discussed in the literature on industrial goods marketing.[33]

If a vertical *cooperation with customers* is sought, the roles are reversed. In this case, it is particularly important that there is also a high degree of willingness to cooperate among the customers. If necessary, this willingness must be promoted by appropriate incentives, e.g. the takeover of inventory management by consignment warehouses. It is also advantageous if the initiator of the cooperation assumes the function of the "channel leader" vis-à-vis the downstream customers.

If it is a matter of vertical *cooperations with logistics service providers*, the process has to be modified, which then largely corresponds to the make-or-buy decision for logistics services. This will be discussed in more detail in the next section.

[32] See Part II, Sect. 5.8.

[33] See, for example, Large (2013, p. 181 ff.).

In addition to cooperating with the traditional actors of the supply chain, a *cooperation with specialized financial service providers* is also possible. In addition to banks, these include, for example, leasing companies, insurance companies, M&A consultants, rating agencies or venture capital companies, as well as institutional investors, private investors or funds.[34] They offer joint services in the following focus areas[35]:

- Acquisition and construction of logistics real estate
- Furnishing of logistics real estate
- Goods in logistics real estate
- Goods transport as well as
- Accounts receivable management and payment transactions.

Horizontal cooperations are generally more difficult to establish, as the direct business interest of a supplier-customer relationship is not given. The advantages are usually more in a joint performance improvement or cost reduction. The initiative of at least one potential cooperation partner is therefore of particular importance. The incentives are stronger for cooperative logistics service networks, as these, especially in the freight forwarding groupage transport, are even a prerequisite for service provision. The design of these cooperative relationships can be done in various forms, from licensing agreements to joint ventures.[36] Depending on the resource profiles of the partners, two forms can be distinguished. In the case of congruent profiles, one speaks of Y- or "scale" joint ventures. They serve primarily to exploit economies of scale. Cooperations based on complementary resource combinations are called X- or "link" joint ventures and are particularly suitable for realizing synergy effects.[37]

The phase of evaluation and selection flows smoothly into that of *contract negotiation and cooperation agreement*. Through negotiations, the concrete contents of the cooperation, especially the intensity of cooperation, are clarified. To work out detailed solutions, cross-company working groups can already be set up. It should be clarified exactly which functions the partners take over (cooperation width) and in what quality they are to be provided. This also includes the definition of control variables. Especially with high cooperation depth, the problems with defining meaningful measurement variables increase.

At the end of the negotiations, a *long-term cooperation contract is concluded.* This is essentially a relational contract. Relational contracts are deliberately formulated openly

[34] Cf. Pfohl et al. (2003, p. 15 f.).

[35] Cf. von Eisenhart-Rothe and Jütte (2003, p. 153); specifically on the financing of logistics real estate, see also Steinmüller (2003, p. 171 ff.).

[36] Cf. Freichel (1992, p. 13 f. and p. 59 f.).

[37] Cf. Holtbrügge and Welge (2015, p. 118 f.).

and thus allow adaptation to future situations.[38] This form of contract is particularly suitable for the cooperation situation, which is usually characterized by a high specificity of the service and by repeated transactions.

9.2.4 Relationship Management

Due to the relationality of the contracts, a *permanent adjustment and concretization* according to the current development is necessary and possible. In principle, the same operational logistics tasks arise in inter-organizational logistics systems as in individual companies. However, the partners will also be less willing to share planning information in cooperative systems than within their own company.[39] Nevertheless, for example, the logistics service provision must be adapted to changed production numbers. Another example is the adjustment of package sizes due to changed customer requirements.

These concretizations will not always be possible without friction. Therefore, an appropriate *conflict handling* is of great importance during the duration of the cooperation. The causes of conflicts in cooperations are manifold and do not necessarily have their origin in pending adaptation measures. The causes are rather generally to be sought in goal, role, power and communication relationships.[40]

Goal conflicts are based on competing goals of the partners. Often, cost savings of one partner lead to cost increases of the other. An example of this is the transfer of responsibility for inventory to the cooperation partner. In this case, a compensation of costs must occur in order not to reduce the cooperation willingness of the affected partner. Role conflicts arise when a partner is supposed to take over tasks that contradict his self-image. Examples of this are the takeover of assembly work by logistics service providers or the takeover of responsibility for inventory management by a supplier within the framework of a "Vendor-Managed-Inventories" project. Power conflicts result from an inappropriate exercise of power. If power is used to force a cooperation partner to take measures that have negative consequences for him, this will reduce his cooperation willingness in the long run. It must even be expected that the injured partner will behave opportunistically as a consequence. An example of this is the reduction of efforts in quality assurance, after the cooperating logistics service provider was forced to price

[38] In relational contracts, the explicit agreements are largely supplemented by the implicit ones, which are based on common values. "The performance relationship that develops over time, the common value orientations, the mutual trust and solidarity between the contracting parties thus gain overriding importance…" Picot et al. (2020, p. 16).

[39] But even within the company there are barriers to bringing in and exchanging knowledge. See e.g. Watson and Hewett (2006, p. 141 ff.).

[40] See Pfohl (2022, p. 289 f.).

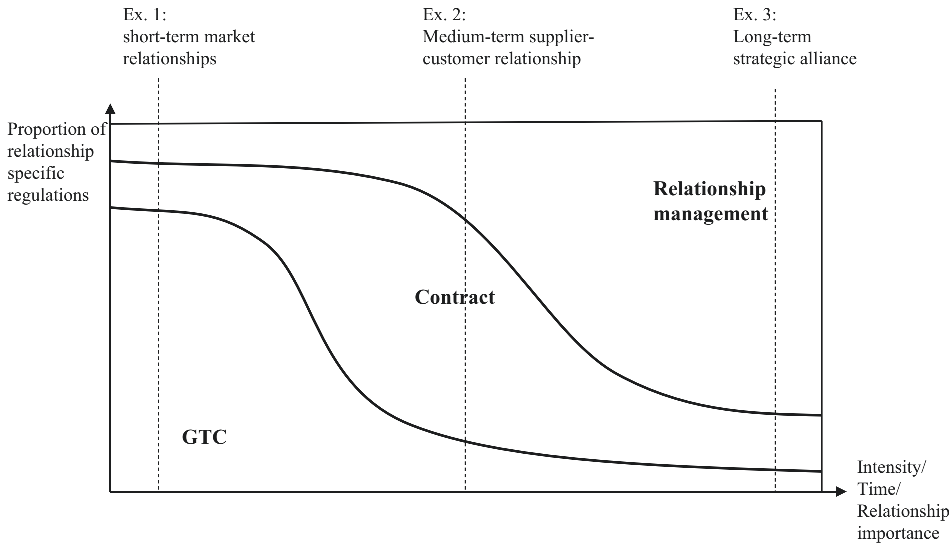


Fig. 9.7 Composition of relationship-specific regulations depending on the timeliness of the cooperation. *Source* Trumpfheller and Hofmann 2004, p. 86

reductions by threatening to change partners. Another cause of conflict can also be the different information levels of the cooperation partners (information asymmetry).

If one considers the regulation of the relationships under the aspect of timeliness, then formal regulations in the form of general terms and conditions (GTC) dominate in short-term market relationships, formal regulations in the form of contracts in medium-term relationships, and relationship management in long-term relationships (see Fig. 9.7). The relational contract and the behavioral obligations formulated therein open up the possibility of relationship management. Within the scope of the present work, relationship management is related to the control and monitoring of the business, social and information technology relationships. Relationship management in cooperations is thus the *targeted influence and supervision of the cooperation partner,* in order to secure the goals of the cooperation permanently. This can be explained by the example of the logistics cooperation with suppliers. In this case, relationship management is equivalent to the *supplier control* in vertical cooperations.[41]

Supplier control should represent an active control, which provides for the influence of the behavior of people and organizations by direct social interaction. In principle, the

[41] For the following, see in detail Large (2013, p. 251 f.). For the concept of supply chain relationship management in general, see Trumpfheller and Hofmann (2004). For the quantitative and qualitative relationship intensity in the course of a cooperation, see the model of the relationship life cycle: ibid., p. 84 f.

renegotiation and the direction can be distinguished as basic forms of control. Obligations that establish the buyer's right of direction are also the exception in cooperations, although short-term delivery calls can certainly be understood as a form of unilateral instruction. Far more important for cooperations is the control by renegotiation, which differs significantly from the contract negotiations before the cooperation agreement:

- The cooperation partners know each other and have previously collected (negative and positive) experiences in the cooperation.
- Often, a concrete negative experience is the occasion of the renegotiation, e.g. a misconduct of the cooperation partner.
- Often, there is a one-sidedness of interests, as one partner pursues a control intention and the other partner wants to avoid a control.

Renegotiations are therefore to be regarded as complex and conflict-prone. This is especially true when they are directed against the interests of the cooperation partner.

Although cooperations should be trust-based relationships, a monitoring of the success of the cooperation is important. By *control* of the actions of the cooperation partner and the results of the cooperation, it should be ensured that the goals of the cooperation are realized. In addition, the control should be the prerequisite for recognizing errors in the planning and taking appropriate internal adaptation measures or, if necessary, measures of relationship management. For the case of vertical cooperation with suppliers discussed above, the conventional supplier evaluation system can and should be expanded to a comprehensive system of relationship control.

The design possibilities discussed here can be theoretically substantiated. The transaction cost theory and the network competence theory have a special significance for the explanation of the inter-organization.

9.3 Approaches to Explain the Inter-Organization

9.3.1 Transaction Cost Theory

From the perspective of transaction cost theory[42] the problem of inter-organizational design of logistics lies in finding the form of inter-organizational division of labor in the supply chain that allows the *transaction cost minimizing coordination* of the logistical subtasks while achieving an overall system optimum. The coordination of logistics tasks is done by transactions, i.e. by transferring property rights—such as the right to dispose

[42] For a detailed presentation see Pfohl and Large (1992), who specifically refer to the design of inter-organizational logistics systems. For the origin of transaction cost theory see Williamson (1975).

Behavioral assumptions	• Humans are characterized by bounded rationality. This excludes the possibility of perfect contracts, monitoring and adjustment of existing contracts becomes necessary. • Individuals tend to pursue self-interest. This assumption includes opportunistic behavior and also fraudulent deception.
Transaction properties	• Factor specificity, which is lower the more easily a factor can be put to another use without loss of value. • Uncertainty resulting from the development of the transaction environment and the expected behavior of the contracting party. • Frequency of settlement of similar transactions.

Fig. 9.8 Factors influencing the level of transaction costs. *Source* Pfohl 1994, p. 224

of goods to be transported—between the actors entrusted with the execution of these tasks. The starting point of the analysis is a total task to be performed, which has to be distributed among several task carriers due to the limited capacity of the economic subjects, especially with regard to the availability of resources. The fulfillment of these subtasks has to be coordinated in terms of content and time. For this purpose, task-related relationships have to exist between the participants, which enable the execution of the task. Such coordinating relationships are created by *transactions*, whereby a transaction comprises the process of initiation, agreement, control and adjustment of an exchange of services. Accordingly, the costs caused by these activities can be defined as transaction costs, whereby it has become established to make a classification into cost types according to the described transaction phases.

Essential influencing variables on the *level of transaction costs* are the assumptions about the behavior of the parties involved (contract partners) and the characteristics of transactions shown in Fig. 9.8. Further influencing factors are legal and technological framework conditions as well as measurement problems.

While these influencing variables are given as framework conditions, the level of transaction costs can be reduced by choosing a contract form that is favorable for the respective transaction situation. The choice of the contract form is closely linked to the choice of a specific institution, whereby *market* and *hierarchy* form the extreme points of a continuum of possible forms of institutions. Here, the classical contract represents the characteristic contract form of coordination by the market. The basis of the institutions hierarchy and cooperation is a relational contract, which is characterized by an open formulation that allows an adaptation to changes in the transaction relationship due to future developments.

Using the analytical framework of the transaction cost approach given in this way, it can be justified in which situations a market-based coordination of economic activities fails and why a hierarchical coordination can be associated with lower costs. If investments in specific factors, such as physical and human capital, are required to carry out a transaction, both sides are bound to each other by these investments, since a dissolution of the contract would result in the loss of the specific investments. This situation, in interaction with the transaction uncertainty, which makes explicit contractual agreements difficult, favors opportunistic behavior. A hierarchical coordination can be a suitable means to counter this danger. *Intermediary forms of organization* (e.g. cooperations) between market and hierarchy can combine the advantages of both institutions under certain conditions.

The presentation of the circumstances when such an intermediary form can be economically efficient is based on the approach chosen by Jarillo.[43] He starts from the consideration of the total costs for the execution of an activity. If the *internal costs of own production* (including internal transaction costs) exceed the *costs of external procurement* (price demanded by the supplier plus the transaction costs incurred in external procurement), an externalization of the corresponding activity is recommended. If the internal costs of own production are lower, it can be expected that an internalization of the activity will be chosen. Even if the internal costs are higher than the price for external procurement, the additional transaction costs of an externalization may be opposed. However, if it is possible to reduce the transaction costs by a network-like coordination, an efficiency advantage over other companies not integrated in such a cooperative organizational form results.

One way to *reduce transaction costs* in networks or inter-organizational logistics systems is to achieve a mutual trust of the members in order to avoid opportunistic behavior as much as possible. In particular, control costs can be significantly reduced.[44] Further possibilities of reducing transaction costs[45] in an inter-organizational logistics system arise in the following ways:

- Reducing the risk associated with transaction-specific investments by making long-term arrangements with suppliers and customers
- Enabling and/or accelerating inter-organizational learning

[43] Jarillo (1988, p. 34 f.).

[44] Cf. ibid. p. 37.

[45] Cf. Sydow (1992, p. 268 f.).

Transaction cost advantages of cooperations compared to
Market reasons • lower costs in the search for customers and suppliers • Saving of costs of contract initiation, negotiation and control • better information flow as a result of closer coupling; transfer also of non-codifiable knowledge • Transfer of also competition-relevant information with better control of knowledge exploitation • Stability of inter-organizational relationships with high transaction-specific investments • possible abandonment of redundant activities, e.g. double quality control • faster implementation of innovations
Hierarchy reasons • targeted function-specific cooperation • greater reversibility of cooperation decisions • greater environmental sensitivity of the decentrally organized overall system • easier to overcome organizational conservatism when adapting to a changing environment • Applicability of the market test

Fig. 9.9 Presentation of possible transaction cost advantages of cooperations. *Source* With minor changes taken from Sydow 1992, p. 271

- Reducing quality risks by intensive mutual information, which can especially lower control costs
- Facilitating communication by building cross-company information systems
- Creating an adequate inter-organizational culture by trust-building measures.

An important advantage of a cooperative organizational form is that the *market test* always remains applicable, i.e. regardless of how long such a relationship has existed or how close it is, it cannot be prevented in the long run that a partner faces the threat of exclusion from the network if better performance or conditions are offered elsewhere. In this way, a cost discipline is achieved that is lacking in hierarchical institutions.[46] In connection with a suitable inter-organizational culture, the market test can counteract opportunistic behavior by the threat of exclusion, but only if the membership in the cooperation is perceived as advantageous. In Fig. 9.9 potential transaction cost advantages of a cooperation compared to the institutions market and hierarchy are summarized.

It should be noted that not all influence relationships on the emergence and development of organizational forms can be captured in transaction cost categories. Production costs and technology development also have a significant influence, so it seems sensible to supplement the explanatory approach based on the transaction cost theory by explicitly considering these influencing factors.

[46] Cf. Jarillo (1988, p. 35).

9.3.2 Network Competence Theory

Due to the different understanding of networks, two types of network competences can be distinguished with the individual and the collective.[47] Both have fundamental importance for the emergence of cooperation. However, the advantage of cooperation is explained differently.

The *individual network competence* sees the advantage of cooperation in networks in the opportunity to expand the resource, capability and competence base of one's own company. By participating in the existing resources, capabilities and competences of the cooperation partner, the strategic success position of one's own company should be improved.[48] The goal of such a cooperation is the internalization of non-marketable factors. Learning from the cooperation partners is the highest commandment. Therefore, one also speaks of a means to "outlearning" or of "races to learn". However, such a cooperation can only work if the partners do not take advantage of each other and engage in a bilateral exchange.

The *collective network competence*, on the other hand, focuses not on the generation of competitive advantages at the company level, but on the cooperative value creation at the network level. It is about the long-term expansion or consolidation of the business relationships between the cooperation partners by using complementary factors, which leads to a horizontal or vertical co-specialization of the partners. As a basis for creating competitive advantages at the network level, four cooperative competences were identified[49]:

- Complementary resource and competence provisions: The provision with complementary factors is the basic condition for a successful cooperation. By jointly, synergistically using the resources, capabilities and competences available in the network, a greater return can be generated compared to the sum of the returns that would be achieved by individual use. A prerequisite for the successful combination of the partner factors are their strategic compatibility as well as an organizational and cultural "fit" between the companies.
- Inter-organizational relationship-specific resources: In accordance with the transaction cost theory, three types of specificity can be distinguished: "Site specifity" results from the location of successive stages of value creation in close proximity. "Physical asset specifity" results, for example, from the establishment of common technological standards. "Human asset specificity" results, for example, when cooperation partners gain common experiences in different stages of value creation.

[47] The following closely based on Frunzke (2004, p. 32 ff.).

[48] See also Part I, Sect. 3.3.

[49] Cf. Dyer and Singh (1998, p. 662 ff.).

- Inter-organizational routines for the exchange and combination of knowledge stocks: To increase the learning and problem-solving ability in the network, mechanisms of knowledge transfer and knowledge combination have to be developed.
- Effective institutional framework for network governance and control: In particular, it is about creating a "governance structure" in the network to prevent opportunistic behavior.

"In principle, risks can arise from participating in networks, such as the reduction of strategic autonomy, the increase of coordination and transaction costs, the uncontrolled outflow of knowledge, the complication of strategic control, as well as dependencies and competence losses."[50] These risks have to be minimized by the emergence and relationship management discussed in the previous section. An example of this is also the "Guideline Contract Logistics-Tendering" presented in the following section.

9.4 Contract Logistics-Tendering

A working group of the Federal Association of Logistics (BVL) e. V. has developed a guideline for contract logistics tendering. The basics for this are taken literally from this guideline in the following.[51]

"The starting point for the creation and structure of the guide is based on six core phases of the tendering process in contract logistics projects. Each phase involves parallel and time-delayed activities of the industrial client (IC) and the potential contract logistics service provider (CLSP). As an introduction, the six phases are briefly characterized here in their respective contents:

- **Phase 0—Project start and acquisition:** Starting with the decision of the IC to carry out a contract logistics project, the associated internal project management process starts with the kick-off workshop. Since no contact between the contracting parties has taken place yet, the CLSP is parallel still in the phase of acquisition or the establishment of the business relationship or customer care.
- **Phase 1—Bidder search and RFI:** The first active action to initiate contact with the provider market is for the IC to create and send the → *Request for Information (RFI)*. A query, which is sent by e-mail or often by telephone, to potential candidates, is intended to determine the extent to which interest, capacities and competence for participating in the actual tendering process are available on the part of the contract logistics service providers contacted. Closely linked to this and an important prereq-

[50] Frunzke (2004, p. 36 f.).

