Information Needs of Logistics Service Providers in Strategic Decisions

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St. Gallen, May 19, 2014

The President:

Prof. Dr. Thomas Bieger

„Diss abgeben ist wie Skischuhe ausziehen.“

(in Andermatt, Februar 2014)

Vorwort

Die vorliegende Dissertation ist das Ergebnis meiner Forschungstätigkeit am Lehrstuhl für Logistikmanagement der Universität St.Gallen (LOG-HSG). Die Motivation zur Untersuchung des Themas „Information Needs of Logistics Service Providers in Strategic Decisions" entstand im Rahmen meiner Arbeiten an und rund um die „Logistikmarktstudie Schweiz", die in ihrer jährlichen Erscheinungsform den Schweizer Logistikmarkt quantitativ und qualitativ erfasst. Die Herausforderungen, einen Markt aus wissenschaftlicher Sicht abzubilden sowie die adäquate Anwendung jener Ergebnisse in der Logistikdienstleistungsindustrie haben mich dazu veranlasst, diese Thematik im Rahmen meiner Dissertation zu untersuchen.

Dieses Vorwort möchte ich nutzen, um mich bei den vielen Personen zu bedanken, die mich während meiner Dissertationszeit begleitet und unterstützt haben.

Allen voran möchte ich mich bei meinem Doktorvater Prof. Dr. Wolfgang Stölzle (LOG-HSG) für die vorbildliche fachliche und persönliche Betreuung während meiner Zeit am Lehrstuhl bedanken. Eine stets offene Tür und ein offenes Ohr für sämtliche Belange – ob beruflich oder privat – habe ich in den vergangenen dreieinhalb Jahren sehr geschätzt. Ebenso gilt mein Dank Prof. Dr. Sven Reinecke (Institut für Marketing der Universität St.Gallen) für die Übernahme des Koreferats. Besonderer Dank gilt zudem Prof. Dr. Erik Hofmann (LOG-HSG), der meinen Dissertationsprozess als „Coach" begleitet hat. Die Einbringung seiner Erfahrungen, kreativen Ideen und die – teilweise auch emotionalen – fachlichen Diskussionen, haben massgeblich zum erfolgreichen Abschluss meiner Dissertation beigetragen. Das angenehme Arbeitsklima am Lehrstuhl und die intensive Betreuung und Unterstützung durch Prof. Dr. Wolfgang Stölzle und Prof. Dr. Erik Hofmann haben neben meiner fachlichen, auch meine persönliche Entwicklung stark geprägt.

Erfolgreiches wissenschaftliches Arbeiten zu einer praxisrelevanten Themenstellung setzt die Kooperation mit Partnern aus der Wirtschaft voraus. Daher möchte ich mich an dieser Stelle bei allen Unternehmen bedanken, die meine Dissertation, insbesondere durch die Bereitstellung von Informationen, unterstützt haben.

Der erfolgreiche Abschluss einer Dissertation setzt neben einer professionellen Arbeitsumgebung vor allem die Unterstützung von Kollegen, Freunden und Familie voraus. Daher möchte ich einen grossen Dank an meine Kollegen vom LOG-HSG aussprechen, die vor allem in den letzten Monaten des Dissertationsprozesses ein hohes Mass an Verständnis für mich aufgebracht haben. Besonderer Dank gilt meinen wunderbaren Freunden, die ich am LOG-HSG kennenlernen durfte: Danke Patrick

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List of abbreviations

1PL	First party logistics
2PL	Second party logistics
3PL	Third party logistics
4PL	Fourth party logistics
AHP	Analytical hierarchy process
APT	Arbitrage pricing theory
C	Consultancy
CAPM	Capital asset pricing model
CoC	Cost of capital
DCF	Discounted cash flow
DEMATEL	Decision-making trial and evaluation laboratory
EBIT	Earnings before interest and taxes
EVA	Economic value added
FI	Federal institution
GDP	Gross domestic product
GNI	Gross national income
H	Hypothesis
IC	Information category
ICT	Information and communication technology
IO	Industrial organization
ISM	Interpretative structural modeling
ITO	Inter-trade-organization
LLP	Lead logistics provider
LMS	Logistics market survey
LSP	Logistics service provider
Ltd.	Limited
M&A	Merger and acquisition

MCDM	Multi-criteria decision-making
OL	Organizational learning
PLC	Public limited company
ROA	Return on assets
ROE	Return on equity
RQ	Research question
SCM	Supply chain management
SI	Scientific institution
SIC	Standard industry classification
TEU	Twenty-foot equivalent unit
TPL	Third party logistics
WACC	Weighted average cost of capital

Summary

In order to achieve business objectives such as organizational success, profitability, and growth, as well as to survive competition, logistics service providers (LSP) have to understand the market characteristics of both home and future target markets. To survive in the global economy, LSPs have to make the right strategic decision, for which information on general market developments, customers, and competitors is inevitable. Because of the specific characteristics of logistics services, for example, derivative and market-driven demand, as well as the non-transparency of logistics markets, external information particularly plays a crucial role in the decision-making of LSPs. Despite the relevance of information for strategic decisions, LSPs often do not know which information to collect, and how to acquire, process, interpret, and use available information. Although these aspects are widely considered in strategic management literature or from a shipper's viewpoint, the information needs of LSPs have rarely been focused on in recent research. Therefore, the overall objective of the present thesis is the investigation of the information needs of LSPs in strategic decisions and the satisfaction of these needs with available information.

Adopting the theoretical lenses of (1) industrial organization, which emphasizes the importance of external information; (2) the knowledge-based theory of the firm that acknowledges knowledge as a strategic resource for LSPs to achieve competitive advantage; and (3) organizational learning, which describes the transformation of information into knowledge, three studies are conducted in this research context. The first study aims at the identification of LSPs' information needs by conducting a survey amongst 17 LSPs. The second and third studies focus on available information and its appropriateness for strategic decisions of LSPs. In this context, 34 logistics market surveys (LMS) and financial data on 702 LSPs are analyzed.

The results outline the particular importance of monetary customer-, competitor-, and market-information in strategic decisions of LSPs, and illustrate the interrelationships among such information in different strategic directions that can be pursued. Furthermore, the results structure the field of available market information (in terms of LMSs), and emphasize its deficits that have to be considered when processing the information for strategic decision-making. Moreover, the analysis of LSPs' cost of capital reveals new paths for the use of specific information (particularly regarding LSPs' competitors) in strategic decisions. The present research closes the existing gap in strategy-related logistics literature and contributes to the emerging field of financial analyses in both logistical and strategic contexts.

Zusammenfassung

Um im Wettbewerb zu bestehen und Unternehmensziele wie Profitabilität und Wachstum zu realisieren, müssen Logistikdienstleister (LDL) ihr bestehendes und zukünftiges Marktumfeld verstehen. Zu diesem Zweck müssen sie die richtigen strategischen Entscheidungen fällen und dabei Informationen über allgemeine Marktentwicklungen, ihre Kunden und Wettbewerber berücksichtigen. Da logistische Dienstleistungen zahlreiche Besonderheiten, wie zum Beispiel die derivative, marktgeleitete Nachfrage aufweisen und Logistikmärkte durch eine generelle Intransparenz gekennzeichnet sind, spielen insbesondere externe Informationen eine entscheidende Rolle. Trotz der hohen Bedeutung von Informationen für strategische Entscheidungen wissen viele LDLs nicht, welche Informationen sie für diesen Zweck beschaffen, verarbeiten, interpretieren und nutzen sollten. Während diese Aspekte in der strategischen Management Literatur sowie aus Verlader-Perspektive bereits untersucht wurden, ist der Informationsbedarf von LDLs bisher wenig beleuchtet. Folglich ist die übergeordnete Zielsetzung der vorliegenden Dissertation die Analyse des Informationsbedarfs von LDLs in strategischen Entscheidungen sowie dessen Befriedigung durch verfügbare Informationen.

Unter Berücksichtigung (1) der Industrieökonomik, welche die Bedeutung von externen Informationen hervorhebt, (2) der wissensbasierten Unternehmenssicht, welche Wissen als strategische Ressource für LDLs sowie für die Erreichung von Wettbewerbsvorteilen darstellt, sowie (3) des organisationalen Lernens, dass die Transformation von Informationen zu Wissen beschreibt, werden drei Studien durchgeführt. Die erste Studie zielt darauf ab, den Informationsbedarf von LDLs zu identifizieren, wozu 17 LDLs befragt wurden. Die weiteren beiden Studien fokussieren sich auf verfügbare Informationen und analysieren 34 Logistikmarktstudien (LMS) sowie Finanzinformationen von 702 LDLs.

Die Ergebnisse heben die besondere Bedeutung von monetären Kunden-, Wettbewerbs- und Marktinformationen für strategische Entscheidungen von LDLs hervor. Des Weiteren werden verfügbare Informationen (LMSs) strukturiert und Defizite aufgezeigt, die bei ihrer Nutzung für strategische Entscheidungen berücksichtigt werden sollten. Ferner zeigt die Analyse der Kapitalkosten von LDLs neue Wege für die Nutzung spezifischer Informationen (insbesondere über Wettbewerber) in strategischen Entscheidungen auf. Die vorliegende Arbeit schliesst damit eine Lücke in der strategischen Logistikliteratur und erweitert das aufstrebenden Feld der Finanzanalysen in einem Logistik- bzw. Strategie-bezogenen Kontext.

1   Introduction

The present research addresses the information needs of logistics service providers (LSP) in strategic decisions. Section 1.1 and Section 1.2 present the relevance of this research on the information needs of LSPs in strategic decisions from managerial and theoretical perspectives. Based on the relevance of this research as well as managerial and theoretical objectives, the research questions are derived in Section 1.3. Section 1.4 presents the outline of this thesis, chosen in order to answer the research questions.

1.1   Managerial relevance of the research on the information needs of logistics service providers in strategic decisions

In recent years, the global economy has been undergone substantial transformation. The trends towards globalization, division of labor, and outsourcing within a changing business environment have led to the increasing importance of logistics. Currently, logistics has become a sustainable competitive advantage for industry companies (Spillan et al., 2013; Bhatnagar and Teo, 2009) and is a key success factor (Bowersox et al., 2007). LSPs that offer logistics services to companies whose core competency is not logistics (Lieb and Bentz, 2005a) are directly confronted with this market developments. Further, LSPs strive for achieving business objectives, such as organizational success, growth, and profitability (Fugate et al., 2008), to survive competition and maintain presence in the global economy. To meet these objectives, LSPs have to take the right strategic decisions related to their markets and market segments, services, resources, relationships, and alliances (Persson and Virum, 2001). Therefore, LSPs have to understand the market characteristics of both home and future target markets (Rodrigues et al., 2005), within the wider consideration of general market developments, customers, and competitors (Fugate et al., 2008).

A specific characteristic of logistics services offered by LSPs is that the demand for these services is derivative and dependent on the sales of industry companies as customers of LSPs (Pfohl, 2010).[1] Strategic decisions of LSPs are mainly market-driven (Persson and Virum, 2001). The answers to the two principle questions of strategy – which services to offer in which markets (Grant, 2002) – are often anticipated by customers' requirements. This can be illustrated by the example of the LSP CHEP. In 2012, this provider of pallet and container pooling solutions expanded its business to seven additional countries in Eastern and Central Europe. The expansion was based on the requirements of one of CHEP's leading customers, Procter

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[1]   In the context of this work, LSPs customers are also referred to as shippers.

& Gamble (CHEP, 2012). A further example is the LSP Panopa that followed its customers from the automotive industry to the aspiring Eastern Europe region. Having entered new markets and serving its existing customers, Panopa is now intending to acquire new customers that also operate in the automotive industry (Anonymous, 2013). These developments are also underpinned by a statement of a manager of the world's largest online retailer Amazon, who said that the logistics industry worries too much about good locations. Where Amazon was going, other companies, including LSPs, would follow (Weber, 2012). Nonetheless, strategic decisions of LSPs on which services to offer in which markets are not in any case dependent on one or more customers' requirements; intrinsic efforts for growth are further reasons.

Strategic decisions of LSPs require the analysis of information on their internal and external environment, balanced in terms of monetary and non-monetary information (Rajesh et al., 2012; Bhimani and Langfield-Smith, 2007).[2] The internal environment refers to tangible financial, organizational, physical, and technological resources as well as to intangible human, innovation, and reputation resources. The external environment includes information on the market in general, customers, and competitors (Citroen, 2011; Hitt et al., 2003). According to Ansoff (1987), "strategic decisions are primarily concerned with external, rather than internal, problems of the firm and specifically with the selection of the product mix which the firm will produce and the markets to which it will sell it." Furthermore, strategic decisions of LSPs are often market-driven. Based on these aspects, the external information needs of LSPs will be the focus of this research project.

The relevance of information in strategic decisions of LSPs is undisputed (Picot et al., 2009; Baumgarten and Thoms, 2002) and of central importance for achieving competitive advantages (Zöllner, 1990). Furthermore, information itself can constitute a competitive advantage as it cannot be procured from factor markets at random (Schmitt, 2006). Nevertheless, LSPs often do not know which type of information to focus on when pursuing a specific strategic direction.[3] Thus, the investigation and examination of relevant information for strategic decisions is a major challenge for LSPs (Zöllner, 1990).