[51] See also Lynch (2000). For a detailed discussion of contract logistics, see Stölzle et al. (2007). For the handling of industrial customer projects in logistics, see also Glass (2019).

uisite for further information exchange is the → *Confidential Agreement (CA) (also called Non Disclosure Agreement (NDA))* that is sent along. A mutual confidentiality agreement that ensures that business-sensitive information from both contract sides is respected within the scope of the tendering process.

- **Phase 2—Creation of the tender documents (RFQ) and the offer:** The next phase involves the conception and the actual creation of the tender documents for the tender object. The technical term, the → *Request for Quotation (RFQ)*, sometimes also in combination with a price inquiry (Request for Pricing (RFP)) contains all necessary objectives, requirements and data for the tender object. On this basis, in constant exchange and partly time-delayed, the contract logistics service provider creates his offer—connected with the initiation of his own internal project management process.
- **Phase 3—Offer standardization/-calibration and negotiation:** After receiving the offers, a standardization process takes place on the part of the IAG, which, in addition to the completeness of the offers, compares the submitted concepts and, of course, prices. The aim is to identify from the previous → *"longlist"* of providers a → *"shortlist"* of 2–3 contract logistics service providers who are suitable for the joint project. From this process at the IAG, an information and communication process takes place, which, in addition to on-site visits and answering questions, results in a calibration in terms of content and price on the part of the provider.
- **Phase 4—Offer presentation and partner selection:** The outlined process of offer calibration is accompanied by one or more bidder presentations, which in turn can lead to new negotiation rounds and adjustment processes of the offer. In this process, a final contract logistics service provider increasingly crystallizes from the → *shortlist*. With this partner, a → *Letter of Intent (LOI)* is often signed, which expresses the intention to establish a business relationship between both parties (see phase 5).
- **Phase 5—Contract draft, negotiation and conclusion:** One of the most important phases of the tendering process is the contract draft on the part of the IC and the associated contract review by the contract logistics service provider. Since contract terms of three or more years are typical for a contract logistics project, the contract logistics service provider is dependent on the fact that cost-, time- and risk-driving contract components are communicated as early as possible when creating his offer—e.g. the desire for a → *transfer of operations according to §613a German Civil Code.* This means, however, that contract components have to be communicated and negotiated already in the earliest phases. Phase 5 therefore runs in parts parallel to the other tendering phases. On the way to the contract conclusion, the so-called → *Letter of Intent (LOI)* plays an important role. This pre-contractual document in the sense of a "declaration of intent to conclude a contract" is intended to ensure that the selected CLSP can start its work for the start-up phase, e.g. the final commissioning of its suppliers, in time, without jeopardizing the jointly agreed "go-live date".[52]

[52] Schmidt (2013, p. 23–24).

In these phases of the contract logistics tender, two teams of the cooperation partners work together until the successful contract conclusion. On the industrial side, the team, which consists mainly of members of the organizational units logistics and purchasing, is called the “buying center”. This team cooperates with the “selling center” on the side of the contract logistics service provider, which consists mainly of members of the organizational units operations and sales. In the course of the cooperation, these teams have to develop a common understanding for the contract logistics project.[53]

Contract logistics projects can fail in various phases.[54] This can also happen in the “hard-fact phase” of the logistics contract, i.e. the contract itself, in which the main contractual obligations of the contracting parties and the legal consequences of inadequate performance are fixed. For this purpose, “service level agreements” and “key performance indicators” are specified in the contract. However, a contract logistics project can also fail due to difficult-to-evaluate “soft facts”, e.g. the behavior of the persons who form the “buying and selling center”.[55] Aspects of personnel management related to this are discussed in the following part.

References

Burgess K, Singh P, Koroglu R (2006) Supply chain management: a structured literature review and implications for future research. IJOPM 26(7):703–729

Cousins P (2013) A critical discussion on the theory and development of inter-firm relationships. In: Harland C, Nassimbeni G, Schneller F (Eds) The SAGE handbook of strategic supply management. SAGE, London

Cox A, Sanderson J, Watson G (2001) Supply chains and power regimes: toward an analytic framework of managing extended networks of buyer and supplier relationships. J Supply Chain Manag 37(2):28–35

Dahm M, Thorenz D (2010) Kooperation statt Konfrontation. Vertrauen und Kontrolle in zwischenbetrieblichen Kooperationen. Zeitschrift Führung + Organisation 79(2):82–89

Dyer J, Singh H (1998) The relational view: cooperative strategy and sources of interorganisational competitive advantage. Acad Manag Rev 23(4):660–679

Elbert R, Özkan Ö, Bogusch C (2017) Revenue sharing between production, logistics and traffic: an experimental analysis of the actors in distribution logistics. In: Abele E, Boltze M, Pfohl H-Chr (Eds) Dynamic and seamless integration of production, logistics and traffic. Fundamentals of interdisciplinary decision support. Springer, Switzerland, pp 105–118

Fasse M (2013) Enders auf Renditejagd. In: Handelsblatt 186, 26.09.2013, p 1

[53] Cf. Schmidt (2013, p. 25 f.). See also the explanations on the procurement of logistics services by Pfohl (2022, p. 259 ff.). Specifically on the “make-or-buy” decision for 4PL (“4th Party Logistics”) services cf. Pfohl et al. (2015).

[54] Cf. Schmidt (2013, p. 207 ff.).

[55] On the importance of these “soft facts” for a successful project conclusion cf. Vitasek and Maylett (2011).

Freichel S (1992) Organisation von Logistikservice-Netzwerken. Theoretische Konzeption und empirische Fallstudien. Schmidt, Berlin

Frunzke H (2004) Von der Kompetenz im strategischen Management zur Netzkompetenz. In: Pfohl H-Chr (Ed) Netzkompetenz in Supply Chains. Grundlagen und Umsetzung. Gabler, Wiesbaden, pp 13–41

Glass M (2019) Projektabwicklung in der Logistik. In: Furmans K, Kilger C. (Eds) Betrieb von Logistiksystemen. Springer Vieweg, Berlin, pp 1–18

Göpfert I (2009) Die Anwendung der Zukunftsforschung für die Logistik. In: Göpfert I (Ed) Logistik der Zukunft – Logistics for the Future, 5. act., a. enl. ed. Gabler, Wiesbaden, pp 39–87

Hammer M, Champy J (1993) Business reengineering. Die Radikalkur für das Unternehmen. Campus, Frankfurt a. M.

Heskett J (1973) Sweeping changes in distribution. HBR 41(2):123–132

Heskett J, Glaskowsky Jr N, Ivie R (1992) Business logistics. Physical distribution and materials management, 4th edn. Ronald, New York

Holtbrügge D, Welge M (2015) Internationales Management. Theorien, Funktionen, Fallstudien, 6., compl. rev. ed. Schäffer-Poeschel, Stuttgart

Howaldt J, Ellerkmann F (2011) Entwicklungsphasen von Netzwerken und Unternehmenskooperationen. In: Becker T et al (Eds) Netzwerkmanagement: Mit Kooperation zum Unternehmenserfolg, 3., rev. a. enl. ed. Springer, Berlin, pp 23–35

Jarillo J (1988) On strategic networks. Strateg Manag J 9:31–41

Killich S (2011) Formen der Unternehmenskooperation. In: Becker Th et al (Eds) Netzwerkmanagement: Mit Kooperation zum Unternehmenserfolg, 3., rev. a. enl. ed. Springer, Berlin, pp 13–22

Klaus P (2005) Die Frage der optimalen Komplexität in Supply-Chains und Supply-Netzwerken. In: Eßig M (Ed) Perspektiven des Supply Managements: Konzepte und Anwendungen. Festschrift für Ulli Arnold. Springer, Berlin, pp 361–375

Kleer M (1991) Effiziente Gestaltung des Logistikkanals mittels Kooperation zwischen Hersteller und Logistikunternehmen – Theoretische Überlegungen und empirische Befunde. Springer, Berlin

Large R (2013) Strategisches Beschaffungsmanagement. Eine praxisorientierte Einführung mit Fallstudien, 5., compl. rev. ed. Springer Gabler, Wiesbaden

Lutz S (2000) Perspektiven der vernetzten Produktion. In: Wiendahl HP (Ed) Produktionsmanagement in Unternehmensnetzwerken. Praxiswissen, Dortmund, pp 9–35

Lynch C (2000) Logistics outsourcing: a management guide. Council of Logistics Management, Oak Brook

Otto B, ten Hompel M, Wrobel St (2018) Industrial Space: referenzarchitektur für die Digitalisierung der Wirtschaft. In: Neugebauer R (Ed) Digitalisierung: schlüsseltechnologien für Wirtschaft und Gesellschaft. Springer, Berlin, Heidelberg, pp 113–133

Palmatier RW, Dant RP, Grewal D (2007) A comparative longitudinal analysis of theoretical perspectives of interorganizational relationship performance. J Mark 71(4):172–194

Pfeiffer W, Weiß E (1994) Lean management. Eine neue Sichtweise des Managements industrieller Prozesse: Philosophie und Elemente. In: Potthoff E (Ed) RKW-Handbuch Führungstechnik und Organisation. Schmidt, Berlin, pp 1–43

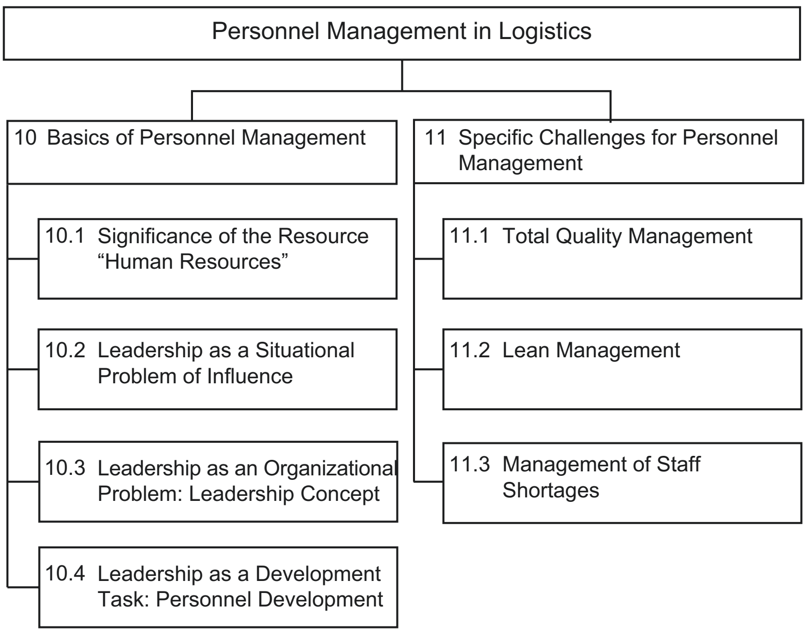
Pfohl H-Chr (1994) Interorganisatorische Probleme in der Logistikkette. In: Pfohl H-Chr (Ed) Management der Logistikkette. Kostensenkung – Leistungssteigerung – Erfolgspotential. Schmidt, Berlin, pp 201–251

Pfohl H-Chr (2001) Management von Produktionsnetzwerken. In: Baumgarten H (Ed) Logistik im E-Zeitalter. Die Welt der globalen Logistiknetzwerke. Frankfurter Allgemeine Buch, Frankfurt a. M., pp 35–54

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. act. ed. Springer, Berlin
Pfohl H-Chr, Berbner U, Zuber Chr (2015) Potenziale der 4th Party Logistics. Chancen und Herausforderungen für KMU und Großunternehmen. In: Wolf-Kluthausen H (Ed) Jahrbuch Logistik 2015. Korschenbroich, pp 34–37
Pfohl H-Chr, Elbert R, Hofmann E (2003) Management der „finanziellen" Supply Chain: Charakterisierung–Aufgabenbereiche–Interdependenzen. In: Bundesvereinigung Logistik (BVL) e. V. (Ed) Finanzierung–eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Schmidt, Berlin, pp 1–64
Pfohl H-Chr, Large R, (1992) Gestaltung interorganisatorischer Logistiksysteme auf der Grundlage der Transaktionskostentheorie. Zeitschrift für Verkehrswissenschaft 63(1):15–51
Pfohl H-Chr, Moraitakis N (2021) Cross-functional Incentives for Purchasing-Logistics and Supplier Integration: with Evidence from China. ZfbF Sonderheft „Arbeitskreis Einkauf und Logistik der Schmalenbach-Gesellschaft für Betriebswirtschaft e. V."
Picot A et al (2020) Die grenzenlose Unternehmung. Information, Organisation & Führung, 6., compl. rev. ed. Springer, Wiesbaden
Roventa P (1991) Strategische Netzwerke. In: Droege W et al (Eds) Zukunftssicherung durch strategische Unternehmensführung. Wirtschaftswoche, Düsseldorf, pp 401–410
Schmidt N (ed) (2013) Leitfaden Kontraktlogistik – Ausschreibung. Handlungsempfehlungen und Checklisten für Industrie. Handel und Dienstleister. DVV Media Group, Hamburg
Schönsleben P (2011) Integrales Logistikmanagement: Operations und Supply Chain Management innerhalb des Unternehmens und unternehmensübergreifend. Springer, Berlin
Steinmüller T (2003) Finanzierung von Logistikimmobilien. In: Bundesvereinigung Logistik (BVL) e. V. (Ed) Finanzierung – eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Schmidt, Berlin, pp 171–186
Stölzle W et al (Eds) (2007) Handbuch Kontraktlogistik. Management komplexer Dienstleistungen. Wiley, Weinheim
Sydow J (1992) Strategische Netzwerke und Transaktionskostentheorie. In: Staehle HW, Conrad P (Eds) Managementforschung 2. Gabler, Berlin/New York
Sydow J (2010) Führung in Netzwerkorganisationen – Fragen an die Führungsforschung. In: Sydow J (Ed) Management von Netzwerkorganisationen: Beiträge aus der „Managementforschung", 5., act. ed. Springer, Wiesbaden, pp 359–372
Sydow J, Möllering G (2015) Produktion in netzwerken: make, buy & cooperate, 3., act. a. rev. ed. Vahlen, München
Trumpfheller M, Hofmann E (2004) Supply chain relationship management. Beziehungsmanagement als konstitutives Element der Netzkompetenz in Supply Chains. In: Pfohl H.-Chr (Ed) Netzkompetenz in Supply Chains. Grundlagen und Umsetzung. Gabler, Wiesbaden, pp 67–91
Vitasek K, Maylett T (2011) A hard look at the soft side of performance. Supply Chain Q 5(4):26–32
von Eisenhart-Rothe F, Jütte S (2003) Innovative Logistikfinanzierung rund um die Supply Chain. In: Bundesvereinigung Logistik (BVL) (Ed) Finanzierung – eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Schmidt, Berlin, pp 151–170
Watson F, Hewett K (2006) A multi-theoretical model of knowledge transfer in organizations: determinants of knowledge contribution and knowledge reuse. J Manag Stud 43(2):141–173
Wenzel F-T (2012) „Wir sind nicht effizient genug". In: Frankfurter Rundschau. https://www.fr-online.de/wirtschaft/airbus-vorstand--wir-sind-nicht-effizient-genug-,1472780,17583986.html. Accessed 12 Mai 2015
Williamson O (1975) Markets and hierarchies: analysis and antitrust implications. Free Press, New York
Yahsi B (2017) Financial Supply Chain Management: Erfolgsfaktoren der Gestaltung von Finanznetzwerken. Diss. Technische Universität Darmstadt

Part IV

Personnel Management in Logistics



The resource personnel is of great importance for logistics because of the personnel intensity of many logistics tasks. Based on the presentation of its importance, this chapter first presents the basics of personnel management. In logistics, human resource management must align human resource concerns with the objectives of the logistics function. Thus, human resource decisions must take into account both the needs of the logistics function, which consists of the best possible supply of employees, and the needs of the logistics employees. Personnel management is the personal influencing of the behavior of the subordinate employees by the manager. It is the responsibility of all superiors and includes all management tasks that are necessary for the smooth fulfilment of tasks by employees in logistics. In particular, this involves integration. of employee and task goals, as well as measures to maintain or enhance performance through the design of incentives. In the second section of the part, specific challenges to human resource management are discussed. To this end, two management concepts, Total Quality Management and Lean Management, are first introduced, which are of great relevance to logistics management and place high demands on personnel management. To conclude this part, the management of personnel shortages is discussed, which is becoming increasingly important for logistics in the competition for qualified personnel. It is about how the attractiveness of jobs in the logistics sector can be increased and communicated accordingly. In addition, it is the task of managers to select and promote successors in good time in order to ensure the continuous management of the company. These areas of responsibility are presented in relation to special features of logistics.

10 Basics of Personnel Management

10.1 Significance of the Resource "Human Resources"

Starting from increasing dynamics and complexity in the competitive environment, the understanding of the resource "human resources" is developing more and more away from the "cost factor in the company" towards the "most important resource in the company".[1] Looking at current theories of strategic management, the knowledge-based approach ("Knowledge–based View") to explain entrepreneurial competitive advantages captures this change best: It defines the factor knowledge as the central resource for achieving competitive advantages.[2] Knowledge is always bound to the employees, who apply their knowledge, create new knowledge and thus form the basis for a learning organization.[3] This knowledge orientation is the basis for mastering complexity and dynamics as characteristic factors of logistics management.[4] Changes in customer wishes, the need to reduce throughput times or the shortening of product life cycles are concrete manifestations of these factors. Against this background, companies introduce concepts such as, for example, for the management of quality and lean processes, further develop information and communication systems, actively shape customer and supplier relationships and thus find themselves in a continuous change that is characterized by high demands on the employees (see Fig. 10.1). Competitive advantages can only be achieved if such personnel-based concepts for dealing with increased complexity and dynamics are successfully implemented. A high innovation capability, flexibility and

[1] See Schmidt and Hua-Kellermann (2008, p. 7); Pfohl et al. (2009a, p. 2).

[2] See Part I, Sect. 3.3.1.

[3] Cf. Rothländer (2009, p. 141 ff.).

[4] Cf. the following Isik (2010, p. 3681 f.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_10

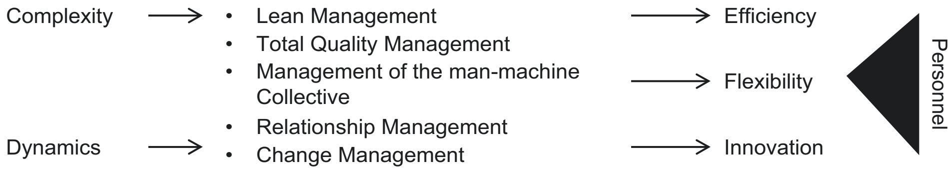


Fig. 10.1 Requirements for the resource personnel in logistics

efficiency on the part of the employees based on a high level of basic and experiential knowledge as well as a high motivation are necessary for the successful implementation.