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[2] In the context of the present research, the terms monetary information and financial information must be distinguished. Monetary information refers to information that is measured in monetary units (e.g., the GDP), whereas financial information refers to financial key performance indicators (e.g., the cost of capital or EBIT).

[3] In the context of the present research, the terms strategic decision and strategic direction must be distinguished. In contrast to a strategic decision, a strategic direction is a specific strategy that can be pursued and may be seen as the result of a strategic decision. Considering various possible strategic directions, one can discuss of strategic decisions in general.

To the present, there are a variety of sources that offer (logistics-related) information on markets, shippers (LSPs' customers), and LSPs (LSPs' competitors), for example, industry or trade journals, various surveys and studies, information of market research institutes, and official statistical databases. In recent years, logistics market surveys (LMS) that provide country-specific logistics-related information and encompass a broad range of topics have become popular. In the meantime, a variety of LMSs can be used as an information basis for LSPs when collecting input for strategic decisions (Lampe and Hofmann, 2012; Rantasila and Ojala, 2012). However, LMSs are often not directly targeted at LSPs and their specific requirements. Furthermore, these surveys differ with regard to their data basis and methodology applied, as well as indicators analyzed. This hinders the comparability of different LMSs and does not allow for profound decision-making in every case, for example, when LSPs have to choose between different markets. Consequently, LSPs are faced with the challenge of acquiring accurate information for strategic decisions from a variety of sources, and furthermore to process, interpret, and use this information appropriately.

One of the main objectives of a strategy (as the result of a strategic decision) is to achieve returns over the cost of resources or capital. Hence, strategic decisions of LSPs are dependent on their capability to realize a profit that is higher than its cost of capital (Apergis et al., 2012; Grant, 1991). The cost of capital primarily comprises the cost of debt and cost of equity (Pratt and Grabowski, 2010) and provides important information for strategy development and capital investments. For this reason, apart from general information on markets, customers, and competitors, information on the financial performance of LSPs becomes increasingly important for their strategic decision-making. On the one hand, financial performance is an important decision criterion for shippers who intend to outsource their logistics activities (Gotzamani et al., 2010) as well as for shareholders who make their investment-decisions. Furthermore, LSPs are more and more under pressure of capital markets (Bohlmann and Krupp, 2007). On the other hand, and of major relevance for the present investigations, financial performance indicators offer important information when pursuing growth strategies and establishing cooperation with other LSPs, seeking for mergers and acquisitions (M&A), or striving for organic growth (Hofmann and Lampe, 2013; Häkkinen et al., 2004). In the context of strategic decisions, the cost of capital not only allows for own profitability considerations, but also for the valuation of competitors, for example, as potential takeover targets (Ogier et al., 2012). For the assessment of an LSP's value or, in other words, its shareholder value, the cost of capital is an important input factor to calculate monetary performance measures such

as the economic value added (EVA). Based on these aspects and against the backdrop of global capital markets with high competition, value-based management of LSPs has gained more importance. The underlying principle of this approach is to realize returns of investor's capital that exceed the cost of capital of an LSP (Young and O'Byrne, 2001). Decisions on the determination of a company's cost of capital are considered fundamental because of the "substantial impact on both the composition of the firm's operations and its profitability, since shocks onto anticipated cash flows are reflected in a firms cost of capital" (Apergis et al., 2011, p. 589). Additionally, knowledge of LSPs' competitors' cost structure is – apart from information on products, strategies, and resources – indispensable to succeed and gain competitive advantage and growth, which are further objectives of strategic decisions (Bohlmann and Krupp, 2007). Admittedly, the concept of value-based management of LSPs cannot be taken for granted and the cost of capital is not always easy to determine; this is because of data requirements, particularly for LSPs that are not quoted, as is mostly the case. For LSPs focusing on financial information like the cost of capital for strategic decision-making, a major challenge is – apart from processing the information – to acquire appropriate information, particularly on competitors.

Therefore, LSPs are faced with some major challenges when taking strategic decisions that particularly concern their information needs:

- LSPs have to make a variety of strategic decisions, which may be driven by their customers or growth efforts. A majority of LSPs is not aware of which information to collect for strategic decisions.

- To take a strategic decision, LSPs have to acquire, process, and interpret information for its use in specific decision problems.

- Value-based management of LSPs has not been fully established yet, but is of major importance. LSPs have to expose with relevant financial variables, such as the cost of capital, and understand their contribution to strategic decisions.

Accordingly, the objective of this research is to provide practical implications for LSPs regarding which information to collect for taking strategic decisions, how "to use" available information, and provide suggestions for the exploitation of financial (competitor-) information such as the cost of capital. Furthermore, the results aim to encourage LSPs that do not take systematic strategic decisions (Bohlmann and Krupp, 2007) to improve their strategic decisions to be more profound. In particular, small

LSPs often take decisions according to instinct, which was underlined in several discussions with LSPs during the research process.[4]

1.2 Theoretical relevance of the research on the information needs of logistics service providers in strategic decisions

The present research on the information needs of LSPs in strategic decisions encompasses different research streams and may be considered cross-sectional. Thereby, general and logistics-related approaches from strategic management, information for strategic decision-making, and financial investigations in the context of strategy or logistics are considered.

First, strategy-related logistics literature has made initial efforts based on general strategic management. Different approaches for the strategic positioning or strategic directions for LSPs have been developed. On the one hand, market-based approaches focusing on the range of service offered by LSPs and number of markets they operate in have been established (Dornier et al., 2008; Juga et al., 2008; Bask, 2001). On the other hand, resource- and competence-based approaches feature the resources or assets as well as capabilities for problem solving and customer adoption of LSPs (Halldórsson and Skjøtt-Larsen, 2004; Hertz and Alfredsson, 2003; Berglund et al., 1999; Africk and Calkins, 1994; Cooper et al., 1994; Delaney, 1991). Stemming from market- and resource-based approaches, Persson and Virum (2001) developed four growth strategies that can be pursued by LSPs. The relevance of information in strategic decisions related to strategic positions or directions of LSPs is emphasized by Picot et al. (2009), Bohlmann and Krupp (2007), Baumgarten and Thoms (2002), and Zöllner (1990), but an in-depth investigation of LSPs' information needs has not been conducted. Thus far, logistics-related research on information needs has mainly adopted a shipper's perspective. Lieb and Randall (1996, p. 311) identified service and cost issues as well as "expertise and reputation […], information systems capabilities, financial stability, and geographic coverage" offered of / by LSPs as most important decisional criteria for shippers when choosing an LSP. Razzaque and Sheng (1998) as well as Richardson (1995) conducted similar studies, emphasizing that companies tending to outsource their logistics activities have to gain information regarding potential LSPs, their capabilities, and performance.

General literature on strategic management also highlights the importance of information in strategic decisions, but presents contrary to logistics research detailed

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[4]   The discussions with LSPs were primarily led in the context of study A (Appendix A) to detail questionnaire-based results.

analyses of different types of information. Investigations are related to internal information regarding a company being in the process of taking a strategic decision, as well as its external environment, which implies market-, customer-, and competitor-related information (Mentzer, 2008; Hitt et al., 2003; Choo, 2002; McNeilly, 2002). Citroen (2011, p. 493) focused on the entire decision process and analyzed "the way information is obtained, analyzed, judged, and applied by executives in industry" by conducting interviews in 13 European industrial companies. Similar investigations on the specific information needs of LSPs in strategic decisions have not been conducted yet, despite the peculiarities of LSPs' business, for example, market-driven influence.

In addition, with regard to strategic research in logistics, Olavarrieta and Ellinger (1997, p. 559) claimed that "ten to 15 years of theory development in strategy research has been largely neglected in the strategic logistics literature." Further, Yeung et al. (2006) asked for more research activities integrating the fields of logistics or LSPs in specific and strategic management issues.

Second, there is a variety of available logistics-related information. Apart from the provision of information by official bodies, for example, federal statistical offices, trade journals, company reports, and studies or surveys among others conducted by business consultancies or market research institutes, scientific research has also focused on the preparation and provision of logistics-specific information. Meanwhile, LMSs have become a very common source for basic (logistics-related) information considering several indicators related to market-, customer-, and competitor-information (Rantasila and Ojala, 2012).

Recent scientific literature analyzes information or methods for the measurement of specific indicators (e.g., Bowersox et al., 2003), but does not provide a comprehensive picture of available information and its utility in strategic decisions of LSPs. Furthermore, analyses of information primarily refer to shippers and their choice of an LSP. Anderson et al. (2011) and Menon et al. (1998) analyzed different types of information or indicators that should be considered by shippers when choosing an LSP, for example, reliable performance, price, customer interaction and service recovery, innovativeness, financial stability, and company size. Bardi et al. (1994) analyzed the utility of logistics information systems among others for strategic problems of shippers. Moreover, 10% of their industry sample comprises transportation providers, but the results are not differentiated and only show that logistics-specific information plays a critical role in strategic decisions.

Despite the relevance of information for strategic decisions of LSPs and the variety of available information, there is a lack of literature related to this information. Rantasila and Ojala (2012) provided a first overview of existing LMSs and conducted some cross-survey comparisons. However, a kind of framework that identifies the most established indicators for providing information on logistics markets, deficits and recommendations regarding their applicability particularly in strategic decisions of LSPs, does not exist. This implies that a comparative overview of relevant available information for strategic decision-making of LSPs is missing, as is the assessment of appropriate information with regard to usability aspects.

Third, financial research has found its way into logistics. Financial information (regarding performance) has become increasingly important for strategic decisions of LSPs and their performance assessment (e.g., by shippers). Gotzamani et al. (2010) analyzed the importance of financial measures of LSPs related to outsourcing decisions of shippers. Furthermore, they identified a strong relationship between the quality of services offered by an LSP and its financial performance. In their investigation of service provision and performance of LSPs, Liu and Lyons (2011) revealed that the financial performance of an LSP is linked to its operational performance, but not directly to the range of services. A general analysis of the financial statements of LSPs was conducted by Hofmann and Lampe (2013). Focusing on the influence of LSP-specific characteristics on their asset-, liquidity-, and capital-structure, they found out that the asset- and liquidity structure of LSPs significantly differs between LSPs operating in different market segments.[5] Drobetz et al. (2013) analyzed determinants of capital structure decisions of quoted LSPs, concluding that they are exposed to higher leverage ratios and financial risk than industry companies. Logistics research with a financial focus is limited to only a few investigations. Relevant financial characteristics like the cost of capital (Ogier et al., 2012; Apergis et al., 2011) have not been considered; above all, the linkage to strategic decisions is underrepresented from an LSP's viewpoint. Investigations linking financial information and strategic decisions primarily adopt a shipper's perspective, for example, when choosing an LSP, despite the growing relevance of financial information in the strategic or value-based management of LSPs.

In addition, Liu and Lyons (2011), who analyzed the financial performance of LSPs and emphasized its capabilities for strategic decisions of LSPs, concluded with a need

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[5] In this context, market segments were distinguished in terms of services offered, for example, railroad or water transportation.

for in-depth investigations within the field of strategy-related logistics research linked to financial issues.

Therefore, the following gaps in the literature regarding the information needs of LSPs have been identified:

- Strategic issues of LSPs have become focus of attention in recent research, but contrary to management literature, information needs in strategic decisions have not been investigated.

- There is a variety of information available that could be collected in strategic decisions of LSPs, but a comprehensive analysis of this information regarding established indicators, deficits, and recommendations for usage has not been conducted.

- Despite its growing relevance, the analysis of financial information as a source for strategic decisions of LSPs has only found little attention in logistics-related literature. Particularly important financial indicators like the cost of capital have not been systematically analyzed yet.

1.3 Research questions

Based on the managerial and theoretical relevance of the research (Figure 1), the research questions (RQ) of this thesis are derived.
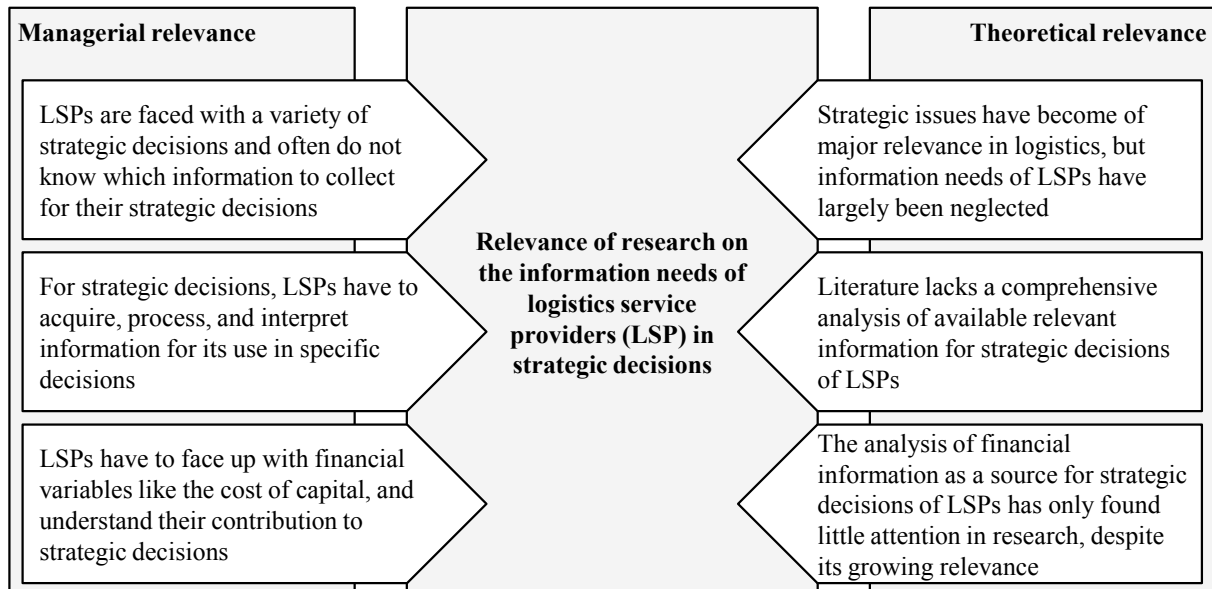
Figure 1.   Managerial and theoretical relevance of the research on the information needs of logistics service providers in strategic decisions

Encompassing the relevance of this research (Section 1.1 and Section 1.2), the overall research objective is stated below:

Investigation of the information needs of logistics service providers in strategic decisions and the satisfaction of these needs by available information.

To address the overall research objective, three research questions have been developed, each based on a single aspect of the relevance of the entire research project.

The first research question (RQ1) aims to identify the external information needs of LSPs in strategic decisions or pursuing different strategic directions, because "different strategies have different information needs" (Rogers et al., 1999, p. 569). On the one hand, the results shall provide suggestions for better information acquisition for LSPs, particularly when taking decisions according to instinct. On the other hand, the results shall contribute to strategy-related logistics research that has not recently focused on the information needs of LSPs.

RQ1: *Which external information is required in strategic decisions, from a logistics service provider's viewpoint (particularly in specific strategic directions)?*

The second research question (RQ2) focuses on available information that can be collected for strategic decisions of LSPs. Based on RQ1 that aims at providing an overview of the information needs of LSPs, RQ2 intends to examine available information, the data basis and methodological development, and hence applicability or appropriateness for strategic decisions of LSPs. From a theoretical perspective, RQ2 has the objective of structuring the field of logistics market information and additionally of giving recommendations for the provision of corresponding information.

RQ2: *How can logistics service providers use available information (particularly provided in the form of logistics market surveys) in their strategic decisions?*

The third research question (RQ3) also focuses on available information. As financial indicators become more and more important in the management and for strategic decisions of LSPs, using the example of the cost of capital of LSPs shall give first implications on how to utilize such information. Furthermore, the results shall extend financial-related logistics research that requires in-depth investigations.

RQ3: *How can financial information be used in strategic decisions of logistics service providers (particularly the cost of capital)?*

A theoretical framework is necessary to serve as a basis for providing answers to these research questions; this is briefly discussed below.[6]

From a theoretical viewpoint, in strategy-related logistics research, two general directions of impact have established:[7] market-based approaches – like industrial organization (IO) (Porter, 1980, 1985) – and resource-based approaches, for example, the knowledge-based theory of the firm (Barney, 1997; Grant, 1996; Peteraf, 1993). The former focuses on the external environment "to explain the success of a company because of industry factors and their influence" (Delfmann, 2008, p. 891).[8] Resource-based approaches focus on capabilities and companies as the source of competitive advantages. Both theoretical perspectives ought to be integrated into the research on the information needs of LSPs in strategic decisions.

The market-based viewpoint seems to have a comprehensive significance for the present research. Strategic decisions, and hence the information needs of LSPs, are often externally driven. The focus of the industrial organization approach is the external environment of companies. Industrial organization contributes to the analysis of strategic choices (Porter, 1981) by understanding the structure of markets and companies operating on the same (Rothfuss, 2009), and "views the sources of profitability" (Amit and Schoemaker, 1993, p. 35). It may also underline the focus on external information in the present research context. The capabilities and resources of an LSP determine its profitability, which also requires the consideration of a resource-based perspective. Moreover, the application in a logistical context was explicitly claimed by Olavarrieta and Ellinger (1997). In this context, the knowledge-based theory of the firm, which is based on the resource-based view, considers company's knowledge, generated from information, as a core element for strategic decisions and competitive advantage (Grant, 1996, 2002). The theoretical viewpoint may also highlight the importance of information for strategic decisions of LSPs.

A limitation of the resource-based perspective is its restricted managerial adaptability, because of missing implications for resource or knowledge generation (Porter, 1991). The integration of the organizational learning (OL) theory (Crossan et al., 1999; Huber, 1991; Argyris and Schön, 1978) – which describes the process of information acquisition, processing, interpretation, and use – contributes to the usability of

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[6] A detailed discussion of the theories mentioned in the following account, as well as the reasons for their application, can be found in Section 3.

[7] Delfmann (2008), Rümenapp (2002), Schmitt (2006), Reve (1990), Amit and Schoemaker (1993) – among others – consider market- and resource-based approaches.

[8] Own translation from German.

available information for LSPs and its transformation into knowledge; hence, it could make up for the limitation of the resource-based perspective.

To answer the three research questions, three studies are conducted, which are embedded in the theoretical framework. All studies are based on the explanatory contributions of industrial organization and the knowledge-based theory of the firm as they underline the importance of information in strategic decisions of LSPs. Generally, an explorative approach is followed, which combines qualitative as well as quantitative research. The first study analyzes the information needs of LSPs in strategic decisions by collecting primary data to initially structure the research field and is closely related to industrial organization and the knowledge-based theory of the firm. The second study on available logistics market information and the third one on the cost of capital of LSPs are in-depth investigations, based on the first study, of specific available information (secondary data) that can be collected for strategic decisions of LSPs. For these reasons, both studies additionally integrate organizational learning viewpoints to explain the applicability and utility of specific information for strategic decision-making of LSPs.

In summary, the objective of the present research is to investigate the information needs of LSPs in strategic decisions and the usability of available information sources by (1) the identification of the information needs of LSPs in strategic decisions or pursuing specific strategic directions respectively; (2) the examination and structuring of fundamental available logistics market information with regard to LSPs' requirements; and (3) the analysis of financial information, like the cost of capital, for strategic decision-making of LSPs. The results shall also contribute to and extend logistics-related research regarding strategic, information-related, and financial issues. Finally, not only may LSPs as "processors" of information benefit from the results, but also administrative bodies, consultancies, and researchers providing (and investigating) information relevant for strategic decisions of LSPs.

1.4 Outline of the thesis

The thesis is structured as depicted in Figure 2 and subdivided into five chapters.

Chapter 1 explains the relevance of the research on the information needs of LSPs in strategic decisions from managerial (Section 1.1) and theoretical perspectives (Section 1.2). Based on the relevance, the research questions are derived and overall research objectives are highlighted (Section 1.3).

Chapter 2 provides the conceptual background of the thesis, aiming to define the unit of analysis of the research and provide the state-of-the-art of relevant literature. For this purpose, the characteristics of LSPs and logistics markets are analyzed to provide a general understanding for the present research context (Section 2.1). Literature regarding the strategic management of LSPs is reviewed, including general strategic management literature (Section 2.2). Furthermore, literature on the information needs of LSPs in strategic decisions is analyzed, focusing on different information required in strategic decisions as well as the state-of-the-art of available information (Section 2.3). Finally, the definite unit of analysis, based on the literature review, is presented (Section 2.4).

Chapter 3 establishes the theoretical position of the conducted research. Based on previous elucidations, requirements for theory selection are derived and possible theoretical approaches are presented (Section 3.1). Consequently, applied theories are presented in greater detail (Section 3.2). Summarizing the considerations, the theoretical framework for the research is constituted (Section 3.3).

Chapter 4 begins with combining the previous considerations to the research framework, which also provides an overview of the studies conducted and methodologies applied (Section 4.1). Thereafter, each study conducted in the context of this research is briefly described, focusing on the objectives and methodologies applied. Then, the key findings and contributions of each survey are presented (Section 4.2 - Section 4.4). Finally, the overall contributions of the studies to the research framework, implications for the overarching research objective, and the research questions are outlined (Section 4.5).

Chapter 5 summarizes the results by providing managerial (Section 5.1) as well as theoretical implications (Section 5.2). Additionally, limitations of the research are discussed and suggestions for future research are given (Section 5.3).

Additionally, the full-length versions of the studies briefly described in Chapter 4 are provided in *Appendices A - C.*

1. Introduction

1.1 Managerial relevance of the research	1.2 Theoretical relevance of the research	1.3 Research questions	1.4 Outline of the thesis

2. Conceptual background of the information needs of logistics service providers in strategic decisions

2.1 Characteristics of logistics service providers and logistics markets	2.2 Strategic management of logistics service providers	2.3 Information needs of logistics service providers in strategic decision and the availability of information

2.4 Unit of analysis for the research on the information needs of logistics service providers in strategic decisions

3. Theoretical positioning of the research on the information needs of logistics service providers in strategic decisions

3.1 Theory selection and applicability

3.2 Applied theories

3.3 Theoretical framework for the research on the information needs of logistics service providers in strategic decisions

4. Studies on the information needs of logistics service providers in strategic decisions

4.1 Overview of the research framework and methodology

4.2 Study A: Information needs of logistics service providers in strategic decisions: an outside-in perspective	4.2 Study B: Logistics market surveys: state-of-the-art, deficits, and quality criteria	4.3 Study C: Understanding the cost of capital of logistics service providers: an empirical investigation

4.5 Overall contributions of the studies on the information needs of logistics service providers in strategic decisions to the research framework

5. Conclusions

5.1 Managerial implications	5.2 Theoretical implications	5.3 Limitations and future research

Appendix

A Information needs of logistics service providers in strategic decisions: an outside-in perspective	B Logistics market surveys: state-of-the-art, deficits, and quality criteria	C Understanding the cost of capital of logistics service providers: an empirical investigation

Figure 2.   Outline of the thesis

2   Conceptual background of the information needs of logistics service providers in strategic decisions

The following sections provide the conceptual background for the present thesis. To define the unit of analysis for the research, the understanding of LSPs and logistics markets in the context of this research is presented first (Section 2.1). This is followed by the investigation of the strategic management of LSPs and possible strategic directions that can be pursued (Section 2.2). Thereafter, the information needs of LSPs and the state-of-the-art of available information are considered (Section 2.3). Finally, the elucidations are combined to outline the unit of analysis for the thesis (Section 2.4).

2.1   Characteristics of logistics service providers and logistics markets

LSPs are in the focus of the analysis of the present research. They exhibit certain specific characteristics, just as the (logistics) markets they are operating in. For these reasons, the understanding of LSPs and their peculiarities (Section 2.1.1) as well as logistics markets and their specifics (Section 2.1.2) are presented in the following subsections.

2.1.1   Definition of logistics service providers

"Generally speaking, LSPs are companies which perform logistics activities on behalf of others" (Delfmann et al., 2002, p. 204). Despite a general understanding of LSPs, a universally valid definition has not been established. A variety of concepts associated with the term LSP are mentioned in literature and are briefly described below:

- Carrier: Carriers are transport operators that haul products (Sink et al., 1996; Sheffi, 1990). The services offered are often referred to as basic services, like transportation (Hofmann and Lampe, 2013).

- 2PL: Second party logistics providers can be equated with carriers (Scholz-Reiter et al., 2008). In scientific literature, the term carrier is more common.

- 3PL: Third party logistics providers (also TPL) or contract logistics firms (Razzaque and Sheng, 1998; Sink et al., 1996) are probably the most common terms in the context of LSPs. However, as the term LSP itself suggests, there is no common understanding of it. Fundamentally, two perspectives on 3PLs can be distinguished: The narrow perspective of 3PL characterizes their services as bundled, customized, with a long-term focus, and often contract-based (Weber et al., 2007). The services exceed basic carrier activities. Among others,

Selviaridis and Spring (2007), Murphy and Poist (1998, 2000), van Laarhoven et al. (2000), as well as Bagchi and Virum (1996, 1998) followed the narrow understanding. The broad understanding considers 3PLs as providers of all types of logistics-related services, without being constrained to specific characteristics. This perspective was adopted by Zacharia et al. (2011), Stefansson (2006), Berglund et al. (1999), Coyle et al. (1996), Sink et al. (1996), Stank and Maltz (1996), Lieb et al. (1993) and Lieb (1992), among others.

- 4PL: The phrase fourth party logistics provider was coined by consultancies (Scholz-Reiter et al., 2008; Stefansson, 2006). A 4PL has a coordinative role and does not own physical assets, contrary to 3PLs. The 4PL subcontracts other service providers (3PLs, freight forwarders, or carriers) to manage the logistics activities of a supply chain (Bumstead and Cannons, 2002). According to Schmitt (2006, p. 47), who intensively analyzed 4PLs, their services can be described as "the integrated offer of high quality logistics and supply chain management services by a logistical prime contractor."[9]

- Freight forwarder: Freight forwarders offer basic services, but also as bundled services. Hence, the understanding of these entities also partly includes 2PLs and 3PLs (Scholz-Reiter et al., 2008).