Surveys of executives in logistics and supply chain management underline the importance of personnel management. In particular, the supply of qualified employees in the supply chain is not sufficient for the foreseeable future.[5] Talent management and the support of employees in making fast decisions are assessed as important strategic fields of action.[6] This and the central role of the "resource" personnel can be seen in the framework of logistics strategies in Fig. 10.2: The employee is at the center of the framework and requires continuous and strategic development as well as the possibility to implement fast, correct decisions in the company. Against the background of the importance of human resources for logistics, the basics of personnel management are explained in detail below.

10.2 Leadership as a Situational Problem of Influence

Personnel management (leadership in the narrower sense) is one of the *management functions,* with the help of which the behavior of the employees is structured and coordinated in such a way that the goals and measures outlined in the corporate policy and concretized in the planning can be realized.[7] It differs from the organization by the form in which the behavioral expectations towards the employees are stabilized and enforced: While formal regulations establish the long-term valid structure independent of specific individuals within the framework of the organization, personnel management represents the direct, personal influence of the behavior of an individual employee or a group in the direction of common goals. The behavioral expectations are not enforced by formal regulations, but with the help of professional authority (arguments), personality authority

[5] Cf. Handfield et al. (2013, p. 25); McKinnon et al. (2017, p. 15 ff.); Schwemmer (2019, p. 6); Kersten et al. (2020, p. 12) point out that the personnel shortage, which was still considered very significant in 2018, was relativized in view of the "corona crisis" in 2020.

[6] Cf. Handfield et al. (2013, p. 34).

[7] Cf. Ulrich and Fluri (1995, p. 161).

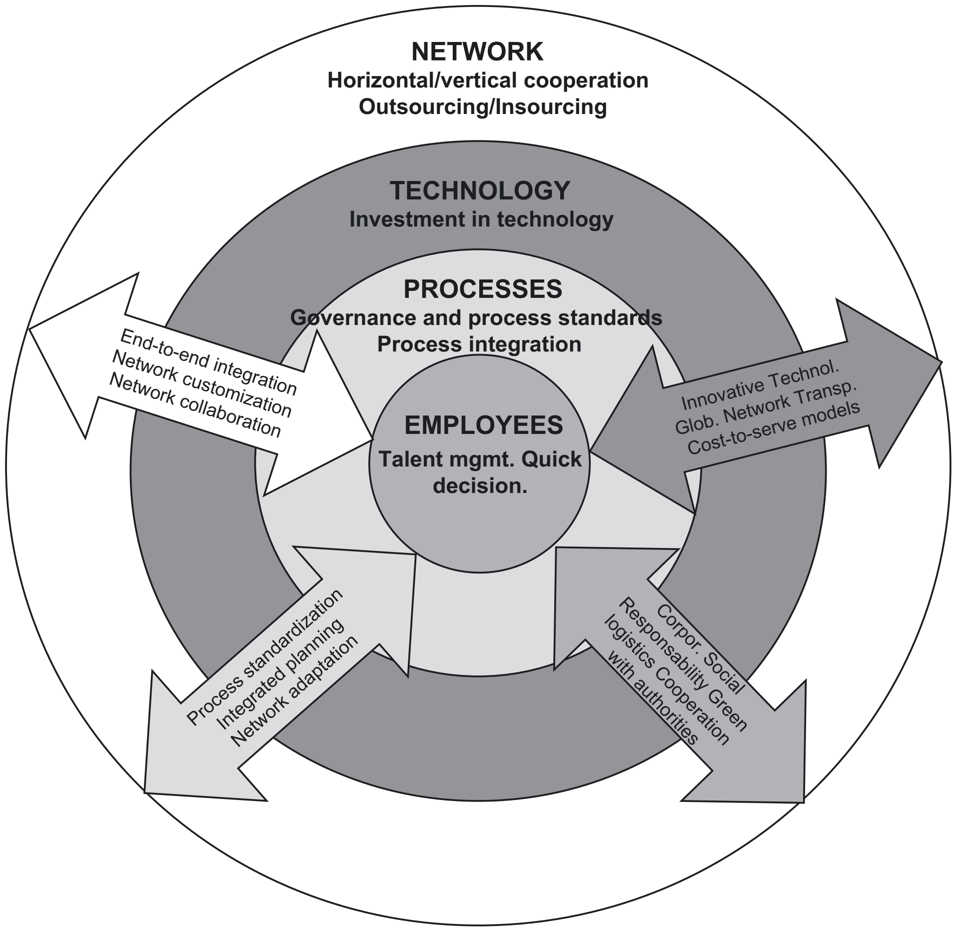


Fig. 10.2 The classification of the employee in the framework of logistics strategies. *Source* With minor changes taken from Handfield et al. 2013, p. 34

(charisma) and positional authority (sanction power) of the leader. Thus, leadership is the task of every employee with personnel responsibility.

The leadership task in logistics depends on the controllable and uncontrollable variables specified in the model of logistics management.[8] Therefore, the treatment of leadership in the following should be *situational*, i.e. no absolutely set principles and causal relationships for the design of the leadership tasks, but alternative leadership approaches for different situations are presented. In addition, a decision-oriented logic is followed

[8] See Part I. Sect. 2.3.2. For the support of personnel management by the human resources department, see Swart et al. (2012, p. 16 ff.).

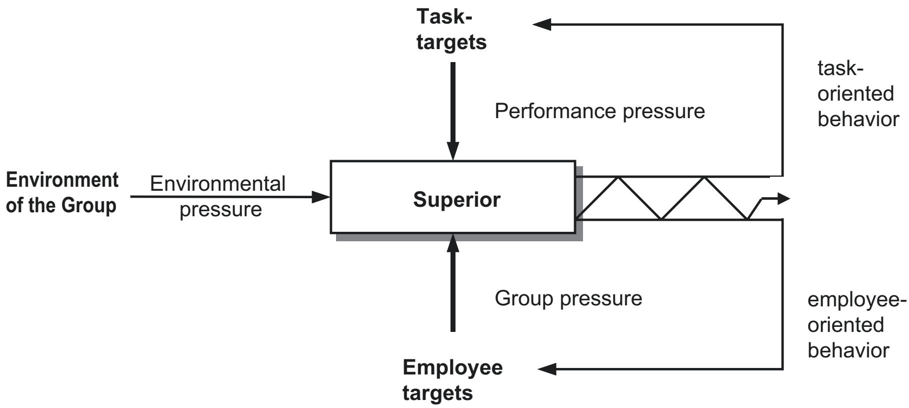


Fig. 10.3 Leadership problem of the superior. *Source* Ulrich and Fluri 1995, p. 226

to support the selection of a promising leadership style in the respective situation and its flanking by means of suitable leadership instruments to achieve certain goals. However, before that, it is necessary to work out what the actual challenge of leadership is. Because only when employees work committedly and commit themselves to the goals of the company, the resource personnel can develop and become a potential for success.

10.2.1 Leadership Problem of the Superior

The basic problem to be solved within the framework of leadership is, as schematized in Fig. 10.3, the integration of task and employee goals, whereby the superior has to take into account the expectations and organizational regulations of the group environment.[9] The task goals (performance goals) result from the fulfillment of the tasks associated with the corporate purpose and are demanded by the leader from his own superior. It is not the task of the superior to perform the activities required for the realization of the tasks himself, but to make arrangements for the distribution and work relationships among his employees within the framework of the *task-oriented leadership function*. Thus, leading for him means influencing his employees to make them perform the required services to achieve the task goals. The task-oriented leadership function essentially involves,

- “to define and structure the group task,
- to create a rational division of labor in the group,

[9] The leadership problem is explained in the following based on Ulrich and Fluri (1995, p. 225 ff.).

- to design the communication structure in the group appropriately,
- to control the consultation and decision processes in the group,
- or, if necessary, to make decisions himself and
- to ensure the implementation of the decisions made."[10]

On the other hand, the superior is confronted with the aspiration of his employees to satisfy certain needs in the company. Leading also means allowing the achievement of employee goals. Because the employees will only identify themselves largely with the task goals if they expect a significant contribution to the achievement of their personal goals from them.

The *employee-oriented leadership function* first includes the motivation of the employees in the company.[11] Here, a distinction is made between *extrinsic motivation* and *intrinsic motivation*. Extrinsic motivation exists when the needs of an individual employee are indirectly fulfilled—e.g. by means of the salary or other monetary incentives. Intrinsic motivation, on the other hand, exists when an individual need satisfaction is achieved by performing an activity itself. This means, for example, offering the individual employees opportunities for personal development. This can be done by assigning a challenging—but not overwhelming—task, thereby giving the employee the opportunity to satisfy the need for the successful fulfillment of a meaningful task. There is a dynamic relationship between both types of motivation and the control in the form of support and strengthening of these types of motivation is the task of the leader.

The employee-oriented leadership function takes into account not only employee motivation but also the factor of *group integration*. To ensure the achievement of the task objectives under performance and time specifications, the employees must be activated and motivated to cooperate on a common goal. Employee orientation means that motivating working conditions are created for both the individual employee and the group. Cohesion and loyalty within the group are to be promoted. A strong group integration, i.e. the "welding together" of the employees into a team, can be specifically fostered by the leader by creating an open communication[12] and building mutual trust among the group members.

The integration of employee and task orientation is achieved when they mutually support each other. Whether this succeeds, "depends on the individual case

- on the *task* to be fulfilled, especially its routine or problem-solving character, the time pressure under which it has to be fulfilled, and whether it is an analysis or coordination task;

[10] Ulrich and Fluri (1995, p. 226).

[11] See Pfohl et al. (2009a, p. 47 ff.).

[12] On the importance of internal communication see Pfohl et al. (2009a, p. 35 f.).

- on the *environment* of the group, especially the organizational environment and the expectations of the superior system;
- on the *leader* himself, especially his knowledge and skills, his personality and his position authority;
- on the *other group members* as individuals (knowledge and skills, motivation, expectations) and as a group (structure and cohesion of the group)."[13]

10.2.2 Leadership Tasks

The higher the position of a leader is, the more his task consists of planning and distributing work to his employees, selecting suitable employees and using them according to their abilities, introducing improvements in his work area and instructing his employees. To be able to fulfill these leadership tasks, the leader must *delegate* work to his employees, i.e. assign tasks with precisely defined authorities and responsibilities to suitable employees for independent completion.[14] The leader has to ensure that certain tasks are carried out. For this purpose, it must be ensured that the employee can also perform the assigned tasks. If the employee does not have the necessary technical knowledge, he must first be instructed in the execution of the tasks. In addition to the question of the right employee selection, a leader has to decide what counts as delegable tasks. A common mistake is to assign only routine tasks to the employees, while the leader handles the interesting areas himself. This approach is critical because new and interesting tasks motivate the employees and can help them grow and develop their full potential on these tasks. Furthermore, it is part of the leader's task to break down the assigned task objectives into concrete, clearly defined and delimited sub-objectives.[15] In this way, each employee or group can be given or agreed upon a sub-objective that is aligned with the logistics and corporate objectives. In the latter case, a higher level of motivation can be expected, as the employee is actively involved in the goal formation process, which increases his identification with the goal and his activity.[16]

[13] Ulrich and Fluri (1995, p. 228).

[14] Cf. Jung (2017, p. 450 f.).

[15] The transparency of the requirements of the tasks has a significant influence on the work result. In an empirical study in logistics, it turned out that the main expectations on the part of the leaders lie in a flawless execution, a self-responsible and independent work and a good customer service. On the other hand, the leaders estimate the criteria of timely, prompt and fast execution of tasks as less important, while the employees attach a higher importance to these criteria. By improving the transparency and communication, the work result can be improved. See Pfohl et al. (2009b, p. 100).

[16] See also Sect. 10.3.2.

An important basis for the fulfillment of leadership tasks are *conversations,* whereby the purpose of the conversation must be distinguished. "An open conversation promotes cooperation, creates understanding for the problems of others and is the basis for mutual trust."[17] In general conversations, no specific operational purpose is pursued. They can relate to general operational but also to non-operational matters. *Informative conversations* relate to operational matters, for example from bottom to top the information about the status of a work or from top to bottom the information about a personnel change in a department. *Consultative conversations* relate for example to the consultation of the employee on his work performance or also to the consultation of the leader on the work distribution.

Directives are used by the superior to induce employees to perform certain actions. In daily practice, however, it often turns out how difficult it is to give *instructions* clearly and completely, so that they are clear and complete, that nothing is left open and the employee really knows what is meant. This requires not only a clear communication, but also the superior's knowledge of the temporal and content-related delimitation of the task. It must also be clear to the employee whether it is a piece of advice or a strict instruction. While the instruction includes the way in which a task is to be performed, the employee is only given a rough framework for the *assignment*, what is to be done by when and why. It is largely left to his or her independence how and with what he or she performs the task. Assigning tasks instead of having to give instructions works better the more qualified the employee is. Nevertheless, this approach is also worthwhile for less qualified employees, who, with appropriate motivation, are capable of performing tasks independently after a period of time appropriate to their qualification and a gradual approach. If instructions are to be followed or assignments are to be completed properly, it is necessary that the employee receives all the necessary and task-related *information* from the instructing superior. In the case of employee-oriented leadership, this also includes information that is not absolutely necessary for the task fulfillment, but is related to it in a broader sense. For example, an employee who is sufficiently informed about the purpose and context of his or her activity knows what consequences it can have for the process of logistical service provision if he or she does not fulfill his or her task properly. He or she will then feel less like a dependent recipient of orders, but rather understand himself or herself as a (in the truest sense of the word) co-worker of logistics, whose reliable and responsible cooperation is important. Purely task-oriented leaders who do not inform their employees often assume a lack of interest in such questions on their part.

In addition to the purpose of the conversation, a distinction can also be made according to the type of conversation: employee conversation and group conversation. The *employee conversation* is a conversation between employee and superior under four eyes. The superior discusses important decision-making facts or significant events in the work

[17] Jung (2017, p. 477). On the different types of conversations see p. 477 ff.

process of his or her area of activity, especially the work situation, the personal and factual performance prerequisites, the task distribution and the cooperation behavior. On the one hand, the superior can get to know the motives and attitudes of his or her employees better. On the other hand, the employee can better understand the decisions of the superior and comment on them. The employee conversation ultimately serves to promote the willingness to perform and satisfaction of the employees.

Group conversations (meetings) are conducted with several employees at the same time. A group of employees is to be convinced, activated and motivated with regard to a certain state to be achieved. The content of the conversation can be distinguished between work discussion, decision preparation and problem identification. In the work discussion, the superior informs about his or her own prior knowledge. It should be ensured that the information can be processed by the employees. The decision preparation is about problems where the superior's prior knowledge is no longer sufficient for problem solving. The employees are to contribute to the problem solution. In the problem identification, the employees are to bring in as many problem perspectives as possible based on their experience. In order to make the performance advantage of the group—which can lie, for example, in mutual stimulation and creativity promotion, professional support or use of all available information, skills and experiences—effective, the superior should try to promote the group integration through open communication and trust-building measures.[18] This is especially important against the background that communication is a complex and error-prone process.

Finally, the *control*[19] of the performance results of the employees is part of the tasks of the manager. It is important here to provide feedback on whether the assigned tasks have been performed satisfactorily. In addition to factual complaints in case of poor performance, good work results of the employees are to be expressly acknowledged and praised. It has been empirically shown that the perceived recognition has a positive effect on both the relationship with the manager and the motivation.

The importance of good communication also results from the fact that the employees underestimate their influence on the performance result and consequently do not recognize their importance for logistics (see Fig. 10.4). Regular communication and feedback on activities and achievements in relation to logistics and corporate goals can reduce this discrepancy and thus also strengthen the motivation of the employees.

[18] Cf. Ulrich and Fluri (1995, p. 226 f.).

[19] In the survey of managers and employees from logistics, a perception discrepancy also emerged here: While the employees assume that the "correct and timely completion of tasks" and the "compliance with working hours" are the central control contents, for managers the "quantity that was actually achieved in the working hours" and "idle times" are also of central importance. This is not clear to the surveyed employees. Cf. Pfohl et al. (2009b, p. 100 f.).

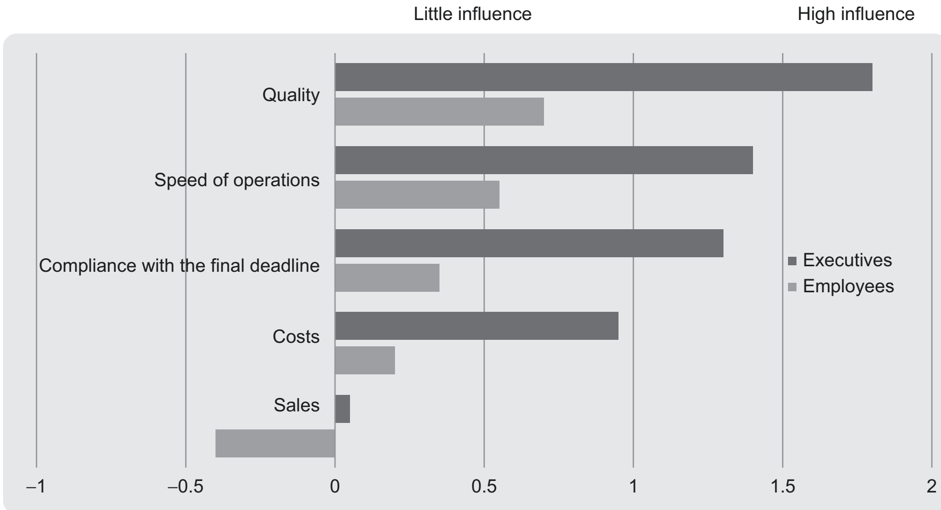


Fig. 10.4 Influence of employees on the performance result—assessments of employees and managers. *Source* Pfohl et al. 2009b, p. 102

10.2.3 Leadership Skills

The leadership tasks described can only be fulfilled by leaders if the corresponding prerequisites are given. As far as the personal prerequisites of logistics leaders are concerned, it is clear from the functions and roles shown that they must have a number of very different capabilities if they want to meet the complex character of the tasks they face. As a basis for the further explanations, the so-called "Three-Skill-Approach" shall be used as an approach to systematize the qualification requirements. According to this approach, leaders must have specialist, methodical/conceptual and social skills to perform their tasks.[20] All three types of skills work together in a leadership task; the fulfillment of each function depends, albeit with different emphases, on the interaction of the skills.