- LLP: Lead logistics providers combine the extended services offered by 3PLs and the coordinative services offered by 4PLs, and own physical assets. A LLP plays the leading role and takes over all logistical tasks within a supply chain, and is hence the central point of contact for its customers (Froschmayer and Göpfert, 2010).

- 1PL: The first party logistics provider is mentioned for the sake of completeness. Companies who perform logistics activities independently (without a carrier / 2PL, 3PL, 4PL, freight forwarder or LLP), are described as 1PL. Similar to the term 2PL, the phrase 1PL is not very common in literature (Scholz-Reiter et al., 2008).

In the context of this research, the understanding of an LSP is related to the definition of Delfmann et al. (2002). All considerations will include carriers / 2PLs, 3PLs, 4PLs, freight forwarders, and LLPs, without further distinctions (Figure 3).

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[9] In the context of 4PLs, it has to be mentioned that this term or concept of LSPs has not been fully established in praxis yet, which led to the development of LLPs (Froschmayer and Göpfert, 2010).

Understanding of logistics service providers (LSP) in the context of this work		
"Performance of logistics activities on behalf of others"		
Carrier / 2PL	**3PL – narrow perspective**	**4PL**
Basic services, e.g., • Transportation • Transshipment • Warehousing	Extended services, characterized by • Bundled services • Customization • Long-term focus • Contracts	Coordinative services, characterized by • No physical assets • Integration of sub-contractors • Management of the supply chain
Freight forwarder	**LLP**	
Bundled services	3PL services combined with 4PL coordinative services	
3PL – broad perspective		

Note: The size of the boxes does not indicate the relevance of the different LSP concepts.

Figure 3.   Understanding of logistics service providers in the context of the research (based on Scholz-Reiter et al., 2008, p. 585)

Therefore, the understanding of LSPs in the context of this work can be equated with the broad 3PL perspective. As 1PLs do not perform logistics activities on behalf of others, they are not included. In this context, 1PLs can be understood as shippers and hence (potential) customers of LSPs.

Apart from the general concepts of the understanding of LSPs, there are several further approaches for the differentiation of LSPs. The most common differentiation criteria are summarized in Table 1. These criteria are often used to classify the different types of LSPs, as shown in Figure 3.

For the present research, the differentiation criteria will be taken up for the discussion and interpretation of selective results. Contrary to the different concepts of LSPs (Figure 3), which partly overlap, the criteria allow for a clearer distinction of LSPs. Consequently, the broad 3PL perspective was chosen in the research context, which is then specified by referring to the differentiation criteria (Table 1). Furthermore, some of the criteria are also referred to for describing strategic directions of LSPs (Section 2.2.2).

Table 1.   Differentiation criteria for logistics service providers

Differentiation criteria	Characteristics	Example	Selective literature
Asset intensity	Asset vs. non-asset based LSPs (referring to physical assets)	A 4PL that does not own physical assets and offers its services by sub-contracting other LSPs.	(Stefansson, 2006; Africk and Calkins, 1994; Muller, 1993; Sheffi, 1990)

Differentiation criteria	Characteristics	Example	Selective literature
Degree of customization	Degree of adaption to specific customer requirements	These differentiation criteria are believed to increase in most considerations from carriers over 3PLs (narrow perspective) to 4PLs.	(Hofmann and Lampe, 2013; Klaas-Wissing, 2010; Stefansson, 2006; Delfmann et al., 2002; Bask, 2001)
Geographical range of services	Number of (geographical) markets that LSPs are operating in		(Klaas-Wissing, 2010; Juga et al., 2008; Berglund et al., 1999; Niebuer, 1996)
Scope of services	Scope of offered services, from basic core processes to value-added and management or financial services		(Hofmann and Lampe, 2013; Klaas-Wissing, 2010; Juga et al., 2008; Stefansson, 2006; Carbone and Stone, 2005; Delfmann et al., 2002; Berglund, 2000; Sink et al., 1996; Muller, 1993)
Type of goods handled	Specialization of LSPs to the handling of one or more specific goods	For example, an LSP that offers only services (all types) for the handling of perishable goods.	(Lemoine and Dagnæs, 2003; Niebuer, 1996)

Finally, the specific characteristics of logistics service offered by LSPs are briefly investigated in the following manner:[10]

- Immateriality of services: As shippers cannot directly observe and evaluate the services offered by LSPs, challenges arise particularly for distribution and marketing, for example, when establishing new services or entering new markets.

- Integration of the external factor: Logistics services are kind of heteronomous, which leads to the necessity of flexible reactions to changes in external factors. The demand for logistics services is derivative and based on customer requirements.

- Simultaneity of production and usage: LSPs cannot store their "products", meaning services, which makes LSPs vulnerable to fluctuations in demand.

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[10] The listing of the specific characteristics of LSPs is based on findings from Kudla (2012), Hoffmann and Resch (2010), Pfohl (2010), Bachmann (2008), and Benkenstein (1993).

- Heterogeneity of customer demand: LSPs have to serve a broad spectrum of different customers with different requirements.

- Heterogeneity of offered services: Services offered by LSPs are often customized, which requires the consideration of customer demands and industry standards, as well as the acquisition of specific know-how.

- Function of covering distances: Logistics services are characterized by decentralization and are geographically spread.

- Capital-intensive services: The supply of logistics services often requires high capital investments.

- Dependence on exogenous circumstances: LSPs have to consider governmental regulations, transport policies, and are dependent on public infrastructure.

The eight specific characteristics of logistics services have a direct influence on the strategic management and information needs of LSPs. These aspects will be examined in Section 2.2 and Section 2.3.

2.1.2 Logistics service providers as actors in logistics markets

A market can be defined in various ways; there is no unique, accurate definition (Forlani and Parthasarathy, 2003; Buzzell, 1978). As Papadopoulos and Martín (2011, pp. 132–133) stated, the "environments in which a firm operates are the result of the various strategic decisions […]. One such strategic decision is the selection or segmentation of markets." Regarding this statement, a market has to be defined in each single context, which includes also the definition of market boundaries. Market selection implies the differentiation due to geographical boundaries (Sakarya et al., 2007; Root, 1998), whereas market segmentation refers to other characteristics (e.g., customers) that are cross-nationally valid. For example, a relatively broad definition of a market is given by Samuelson and Nordhaus (1985, p. 43), who defined a market "as set of customers served by set of suppliers where both sets are defined in terms of products and services and geographic locations." They indicated the geographical dimension of market definition and hence refer to market selection toward segmentation. This viewpoint was also adopted by Berglund (2000) in his work on strategic positions of LSPs. Market boundaries can be defined corresponding to market selection or segmentation, which means on the basis of geographical boundaries or other segmentation criteria, for example, by means of a specific group of customers (Papadopoulos and Martín, 2011).

The first efforts to define a logistics market were made by Sheffi (1986, p. 2), who described a transportation market in the following manner: "Interactions between carriers and shippers can be considered supply and demand actions in a freight transportation "market." In the transportation market, carriers "supply" and shippers "consume" transportation services." Martinsen and Björklund (2012, p. 564) defined logistics markets as "the interface between shippers and LSPs." As stated by Zöllner (1990), there is no universally valid definition for a logistics market. Based on the work of Martinsen and Björklund (2012) and Sheffi (1986), a broad understanding of a logistics market is followed in the context of this work. Accordingly, a logistics market is referred to as the interface between shippers and LSPs, surrounded by competitors (from an LSP's and shipper's perspective) and the environment, for example, regulations, economic conditions, and the provided infrastructure (Figure 4). The market boundaries will not be set at this point, but most considerations in the research context consider geographical boundaries. This approach is followed because market boundaries have to be defined in each specific consideration of an LSP and it allows for broader considerations.
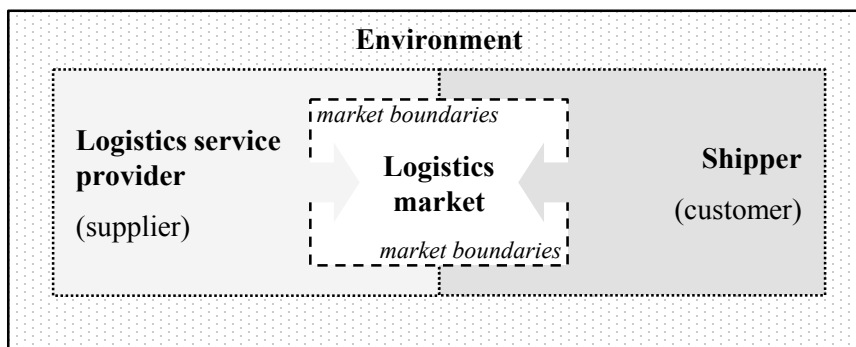
Figure 4. Understanding of a logistics market in the context of the research

Logistics markets have to be defined for each specific context. Logistics literature refrains from defining logistics markets in its entirety and focuses on logistics market segmentation. The most common approaches are summarized in Table 2.

The logistics market segments described in Table 2 are not necessarily free of overlapping categories. They can also be considered integrative if appropriate. For example, an LSP offering tanker transports (type of receptacle) can also limit its services to a specific industry.

Table 2.   Segmentation criteria for logistics markets

Segmentation criteria	Characteristics	Example	Selective literature
Mode of transport	Railroad, road, water, air	LSPs offering road transportation for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010; Aberle, 2009; Kille, 2007; Zöllner, 1990)
Type of goods	Perishable / non-perishable food	LSPs offering temperature-controlled food transports (all modes of transport) for customers from the food industry.	(Hofmann and Wessely, 2010; Pfohl, 2010; Kille, 2007; Zöllner, 1990)
Customer industry	Pharmaceutical industry, engineering industry, textile and clothing industry	LSPs offering all types of services required from customers of a specific industry, for example, the textile and clothing industry.	(Hofmann and Wessely, 2010; Kille, 2007; Zöllner, 1990)
Type of order	Courier-, express- or parcel-services	LSPs offering courier services (all or one mode of transport) for appropriate customers, irrespective of the industry.	(Kille, 2007)
Type of receptacle	Tanker, silo trucks, container	LSPs offering transport with specific receptacles such as tankers (all modes of transport) for appropriate customers, irrespective of the industry.	(Kille, 2007; Isermann, 1997)
Functional context	Reverse logistics, transport, transshipment, warehousing	LSPs offering warehousing-services for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010; Pfohl, 2010; Kille, 2007; Zöllner, 1990)
Legal and organizational relationship between LSP and shipper	Contract logistics	LSPs offering customized, contracted-services for appropriate customers, irrespective of the industry.	(Kille, 2007)
Type of good	Break bulk cargo, bulk cargo, dry bulk	LSPs offering transportation of break bulk cargo (all modes of transport) for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010; Appelt, 1997; Zöllner, 1990)

Segmentation criteria	Characteristics	Example	Selective literature
Size of good	Weight, volume	LSPs offering heavy haul transport (all modes of transport) for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010; Pfohl, 2010)
Service characteristics	Standardized, bundled	LSPs offering standardized services without customization (all modes of transport) for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010)
Dimension of services	Import, export	LSPs offering import services (all modes of transport) for appropriate customers, irrespective of the industry.	(Hofmann and Wessely, 2010; Zöllner, 1990)

Furthermore, similar to logistics services, logistics markets also exhibit certain specific characteristics:

- Non-transparency: Logistics markets generally lack transparency (Kille, 2010; Hegemanns, 2008).

- Differentiation of internal services and outsourcing: LSPs are in a constant rivalry with shippers who perform logistics activities independently (as internal service) and do not outsource them to LSPs (Gotzamani et al., 2010).

- Atomistic analogical structure: Logistics markets are characterized by a huge number of small LSPs, often owner-managed. However, because of the trend toward consolidations, large LSPs are increasingly emerging (Bohlmann and Krupp, 2007; Carbone and Stone, 2005).

- General heterogeneity: In logistics markets, highly diverse shippers (LSPs' customers) with different requirements come upon highly diverse LSPs offering a broad range of services (Hoffmann and Resch, 2010; Pfohl, 2010; Benkenstein, 1993).

For the present research, the segmentation criteria will be utilized for the discussion and interpretation of selective results without limiting the research to one specific logistics market segmentation and market boundaries. Furthermore, the four specific characteristics of logistics market have a direct influence on the strategic management and information needs of LSPs. These aspects will be captured in Section 2.2 and Section 2.3.

2.2   Strategic management of logistics service providers

The strategic management of LSPs is faced with some challenges that are based on the specific characteristics of LSPs and logistics markets.[11] Thus, strategic management in general and the peculiarities of strategic management of LSPs are investigated (Section 2.2.1), followed by the depiction of different strategic directions for LSPs present in literature (Section 2.2.2).

2.2.1   General understanding of strategy in the context of logistics service providers

"Strategy at its heart is about positioning for future competitive advantage" (Wells, 1998, p. 52). Basically, a strategy comprises three core elements (de Wit and Meyer, 2001):

- Strategy process: The strategy process addresses the questions of *how* a strategy is formulated, implemented, and evaluated; *who* is involved; and *when* activities will be realized.

- Strategy content: Strategy content is the product of the strategy process and is concerned with *what* a strategy is for a company.

- Strategy context: The strategy context focuses on the environment *where* a strategy is embedded. In this context, the environment refers to the company itself and its external environment.

"The strategy of an enterprise is defined by the answer to two questions: where does the firm compete and how does it compete (Grant, 2002, p. 72)?" Strategic decisions aim at achieving above-average returns (that exceed the cost of capital) and competitive advantages for a company (Johnson et al., 2008; Hitt et al., 2003; Porter, 1980) and answer the questions related to the dimensions of strategy.

Strategy itself can be considered from two perspectives: the outside-in and the inside-out perspective, which are characterized by different attributes, as shown in Figure 5. The outside-in perspective reasons that companies striving for successful strategies should always focus on their external environment (e.g., markets over resources, adaption to environment, see Figure 5). Strategies are developed by analyzing the external environment, including customers and competitors. Hence, according to Day (1990) and Webster (1994), successful companies pursue the outside-in perspective, are externally oriented, and market driven. In sum, the outside-in perspective is "about

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[11] Section 2.2 is based on Section A.2.1 of Appendix A.

market positioning and understanding and responding to external developments" (de Wit and Meyer, 2001, p. 330). The inside-out perspective is resource- or competence- and capability-based (Stalk et al., 1992; Prahalad and Hamel, 1990), and argues that companies' strategic decisions should be based on its strengths, capabilities and resources (e.g., resources over markets, adaption of environment; see Figure 5).

Outside-in perspective		Inside-out perspective
• Markets over resources • Market- / Industry-driven • Market / Industry structure • Adaption to environment • Attaining advantageous position • Market / Industry positioning • Attaining necessary resources • Bargaining power and mobility barriers	**Strategy process** **Strategy content** **Strategy context**	• Resources over markets • Resource-driven • Firm's resource infrastructure • Adaption of environment • Attaining distinctive resources • Developing resource base • Industry entry and positioning • Superior resources and imitation barriers

Figure 5.   Dimensions of strategy and the outside-in and inside-out perspectives on strategy (adapted from de Wit and Meyer, 2001, p. 6 and 332)

Strategic management of LSPs exhibits some specific characteristics: It is often intuitive and does not follow a structured process and systematic analyses. This can be ascribed to the fact that LSPs are often owner-managed. An intuitive management is not said to fail; LSP owners often have a good market and customer knowledge. However, the internal communication and implementation of strategic decisions are often difficult (Bohlmann and Krupp, 2007). The fact that strategic decisions of LSPs are often made in accordance with intuition was also confirmed when conducting some discussions with LSPs that were asked to participate in a survey conducted in the course of this research.[12] In particular, smaller, owner-managed LSPs were not able to provide detailed answers to their information needs in a structured strategic decision, because no process is established and decisions are made "with gut instinct." However, the peculiarities of logistics services (Section 2.1.1), for example, the immateriality of services and the simultaneity of production and usage, as well as the characteristics of logistics markets, for example, the atomistic analogical structure, require a "definite strategic position of LSPs and a clear commitment to customers or their industry sector"[13] (Bohlmann and Krupp, 2007, p. 25). Furthermore, the demand for logistics services is derivative, and LSPs are forced to realize customer requirements and align their strategy to their external environment (Klaas-Wissing, 2010). A further

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[12] The discussions with LSPs were primarily led in the context of study A (Appendix A) to detail questionnaire-based results.

[13] Own translation from German.

characteristic of the strategic management of LSPs is that strategic decisions are often anticipated by their customers, so that LSPs have to accomplish a given strategic direction (Section 1.1).

Information on the internal and external environment is indispensable for strategic management in general and LSPs specifically. In brief, the latter refers to information regarding competitors, customers and markets in general, the internal information to a company's tangible and intangible resources (Citroen, 2011; Hitt et al., 2003; McNeilly, 2002; Wells, 1998). However, according to Bohlmann and Krupp (2007), only the minority of LSPs uses adequate market- and competitor-information for their strategic decisions, although information particularly about markets, customers, and competitors is a critical success factor for LSPs and their strategic decisions (Zöllner, 1990).

This general consideration of strategy builds the basis for the in-depth consideration of strategic issues of LSPs in Section 2.2.2 as well as the investigation of their information needs in Section 2.3. Generally it is to say that an outside-in perspective on strategy will be taken in the context of this research, which is based on the specific characteristics of logistics services and markets. The demand for logistics services is derivative and strategic decisions of LSPs are mainly market-driven (Bretzke and Barkawi, 2012).

2.2.2 Strategic directions of logistics service providers

In literature, there are few investigations of strategic issues of LSPs. Zöllner (1990) conducted a detailed analysis of the customer and competitor analysis of LSPs in strategic planning processes, which also included issues of strategic market definitions. Africk and Calkins (1994) defined strategic directions of LSPs based on their asset intensity. Berglund et al. (1999) presented empirical findings for the strategic segmentation of LSPs. Furthermore, Berglund (2000) explained strategic positions of LSPs under consideration of their specific characteristics and general market developments. Bask (2001) adopted a strategic viewpoint of the analysis of the relationship between LSPs and shippers or supply chain members. Based on two former studies, Persson and Virum (2001) developed growth strategies for LSPs related to different strategic directions. Moreover, Delfmann et al. (2002) analyzed the impact of market trends, namely electronic commerce, on the strategies of LSPs. Hertz and Alfredsson (2003) analyzed the *Strategic Development of Third Party Logistics Providers* over time. Schmitt (2006) investigated the potential of the 4PL concept as a strategic option for 3PLs (narrow perspective). Yeung et al. (2006)

studied the linkage of financial performance and strategic orientation of LSPs and identified a close relationship. In the edited volume *Strategisches Management für Logistikdienstleister* (*Strategic Management of Logistics Service Providers*[14]) of Bohlmann and Krupp (2007), several authors considered various strategic aspects of LSPs, for example, challenges of the strategic management of LSPs, the market and service choice, value-based approaches, market segmentation, resources or information and communication technology (ICT). In their work on the *Strategic Positioning of Logistics Service Providers*, Juga et al. (2008) reviewed strategic positioning models for LSPs to understand how LSPs position themselves. Klaas-Wissing (2010) focused on the analysis of generic strategies of LSPs.

As the brief literature review shows, the first efforts for the analysis of strategy in an LSP-context were made in the 1990s, while most work has been published within the last 15 years. In 1997, Olavarrieta and Ellinger (1997, p. 559) stated that "ten to 15 years of theory development in strategy research has been largely neglected in the strategic logistics literature." However, even ten years later, Yeung et al. (2006) still asked for integrated research efforts in the field of LSPs and strategy.

Most literature concerned with strategy and LSPs focuses on their strategic positioning or alternative strategic directions.[15] An established approach for strategic directions, referring to strategy content and context (Figure 5), is Ansoff's (1957) product-market matrix that aims to answer the questions of which products to offer in which markets. This "classical" approach for strategy segmentation can be visualized in a 2×2 matrix, with products on the horizontal axis and markets on the vertical axis (both divided into current and new) (Figure 6 A). In their analysis of strategic positioning of LSPs, Juga et al. (2008) adapted a service- / market-based matrix from Johnston and Clark (2001), who also differentiated four strategic directions based on Ansoff's matrix. The horizontal axis of this 2×2 matrix is the range of services (divided into narrow and wide), and the vertical axis is markets (divided into few and many) (Figure 6 B).

Considerations of the strategic positioning of LSPs were also made referring to resource-based or competence-based approaches (Juga et al., 2008). The resource-based model developed by Africk and Calkins (1994) differentiates asset- and non-asset-based LSPs, resulting in a 2×2 matrix with management services on the horizontal axis and physical services on the vertical axis (both divided into low and

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[14] Own translation from German.
[15] The following paragraph is based on Section A.2.1 of Appendix A.

high complexity / customization) (Figure 6 C).[16] Hertz and Alfredsson (2003) pursued a competence-based strategy segmentation for LSPs and developed a 2×2 matrix with customer adaption (of LSPs) on the horizontal axis and general problem solving ability on the vertical axis (both divided into relatively high and high) (Figure 6 D).[17]

A Management literature (product-/market-based)	**B** Service literature (service-/market-based)

Product

	Current	New
Markets New	Market development	Diversification
Markets Current	Market penetration	Product development

Ansoff, H.I. (1957)
Product-/market-based matrix

Range of services

	Narrow	Wide
Markets Many	Service focused	Unfocused
Markets Few	Market and service focused	Market focused

Johnston and Clark (2001)
Service-/market-based matrix

C Logistics literature (resource-based)	**D** Logistics literature (competence-based)

Management services

Increasing complexity / customization →

Physical Services Increasing complexity / customization →	Physical contract logistics services	Integrated contract logistics services
	Basic services	Management contract logistics services

Africk and Calkins (1994)
Logistics service matrix

Customer adoption

	Relatively high	High
Problem solving general ability High	Service developer	Customer developer
Problem solving general ability Relatively high	Standard TPL provider	Customer adapter

Hertz and Alfredsson (2003)
Third party logistics (TPL) provider matrix

Figure 6.   Strategic directions in management, service, and logistics literature

For the present research, considerations of the information needs of LSPs will be made referring to Juga et al.'s (2008) service- / market-based strategic directions for LSPs (Figure 6). The approach is closely related to the outside-in perspective on strategy chosen for this thesis. It must be noted that resource- and competence-based approaches refer to the inside-out perspective. The adoption of the service- / market-

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[16] Further resource-based strategic positioning approaches were also pursued by Bask (2001) and Dornier et al. (2008).

[17] Further competence-based strategic positioning approaches were also pursued by Berglund et al. (1999) as well as Halldórsson and Skjøtt-Larsen (2004).

based matrix allows for differentiated investigations of strategic decisions of LSPs; this implies the analysis of the information needs of LSPs pursuing different strategic directions. In this context, a strategic direction is one element of the service- / market-based matrix; thus, a total of four directions will be considered.[18]

In contrary to general management literature, logistics-related works has hardly spent attention to the information needs of LSPs in strategic decision or specific directions, respectively. This aspect will be considered in the following section.

2.3 Information needs of logistics service providers in strategic decisions and the availability of information

In the following sections, the information needs of LSPs in strategic decisions are derived based on a review of general management literature (Section 2.3.1). Related to the identified information needs, the state-of-the-art of available information is provided (Section 2.3.2).

2.3.1 Information needs in strategic decisions of logistics service providers

As Day (1981) already stated 30 years ago, market information is inevitable for strategic decision-making. "Relevant strategic inputs derived from the analysis of the internal and external environments are necessary for strategic decision. […] Firms understand the external environment by acquiring information on competitors, customers, and other stakeholders to build their own base of knowledge and capabilities" (Hitt et al., 2003, p. 7). Missing information or lack of knowledge can negatively influence strategic activities and their success (Buckley et al., 1987).

General strategic management literature analyzes the type of information needed for strategic decisions in detail. Hitt et al. (2003) basically distinguished between the external and internal information needs for strategic decisions. They subdivided external information needs in the following categories:

- Information on the general environment: demography (e.g., population size), economy (e.g., inflation), politics / legislation (e.g., taxation laws), socio-culture (e.g., workforce diversity), technology (e.g., innovations), global segment (e.g., critical markets), physical environment (e.g., energy sources).

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[18] The analysis of the information needs of LSPs pursuing different strategic directions was conducted in the context of study A (Appendix A).

- Information on the industry environment: threat of new entrants, bargaining power of suppliers, bargaining power of buyers, threat of substitute products, rivalry among competing firms (Porter, 1980).

- Information on the competitors: future objectives (e.g., attitude towards risk), current strategy (e.g., served markets), capabilities (e.g., strengths and weaknesses).

Internal information needs were also divided into three categories (Hitt et al., 2003):

- Resources: tangible resources (organizational, physical, technological resources) and intangible resources (financial, human, innovation, reputational resources).

- Capabilities: concerned with the abilities to exchange information, develop, and create knowledge.

- Core competencies: identification of competitive advantages.

McNeilly (2002) distinguished three relevant information categories as well as their sources:

- Knowledge of competition: for example, financial results, number of employees, offered products (and services), markets operating in. Sources are annual reports, advertising and announcements, trade journals, and analysis of past behaviors.

- Knowledge of own company: for example, strengths and weaknesses, customers and their intentions, cost structures, critical processes, employees. Sources are internal reports, balance scorecards, and employees themselves.

- Knowledge of market: for example, size of market, growth rate, industry forces. Sources are own market research and analysis, trade journals, and market estimates.