The *specialist capability* or the "Technical Skills" primarily refers to the knowledge and mastery of specific methods, procedures and techniques of a subject area as well as the ability to apply theoretical knowledge to the specific case. The importance of specialist knowledge for the performance of leadership tasks is seen differently in different cultural circles. While e.g. in Japan, technical knowledge is given little importance, e.g. in Germany, technical knowledge forms the necessary prerequisite for the performance of leadership tasks. Because there is the opinion that whoever wants to lead must

[20] Cf. e.g. Holtbrügge (2018, p. 144), where intercultural competence is also listed, or Arnold et al. (2008, p. 345), where personality competence (ability for self-knowledge) is also listed.

also master the operational business.[21] It is difficult for a leader who is not familiar with logistics to form and concretize subgoals for the employees from the given task goals, to select the right employees for the fulfillment of the task, to name the suitable methods for solving the problem or to make a temporal and content-related delimitation. If, on the other hand, the leader is able to think through the task fulfillment in advance due to his or her technical knowledge, the technical leadership tasks do not pose any difficulties. Regardless of the hierarchical level, the requirement profile for logistics employees is characterized by the combination of technological and business knowledge. Examples for the technological area are knowledge of material flow systems and information processing systems and for the business area knowledge in order processing and transport. From the character of a cross-sectional function of logistics, the requirement for a logistics leader also results that he or she also has the knowledge at the interfaces from the other functional areas, e.g. procurement or production.

In addition to technical knowledge, the *conceptual capability* or the "Conceptual Skills" are also important for the performance of the leadership tasks. In the broadest sense, this means the ability to optimally use existing technical knowledge. In detail, this includes creative, analytical, logical, critical and structured thinking as well as the mastery of algorithms, heuristics and creativity techniques. The term "Conceptual Skills" is also translated as methodological competence for management. This competence includes work and management methods that enable the leaders to use their technical potentials to organize themselves. "Such methods include planning, innovation, decision and organization methods as well as methods of strategy planning and methods of systematic weakness analysis."[22] They support the leader in performing the task-oriented leadership function, e.g. by using portfolio analyses to identify and structure tasks. The support by planning and analysis instruments is particularly important for logistics. Because of the cross-sectional character, the complexity is very high and it becomes difficult to overlook the interrelationships of different influencing factors of logistics services and costs and to design the system according to the desired logistics strategies. The logistics system is an example of a leadership task that requires a high degree of methodological competence. For example, when introducing logistics innovations, the effects on the most diverse areas of the company have to be considered as well as the possible conflicts of objectives that may arise have to be balanced.

While the conceptual competence supports the superior in forming and formulating tasks and goals, the *social capability* or the "Human Skills" play the decisive role in communicating them to the employees within the framework of leadership communication. Social competence characterizes the ability to work effectively with other people. Those who recognize human behavior and its backgrounds, demonstrate conflict and confrontation skills and are able to give and receive constructive "feedback"

[21] Cf. Katzensteiner (2003, p. 60).

[22] Cf. Jung (2017, p. 255).

and criticism are considered socially competent. This includes the ability to perceive and analyze social problems as well as the skill to influence social processes in a targeted way. This makes the connection to leadership evident, since a leader, as already explained, should primarily lead, promote, help solve conflicts, explain goals and contexts and be able to motivate employees. The ability to promote the cross-functional and cross-departmental thinking that is necessary in the context of decentralization is a task within the framework of leadership across all hierarchical levels. A high degree of social competence is required from the superiors in addition to the routinely running communication processes, e.g. in organizational changes, which occur frequently according to the development phases of logistics management. Such changes contain potential for conflict, which the superior has to recognize and resolve. This involves the (justified or unjustified) fears of affected employees, who can be met by transparency of the situation and early involvement, as already shown in the case of reorganization,[23]

10.2.4 Employee Orientation

A high motivation is a prerequisite for the optimal utilization of the performance potential of the employees to realize the logistics and corporate goals.[24] It depends largely on the extent to which the employees can realize their own goals through their personal commitment to the company. The basis of motivation are individual needs of the employee, which must be known to the superior in order to be able to lead effectively. From the human striving to satisfy his needs, results the willingness to perform, which is also called a motive. In the context of motivation research, it is attempted to explain how human behavior and in this context the performance in the company is motivated.

A well-known motivation theory goes back to Maslow, who developed a hierarchy of five categories of needs.[25] If the hierarchically lower needs are satisfied, the higher needs become effective for motivation. At the base of the pyramid of needs are *physiological needs* as basic needs, which arise from the striving for securing the physical existence. Transferred to work, this means that an existential support must be ensured by sufficient payment and a secure job.

Safety needs form the next higher level of the pyramid of needs, whereby a distinction is made between the needs for safety from physical, psychological and economic dangers. This includes e.g. for warehouse workers the protection from dangers by measures for accident or hazard prevention, especially when the workplace entails special risks, such as when handling hazardous substances. The ergonomic design of workplaces and operating resources is particularly important when physical activities have to be

---

[23] See Part III, Sect. 7.4.

[24] Cf. Pfohl et al. (2009b, p. 109 f.).

[25] Cf. to this pyramid of needs e.g. Ulrich and Fluri (1995, p. 33) and Pfohl et al. (2009a, p. 49 f.).

performed, such as transport, handling or picking activities in the warehouse, in order to preserve the employee's work capacity in the long term by measures for health protection. This also includes strains caused by flexible working time models with a possibly changing daily rhythm. Financial security can e.g. express itself in the desire for company pension schemes or a calculable, constant income even with flexible work deployment. Although the demand for labor in logistics is very high across all levels, especially employees in execution activities can e.g. be affected by outsourcing decisions regarding financial security also in the short term. Further education can also be assigned to this level of the pyramid of needs. Here, too, there are opportunities to further qualify, earn higher incomes and pursue a career with increasing qualification requirements.

Social belonging needs are expressed in the next higher category of needs in the desire for social contacts, i. e. being part of a social group. The contact motive is satisfied by the comparatively good opportunities to perceive diverse social contacts in the environment of logistics. This applies to all hierarchical levels through the cooperation with employees of other functional areas within and outside the company boundaries. The cross-sectional function of logistics emphasizes this aspect additionally. Especially on low employee levels, this motive can have a prominent importance besides the remuneration.

The next category of needs of *recognition* is differentiated by Maslow into the need for self-esteem based on one's own achievements and successes, one's own independence and power, and the one for recognition by others (external confirmation). For the performance-oriented employee, a special appeal comes from the task, especially when challenging tasks challenge him to perform. Intrinsic motives are addressed, in which the performance incentive comes from the work itself. The more an employee enjoys his work and identifies with it, the more willing he is to perform. As the explanations of the previous section have shown, the holistic view of logistics tasks provides the basis for interesting and challenging activities both on the various management levels and on the execution level. Although it can be assumed that employees on the execution level are tendentially less intrinsically motivated than managers, the design of the work content, e.g. with regard to holism, plays a decisive role for their job satisfaction. A positive effect here is that there has rarely been such a high degree of division of labor in logistics as in the production area of the company. But not only the work content influences the performance motivation, but also the perceived importance. The higher this is, the higher is the performance motivation.[26]

In addition, the employees also demand recognition of their achievements by the superior, which can ultimately express itself in the desire for a performance-related remuneration.[27] The importance of this motive is very different among different people, however. For the majority of low- or unskilled workers, the money and security motive

[26] Cf. Pfohl et al. (2009b, p. 112 ff.).

[27] See in detail on performance- and success-oriented remuneration systems in logistics Brauckmann (2009, p. 294 ff.).

is in the foreground, although the earning opportunities for simple execution activities in logistics are rather below average compared to other functional areas. On the other hand, money can represent not only material but also emotional values and in this sense serve as a measure for performance, prestige, power or security.[28] The motivation that comes from the factor money is directed in its strength according to the expectations of the human being. Especially younger people can be strongly money-motivated, in order to provide themselves thereby satisfaction of the most different material needs. However, an immaterial recognition in the form of praise by the superior can influence the performance motivation more positively.[29]

At the top of the hierarchy of needs is *self-actualization* as the desire for the best possible development of all individual abilities. It expresses itself in the striving for professional development and the desire to influence future developments in the company. Creative activities and initiative are seen by the employee as a challenge. Routine or heavily supervised tasks, on the other hand, lead to frustration. Logistics offers here as a comparatively "young discipline" the chance to shape development paths. The possibility of self-development and self-actualization remains reserved for the higher management levels in the rule. Power and the prospect of recognition on a broad basis are their incentive, after the subordinate needs are met and no longer have any motivational effects.

10.3 Leadership as an Organizational Problem: Leadership Concept

The task of proper employee leadership does not need to be left to the individual superior. Through a formally enacted leadership concept and organizational measures, they can be supported in their efforts to achieve task and employee goals. The most important elements of a leadership concept or guiding principle are principles in relation to the leadership style and the leadership technique to be applied.

10.3.1 Leadership Style

The leadership style refers to a specific behavior that is repeatedly shown by the superior towards the employees. With the leadership style, the *basic orientation of the leadership behavior* is determined.[30] This depends on the way the leader uses his position, expertise and personality authority to influence his employees in the desired way.

28 Cf. Jung (2017, p. 372).

29 Cf. Pfohl et al. (2009b, p. 111 f.).

30 Cf. on the term Jung (2017, p. 421 f.). The leadership style is explained below in accordance with Ulrich and Fluri (1995, p. 169 f. and 228 ff.).

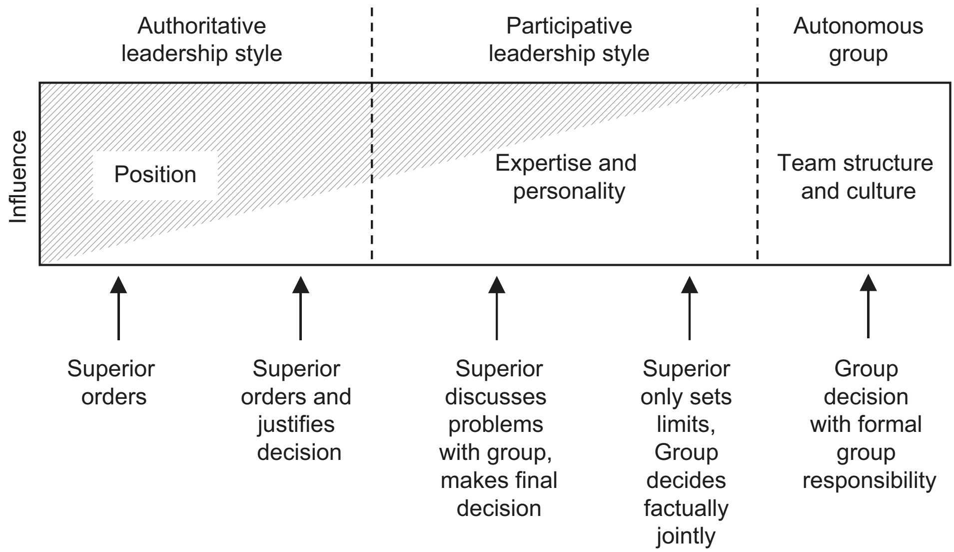


Fig. 10.5 The leadership style continuum. *Source* Ulrich and Fluri 1995, p. 232

A widespread behavior-oriented approach to classifying leadership behavior uses as a distinguishing feature the type of decision making. Here, on the one hand, the authoritarian (authoritative) leadership style and, on the other hand, the cooperative (democratic, participative) leadership style are conceived as extreme points of a continuum. Overall, the ideal-typical leadership styles shown in Fig. 10.5 are distinguished, which characterize the behavior of the leader.

At the level of operational logistics management, an *authoritative leadership style* is still applied in many companies. This may be due to the assumptions that foremen and shift leaders have regarding the characteristics, motives, needs, expectations and attitudes of their employees. In the human image formulated by McGregor according to the Theory X, the employees are assumed to have a natural aversion to work, which is why they have to be authoritatively forced and constantly controlled by their superiors. The employees react accordingly demotivated to the authoritative leadership style and thus confirm the assumption in the sense of a “self-fulfilling prophecy”. Another reason for the application of an authoritative leadership style could be the lack of qualification for leadership tasks, so that the leader chooses the “path of least resistance” by not striving for the integration of task and employee goals, and relying solely on his position authority.

Against the background of the value change and the changes in the work, a higher degree of participation of the employees seems appropriate. The *participative leadership style* consciously places the employee as a social being, with all his human qualities and needs, at the center of his actions. He understands him as a “co-worker” and not as a passive "work-taker" who only receives and executes instructions unreflectively. The superior no longer has the task of a "disciplinarian" in this value system. Rather, he has in his role as a "coach" to communicate the company concept to his employees in an understandable way. He has to explain its meaning, the implications and dependencies associated with it, and break them down to the level of his department. Companies that have introduced group work in the logistics area or rely on a stronger involvement of the employees show that employees can also be willing to perform at the operational level, provided that the work has an intrinsic value for them and they are motivated accordingly. However, the successful introduction is linked to a number of prerequisites, such as preparatory training of the foremen, team leaders and members with regard to the changed tasks.

Generally, none of the leadership styles listed in Fig. 10.5 is to be preferred. It depends on the situation, which leadership style promises the greatest leadership success.[31] Factors that determine the degree of participation offered are the *characteristics of superiors and employees* with regard to the leader-employee relationship. It can be assumed that logistics employees of higher hierarchy levels are more willing to a high degree of participation, since they already have the necessary social skills from the previous successful fulfillment of the task goals. On the other hand, the degree of intrinsic motivation of the followers increases, which makes the leadership task easier.

Since the employees differ in their abilities, experiences and needs, the superior faces different *participation expectations of his employees*, which he has to take into account in his leadership actions.[32] Especially in view of a sometimes very low level of qualification at the operational level, it can be assumed that there are also employees in the logistics area who attach little value to involvement in the context of leadership and who seek satisfaction only in the money and contact motive. At higher hierarchical levels, a high intrinsic motivation can be expected, which implies a pronounced participation expectation of the employees.

In addition, the *personality type* of the employees plays a decisive role.[33] For the development phase of new or reorganization of old logistics structures, so-called "lively" employees are particularly suitable, who seek variety and excitement, are open-minded, dynamic and creative, but on the other hand can be unpredictable, possibly inconsistent and unreliable. Their leadership requires to curb unrealistic ideas and recklessness by early successes and not to overlook mistakes. The other extreme is the "self-controlled" employee, who is afraid of risk, change and innovation and therefore clings "ironly" to

[31] Cf. on this Stock-Homburg and Groß (2019, p. 539 ff.).

[32] See also the relationship between satisfaction with the participation offer of the leader and employee performance in Pfohl et al. (2009b, p. 114 f.).

[33] See also the distinction of the employee types "The obedient employee" in connection with the strategy of cost leadership and "The independent employee" in connection with the strategy of differentiation in Straube et al. (2005, p. 42 f.).

experiences, attitudes, principles and habits. He is suitable for work steps that require a high degree of perfection and responsibility. He expects clear instructions from the leader in order to be able to perform his performance free of disturbances. The described behaviors do not usually occur in pure form. However, they illustrate that superiors have to adapt their behavior according to the respective type of employee.

Besides the participation offer by the leader and the corresponding expectations of the follower, the *type of tasks* influences the appropriate leadership style. It has to be considered that the requirements of the task have to match the abilities of the employee and that neither over- nor under-demand exists. If the task is, as it is often the case in logistics, a coordination problem, which has to be solved under time pressure, a relatively authoritative leadership style proves to be more effective, as clear instructions are required and discussions within the group would only lead to time losses. In contrast, if there is enough time and it is a challenging decision problem, the performance advantage of the group can be fully realized by a participative leadership style.

Bringing participation offer and expectation into line when choosing the leadership style is not only a prerequisite to give employees enough opportunity to satisfy their personal needs and thus achieve a high level of performance. It also requires the abandonment of uniform concepts of leadership. The leadership style has to be adapted to the situation within the framework given by the corporate policy.

10.3.2 Leadership Technique

Leadership techniques, known as so-called *"Management-by"* techniques, can be understood as a combined use of certain management principles (management concepts) and leadership styles.[34] A systematic order and interpretation of these techniques is possible if one distinguishes the determination of leadership variables in terms of goals from the (outcome) control.

Basically, different degrees are possible for each of the two forms, which have found their way into different "Management-by" forms.[35] The usual form of control is the regular reporting ("Management-by-Results"). A different approach is the "Management-by-Exception", in which the superior intervenes only in exceptional cases. In the goal-setting phase, there are possibilities to prescribe or agree on goals with the employees ("Management-by-Objectives"), decision rules to determine, according to which employees have to proceed ("Management-by-Decision-Rules") or to intervene directly, which is equivalent to replacing the leadership by one's own action. In the following, the "Management-by-Objectives" and the "Management-by-Exception" will be discussed in

[34] Cf. Ulrich and Fluri (1995, p. 244). See also the corporate principles in Part I, Sect. 2.4.1.

[35] The following based on "Management-by" forms in Jung (2017, p. 497 ff.).

more detail, as the combination of these two leadership techniques is of particular importance for the logistics.

The core idea of *Management-by-Objectives* is the involvement of the employee in the goal-setting process, in order to achieve a better identification with the logistics and corporate goals. *Goals* ("Objectives") are *agreed* jointly by superior and employee, so that both feel committed to the goals they have worked out. However, there are no prescriptions on how to achieve these goals. Instead of specifying certain tasks and activities that have to be done according to fixed rules and methods, goals have to be achieved. The "task orientation" is replaced by the "goal orientation", whereby the selection of the means and measures necessary to achieve the goals is largely left to the individual employee, which means a relief of the senior management. This form of leadership is also well suited for simple structured activities in the warehouse area or order processing, which require little guidance. The leadership of the superior is essentially limited to the joint goal agreement and the control of the goal achievement.

The application of management by objectives is linked to a number of *prerequisites*.[36] Management by objectives requires, in addition to the development of sufficiently concrete top-level corporate goals and an expanded system of strategic and operational corporate planning, the complete resolution of the top-level goals into various sub-goals, which corresponds to the hierarchical widening of the organization from top to bottom.[37] The derivation of area, department and position goals must be done in such a way that suboptima are prevented. This shows on the one hand a significant advantage of this management technique with the better coordination of the subsystems on the overall goals, on the other hand this corresponds exactly to the systems thinking with a holistic optimization approach. A disadvantage is the time-consuming planning and goal-setting process. In order for the goals to have their motivating effect, the degree of goal achievement must be subject to the influence of the position holder. The goals should represent a challenge, but not an excessive demand, for him. In addition, they must be sufficiently operationalized, i.e. clearly and precisely formulated and, in order to enable control, also objectively measurable. The definition of measurement points along the logistical process chain can refer to time, quantity and quality variables, from which performance indicators can be formed for various goal dimensions (economic, ecological, social) and logistics areas, e.g. transport or warehouse, performance indicators.

Thus, the organizational instrument of target agreement also provides a basis for the design of *incentive systems*. Incentives can be directly linked to the achievement of goals, thus creating the possibility of directly influencing the desired behavior of the employee. For example, it can be achieved that employees do not only pursue economic

[36] Cf. also Ulrich and Fluri (1995, p. 245 f.).

[37] See also the explanations on goal planning and performance measurement within the framework of controlling in Part II, Sects. 5.2.1 and 5.2.2.

goals when making logistical decisions, but also include environmental protection goals, e.g. by choosing environmentally friendly means of transport. Likewise, employees will pay more attention to personnel development if this is part of their target agreement and if material or immaterial incentives are associated with the fulfillment of this task.

The management technique *"Management by Exception"* is based on the principle of leadership by *intervention in exceptional cases*, i.e. when deviations from goals or problems occur that are outside certain tolerance limits. The employee can act independently in his precisely defined areas of work until an exceptional case occurs, which he has to refer back to his superior, so that he can make a decision.[38] The aim of this principle is primarily to relieve the superior. The control effort for logistics is not focused on the routinely running, functioning processes, which make up the largest share of the value creation, but on exception-based activities that are outside the usual standards (e.g. special customer requests) or on errors in the value creation process. Informationally, the same procedure is followed within the framework of the *"Supply Chain Event Management"* concept, when problems can be detected and solved early by routine, automated analysis of data from numerous measurement points along the entire logistics network for critical supply chain objects (e.g. customer orders).[39]

The most important *prerequisites* for the functionality of management by exception are the definition of suitable measurement variables and tolerance limits within a control system, a task area with clearly defined decision-making leeway for the employees and the specification of clear rules and responsibilities. In addition, it requires the continuous self-control of the employee, which on the one hand requires skills and on the other hand the willingness to fully assume the functions and responsibility for his decisions in his area of responsibility. Management by exception is intended to serve the purpose of expanding the independent decision-making and discretion of the employee without significantly increasing the risk.[40] However, there is a risk of frustrating the employee, as creativity and initiative tend to remain reserved for the superiors and they turn to all the "more interesting" problems. Nevertheless, this management technique is a suitable means to shorten and reduce the decision-making paths in logistics to the necessary extent in view of the prevailing time pressure. The personnel development to be discussed in the following can contribute to the fact that the employees are capable and willing to work within the framework of such a management technique.

---

[38] Cf. also Ulrich and Fluri (1995, p. 246).

[39] See also Part II, Sect. 5.9.4.

[40] Cf. Ulrich and Fluri (1995, p. 247).

10.4 Leadership as a Development Task: Personnel Development

Personnel development is the sum of all measures to impart qualifications with a view to *increasing the performance* of the staff by education and promotion according to a uniform concept.[41] Personnel development thus influences the individual qualification potential and requires the cooperation of the persons concerned in the needs assessment, program planning, implementation and control of the personnel development measures. This makes clear the double goal orientation of personnel development, which must serve both the fulfillment of the corporate goals and the employee goals.

The importance of personnel development for logistics[42] is not only determined by the changing tendencies in personnel management, but especially by the development phases of logistics management already described.[43] An essential condition is the participation of the people involved. The range of the development process extends from the expansion of logistics-related technical and methodological knowledge as well as social competence to motives, values and attitudes.

10.4.1 Qualification Priorities

The same qualification priorities that are determined for managers in general result for *managers in logistics*. Figure 10.6 details the three approximately equally weighted *competence dimensions.* Only on the basis of these competencies can the consequences of logistics thinking be successfully realized in the company.

"To analyze possible consequences of logistics thinking, it is useful to distinguish a functional, an instrumental and an institutional dimension of the logistics conception. Functional consequences arise when logistics is seen as a conceptually separable task complex in the company. Here it would have to be examined whether logistics can be regarded as a "separate" business function. Instrumental consequences refer to the use of software and hardware technologies. The question here would be about possible changes in the techniques to be used to support information processing and to facilitate the flow of goods. Institutional consequences affect the organization of a company and the organization of cooperation between companies. Possible changes in the organizational structure of a company (intra-organizational consequences) or in the cooperation between

[41] Cf. Holtbrügge (2018, p. 141 ff.); Stock-Homburg and Groß (2019, p. 245 ff.).

[42] For personnel development in logistics see various contributions on qualification by Pfohl (2009, p. 314 ff.).

[43] See part I, Sect. 2.2.

Expertise	Behavior	Attitudes/ values Personality skills
• Basics of business administration and commercial thinking • IT application skills • Foreign language competence (English) • Generalist training with additions of sociological/social studies, philosophy, etc. to the classical commercial perspectives. • Analysis capability • Expertise • Skills related to the subject including methodological competence • Experience in the field, industry	• Action and goal orientation: pragmatism, priority setting, output orientation, action competence • Problem solving skills • Communication skills: openness, willingness to cooperate, persuasiveness, enthusiasm • Work technique, self-organization and project management • Leadership: motivation, control, delegation, coaching	• Flexibility and willingness to learn: curiosity, behavioral breadth, mobility, generalist range of interests • Performance motivation: professional ambition, self-motivation, commitment, enthusiasm for content • Dynamism and resilience, performance, concentration, agility, balance • Customer orientation/ entrepreneurial thinking • Integrity/ sense of responsibility
Importance for Employability 1/3	Importance for Employability 1/3	Importance for Employability 1/3

Core message for employability: flexibility to deal with the manifestations of willingness to learn, ability to learn, professional and regional mobility, intercultural competence (foreign languages, international team experience, sensitivity, tolerance)

Fig. 10.6 Competence dimensions for education and training. *Source* Darkow and Jahns 2010, p. 142

companies (inter-organizational consequences) as a result of logistics thinking would have to be uncovered here."[44]

Complexity and dynamics were mentioned at the beginning of this chapter as central challenges for logistics management. A T-shaped competence profile of the manager in logistics is considered advantageous for coping with these challenges (see Fig. 10.7).[45] This profile is also called hybrid, as the manager has in-depth knowledge in a specialized area (e.g. materials management) and broad knowledge in other areas (e.g. marketing or financing). These broad knowledge are required due to the character of the logistics function as a cross-sectional function. In five *core areas* the logistics manager should be able to demonstrate the corresponding competence.[46]

- Knowledge of the classical instruments and techniques to manage the daily business in the logistics function.
- Knowledge of the principles of complex system theory including the effects of the "soft" influencing factors.

[44] Pfohl (2022, p. 40). For an explanation of these consequences and for obstacles to the realization of the logistics conception see ibid., p. 40 ff.

[45] Cf. Christopher (2012, p. 7 f.) and Christopher (2016, p. 296 f.).

[46] Cf. Christopher (2012, p. 9). See also Livolsi (2011, p. 61).

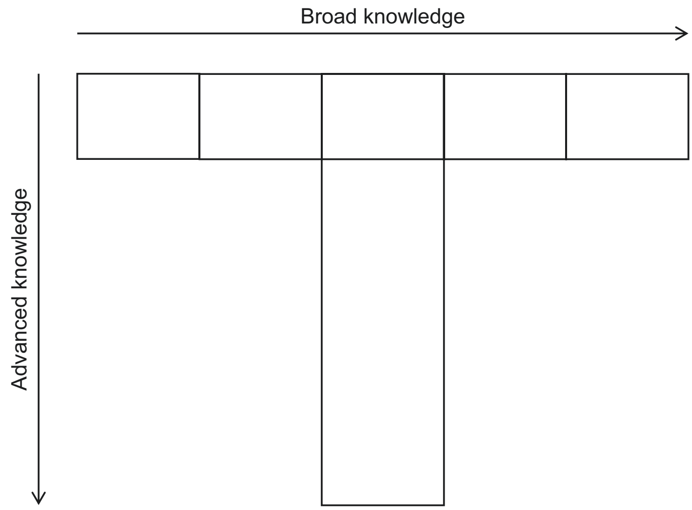


Fig. 10.7 T-shaped competence profile for the realization of logistics as a cross-sectional function. *Source* Adapted from Christopher 2012, p. 9

- Knowledge of process management in horizontally oriented organizational structures.
- Knowledge of the instruments of effective team leadership.
- Knowledge of change management and change strategies.

Characteristic for logistics management is the cross-functional, cross-institutional and cross-flow systems thinking (see Figs. 2.2, 2.3 and 2.4 in Part I). With the increasing complexity and dynamics observed at the beginning of this chapter, the requirements for holistic thinking of the executives in logistics increase accordingly.

For the *employees at the operational level* of logistics, there is a need for qualification regarding the implementation of the personnel-based concepts "Total Quality Management" and "Lean Management" which will be discussed in the second section of this part.

Qualification priorities also result from the efforts to *certify logistics professions*. The aim is to complement existing training courses at universities and other educational institutions and to set standards that are relevant for practice. As an example of a logistics-related personnel development and training concept that addresses the practitioner, the *model of the European Logistics Association (ELA)* is presented here as an example.[47]

[47] See the following Decker (2009). For the requirements for the educational offer for the logistics profession, see Roth (2010, p. 148 ff.). For the change in the professional profile of the logistics manager, see also Pfohl (2004).

The European Logistics Association founded a body for the standardization of professional logistics education and training in Europe, the *European Certification Board of Logistics (ECBL),* in 1996. This organization has the task of defining, formulating, developing and managing European standards for education and training and promoting their recognition in Europe. The ECBL primarily specifies the content to be covered and does not make any specifications regarding the design of the way the content is taught. The aim is to achieve a uniform qualification of logisticians and to promote their mobility between the participating countries in Europe. A total of three titles are awarded: European Master Logistician, European Senior Logistician and European Junior Logistician.[48]

The lowest certification level is the *Certified European Junior Logistician (EJLog)*, which is aimed at younger employees with little experience, such as supervisory staff in the operational area (e.g. warehouse workers or trade packers) as well as managers at the lowest management level (e.g. group leaders). The qualification program includes a compulsory module logistics and three elective modules with the focuses on resources, technology and personnel.

The certification as *European Senior Logistician (ESLog)* is aimed at heads of logistical functional areas, such as warehouse managers, transport managers, etc. but also at the middle management level in the production area and other experienced executives in logistics who have already made their first career step and want to develop further. The compulsory program of this qualification level includes the modules logistics, resources and personnel and a technical elective module.

The certification as *European Master Logistician (EMLog)* is aimed at senior executives with extensive experience in logistics management (e.g. head of the entire logistics area) and at executives from other functional areas who have logistics responsibility. The content of the master's degree focuses primarily on issues of organization, strategies, controlling and implementation in logistics. Candidates should be prepared for the management of logistics organizational units and logistics companies. The three qualification levels, target groups and objectives according to the competence standards of the ELA are shown in an overview in Fig. 10.8.

10.4.2 Career Planning

Closely related to the imparting of qualifications according to the qualification priorities is career planning. "The focus of career planning is the design of the professional

[48] Four professional fields ("Operative Logistics|blue-collar staff; Administrative Logistics staff; Logistics supervisors; Logistics managers") are distinguished by McKinnon et al. (2017, p. 14 ff.).

Level	Target group	Competencies
Junior Level	Operational managers in logistics = Employees who work in a logistics area of responsibility and who influence logistics processes due to their decision-making potential, e.g. warehouse managers of smaller warehouses, dispatch managers, schedulers, software developers, employees with personnel responsibility for the area of logistics who want to become internationally oriented, managers from other areas who want to take on responsibility in the area of logistics.	Participant receives understanding • the overall logistical processes (supply chain, storage/dispatch systems (warehouse)), • the basic technical design possibilities (storage, conveying, transport, I+C), and • the tools of the trade for day-to-day business (principles of personnel management and deployment planning, business management principles, legal expertise (for specific areas). **Target:** **→ Participants should be enabled to perform the present function in an optimized way, with orientation to the field of application, therefore special elective courses required**
Senior Level	Logistics managers, division managers, middle and senior managers with basic logistics knowledge who want to expand and deepen their practical logistics experience, employees who work in the field of logistics system design, i.e. logistics process structures and technical-economic system design.	Building on the knowledge of the junior level, imparting cross-industry specialist knowledge and training junior managers, deepening the teaching content of the junior level, covering all industries. **Target:** **→ Participants should be put in a position to independently handle and implement logistics projects as project managers.**
Strategic Level	Logistics specialists, top managers (and researchers) with many years of logistics experience from practice and/or science.	Knowing and being able to evaluate current trends; optimising strategies and guidelines; initiating and being responsible for the strategic orientation of larger areas; being able to recognize and delimit problems and areas of optimization and to work on them independently according to generally recognized principles. **Target:** **→ Participants should be enabled to perform improved divisional or company management.**

Fig. 10.8 Qualification approach of the ELA: levels, target groups and competencies. *Source* Decker 2009, p. 402

career of selected employees."[49] For capable executives, it is important to know at the beginning of their career what career paths there are in the company, what training opportunities are associated with them and how the remuneration for the career path is structured.[50] Depending on the content focus, the career forms characterized in Fig. 10.9 can be distinguished. Since many companies have a trend towards flatter organizational structures with fewer hierarchical levels, the importance of offering specialist and project careers in addition to the management career increases. This simultaneous offer of career forms is called *trial career system.*[51] Such a system can better meet the individual needs and expectations of the employees.

Two important instruments of personnel development, especially for training system thinking and flow orientation are job rotation and internship.[52] The basic idea of *"job rotation"* is the individual qualification of employees by systematic change of workplaces. This includes changes in terms of the task, the competencies and the responsibility. Essential goals are, among others, the development of professional and leadership skills and the increase of flexibility. The design parameters of job rotation include the functional horizon, the geographical scope and the hierarchical levels involved. For example, a manager from procurement could switch to distribution (vertical direction) or to a foreign subsidiary (international scope). An employee at the operational level could, for example, occupy a new position in his production unit (function-bound horizon) or switch from production to a warehouse (cross-functional horizon).

One aspect of social competence with high relevance for logistics is the ability to cooperate with other organizational units. This is based not only on personal trust, but also on certain conceptual and professional skills. A suitable means for developing such skills is the temporary exchange of employees between cooperating organizational units, which is called *"hospitality"*. This form is particularly useful in case of spatial separation, to give the intern an insight into routines, processes and procedures, but also logistics-relevant information and opportunities for own trial action. The aim is that the affected employees should intervene less directly in the work processes, but rather take on an observer role. In this way, not only learning processes without immediate pressure to act are initiated in logistics, but also personal, trust-building relationships are established. The aim of these learning processes is to anticipate disturbances early, to react better to problems and to avoid misunderstandings within cooperations in the logistics system.

---

[49] Stock-Homburg and Groß (2019, p. 313). In addition to career planning, the measures of promotion also include succession management, which is not discussed here, as it does not have any logistics-specific characteristics.

[50] Cf. Darkow and Jahns (2010, p. 1143).

[51] Cf. Stock-Homburg and Groß (2019, p. 318 ff.).

[52] Cf. Berthel and Becker (2010, p. 438 ff.).

Career Form	Description of the career form	Characteristics of advancement
Management career	*Focus:* Development of social and leadership skills	Increased competencies
	Assumption of personnel and management responsibility through managerial authority over subordinate employees	Gain in prestige
	Advancement takes place along the hierarchy of the company	Increase in remuneration
	Previous tasks are extended by additional personnel and organizational responsibilities	Expansion of personnel and organizational responsibility
		Reduction in the proportion of specialist tasks
Specialist career	*Focus:* Development of specific technical/expert knowledge	Increase in the demand for and scope of specialist tasks
	Assumption of technical tasks	Expansion of scope for action
	Advancement tends to be vertical, meaning an increasing share of specialist tasks without additional management function and administration	Increase in specialist responsibility
	The aim is to promote and retain skilled workers	Increase in remuneration
Project career	*Focus:* Development of social and methodological competence	Increase in responsibility within projects
	Assumption of temporary technical and management tasks	Increase in the number of business or functional areas to be integrated
	Advancement involves participation in planning, decision-making, directing, and controlling within a project-based team.	Increase in the number of disciplines involved
	High emphasis on social skills	Increase in the size of the project team
	Temporary assumption of project responsibility (partly in addition to line functions)	Increase in the strategic importance of the projects
	Opportunity to take on a demanding and complex task with the associated responsibility for a limited period of time and to gain new knowledge and experience.	Assumption of increasing responsibility for results

Fig. 10.9 Characterizing features of central career forms in business practice. *Source* Stock-Homburg and Groß 2019, p. 317

After the treatment of personnel management in logistics, the following will address specific challenges for personnel management. These result on the one hand from the importance of well-known management concepts for logistics management, which are closely related to the system and flow thinking characteristic for the logistics conception. On the other hand, they result from the increasing penetration of many areas of life by technological progress and from the demographic change in society, which are characteristic for highly developed economies.