Citroen (2011, p. 493) stated that "information on the internal and external environment of the organization is a crucial factor in the process of decision-making." He referred to information regarding internal organization, market structures, competitors, customers' attitudes, technologies, regulations and public affairs. Further, Choo (2002) referred to internal and external information, but emphasized that the external environment is much more complex than the organization itself. What is common among the authors is that internal as well as external information of a company should be considered in strategic decisions. Thereby, monetary as well as

non-monetary measures of the different information categories should be considered (Rajesh et al., 2012; Bhimani and Langfield-Smith, 2007).

Information on the external and internal environment is as important for LSPs as for all other companies. However, the strategic management of LSPs shows some specific characteristic that are primarily based on the peculiarities of logistics services and markets (Section 2.1). Despite the relevance of information and their critical function in strategic decisions, logistics literature has not focused on the information needs of LSPs.

In his work on market planning of LSPs, Zöllner (1990) indicated the importance of customer- and competitor-information. He provided a detailed description of the process of customer and competitor analysis of LSPs, ranging from conception, methodologies, and available information sources, for example, federal offices (official statistics) and associations. In summary, he structured customer and competitor analysis, but did not investigate available information in detail and its contributions for strategic decisions of LSPs. The importance of information for strategic decisions of LSPs was also emphasized by Picot et al. (2009), Bohlmann and Krupp (2007), and Baumgartner and Thoms (2002), but detailed analyses of information needs and the information itself are missing. As stated in Section 1.2, most investigations of the information needs in a logistical context have a shipper's perspective and focus on their information needs, for example, when choosing an LSP (Razzaque and Sheng, 1998; Lieb and Randall, 1996; Gore et al., 1992).

It is undisputed that external and internal information of LSPs are of equal importance when taking strategic decisions. However, this research focuses on external information because of the following reasons:

- Logistics services show some specific characteristics (Section 2.1.1) that are primarily based on customers or market circumstances. The immateriality of services, integration of the external factor, simultaneity of production and usage, heterogeneity of customer demand and offered services require broad knowledge, particularly of customer requirements and attitudes. The function of covering distances and dependence on exogenous circumstances further necessitate obtaining information on the market environment of LSPs. To compete and keep up with competition, information on competitors is also indispensable. Moreover, the capital-intensity of LSPs indicates that monetary values should also be taken into account for strategic decisions.

- Logistics markets show some specific characteristics (Section 2.2.2). In particular, the non-transparency of logistics markets justifies the general external information needs of LSPs. The differentiation of internal services and outsourcing, the atomistic analogical structure, and the general heterogeneity make the analysis of the external environment of LSPs difficult. The latter aspects notably necessitate information on customers and competitors as well as on the market in general.

- For LSPs, an outside-in perspective on strategy should be adopted (Section 2.2.1), because the demand for services is derivative and market-driven. Furthermore, strategic decisions of LSPs are often anticipated by their customers. Outside-in strategists emphasize that market and industry knowledge is crucial. Market and industry structure, as well as the "specific demands, strengths, positions, and intentions of all major forces need to be determined. For example, buyers must be understood with regard to their needs, wants, perceptions, decision-making processes, and bargaining chips. The same holds true for suppliers, competitors, potential market and / or industry entrants, and providers of substitute products" (de Wit and Meyer, 2001, p. 331; Porter, 1991).[19]

- Internal company-specific information is easier to collect than external information and, according to Ansoff (1987), strategic decisions are mainly concerned with external problems of a company. Moreover, Choo (2002) emphasized the complexity of a company's external environment contrary to that of the company itself.

Based on the literature review on information in strategic decisions in general, three external information categories are defined[20] for the analyses conducted in the course of this research:[21]

- Market-information:[22] This reflects the economic, social, and political environment of an LSP. The information among others refers to the overall

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[19] This paragraph is based on Section A.2.1 of Appendix A.

[20] The categories were chosen with the aim to provide a generalizable overview of different information, which can also be understood by practitioners, as the categories were also used for a survey conducted in the context of study A (Appendix A).

[21] The listings are based on Section A.2.2 of Appendix A.

[22] In this context, a market is considered as a geographical region. Industry specific markets, such as the logistics market, are included under customer-information as the logistics market volume is derived from customer demand.

economic development (e.g., gross domestic product [GDP]) or infrastructural aspects (e.g., expansion of the road network).

- Customer-information: This concerns the (potential) customers of an LSP. The information among others refers to customer requirements (e.g., quality aspects) or the overall demand for logistics services (e.g., logistics market volume).

- Competitor-information: This regards the (potential) competitors of an LSP. The information refers to the number of competitors within a market, as well as their scope of services and key performance indicators (e.g., turnover), among others.

As information must be balanced in terms of monetary and non-monetary variables (Rajesh et al., 2012; Bhimani and Langfield-Smith, 2007), selected analyses will differentiate monetary and non-monetary variables for each of the three information categories.

The appropriateness of this classification was also confirmed by a survey conducted amongst 17 LSPs.[23] Respondents were asked to name different indicators for each of the three information categories, sub-divided into monetary and non-monetary measures. None of the respondents had any problems in specifying variables. The aggregated results (most mentioned variables) are summarized in Table 3.

Table 3.   Information required by logistics service providers for strategic decision-making (based on survey results)

Information category	Monetary	Non-monetary
Market-information	Fuel prices, GDP, import and export volume (monetary), market volume, taxes	Growth, infrastructure, labor market situation, legislation, political situation
Customer-information	Cash-flow / earnings before interests and taxes (EBIT), liquidity, logistics costs, logistics market volume / demand for logistics services (monetary), turnover	Number of potential customers, outsourcing quote, reputation, service requirements, strategic position
Competitor-information	EBIT, market share, price structure, profit margin, turnover	Customer service, markets operating in, number of competitors, quality of services, quoted / non-quoted, scope of services

Even if the information needs of LSPs in strategic decisions have not been considered in detail in logistics-related research, information in general has been given attention.

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[23] The survey among LSPs was conducted in the context of study A (Appendix A). The results shown in Table 3 were collected as "contextual / soft" information and do not represent the core of the survey.

These investigations and the state-of-the-art of available information for strategic decisions of LSPs will be investigated in Section 2.3.2.

2.3.2 Availability of information for strategic decisions of logistics service providers: state-of-the-art

To benefit from external information and achieve competitive advantage, LSPs have to (1) acquire external information, (2) process this information in order to (3) interpret the information for (4) appropriate usage in strategic decisions (Panayides, 2007; Hitt et al., 2003; Olavarrieta and Ellinger, 1997; Huber, 1991). For this reason, the following considerations provide a brief overview of available information for the three information categories summarized in Table 3, sub-divided into monetary and non-monetary information. In this context, the information is assessed with regard to its (1) accessibility (selected sources), (2) need for adaption, (3) interpretability, and (4) usage. Furthermore, theoretical relevance or considerations of the information is incorporated by presenting logistics-related scientific work. An overview of the considerations is provided in Table 4.

Monetary market-information

Monetary market-information like the GPD, import and export volumes, taxes, or fuel prices can usually be collected from official statistical databases, for example, from federal institutions or the World Bank. The available data is generally provided on a country or regional basis (e.g., cantons in Switzerland, federal states in Germany or Austria, or states in the United States).

The accessibility of monetary market-information is comparatively good; furthermore, the information can generally be processed with little adaptation. As the information is not specifically provided for LSPs and their strategic decisions, its appropriate interpretation and usage are challenges.

In logistics research, monetary market-information, among other aspects, is used to estimate the logistics market volume. Berglund et al. (1999) based their estimation on the GDP and Stölzle et al. (2014) forecasted logistics market development among others on the basis of the GDP. Bowersox et al. (2003) additionally referred to monetary import and export volumes to estimate global logistics expenditures.

Non-monetary market-information

Similar to monetary market-information, non-monetary market-information, for example, on the infrastructure, growth rates, political situations, and legislation can

usually be collected from official (statistical) databases (from federal institutions, on country or regional basis). Moreover, foreign offices provide such information.

Similar to monetary market-information, the accessibility of non-monetary market-information is comparatively good and the information can generally be processed with little adaptation. Challenges arise in its appropriate interpretation and usage.

In logistics research, Bowersox and Calantone (1998) referred to infrastructure systems for their estimation of global logistics expenditures; in subsequent research (Bowersox et al., 2003), they also used country size variables such as the total area, coastline, or urban population.

Monetary customer-information

The accessibility of monetary customer-information is faced with some challenges compared to market-information. Information on single companies, for example, financial indicators such as turnover or EBIT – can be obtained by analyzing annual or financial reports – if published. Furthermore, financial databases like Thomson Reuters or Bloomberg provide detailed financial information on companies, if the companies are quoted or publish relevant information. Aggregated information like the logistics market volume that is composed of the demand for logistics services by LSPs' customers is generally not published in official databases. A variety of LMSs[24] provide country-specific logistics market volumes, published by market research or scientific institutions, consultancies, and in some cases by federal institutions.

While edited information, for example, on the logistics market volume, "only" needs to be interpreted and correctly used for strategic decisions of LSPs, if ever available, plain company specific information like the turnover has to be processed before it can be interpreted and used. This implies that information, for example, that is published in the form of LMSs, has a kind of "logistical target", whereas company specific information is more general without a precise focus and has to be adapted for each specific purpose.

In particular, logistics-related research investigates the estimation of the logistics market volume when referring to monetary customer-information (Kille, 2007; Distel, 2005; Rodrigues et al., 2005; Bowersox et al., 2003; Bowersox and Calantone, 1998).

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[24] For a detailed listing, see Appendix B.

Non-monetary customer-information

Collecting non-monetary customer-information is faced with major challenges. While general information such as the number of potential customers and industry trends may be collected by market analysis, specific information like requirements or outsourcing quotes can only be collected by conducting specific studies. Some LMSs[25] also offer customer-specific information by conducting surveys amongst shippers. Furthermore, a variety of industry-specific studies is published by marketing research institutes and consultancies. In particular, consultancies offer a variety of industry-specific studies (see among others BCG, 2014; McKinsey & Company, 2014; PWC, 2014).

The main challenge regarding non-monetary customer-information is its acquisition. As information, for example, customer requirements, is generally collected with an explicit target, information processing for specific use, meaning strategic decisions is not faced with major challenges. Nonetheless, the correct interpretation and reasonable usage for strategic decisions of LSPs is inevitable.

Logistics-related research on non-monetary customer-information predominantly adopts a shipper's perspective. As stated in Section 1.2, recent research analyzed the information needs of shippers for choosing LSPs (Razzaque and Sheng, 1998; Lieb and Randall, 1996; Richardson, 1995). This supports strategic decisions of LSPs to the extent that they know which information to collect, but the information itself is only difficult to obtain.

Monetary competitor-information

Similar to monetary customer-information, the collection of monetary competitor-information is faced with some challenges. Information on single LSPs, for example, financial indicators such as turnover and EBIT, can be obtained by analyzing annual or financial reports; moreover financial databases provide detailed information on LSPs, if the LSP is quoted or publishes relevant information. As most LSPs are non-quoted and owner-managed, data availability is limited. In the meantime, a variety of LMSs[26] at least provide rankings of the LSPs with the highest turnover in a country.

Similar to monetary customer-information, monetary competitor-information has to be processed before it can be interpreted and used for strategic decisions of LSPs. The usage of monetary competitor-information for strategic decisions of LSPs has not been established yet. However, LSPs are increasingly under pressure of capital markets;

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[25] For a detailed listing, see Appendix B.
[26] For a detailed listing, see Appendix B.

furthermore, financial indicators offer important information when pursuing growth strategies, establishing cooperation, M&A's or striving for organic growth.

As stated in Section 1.2, monetary information becomes more and more important for strategic decisions of LSPs (Drobetz et al., 2013; Hofmann and Lampe, 2013; Liu and Lyons, 2011; Gotzamani et al., 2010). The authors have in common that they identified the relevance of monetary information or financial variables for the strategic management and related decisions of LSPs, but the focus of the analyses is mainly on the financial structure of LSPs. First managerial implications are given, but clear recommendations for strategic management or the usage of correspondent data for strategic decisions is missing.

Non-monetary competitor-information

Information on the scope of services, markets operating in, or the customer service of competitors can in most cases be collected from the web pages or information materials. The quality of offered services cannot be assessed by LSPs themselves, but by their customers. Hence, collecting this information is faced with the same challenges as in the case of non-monetary customer-information. General information regarding the number of competitors is also given by a variety of LMSs.[27] Studies focusing on LSPs or the transportation industry are also published by consultancies (see among others BCG, 2014; McKinsey & Company, 2014; PWC, 2014), and may be used for strategic decisions of LSPs.

Acquiring and processing non-monetary competitor-information is faced with some minor challenges – a variety of information can be found on competitors' web pages or other information material. However, it has to be noted that own market research activities may have to be conducted, which occupies resources. As valid for all information categories, interpretation and reasonable usage of the information is inevitable for strategic decision-making.

Logistics research has given only little attention to non-monetary competitor-information. Various authors emphasize that LSPs have to regard their competitors and have to gain competitive advantage, for example, by differing from competitors (Delfmann et al., 2002; Persson and Virum, 2001). Wang et al. (2006) conducted a survey asking LSPs to position themselves to their primary competitor, but only based on estimations and not reliable competitor-information.