References

Arnold D et al (Eds) (2008) Handbuch der Logistik, 3., rev. ed. Springer, Heidelberg, Berlin

Berthel J, Becker FG (2010) Personalmanagement: grundzüge für Konzeptionen betrieblicher Personalarbeit, 9., compl. rev. ed. Schäffer-Poeschel, Stuttgart

Brauckmann M (2009) Leistungs- und erfolgsorientiertes Entgeltsystem in der Logistik. In: Pfohl H-Chr (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 294–313

Christopher M (2012) Managing supply chain complexity: identifying the requisite skills. Supply Chain Forum 12(3):54–63

Christopher M (2016) Logistics and supply chain management, 5th edn. Pearson, Harlow, England

Darkow J-L, Jahns C (2010) Qualifizierung und Employability. Gewinnung von Führungskräften für die Logistik. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Gabler, Wiesbaden, pp 1135–1147

Decker J (2009) Systematische Kompetenzentwicklung auf Basis internationaler Standards für Logistiker. In: Pfohl H-Chr (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 396–410

Handfield R, Straube F, Pfohl H-C, Wieland A, (2013) Trends und Strategien in Logistik und Supply Chain Management. Vorteile im Wettbewerb durch Beherrschung von Komplexität. DVV Media Group, Hamburg

Holtbrügge D (2018) Personalmanagement, 7., rev. a. enl. ed. Springer, Berlin

Isik F (2010) An entropy-based approach for measuring complexity in supply chains. Int J Prod Res 48(12):3681–3696

Jung H (2017) Personalwirtschaft, 10., act. ed. De Gruyter Oldenbourg, München

Katzensteiner T (2003) Scheu vorm Risiko. Wirtschaftswoche 57(35):59–62

Kersten W et al (2020) Trends und Strategien in Logistik und Supply Chain Management. Entwicklungen und Perspektiven einer nachhaltigen und digitalen Transformation. Studie der Bundesvereinigung Logistik. DVV Media Group, Hamburg

Livolsi L (2011) Profiling the job of a supply chain manager: a French case study. Supply Chain Forum 12(3):54–63

McKinnon A et al (2017) Logistics Competencies, skills, and training: a global overview. A World Bank Study. Washington, DC

Pfohl H-Chr (2004) Berufsbild des Logistikmanagers im Wandel. In: Prockl G et al (Eds) Entwicklungspfade und Meilensteine moderner Logistik, Skizzen einer Roadmap. Gabler, Wiesbaden, pp 311–329

Pfohl H-Chr (Ed) (2009) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. act. ed. Springer, Berlin

Pfohl H-Chr, Gomm M, Frunzke H (2009a) Der Motivations-Mix des Personalmanagements. Ein abgestimmtes System von Anreizen zur Steigerung von Mitarbeitermotivation und -leistung in der Logistik. In: Pfohl H-Chr (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 1–91

Pfohl H-Chr, Gomm M, Frunzke H (2009b) Einflussmöglichkeiten von Führungskräften auf die Mitarbeitermotivation: ergebnisse einer Befragung unter gewerblichen Mitarbeitern in der Logistik. In: Pfohl H-Chr (Ed) Personalführung in der Logistik: innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 92–140

Roth A (2010) Der Logistikbildungsmarkt 2020. Bedarfsgerechte Bildungsangebote für die Logistikwirtschaft der Zukunft. Shaker, Aachen

Rothländer M (2009) Wissensorientierte Personalführung in Dienstleistungsunternehmen. In: Pfohl H-Chr (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg 2009, pp 141–169

Schmidt N, Hua-Kellermann N (2008) Der Erfolgsfaktor „Mensch“ in der Kontraktlogistik. Eine empirische Untersuchung zur Bedeutung der Humanressourcen im Rahmen von Kontraktlogistikprojekten. Fraunhofer IRB, Stuttgart

Schwemmer M (2019) Top 100 in European Transport and Logistics Services 2019/2020. DVV Media Group, Hamburg

Stock-Homburg R, Groß M (2019) Personalmanagement. Theorien – konzepte – instrumente, 4., compl. rev. a. enl. ed. Gabler, Wiesbaden

Straube F, Pfohl H-C, Günthner WA, Dangelmaier W (2005) Trends und Strategien in der Logistik. Ein Blick auf die Agenda des Logistik-Managements 2010. DVV Media Group, Hamburg

Swart W, Hall C, Chen H (2012) Human performance in supply chain management. Supply Chain Forum 13(2):10–20

Ulrich P, Fluri E (1995) Management. Eine konzentrierte Einführung, 7., corr. ed. Haupt, Bern/Stuttgart

Specific Challenges for Personnel Management

11

11.1 Total Quality Management

11.1.1 Characteristics of the TQM Concept

The TQM concept is a management concept that is oriented towards the entire company.[1] The characterization of this management concept can be derived from the components of the term:

- T: Integration of all employees
- Q: Quality orientation towards the customer
- M: Management functions in the TQM concept

TQM is characterized by a strong employee orientation. The term "Total" stands for the *integration of all employees* into the quality concept. Not only individual departments, but all organizational levels and processes are quality variables. The internal interrelationship between business functions results in different business performance processes being directly or indirectly linked. The responsibility for creating high-quality products and services is therefore not limited to individual employees. Rather, every activity in the company influences the quality of the business output. For example, a delayed order of material can increase the production time and thus contradict the customer expectations as well as a mistake in the performance creation that affects the customer benefit of the product. The creation of high-quality performances therefore not only includes the activities that are directly related to the performance creation process, but also takes

[1] The following is closely based on Pfohl (1992, p. 6 ff.).

H.-C. Pfohl, *Logistics Management*, https://doi.org/10.1007/978-3-662-66564-0_11

into account all partial performances that are provided in the company. Each employee is actively integrated into the solution of quality problems, so that his or her specific knowledge and commitment can be used. Trainings are intended to convince the employees of the quality idea and to bring about quality improvements of all performance processes.

Another feature of TQM is the *quality orientation towards the customer.* The quality of the business output is measured by the customer benefit.[2] This results directly from the fulfillment of the requirements that the customer places on a product or a service. If the requirements are not met, the customer perceives the quality as insufficient. It should be taken into account that requirements reflect subjective expectations of the customer and therefore vary individually. Quality also depends on the overall impression that the customer receives when purchasing the service.[3] It therefore includes all types of utilities that lead to need satisfaction or problem solving for the customer. The close relationship of customer orientation to employee orientation is shown by the fact that supplier-customer relationships not only include the external customer orientation, but also project this relationship onto the individual work steps in the company. Each employee thus has the subsequent process as a customer. This internal customer orientation contributes to the fulfillment of external customer wishes by transforming external customer expectations into internal customer expectations.

The third TQM feature is the perceived *management functions in the TQM concept.* It emphasizes the fundamental importance of corporate management for TQM, which can only be successfully implemented by an appropriate anchoring in the management functions "policy", "planning and control", "organization" and "personnel management".[4] The values and problem perspectives associated with TQM must be formulated in the goals and principles of corporate policy. Planning involves setting operational quality goals, providing capacities and budgets, and defining measures to achieve the goals.[5] A central task in the context of TQM is the review of operational performance processes. Execution and control of the processes are largely placed in one hand. The executing employee then bears the responsibility for the execution of the processes and their control. Each employee is thus responsible for the quality of his or her performance. Many tasks of the classical quality department are thus transferred to the line positions. The quality department thus loses part of its classical control function. In addition to the perception of still central control tasks, the quality department supports the employees in

---

[2] See also the logistics driver "customer orientation" in Part I, Sect. 1.3.2 as well as the utility-oriented thinking as a characteristic of the logistics conception in Pfohl (2022, p. 21 ff.).

[3] See also the discussion on the analysis of logistics quality in Part II, Sect. 5.9.3 There, for example, five dimensions of service quality are distinguished.

[4] On the management functions see Part I, Sects. 2.1 and 2.4.

[5] It is also suggested to integrate quality and environmental management. See von Ahsen (2006). See also Engelke (1997, p. 119 ff.).

the other departments in taking over control tasks and conducts training. An essential function of control in TQM is the learning function. For characteristic of TQM is the pursuit of continuous improvement. The organizational problems associated with this are discussed separately. The importance of the fourth management function “personnel management” results from the involvement of all employees in the quality tasks to be performed. A basic element of such an approach is the participative leadership style.[6] It recognizes all employees as supporting elements of the company and integrates their knowledge, skills and interests into the decision-making processes. The managers have, e.g. by appropriate training programs, to create the framework conditions for the realization of the TQM concept. An important aspect is also the role model function of the managers. They have to live the quality awareness and convince the employees by their example of the idea. The role of the managers is also reflected in the three Cs—Culture, Communication and Commitment—which are considered as fundamental for the realization of the TQM concept.[7] The tasks of the managers also include making clear to each individual the relationship between the work process to be performed and the final product. Only in this way can the employee correctly assess the effects of errors and the importance of his or her own work for the quality of the final products.

11.1.2 Continuous Improvement Process (CIP)

The continuous improvement process, which is sometimes also regarded as an independent quality management concept, has great importance in the TQM process.[8] CIP, also called *“KAIZEN”* in Japanese because of its origin, is a method of introducing improvements step by step, as opposed to sudden, technology-oriented innovations.[9] The basic principle is to actively involve all employees in the process design in order to increase the product and process quality. For example, in logistics, not only costs and lead times can be reduced, but also the employees can be motivated at the same time. Because nothing can inspire and encourage an employee more than the implementation of his or her own ideas and the recognition of the associated progress. Therefore, the rapid implementation and subsequent standardization of once agreed measures play a major role. Since the logistics employees know the problems best in their daily work in the existing structures and processes and in dealing with the tools, they often know very well what can be improved. It is the task of the management to create an environment in which this

[6] See also Sect. 10.3.1.

[7] See Oakland (2014, p. 27 f.).

[8] Cf. Zollonds (2011, p. 286 ff.). For a detailed discussion of CIP, see also Oakland (2014, p. 266 ff.).

[9] See also the distinction between radical and incremental innovations in Part II, Sect. 4.8.4.

knowledge is shared, checked, implemented if necessary, and rewarded.[10] In logistics, for example, container sizes can be adapted, surfaces can be used better, shelves can be changed and workflows can be optimized. The changes in the process flow can only be implemented optimally if they are supported by the affected employees.

Organizationally, the CIP can be supported by quality circles. A *quality circle* is a small group of about 5 to 10 employees who voluntarily come together and meet at regular intervals (e.g. every first Wednesday of the month). In regular sessions, this group analyzes self-selected problems and weaknesses from their work area under the guidance of a moderator, in order to develop problem solutions and implement improvement suggestions, with the aim of fulfilling the work more efficiently and effectively than before. A session of the quality circle lasts about 1 to 2 hours and takes place during working hours. The work area of the participants should not be too heterogeneous to enable efficient cooperation.

Sometimes quality circles are also set up specifically to solve a certain problem. In logistics, quality circles are suitable, for example, for identifying and analyzing weak points in logistics processes, as cross-functional and cross-level cooperation is possible.[11] As tools, the "seven tools of quality assurance" are suitable: brainstorming, cause-effect diagram, error collection list, histogram, scatter diagram, Pareto diagram and quality control chart.[12] These tools serve the quality circle to uncover problems and fields of action, to analyze the type and extent of the need for action and to develop possible solutions. In addition to the motivational participation in improvement programs, the use of quality circles also reduces acceptance problems in the implementation of measures, as various employees from the affected areas are involved. To increase the motivational effect for the participants, successful problem-solving suggestions should be rewarded. Especially the combination of stimulating programs ("Incentive Programs") and CIP leads to more sustainable improvements than if such programs are set up separately.[13]

11.1.3 TQM Models

To promote quality orientation in companies, quality awards are awarded in Japan, the USA and Europe. "The awards are a recognition of outstanding achievements in the

[10] As an empirical study shows, the understanding of the work environment has a higher influence on the expression of ideas than the frequency of reward. This also illustrates the importance of communication and transparency. Cf. Pfohl et al. (2009, p. 129 ff.).

[11] Cf. Arnold et al. (2008, p. 362).

[12] A detailed description of the tools ("toolbox") is provided by, among others, Schmitt and Pfeifer (2015, p. 509 ff.).

[13] Cf. European Logistics Association and Kurt Salmon Associates (2004, p. 11 ff.).

implementation of comprehensive quality concepts in the sense of Total Quality Management and are associated with considerable prestige for the respective company… At the same time, the evaluation criteria according to which the applicants are assessed serve as an internal guideline and benchmark for the quality efforts of many companies…, because the requirements go beyond those of the certification standard for quality management systems, DIN EN ISO 9001:2008, and can thus be used as benchmarks for a company on its way towards Total Quality Management."[14] The most well-known awards are the "Deming Prize" in Japan, the "Malcolm Baldrige National Quality Award" in the USA and the "EFQM Excellence Award" in Europe. These awards are based on TQM models developed for this purpose. The European model will be briefly discussed below.

Figure 11.1 shows the EFQM Excellence Model 2010. This model was developed by the "European Foundation of Quality Management" (EFQM) in cooperation with the "European Organization for Quality" in 1992 and has since been revised several times.[15] The model is based on the basic assumption that there is an interdependent relationship between employees, processes and the results achieved. This tripartite division also corresponds to the distinction between potential quality, process quality and outcome quality, which was made in the analysis of logistics quality.[16] A total of 1000 points can be achieved. The percentages indicate the weighting of the evaluation criteria.

The sub-criteria for the criteria leadership and employees, which are particularly relevant in the context of personnel management, are as follows[17]:

- Leadership
  - Leaders develop the vision, mission, values and ethical principles and are role models.
  - Leaders define, review and improve the management system of the organization.
  - Leaders personally engage with external stakeholders.
  - Leaders strengthen a culture of excellence together with the employees of the organization.
  - Leaders ensure that the organization is flexible and that changes are managed effectively.
- Employees
  - Personnel plans support the strategy of the organization.
  - The knowledge and skills of the employees are developed.
  - Employees act in coordination, are involved and empowered to act independently.

[14] Kamiske and Brauer (2011, p. 169 f.).

[15] Cf. ibid., p. 177 ff. See also Weber and Schäffer (2020, p. 201 ff.).

[16] See Part II, Sect. 5.9.3.

[17] Cf. Kamiske and Brauer (2011, p. 181).

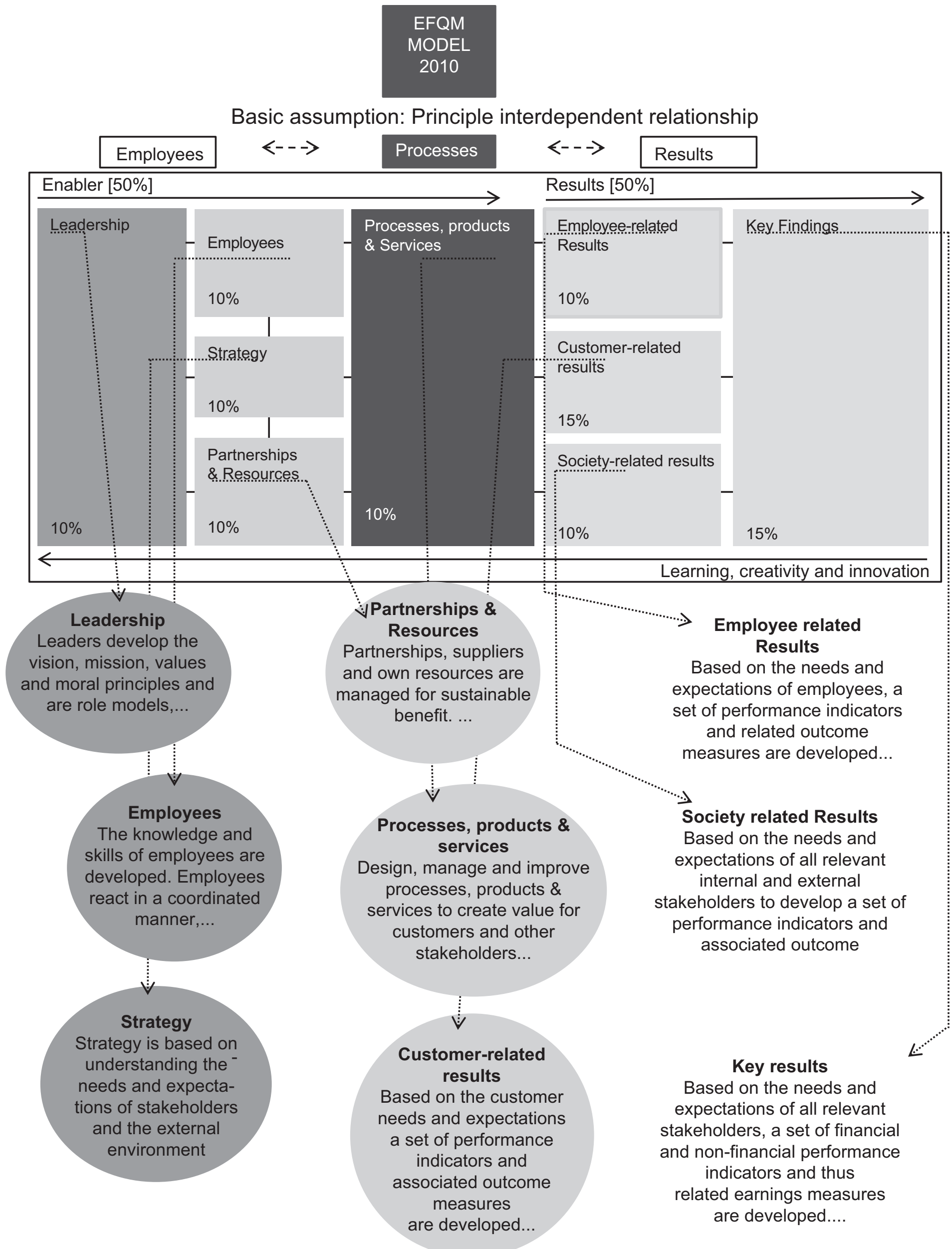


Fig. 11.1 EFQM Excellence Model 2010. *Source* Zollonds 2011, p. 347

– Employees communicate effectively throughout the organization.
– Employees are rewarded, recognized and cared for.

Compared to the previous versions of the EFQM model, learning, creativity and innovation were newly added in the feedback of the results to the enablers. This shows the importance of the learning function that control has in TQM. Learning is also an important feature of lean management.

11.2 Lean Management

11.2.1 Characteristics of the Lean Management Concept

As an *objective* of lean management[18] the avoidance of wasteful use of resources in the creation and utilization of performance is mentioned in the various definitions of this management concept. Its origin lies in the often described Toyota production system, whose most important goal is "to increase the efficiency of production by consistent and thorough elimination of any waste"[19]. Waste can then be defined as any activity that does not increase the value for the customer, but consumes resources and thus causes costs. Basically, the seven types of waste characterized in Fig. 11.2 can be distinguished.

To achieve the objective of lean management, the way of thinking in the corporate policy has to be anchored, which can be characterized by the following five basic attitudes—*sometimes also referred to as the philosophy of lean management* -:

- Proactive thinking: Under the motto "act instead of react", problems should be recognized and solved in time. Crisis prevention then gains more importance than crisis management.
- Sensitive thinking: Changes in the company and its environment are to be captured with all available information. This requires an openness to information internally and externally.
- Holistic thinking: The interdependencies between the subareas in the company are to be taken into account. Partial solutions in subsystems should increase the benefit of the overall system.
- Potential thinking: All available resources should be used, both in the company and with the partners—focus on the core competencies—with whom one cooperates in the value chain.
- Economic thinking: The maximum benefit should be generated with the available resources.

[18] See for the following Thomas (2010, p. 901 ff.).
[19] Ohno (1993, p. 19).

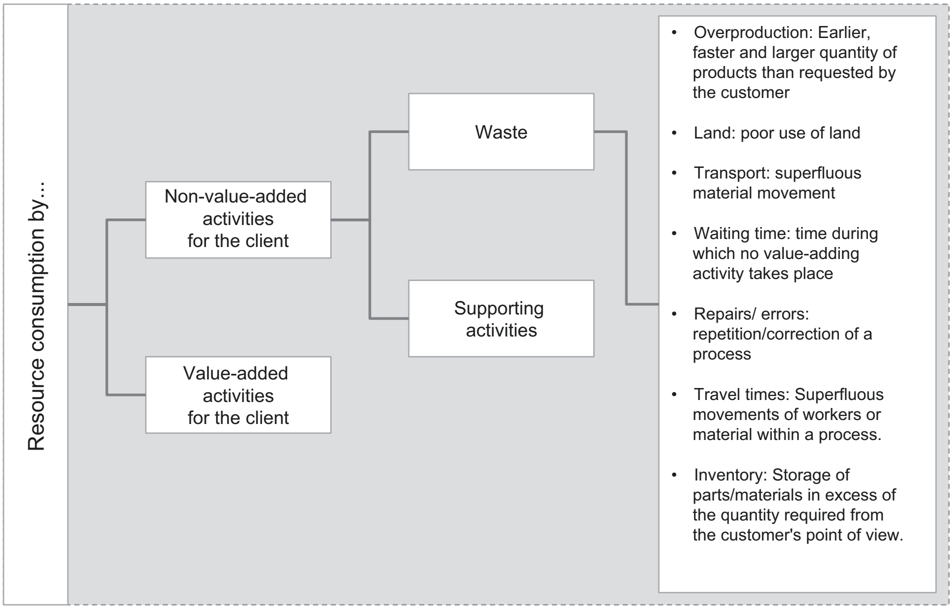


Fig. 11.2 Seven types of waste. *Source* Based on Ohno 1993, p. 46

In connection with these basic attitudes, the essential core ideas of the lean management concept can be characterized by the following five *principles* or steps:

- Value: The starting point of lean management is the definition of the value of a product or service from the customer's perspective.
- Value stream: by an analysis of the value stream, all physical, informational and financial activities that are performed for the creation and utilization of performance are to be determined. The task of the value stream analysis is to identify and eliminate waste.
- Flow: The remaining value-adding activities should be arranged so that a continuous flow is created. The task of process design is to overcome interfaces between subfunctions in the company and between companies.
- "Pull": The continuous flow enables short lead times in the creation and utilization of performance. This in turn is a prerequisite for the realization of the "pull" principle, according to which the performance is provided when the customer wants it. The customer "pulls" the flow.
- Perfection: By continuous improvement of the activities in the flow, a higher degree of perfection should be achieved.

In summary, the lean management concept is characterized in Fig. 11.3 in the "4P model".

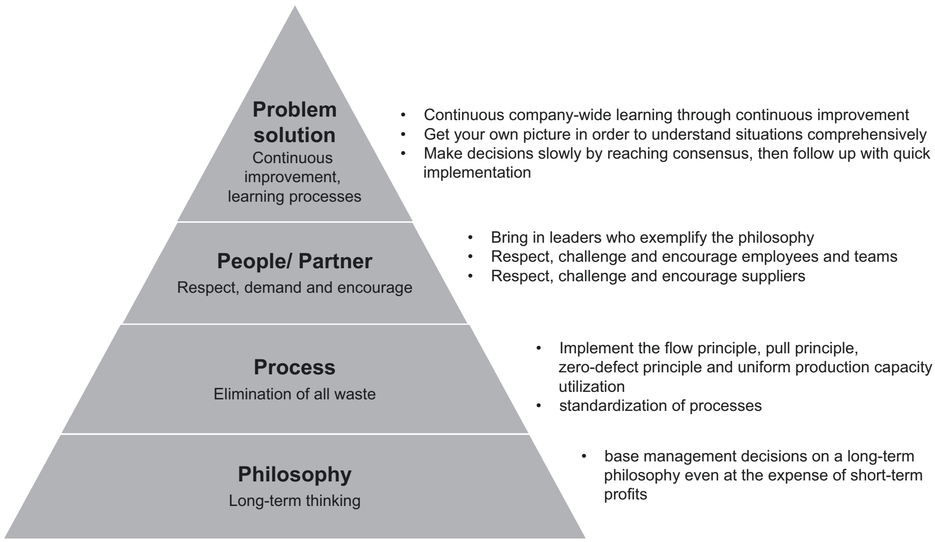


Fig. 11.3 Lean management "4P model". *Source* Liker 2011, p. 39

11.2.2 Lean Logistics

The term "Lean Logistics" was coined for the application of the lean management concept in logistics.[20] The characterization of the lean management concept by its objective, basic attitudes and principles has shown a great proximity of this concept to logistics management. Lean Logistics can contribute to the implementation of the system and flow thinking of logistics management in the company and the entire supply chain through its holistic approach. In the same way, the value thinking and the associated orientation towards customer benefit as well as the efficiency thinking in logistics management are supported. Therefore, it is consistent that in business practice both in logistics companies (see Fig. 11.4), and in industrial companies (see Fig. 11.5) the logistics management is supported by Lean Logistics.[21]

The question of whether the implementation of Lean Logistics requires a stable demand from the end customer or can also be used for volatile demand has to be answered in a differentiated way. The answer depends on the perspective from which supply chain risks[22] are considered. If one sees the build-up of buffers and redundancies

---

[20] See for the following Thomas (2010, p. 906 ff.). For the concept of "Lean Logistics" see also Boppert et al. (2013, p. 27 ff.).

[21] For the implementation of Lean Logistics see also the ten guidelines by Durchholz (2013). For the logistics-oriented value stream analysis see Klenk et al. (2013).

[22] See also Part II Sect. 4.4.7.

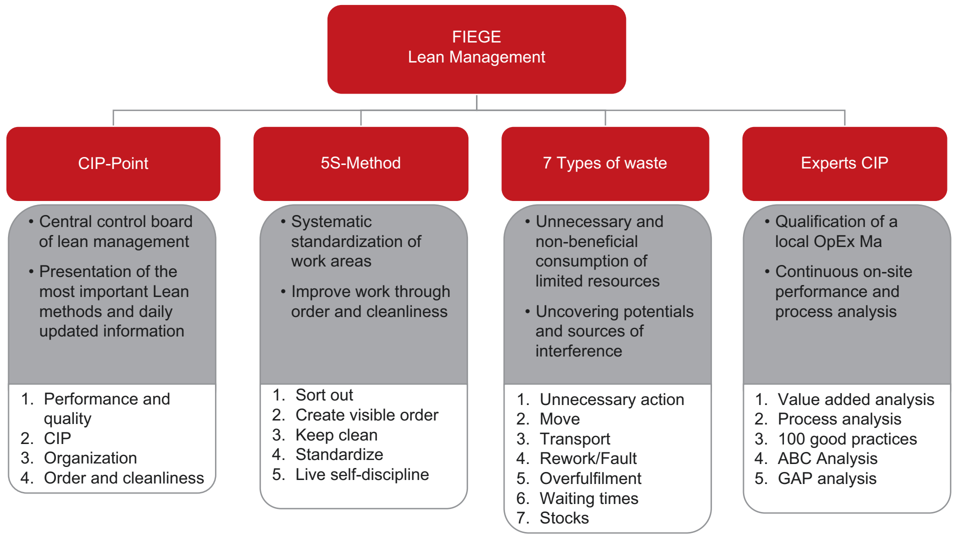


Fig. 11.4 Lean management in logistics companies. *Source* Fiege 2010, p. 22

Workplace	**Provision**	**Material call-off**	**Internal transport**
Clocked logistics chain	Standard small container and roller racks	Pull oriented call-off	Traileryard Management
One-piece flow with surgeon/nurse principle	Containerless large parts supply	Visual inventory control	Intersection free traffic
Short material handle width	Travelling parts supply	Synchronization of partial requirements and call-off	Clocked route traffic
Poka Yoke	Car Set Building	Kanban	Towed train transport
Worker's Triangle	1:1 exchange full/empty container	Simple signal generation	Breakpoint optimization
Andon	One-container principle	Retrieval Mix	Few forklift manufacturing
Internal handling and storage	**External transport**	**External handling and storage**	**Supplier**
Band supermarket	JIT/JIS delivery	Standard supply concepts	Advance goods receipt
Decentralized goods receipt	Increase in direct delivery	Cross-docking close to suppliers	Daily collection
Visual inventory and area control	Pre-run and main run at Milk Runs	Cross-docking close to the plant	Supply Net Collaboration
Material delivery close to the construction site	Cargo Space Optimization	External suppliers	Vendor Managed Inventory
Warehouse on Wheels	Tracking and tracing	Industrial park concept	Partnership in action
Logistics of short distances	Optimized freight management	Single-level storage	Pearl chain principle

Fig. 11.5 Techniques of Lean Logistics in the automotive industry. *Source* With minor changes taken from Klug 2008, p. 59

in logistics systems solely from a cost perspective, then Lean Logistics is only suitable for a stable demand. If, on the other hand, one sees them from the point of view of creating value (benefit) for the customer—and this is a characteristic feature of the modern lean management concept—then Lean Logistics is also suitable for volatile demand. Because through risk management it is achieved that the delivery service for the customer can be fulfilled with greater certainty.

11.2.3 Successful Implementation

As can be seen from Fig. 11.3, personnel management has a special importance for the lean management concept. Because it requires a long-term change in behavior among the employees. "Employees of all departments and functions in the company must want, be able to, be allowed to … in the sense of the lean company. For this, faith and conviction in the correctness of the strategic orientation must permanently come from management and upper management and all members of the company must be encouraged to actively participate in the design of the processes in the company through recognition and appreciation of the individual."[23]

The importance of personnel management for a successful implementation of the lean management concept was also determined in an unpublished study conducted at the Technical University of Darmstadt in 2009/2010 and 2010/2011. First, in an exploratory study with expert interviews, seven influencing factors for the success of the implementation were compiled. In a quantitative study to analyze the effects of these success factors, the relationships shown in Fig. 11.6 were worked out.

The success of the implementation of lean management depends on many influencing factors. The results of the study are briefly presented below:

The factors *qualification* and *key figures* have an indirect influence on the success.

The factor *participation* has no significant influence on the willingness to change.

- A direct participation in decisions on the implementation of lean management has no influence on the willingness to change.
- Often, operational employees do not value being involved in the implementation in addition to their operational tasks.
- This influence only becomes visible at higher levels.
- Nevertheless, participation has a positive effect on success.

[23] Boppert et al. (2013, p. 31). See also Furmans and Förster (2014, p. 4 ff.).

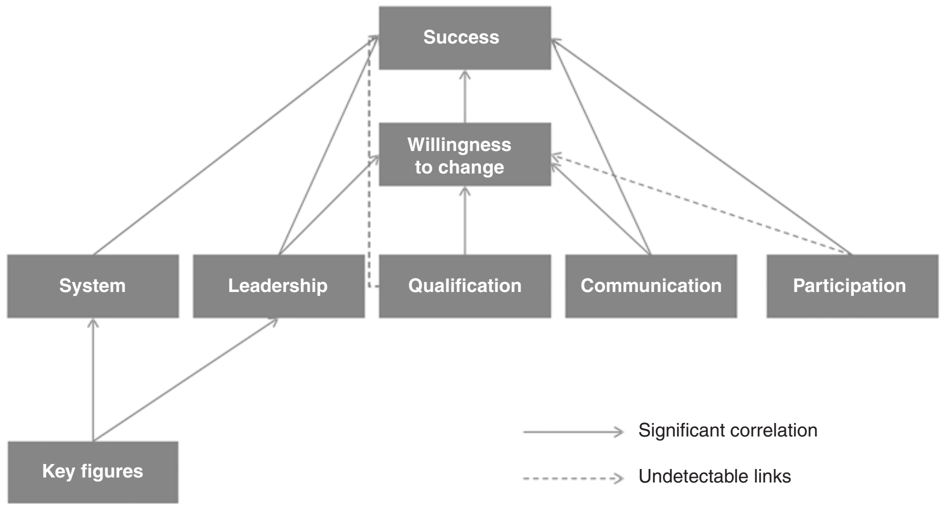


Fig. 11.6 Effect of the influencing factors for a successful implementation of lean management. *Source* Unpublished study at the Technical University of Darmstadt

The factor *qualification* has no significant influence on success.

- Qualification has no direct influence on success
- Qualification, however, has a direct influence on the willingness to change.
- However, qualification does not automatically lead to a higher success.

The greatest influence is *communication.*

- Communication influences success directly and additionally indirectly via the willingness to change.
- Direct communication is especially important for employees who have a more passive attitude and are less engaged.

Another very important influencing factor is the use of suitable *key figures*.

- Key figures help to measure and evaluate as a basis for management decisions.
- Key figures also provide structure and make *systematics* transparent.

Leadership is the third very important influencing factor.

- Here, too, the double effect on success exists
- Leadership promotes and supports employees in the implementation and understanding.

The explanation of Total Quality Management and Lean Management has shown that a successful implementation of these management concepts can only be achieved with the intensive support of personnel management. Personnel management also has to contribute to the fact that the company can rely on the suitable personnel for this purpose.

11.3 Management of Personnel Shortage

11.3.1 Staff Shortage

Across regions and sectors, the logistics industry is experiencing *a shortage of qualified staff*.[24] This applies to both planning and controlling functions at the decision-making level and to the executing functions in order processing, transport and warehousing at the operational level. In Europe, this is mainly due to the demographic development. In the emerging countries, the shortage is mainly caused by a high catch-up demand in qualification. Generally, the competition of companies for the scarce resource of personnel is often referred to as a "war of talent". In the framework for logistics strategies shown in Fig. 10.2, the management of employees is therefore at the center of attention. Only with qualified staff who can make quick decisions, the logistics strategies that aim at changing the networks, technologies and processes can be realized. Managers are aware of this and have to plan and implement the necessary "talent management strategies" for the recruitment of new staff as well as the development and retention of existing staff together with the human resources department.[25] This chapter will not go into detail on this talent management, which is a core task of the human resources department. Because of their special importance for personnel management, four human resource challenges will be outlined that result from the three central development trends of demographic change.[26]

Development trends of demographic change (Europe of 27 countries):

- Decline of the labor potential: Between 2005 and 2030, the working-age population (age: 15–64 years) is expected to decrease by 7.7%. With regard to the qualification of the staff, this trend is reinforced by the fact that in many countries the proportion of low-skilled young people of their age group is increasing.
- Ageing of the working-age population: The share of the older generation (age: over 55 years) in the working-age population will increase by 2.6% by 2030. However, this group is often discriminated against by a recruitment policy that mainly targets younger people or a personnel development that considers the older ones as "no longer capable of development".

[24] See Sect. 10.1.

[25] Cf. Handfield et al. (2013, p. 34 ff.).

[26] For the following cf. Pfister (2009).

- Increasing migration: Europe is the largest immigration region with about one third of the global migration. This immigration will continue.

Challenges of demographic change:

- Procurement of highly qualified staff: In the competition for the scarce resource of personnel, it is important to differentiate oneself through a "human capital offensive". The core of such a talent management strategy is the offer of attractive jobs with working conditions under which people like to work productively.
- Maintaining the full employability of all staff: This mainly concerns the overlapping design fields of health management and ergonomics. The goal is to maintain and enhance the performance of the staff in the company. In this context, it is necessary to identify physical and psychological hazards and stress areas, to improve working time models and to determine and use the employability and potential of the staff.
- Enabling intercultural and intergenerational cooperation: In order to take advantage of the opportunities that arise from migration and the continued employment of older staff, the conditions for constructive cooperation in increasingly age-heterogeneous and ethnically heterogeneous workforces must be ensured.[27]
- Securing know-how and experience in the companies: Closely related to the age-heterogeneous workforce is the question of how older staff can pass on their professional experience to younger staff. It must also be the task of knowledge management to ensure that valuable know-how remains in the company in this way.

A weak point in the competition for qualified staff is the perception of a lack of attractiveness of the positions to be filled in the logistics area that is still often present in the labor market. As one of the talent management strategies, therefore, the *"marketing for logistics"* is also mentioned. Since technology, as a key driver of the development of logistics, also has a strong influence on the design of working conditions, the networking of human and technology will be discussed first, which can significantly increase the attractiveness of the job offer. Finally, the possibility of enhancing the image of the logistics industry as an employer will be addressed.

11.3.2 Interlinking of Human and Technology

The already mentioned technological development towards Industry 4.0 makes clear,[28] that the interlinking of human and technology has a particularly high importance. It is

---

[27] On the importance of intercultural management for logistics, see also Straube and Pfohl (2008, p. 104 ff.).

[28] See Part I, Sect. 1.3.5 and Part III, Sect. 8.4.

about the intelligent combination of human and machine, the "human-machine collective".[29] Such a socio-technical system can be characterized by the fact that the role of the human changes. He transforms from the operator of a machine or a computer to the "cooperation partner". To be distinguished here is the role of the human as a decision maker in the planning and control on the one hand and as a worker in the execution of the operative processes on the other hand. In both cases, the working conditions for the human can be positively influenced by the technological support ("digital assistants" "physical assistants").

The second important strategy for personnel management, besides the talent management strategy, is the necessity for "fast decisions" that is characteristic for complex and dynamic decision situations.[30] For this, the employees on the *decision level* have to receive sufficient authority, so that they are able to make short-term and decentralized decisions within the existing guidelines. An essential support consists in the provision and evaluation of the available information.[31] An example for this is the support by logistics assistance systems, whose core is the online simulation based on real-time data, which gain an increasing importance by cyber-physical systems (CPS). "On the one hand, the intelligent sensor technology of the CPS simplifies the capturing of the state information from the material flow. On the other hand, the use of the online simulation offers the possibility to make the… behavior of the CPS predictable for the human planner. The planning and the controlling intervention in such a system become as far as possible virtually experimentable in advance and allow the making of a secured decision in the context of this quasi-stochastic system."[32]

A prerequisite for being able to use such a support is the qualification of the employees to be able to deal with the technology. For the younger generation, who grows up with the advancement of the information and communication technology, this qualification is usually present. The attractiveness of a workplace with the corresponding technological support is therefore high for them. For the older generation of employees, the corresponding qualification can be achieved by further education as one of the talent management strategies.

A successful networking of human and technology requires an "intelligent" combination of the two approaches to master the complexity and dynamics of logistic systems, namely the mastery by technology and the mastery by human problem-solving ability, which is based on the implicit experiential knowledge of the human.[33] The achievable advantage by the use of technology is the greater, the better the technology supports the

[29] For the characterization of this combination see Schwede and Kerner (2015).

[30] See Figure 10.2 and Handfield et al. (2013, p. 39 f.).

[31] See also the model-based decision making in Part II, Chap. 6.

[32] Schwede and Kerner (2015, p. 35).

[33] See Pfohl and Elbert (2005).

human problem-solving ability. The achievable advantage by the human problem-solving ability is the greater, the more it is fostered by a free information and experience exchange.

On the *operational level*, the attractiveness of the jobs for the employees can be increased by ergonomic work design, by reducing the physical and mental stress of the employees both by specifications regarding the work execution and by the use of technological aids. For transport, for example, the ergonomic design of forklift and truck seats was already investigated in the 90s of the last century[34] and adapted to the requirements of intensive daily use and constantly further developed in the following years.[35] For storage and handling, for example, the prescribed weight limits must be observed and the correct lifting technique as well as appropriate technical aids, such as active lifting aids or semi-automated picking systems[36] must be used. When working on shelves, the goods to be picked must be arranged so that they are accessible without overstraining the joints and the back. Storage compartments should not be so deep that the picker has to lean forward. Also, all compartments, containers and storage should be accessible so that the employee does not have to bend down, as shown in Fig. 11.7 by way of example. A problem with the ergonomic design of the workplace is that the optimal arrangement and size of the storage, picking systems, etc. depend on the size of the respective employee and only in the rarest cases a simple rearrangement or adjustment as needed is possible.