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[27] For a detailed listing, see Appendix B.

Logistics market surveys as comprehensive information sources[28]

As the brief investigation of the information categories has shown, there are a variety of sources for external information required in strategic decisions of LSPs. The information provided has to be distinguished in the sense that on the one hand some is "ready to use", for example, specific studies on logistics market volumes or customer branches. On the other hand, general information, for example, from statistical or financial databases has to be processed for correct interpretation and usage in strategic decisions of LSPs.

Table 4.   Assessment of available information from managerial and theoretical perspectives

	Accessibility (acquire)	Need for adaption (process)	Interpretability (interpret)	Usage (use)	Theoretical considerations
Monetary market-information	Good	Low-medium	Major challenge		Established, for example, for market estimates
Non-monetary market-information	Good	Low-medium	Major challenge		Established, for example, for market estimates
Monetary customer-information	Medium	Medium-high	Major challenge if no specific logistics information		Established, for example, for market estimates
Non-monetary customer-information	Low	Low	Medium challenge	Dependent on the LSPs or employees capability	Predominantly a shipper's perspective, for example, requirements on LSPs
Monetary competitor-information	Medium	Medium-high	Major challenge if no specific logistics information		First general considerations, for example, financial structure of LSPs
Non-monetary competitor-information	Low-medium	Low	Medium challenge		Not established

LMSs that have been selectively mentioned before, publish a broad range of logistics-related information (most on country basis), referring to markets, shippers, and LSPs. The studies are not explicitly targeted at LSPs, but they also address shippers, politics, or researchers. However, LMSs provide a fundamental basis of information for strategic decision-making of LSPs. In the meantime, a variety of LMSs is available,

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[28] This paragraph is based on Section B.2 of Appendix B.

but exhibit substantial differences, for example, the analyzed market, analyzed indicators, data basis, and methodology.

Because of the differences of LMSs and their broad target group, information also has to be processed for usage in strategic decisions. Furthermore, the publishers of LMSs also have to collect the appropriated data, and are hence faced with the same abovementioned challenges related to the three information categories (Rodrigues et al., 2005; Bowersox et al., 2003). Despite the awareness of the increasing importance of information in logistics, recent research did not analyze LMSs as information sources.[29]

2.4 Unit of analysis for the research on the information needs of logistics service providers in strategic decisions

Based on the considerations of the characteristics of LSPs and logistics market, and the strategic management as well as information needs of LSPs in strategic decisions, the unit of analysis of this research is presented in Figure 7.

As the literature review has shown, the information needs in strategic decisions are indispensable. Recent research has focused on the strategic management of LSPs, but in-depth investigations of the information needs of LSPs in strategic decisions have only found little attention, despite its relevance. For this reason, the present research aims to close the gap between general strategic management and logistics-related literature by analyzing the information needs of LSPs in strategic decisions. Because of the specific characteristics of the strategic management of LSPs, an outside-in perspective on strategy (content and context) is adopted. The focus will be on the external information needs of LSPs – including market-, customer-, and competitor-information – sub-divided into monetary and non-monetary information. To integrate recent research on LSPs' strategy, the information needs in four strategic directions of LSPs or the importance of different information categories in each strategic direction will be investigated, respectively. The strategic directions are derived from the service- / market-based matrix (Juga et al., 2008), as it is closely related to the outside-in perspective on strategy. On this basis, relevant available information will be analyzed (in the form of LMSs) to investigate if LSPs' information needs are met. Furthermore, because of its increasing importance, monetary competitor-information (referring to cost of capital) will be analyzed to provide implications for the processing and usage of such information.

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[29] An in-depth investigation of LMS is conducted in study B; for details see Appendix B.
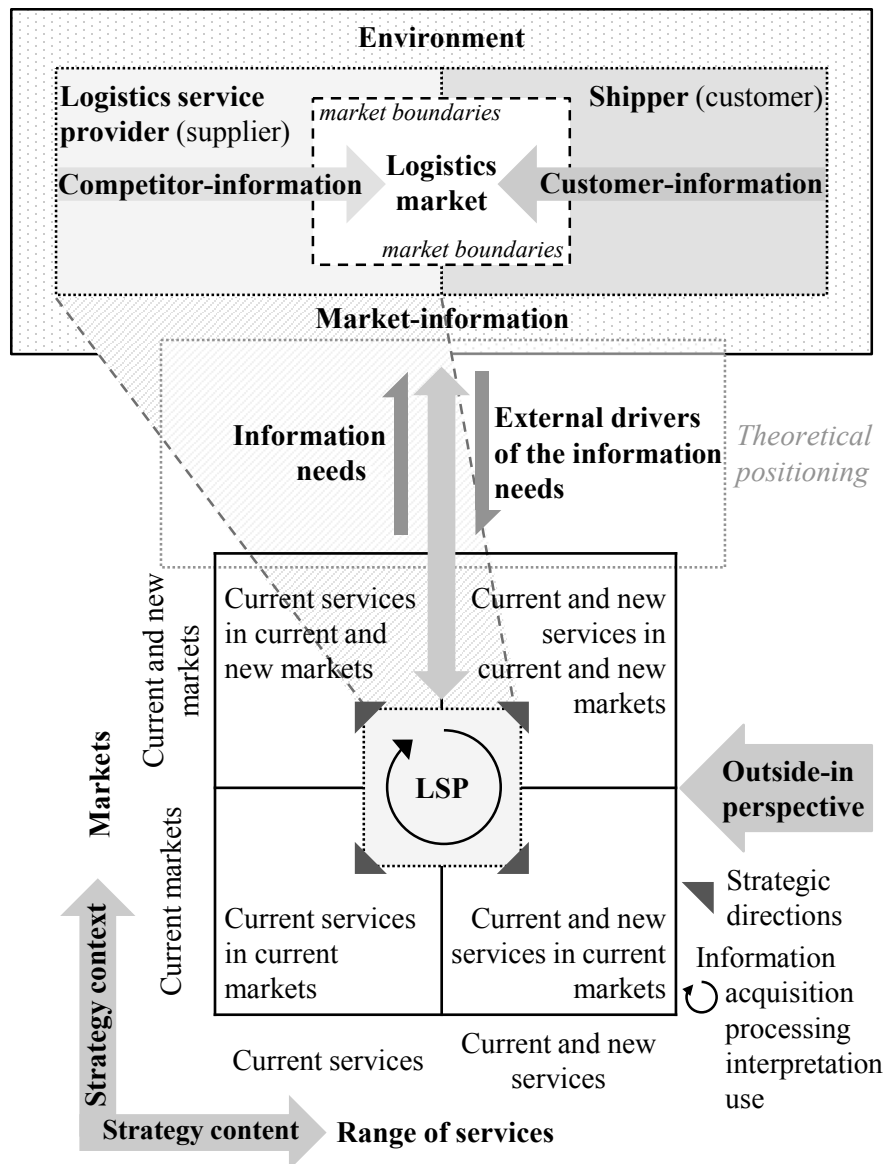
Figure 7.   Unit of analysis of the research on the information needs of logistics service providers
                in strategic decisions

As briefly described in Section 1.3, the unit of analysis has to be embedded in market-
and resource-based theoretical approaches. On the one hand, theories related to
market-based approaches help understanding the structure of markets, and hence the
external environment of LSPs, which mainly influences their strategic decisions. On
the other hand, LSPs have to acquire and process the collected information for
strategic decisions, which requires the integration of resource-based approaches. The
theoretical positioning of the research, implying the definite theory selection and
application, will be considered in Section 3.

3 Theoretical positioning of the research on the information needs of logistics service providers in strategic decisions

In the following sections, the theoretical framework for the present research is developed. Section 3.1 is concerned with theory requirements, possible theoretical approaches and their applicability. The selected theories are described in Section 3.2, whereas Section 3.3 combines the elucidations into the theoretical framework of the present research.

3.1 Theory selection and applicability

In Section 3.1.1 theory requirements are developed on the basis of the research context, and general criteria for theory selection are derived. Based on the requirements and selection criteria, in Section 3.1.2, possible theoretical categories for the present research are provided. On this basis, possible theories are briefly described and evaluated with regard to their application in Section 3.1.3.

3.1.1 Theory requirements

"Compared to older and more established academic disciplines […], logistics does not have as rich a heritage of theory development and empirical research" (Stock, 1997, p. 515). Consequently, logistics research often applies theories from other disciplines. In the present research context, the following requirements on theory application can be derived from the outlined conceptual background (Section 2) as well as the relevance of the research on the information needs of LSPs in strategic decisions (Section 1). An applicable theory acknowledges and explains

- the influence of external drivers on the strategic management or strategic decisions of LSPs,

- the importance of external information for the strategic decisions of LSPs,

- information or knowledge as an LSP's strategic resource for achieving sustainable competitive advantage,

- the process of information acquisition, processing, interpretation, and use or its transformation into a knowledge resource.

Because no theory is expected to fulfill all requirements,

- an applicable theory should furthermore exhibit the ability for integration and combination with other theories.

In logistics-related research, a variety of theoretical approaches is applied. In their work *An Inventory on Theories in Logistics and SCM Research*, Defee et al. (2010) reviewed 683 articles published in the most relevant logistics and supply chain management (SCM) journals.[30] In total, they identified 183 different theories, applied in a logistical or SCM context, which they classified into 12 categories. Similar analyses of theories in a logistical research context have also been conducted by Stock (1996, 1997).

With regard to the substantial amount of potential theories for logistics research, the selection of appropriate theories has to follow a structured process. Stölzle (1999) identified four categories of criteria, by which theory selection can be structured:

- Theoretical attractiveness: This refers to the explanatory power of a theory under the existence of a research paradigm. The latter is said to be generalizable, precise, structured, and offers approaches for problem solving (Ulrich and Hill, 1979). In the context of the present research, a theory is attractive when it has found diverse application in the field of logistics research, explaining and acknowledging various research problems.

- Design-orientation: This refers to the existence of efficiency criteria (design objectives), design variables, and determinants for the operationalization of theoretical approaches. From a formal viewpoint, informative content, empirical relevance, and applicability are considered to ensure managerial practicability (Grochla, 1980). In the context of the present research, an applicable theory provides implications for the identification of LSP's information needs, as well as information acquisition, processing, interpretation, and use or its transformation into a knowledge resource, respectively.

- Integration-ability: This refers to the possibility of the further development of a theory, the integrative consideration with other theories, and its ability for structuring (Bruhn and Bunge, 1996). In the context of this research, an applicable theory should particularly exhibit the ability for integration and combination with other theories.

- Adaptability to the present research context: The most fundamental criterion is the general suitability of a theory to the research context and the proposal of

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[30] Journal of Business Logistics (JBL), Transportation Journal (TJ), Journal of Supply Chain Management (JSCM), International Journal of Physical Distribution & Logistics Management (IJPDLM) and The International Journal of Logistics Management (IJLM).

implications. In the context of this research, an applicable theory fits the research on the information needs of LSPs and fulfills at least one of the theory requirements mentioned earlier.

The requirements on applicable theories derived from the conceptual background of the research, as well as the criteria for structuring theory selection identified by Stölzle (1999), will be used for theory selection (Section 3.1.2 and Section 3.1.3).

3.1.2 First selection of theory categories

For the first limitation of possible theories for the present research context, 12 theory categories derived by Defee et al. (2010) are evaluated. Additionally, information economics[31] is investigated (which was not considered by Defee et al. 2010), as it is often mentioned in the context of strategic management research. For example, Makadok and Barney (2001) borrowed theories from information economics to investigate "decisions made by firms about the amount and type of research they do about the value of a new resource [information]." The theory categories are evaluated in terms of their theoretical attractiveness and adaptability to the present research context (Table 5).[32] The other two selection criteria will be applied when assessing single theories (Section 3.1.3). Thereby, the theoretical attractiveness is evaluated on the basis of its frequency of application.[33]

Table 5.   Description, attractiveness, and adaptability of theory categories[34]

Theory category	Explanatory power of theories	TA[1)	Adaptability (L=low, H=high)	[2)
Competitive	Explain relationships of competitive market processes, focusing on market forces and a company's resources	+	High adaptability because of the focus on market forces and companies resources as well L ▬▬▬▬▬ H	✓
Decision	Provide criteria and methodologies to solve decision problems	-	Medium adaptability, focus on criteria and methodologies for decisions, not information L ▬▬▬ H	✗

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[31] In most considerations, information economics is not considered as a single theory (Raff, 2000), but as a kind of "meta construct" that includes different theoretical approaches, such as search theory (Stigler, 1961), decision theory (Marschak, 1954) and information asymmetries (related to the principal agent theory) (Lofgren et al., 2002). For this reason, information economics is considered as a theory category in the context of the present research.

[32] The classification of theories to the different theory categories by Defee et al. (2010) is listed in Appendix I.

[33] The frequency of application has also been investigated by Defee et al. (2010). For information economics, the frequency of application was derived from a brief literature review.

[34] The description of the theory categories is based on the references given by Defee et al. (2010).