To minimize the physical and mental stress of the employees in storage and picking systems, there are a variety of recommendations and regulations.[37] Common mistakes when handling loads are lifting too heavy, incorrect body posture or twisting of the trunk, hollow back posture when manually transporting, etc. For the correct lifting technique, there are the following recommendations[38]:

- Use of technical aids or assistance from other employees when lifting larger loads
- Lifting close to the trunk
- Observance of the correct lifting technique with a straight back
- From a lifting height of about hip level, set down the load and regrip
- Coordinate the removal and delivery point
- Avoid unnatural postures
- Use of steps or ladders when lifting loads from greater heights.

---

[34] Cf. Oberkinkhaus (1995, p. 689 ff.).

[35] Cf. o. V. (2014). For the requirements of manual activities in logistics, see Bruder and Rademacher (2009, p. 218).

[36] Cf. Bennühr (2010). For the practical test of exoskeletons in picking, see mh (2019).

[37] Cf. e.g. the DIN 33411 on the load capacity of humans.

[38] With minor changes taken from Jünemann and Schmidt (2000, p. 228).

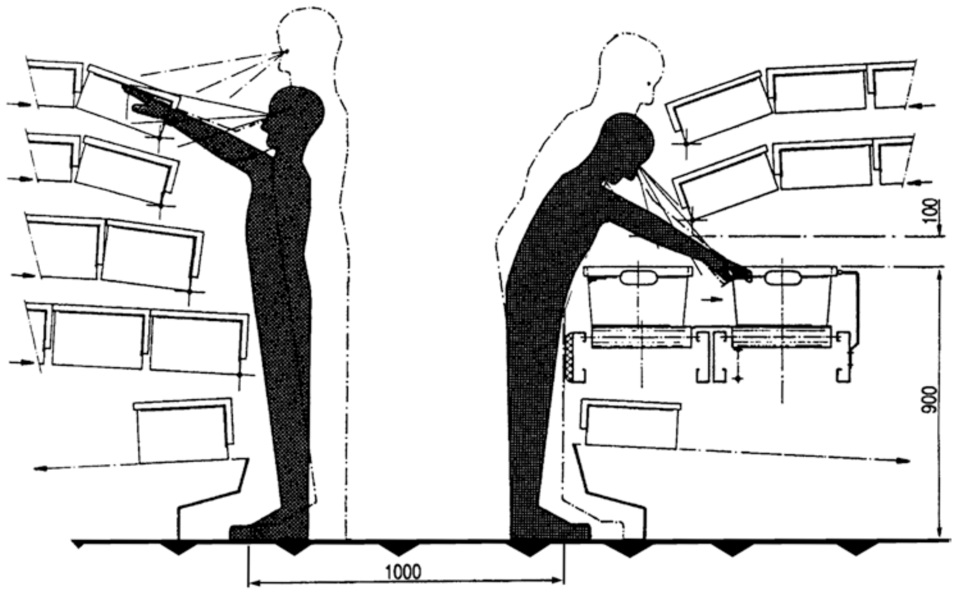


Fig. 11.7 Ergonomically designed picking. *Source* Heinz and Wichmann 1993, p. 155

Another important aspect of workplace design in logistics concerns the lighting by daylight and/or artificial lighting. This must be designed in such a way that it facilitates the visual process. Because the lighting has effects on the quality of the workplaces in logistics. It facilitates the visual task, reduces eye fatigue, improves the work action, reduces errors, improves the work quality and helps to reduce work accidents. Recommendations for a good lighting of the workplace include[39]:

- lighting intensity adapted to the workplace
- harmonious brightness distribution (uniformity of lighting)
- glare limitation (no direct or reflected glare)
- light direction and shadowiness
- luminance and contrasts
- light color and color rendering.

The information-technical design of work[40] is of increasing importance for enhancing the attractiveness of the workplace. The increasing use of IT technologies in logistics means that employees have to operate keys and screens as part of their work (e.g. in

[39] Cf. the quality criteria of lighting at Landau (2007, p. 308 f.).

[40] See Bruder and Rademacher (2009, p. 234 ff.) on this.

picking, in goods receipt, etc.). These should be designed so that they can be operated effortlessly and without setup time (e.g. taking off gloves). The information perception of the employee can be supported in picking by "pick-to-light" systems (signal lamps at the storage compartments), "pick-by-voice" systems (voice communication) or "pick-by-vision" systems (data glasses).

In addition to the ergonomic design of the work processes and systems, training or information events for the employees can promote ergonomic work and occupational safety. In particular, the importance of possible psychological stress can be addressed. In logistics, this can arise, for example, from excessive concentration requirements, stress, loneliness due to isolation or underdemand due to monotonous work content.[41]

By designing the workplaces in an age-appropriate way, older employees can also continue to be employed in the work process at the operational level. Age-related limitations, such as low resilience when carrying weights or restricted mobility of extremities, can be compensated for. This also has the positive effect that the experience knowledge of the older employees is retained by the company.[42]

11.3.3 Image of the Logistics Industry

A major influence on the competition for qualified personnel is also the image of a company or the entire industry. It became quite obvious that the image of the logistics industry improved somewhat during the economic and social crisis triggered by the Corona pandemic. Because a broader public suddenly realized how important functioning supply chains are for the "supply" of the population. Likewise, their importance for maintaining employment in the industry, which is endangered by an interruption of international supply chains, became apparent.

The logistics industry still suffers from a negative image, which is based on numerous prejudices in the public.[43] In the public perception, logistics is often limited to transport and traffic. "The logistics industry: These are mostly self-overtaking 40-tonners, traffic jams and environmental damage caused by trucks, loud and land-consuming airports, empty container ports, poorly paid logistics personnel."[44] This negative image can be countered by professional *public relations* (PR), which is based on economic and macroeconomic facts. It is important, for example, to communicate the diverse professional fields of logistics and the importance of logistics for creating and maintaining

---

41 Cf. Jünemann and Schmidt (2000, p. 229).

42 Cf. Walch et al. (2009). For the performance and willingness to perform of the factor age, see Bruder and Rademacher (2009, p. 219 ff.).

43 Cf. Bundesvereinigung Logistik (BVL) e. V. (2010, p. 9); Schöppner (2015, p. 11).

44 Schöppner (2015, p. 11).

jobs. The various PR instruments, such as press releases, name and background articles, interviews, company visits, etc. are to be used for this purpose. A guideline for this was published by the professional association of logisticians in Germany, the Bundesvereinigung Logistik (BVL) e. V.[45] A good contribution to improving the image of the logistics industry is also the “Logistics Day” initiated by the BVL on every second Thursday in April of each year. Several thousand companies in the logistics industry open their doors on this day to give the public an insight into the professional world of the logistician. As “Supply Chain Management Day”, this concept was adopted by the European Logistics Association (ELA). In several countries in Europe, such days, which offer the opportunity to present logistics to the public in a practical way, take place. In the same direction, the publication of the statements on their profession by so-called “logistics heroes”, who report positively about their professional world and their career, aims.

Specifically for the labor market, the development of an “employer branding strategy” is recommended.[46] *Employer Branding,* employer brand building, uses measures from marketing, especially brand building,[47] to establish the company as a brand in the labor market. The company is communicated to the labor market as an attractive employer, in order to position it positively against the competitors. An example for this is to highlight the opportunities for further education in the company. Since digitization changes the job profiles, this is especially true for further education in this area. Employees miss corresponding offers and support from companies in the logistics industry.[48] It is also important to consider the concern of employees who see digitization as a threat to their jobs.[49]

The image of the logistics industry can be improved if it is possible to communicate the importance of logistics for all *stakeholders* in broad sections of the population in an understandable way. For this purpose, it can be helpful to address global challenges, such as “scarcity of resources and environmental impact”, “empty rural areas and megacities”, “new consumption patterns and technological progress”, “common good internet”, “terrorist threat and political unrest” or “natural disasters” and report on innovative logistical solutions.[50]

Good conditions for the development of such innovative logistical solutions are apparently offered by *logistics locations* in Europe and especially Germany, as a biennial worldwide study by the World Bank shows. Figure 11.8 gives an overview of the ranking of the 10 most efficient countries in the field of logistics based on the last four studies, whereby the ranking covers a total of 160 countries. The studies are based on a survey

---

[45] Bundesvereinigung für Logistik (BVL) e. V. (2010).

[46] Cf. Schuhmacher and Geschwill (2014, p. 33 ff.).

[47] See Part II, Sect. 4.8.1.

[48] See the results of a survey at mp (2019).

[49] See the results of a survey at tm (2020).

[50] See in detail Lehmacher (2013, p. 39 ff.).

	2018		2016		2014		2012	
Economy	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Germany	1	4.20	1	4.23	1	4.12	4	4.03
Sweden	2	4.05	3	4.20	6	3.96	13	3.85
Belgium	3	4.04	6	4.11	3	4.04	7	3.98
Austria	4	4.03	7	4.10	22	3.65	11	3.89
Japan	5	4.03	12	3.97	10	3.91	8	3.93
Netherlands	6	4.02	4	4.19	2	4.05	5	4.02
Singapore	7	4.00	5	4.14	5	4.00	1	4.13
Denmark	8	3.99	17	3.82	17	3.78	6	4.02
United Kingdom	9	3.99	8	4.07	4	4.01	10	3.90
Finland	10	3.97	15	3.92	24	3.62	3	4.05

Fig. 11.8 Top 10 "Logistics Performance Index" countries. *Source* World Bank 2018, p. 11

of logistics experts, who rate the countries according to six criteria on a scale of 1 to 5. For the 2018 study, 6000 country ratings were made in this way. The overall rating is done by summarizing the six criteria. These are the efficiency of customs clearance, the quality of logistics infrastructure, the possibility of organizing international shipping at competitive prices, the competence and quality of logistics services, the ability to transparently track shipments, and the frequency with which shipments arrive at the recipient within the planned or expected delivery time. The top ranking by the "Logistics Performance Index (LPI)" of the World Bank also provides a good basis for communication to improve the image of the logistics industry.

References

Arnold D et al (Eds) (2008) Handbuch der Logistik, 3., rev. ed. Springer, Heidelberg

Bennühr S (2010) Physio-Therapie für Lagerveteranen. LOG.Kompass 5:24–25

Boppert J, Durchholz J, Günthner W (2013) Lean Logistics im Wandel – neue Aufgaben, Partner und Rahmenbedingungen. In: Günthner W, Boppert J (Eds) Lean Logistics. Methodisches Vorgehen und praktische Anwendung in der Automobilindustrie. Springer, Heidelberg, pp 27–33

Bruder R, Rademacher H (2009) Abgleich von Anforderungs- und Fähigkeitsanalysen für menschengerechte Arbeitssysteme in der Logistik. In: Pfohl H-Chr (Ed) Personalführung in der Logistik. Innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 216–243

Bundesvereinigung Logistik (BVL) e. V. (2010) Investition in Kommunikation. Imagebildung in der Logistikwirtschaft, BVL, Bremen

Durchholz J (2013) Zehn Leitlinien für schlanke Logistik. In: Günthner W, Boppert J (Eds) Lean Logistics. Methodisches Vorgehen und praktische Anwendung in der Automobilindustrie. Springer, Heidelberg, pp 43–58

Engelke M (1997) Qualität logistischer Dienstleitungen. Operationalisierung von Qualitätsmerkmalen, Qualitätsmanagement, Umweltgerechtigkeit. Schmidt, Berlin

European Logistics Association, Kurt Salmon Associates (2004) Success factor people in distribution centres. ELA, Brussels

Fiege (2010) Schlank durch Lean Management. Logo 75:22–23

Furmans K, Förster H-U (2014) Erfolgsfaktoren für den Roll-Out. In: Furmans K, Schwab M (Eds) Roll-Out von Lean Management in Lägern. Schriftenreihe Wirtschaft und Logistik der Bundesvereinigung Logistik (BVL) e. V. DVV Media Group, Hamburg, pp 1–12

Handfield R, Straube F, Pfohl H-C, Wieland A, (2013) Trends und Strategien in Logistik und Supply Chain Management. Vorteile im Wettbewerb durch Beherrschung von Komplexität, DVV Media Group, Hamburg

Heinz K, Wichmann A (1993) Kommissionier-Handbuch. Huss, München

Jünemann R, Schmidt T (2000) Materialflußsysteme. Systemtechnische Grundlagen, 2nd edn. Springer, Berlin

Kamiske G, Brauer J (Eds) (2011) Qualitätsmanagement von A-Z: wichtige Begriffe des Qualitätsmanagements und ihre Bedeutung, 7., act. a. enl. ed. Hanser, München

Klenk E, Klevers M, Günthner W (2013) Logistikorientierte Wertstromanalyse. In: Günthner W et al (Eds) Schlanke Logistikprozesse. Handbuch für den Planer. Springer, Berlin, pp 135–173

Klug F (2008) Gestaltungsprinzipien einer Schlanken Logistik. Z Gesamte Wertschöpfung Automobilwirtsch 11(4):56–61

Landau K (Ed) (2007) Lexikon Arbeitsgestaltung. Best Practice im Arbeitsprozess. Gentner, Stuttgart

Lehmacher W (2013) Wie Logistik unser Leben prägt. Der Wertbeitrag logistischer Lösungen für Wirtschaft und Gesellschaft. Springer Gabler, Wiesbaden

Liker J (2011) Der Toyota Weg: 14 Managementprinzipien des weltweit erfolgreichsten Automobilkonzerns. FinanzBuch, München

mh (2019) Der Kraftanzug. VerkehrsRundschau (35):32–33

mp (2019) Lernen für den Umbruch. LH 41(5):28–29

n. A. (2014) Ergonomie steht im Vordergrund. Logis Unterneh 28(9):30–31

Oakland J (2014) Total quality management and operational excellence. Text with cases, 4th edn. Routledge, London New York

Oberkinkhaus H (1995) Was bringt die Ausbildung der Staplerfahrer? Fördern Heben 45(10):689–691

Ohno T (1993) Das Toyota-Produktionssystem. Campus, Frankfurt a. M.

Pfister J (2009) Vorsprung durch Vielfalt. Strategien zur Gestaltung des demographischen Wandels aus Unternehmenssicht. In: Wimmer T, Wöhner M (Eds) Erfolg kommt von innen. BVL Kongressband 2009. DVV Media Group, Hamburg, pp 294–320

Pfohl H-Chr (1992) Total quality management. Konzeption und Tendenzen. In: Pfohl H-Chr (Ed) Total Quality Management in der Logistik. Schmidt, Berlin, pp 1–50

Pfohl H-Chr (2022) Logistics Systems: Business Fundamentals, 9., rev. a. act. ed. Springer, Berlin

Pfohl H-Chr, Elbert R (2005) Komplexitätsbeherrschung in der Planung durch den Menschen oder IT/DV-Systeme? Ergebnisse einer Expertenbefragung zur Planung von Produktions- und Logistikprozessen. In: Wäscher G et al (Eds) Intelligente Logistikprozesse. Konzepte, Lösungen, Erfahrungen. 11. Magdeburger Logistiktagung. Logisch, Magdeburg, pp 210–224

Pfohl H-Chr, Gomm M, Frunzke H (2009) Einflussmöglichkeiten von Führungskräften auf die Mitarbeitermotivation: ergebnisse einer Befragung unter gewerblichen Mitarbeitern in der Logistik. In: Pfohl H-Chr (Ed) Personalführung in der Logistik: innovative Ansätze und praktische Lösungen, 2., act. a. enl. ed. DVV Media Group, Hamburg, pp 92–140

Schmitt R, Pfeifer T (2015) Qualitätsmanagement: strategien, Methoden, Techniken. 5. act. ed. Hanser, München

Schöppner K-P (2015) Die gute Logistik 2020. In: VerkehrsRundschau Sonderheft „Who is Who Logistik 2015“, pp 10–16

Schumacher F, Geschwill R (2014) Employer Branding: human Resources Management für die Unternehmensführung, 2., rev. a. enl. ed. Springer Gabler, Wiesbaden

Schwede C, Kerner S (2015) Das Mensch-Maschine-Kollektiv. In: Logistik Heute (Ed) Software in der Logistik. Fit für Multichannel. Huss, München, pp 32–35

Straube F, Pfohl H-Chr (2008) Trends und Strategien in der Logistik – globale Netzwerke im Wandel. Umwelt, Sicherheit, Internationalisierung, Menschen. DVV Media Group, Hamburg

Thomas D (2010) Die Auswirkungen des Lean Managements auf die Logistik. Lean Logistics unterstützt das Systemdenken und führt zu einer flussorientierten Logistik. In: Schönberger R, Elbert R (Eds) Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. Gabler, Wiesbaden, pp 895–925

tm (2020) Digitaler Stressfaktor. LH 42(9):24

von Ahsen A (2006) Integriertes Qualitäts- und Umweltmanagement. Mehrdimensionale Modellierung und Umsetzung in der deutschen Automobilindustrie, Dt. Universitäts, Wiesbaden

Walch D, Günthner W, Neuberger M (2009) Auswirkungen der demographischen Entwicklung auf die Intralogistik. Industrie Manag 25(2):67–70

Weber J, Schäffer U (2020) Einführung in das Controlling, 16., rev. a. act. ed. Schäffer-Poeschel, Stuttgart

World Bank (2018) Connecting to compete 2018. Trade logistics in the global economy. The logistics performance index and its indicators. World Bank, Washington

Zollonds H-D (2011) Grundlagen Qualitätsmanagement. Einführung in die Geschichte, Begriffe, Systeme und Konzepte, 3., rev., act. a. enl. ed. Oldenbourg, München

Abbreviations of literature

BFuP	Betriebswirtschaftliche Forschung und Praxis
BH	Business Horizons
BME	Bundesverband Materialwirtschaft, Einkauf und Logistik e. V.
BVL	Bundesvereinigung Logistik e. V.
CSCMP	Council of Supply Chain Management Professionals
DBW	Operations Management
DVZ	German Transport Newspaper
ELA	European Logistics Association
HBM	Harvard Business Manager
HBR	Harvard Business Review
IJPD & MM	International Journal of Physical Distribution and Materials Management
IJOPM	International Journal of Operations & Production Management
ILDM	Institute of Logistics & Distribution Management
LH	Logistik Heute
NCPDM	National Council of Physical Distribution Management
RKW	Rationalisierungs-Kuratorium der Deutschen Wirtschaft e. V.
VDI	Verein Deutscher Ingenieure e. V.
Wist	Economic Studies
Wisu	Economic Studies
ZfB	Journal of Business
ZfbF	Journal of Business Research
ZfL	Journal of Logistics
ZfO	Journal of Leadership and Organization

H.-C. Pfohl, *Logistics Management,* https://doi.org/10.1007/978-3-662-66564-0