Theory category	Explanatory power of theories	TA[1]	Adaptability (L=low, H=high) [2]
Information economics	Focuses on information asymmetries, related uncertainties, and costs that arise when intending to reduce both	+	Medium adaptability, focus is on information, but particularly on its costs, which is not in the focus of the present research ✘ L ▬▬▬ H
Innovation	Explain the adaption and diffusion of innovations and related processes	–	Low adaptability because innovations are not in focus of the present research ✘ L ▬ H
Institutional	"Examine the processes and mechanisms by which structures, schemas, rules, and routines become established as authoritative guidelines for social behavior"[35]	–	Low adaptability because of the focus on institutional design and the integration of social behavior ✘ L ▬ H
Inventory	Explain cost minimization with regard to order quantity and inventory systems	●	Low adaptability because inventory is not in the focus of the present research ✘ L ▬ H
Marketing	Primary focus on customer / buyer-supplier relationships, customer orientation, acknowledge the need for a position in the marketplaces that causes a customer's need	+	Medium adaptability, focus not only on external environment and customer needs but also their cause and relationships ✘ L ▬▬▬ H
Micro-economic	Explain transaction costs, the dependency and competition of companies on resources, and agency problems	+	Medium adaptability, focus on various internal and external aspects of a company, but not directly linked to the information needs and their drivers ✘ L ▬▬▬ H
Other social psychological theories	Explain behavioral aspects and information systems in communication and information processes	●	Low adaptability because behavioral aspects are not in focus of the present research ✘ L ▬ H
Psychological theories of individuals	Explain individual behavior	–	Low adaptability because individual behavior is not in focus of the present research ✘ L ▬ H
Social exchange	Explain social (network) structures and related process between individuals and groups	●	Low adaptability because social structures are not in focus of the present research ✘ L ▬ H
Systems	Explain various aspects of systems, for example, errors, accidents and risks, costs and constraints	+	Medium adaptability, focus on systems in general, but not specifically linked to the present research context ✘ L ▬▬ H

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[35] Scott (2004, p. 411).

Theory category	Explanatory power of theories	TA[1]	Adaptability (L=low, H=high)	[2]
Theories of organization	Explain organizations, their development and learning, reactions to change and the influence of the external environment as well as the interrelation with it	+	High adaptability because of the focus on the external environment and related adaptations of companies L ▬▬▬▬▬▬ H	✓
Other	*Those theories could not have been classified to one of the 12 categories and will be separately considered if appropriate*			

Note: [1] TA is theoretical attractiveness, + is high, ● is medium, - is low; [2] ✓ category is selected for further investigation, ✗ category is not selected for further investigation.

For definite theory selection, theories related to the categories with the highest adaptability, namely "competitive" and "theories of organization" will be investigated in detail. Contrary to the excluded theory categories, they were chosen as they refer to LSPs' resources (information) and the influence of the external environment, and consequently meet most of the defined theory requirements (Section 3.1.1). To fulfill all requirements, logistics- and strategic management-related literature is consulted to support theory selection. Moreover, the theories from the "other" category will be considered if appropriate.

3.1.3 Possible theoretical approaches

Based on the investigations in Section 3.1.3, the work of Defee et al. (2010) and related logistics and strategic management literature, possible theoretical approaches will be investigated in this section. Referring to Defee et al. (2010), the most common competitive theories as well as theories of organizations will be assessed in greater detail for their possible application in the research context. Namely, these are contingency theory, dynamic capabilities, interdependence theory, knowledge-based view, organizational learning, organizational theory, porter's framework, and the resource-based view.

In their work on *Resource-Based Theory and Strategic Logistics Research*, Olavarrieta and Ellinger (1997) explicitly asked for the integration of the resource-based view or, in other words, the resource-based theory of the firm in logistics research. Further, because of its managerial limitations, they suggested the combination with organizational learning theory to understand strategic logistics issues. Moreover, they referred to industrial organization (as basis of Porter's framework), which traditionally has found high attention in management and strategy research. Similar suggestions were made by Yew Wong and Karia (2010). Hence, industrial organization will also be considered as a possible applicable theory. Along with organizational learning,

several authors furthermore mentioned the theory of information processing (Rogers et al., 1999; Sinkula, 1994; Egelhoff, 1991). Consequently, information processing will also be investigated.

The characteristics of possible theoretical approaches are briefly below:

- Contingency theory: "The essence of the contingency theory paradigm is that organizational effectiveness results from fitting characteristics of the organization, such as its structure, to contingencies that reflect the situation of the organization" (Donaldson, 2001, p. 1). In this context, contingencies represent the environment, size, and strategy of an organization. For the present research, the contingency theory could be applied to structure the research, which implies the integrated consideration of LSPs (as organizations) and their external environment (as the driver for LSPs' information need).

- Dynamic capabilities: Dynamic capabilities can be defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage, given path dependencies and market positions" (Teece et al., 1997, p. 516). The overall objective is the generation of competitive advantage by dynamic capabilities. For the present research, dynamic capabilities could be applied to constitute the required capabilities of LSPs to process information.

- Industrial organization:[36] Approaches from the 1950s state that the "essence of this [IO] paradigm is that a firm's performance in the marketplace depends critically on the characteristics of the industry environment in which it competes" (Porter, 1981, p. 610). Porter further developed the approach and applied industrial organization to single companies. Finally, this led to the market-based view. Explanatory power refers to the understanding of market structures and companies operating on such structures as well as their interaction (Carlton and Perloff, 2005). For the present research, industrial organization could be applied to acknowledge the influence of external drivers on the strategic management or strategic decisions of LSPs.

- Information processing: This is closely related to organizational learning. According to Huber (1991, p. 89), "an entity learns if, through its processing of information, the range of its potential behavior is changed." Here, an entity can

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[36] This is also referred to as industrial economics.

refer to individuals or organizations as well that process information by acquiring, distributing, or interpreting it. For the present research, information processing could be applied to describe the process of information processing by LSPs or employees.

- Knowledge-based theory of the firm:[37] The knowledge-based theory of the firm is a further development of the resource-based view. "Knowledge is viewed as residing within the individual, and the primary role of the organization is knowledge application […]. The […] theory has implications for the basis of organization capability, the principles of organization design […], and the determinants of the horizontal and vertical boundaries of the firm" (Grant, 1996, p. 109). Knowledge is said to be the most important source for strategic management and the achievement of competitive advantage. For the present research, the knowledge-based theory of the firm could be applied to acknowledge the importance of information as a resource for LSPs' strategic decision-making.

- Organizational learning: A variety of concepts of organizational learning exist. According to Argote (2012, p. 31), "most researchers agree with defining organizational learning as a change in the organization's knowledge that occurs as a function of experience." For the present research, organizational learning could be applied to explain how an LSP could transform market-, customer- and competitor-information into knowledge for use in strategic decisions.

- Organizational theory: "Organizational theory is seen as the academic field specializing in the study of organizational phenomena (both micro and macro)" (Tsoukas and Knudsen, 2005, p. 3). The theory examines the development of organizations, and apart from organizations themselves, the relationship with their environment. For the present research, organizational theory could be applied to structure the research, which implies the integrated consideration of LSPs and their external environment.

- Porter's framework: The framework of industry analysis and strategy development is based on industrial organization. It describes five forces from the external environment determining profitability: Threat of new entrants, threat of substitute products or services, bargaining power of customers, bargaining power of suppliers, and intensity of competitive rivalry (Porter,

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[37] This is also referred to as the knowledge-based theory or knowledge-based view.

1980). For the present research, Porter's framework could be applied to identify external influences on the strategic management or strategic decisions of LSPs.

- Resource-based view:[38] The resource-based view explains competitive advantage by focusing on a company's resources, its possession and application (Wernerfelt, 1984). These resources "include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm" (Barney, 1991, p. 101). For the present research, the resource-based view could be applied to acknowledge the importance of LSPs' resources (such as information) for achieving competitive advantage.

In Table 6, the introduced theories are evaluated based on the selection criteria provided by Stölzle (1999). As the theoretical attractiveness of the theories has already been emphasized in Table 5 and related literature, and the integration ability of all considered theories is high, these aspects are not illustrated. The adaptability to the present research objectives is evaluated in greater detail, regarding the specific theory requirements in the context of the research on the information needs of LSPs.

Table 6.   Design orientation and adaptability of possible theories

Theory	Design orientation (L=low, H=high)	Adaptability (L=low, H=high)	[1)]
Contingency theory	Suggests that an organization should adapt to contingency variables (determinants)	Acknowledges the influence of contingencies (external and internal) on the performance of LSPs; the present research focuses only on external contingencies	✗
	L ▬▬▬▬▬▬ H	L ▬▬▬▬▬▬ H	
Dynamic capabilities	Explains methods and sources (determinants) for the generation of competitive advantage	Focuses on the capabilities of LSPs to create competitive advantage; the present research focuses on resources instead of capabilities	✗
	L ▬▬▬▬▬▬ H	L ▬▬▬▬▬▬ H	
Industrial organization	Analyzes determinants of a company's performance	Acknowledges the influence of external drivers on the strategic management or strategic decisions of LSPs	✓
	L ▬▬▬▬▬▬ H	L ▬▬▬▬▬▬▬▬ H	
Information processing	Examines information processing	Focuses on the capabilities of LSPs for acquiring, processing, interpreting and using information; the present research focuses on resources	✗
	L ▬▬▬▬▬▬▬▬ H	L ▬▬▬▬▬ H	

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[38] This is also referred to as the resource-based theory of the firm.

Theory	Design orientation (L=low, H=high)	Adaptability (L=low, H=high)	[1]
Knowledge-based theory of the firm	Focuses on knowledge for the achievement of competitive advantage	Acknowledges the importance of information / knowledge for strategic management / decisions of LSPs and for achieving competitive advantage	✓
	L ▰▰▰▰▰▰▰▰ H	L ▰▰▰▰▰▰▰▰ H	
Organizational learning	Examines a learning process in order to create knowledge	Explains knowledge generation by processing information, in order to enable strategic decisions of LSPs	✓
	L ▰▰▰▰▰▰▰▰ H	L ▰▰▰▰▰▰▰▰ H	
Organizational theory	Examines the development of organizations and their relationship with the environment	Explains the development stages of LSPs and has a very broad perspective	✗
	L ▰▰▰▱▱▱▱▱ H	L ▰▰▰▱▱▱▱▱ H	
Porter's framework	Describes five forces determining an organization's profitability	Acknowledges the influence of customers, competitors / services and suppliers on LSPs' profitability; the present research also focuses on general market conditions	✗
	L ▰▰▰▰▰▰ H	L ▰▰▰▰▰▱▱ H	
Resource-based view	Focuses on a company's resources for achieving competitive advantage	Acknowledges the importance of resources for strategic management / decisions of LSPs and for achieving competitive advantage; the present research explicitly focuses on knowledge as a resource	✗
	L ▰▰▰▰▰▰ H	L ▰▰▰▰▰▰▰ H	

Note: [1] ✓ theory is selected for present research, ✗ theory is not selected for present research.

For the present research, (1) industrial organization, (2) the knowledge-based theory of the firm, and (3) organizational learning will be applied. In general, the chosen theories have a higher explanatory power for achieving the research objectives, whereas the excluded theories rather support structuring the research. Industrial organization is preferred compared to the contingency theory, as it explicitly focuses on the external environment of an LSP, whereas contingencies are, for example, also related to size and strategy, and hence internal aspects of an LSP. Industrial organization is also chosen over Porter's framework, because the latter has a relatively narrow perspective on external drivers of an LSP's profitability. The knowledge-based theory of the firm is preferred compared to the resource-based view, as it can be considered as a further development of the latter, explicitly focusing on information or knowledge. Organizational learning is chosen over dynamic capabilities and information processing, because the former focuses on dynamic capabilities that can be understood as "processes to integrate, reconfigure, gain, and release resources" (Eisenhardt and Martin, 2000, p. 1107). Furthermore, the resources processed with dynamic capabilities do not exclusively refer to information or knowledge. The theory

of information processing focuses on the capabilities of an organization (or an individual) to process information. Both dynamic capabilities as well as information processing focus on capabilities for processing information and not the information (as a resource, which is the focus of this research) itself. Since the approach of the organizational theory is generally very broad and too unspecific for the current thesis, it will not be considered in detail.

The three selected theories will be considered in detail in Section 3.2, focusing on their contributions to the present research context. Although the contingency theory, dynamic capabilities, information processing, organizational theory, Porter's framework, and the resource-based view are not investigated in detail, as mentioned before, there are some overlaps with applied theories and a strict exclusion is barely appropriate. Moreover, they contribute to structure the present research (see Section 3.3), but do not have direct design implications.

3.2 Applied theories

In the following sections, the theory of industrial organization (Section 3.2.1), the knowledge-based theory of the firm (Section 3.2.2), and organizational learning (Section 3.2.3) are described. Their explanatory power to the present research is depicted, as well as their limitations.

3.2.1 Industrial organization

The origins of industrial organization can be ascribed to Bain and Mason (1972) who acknowledged that a company's environment guides its strategy and ultimately its performance (e.g., profitability, cost minimization, and innovativeness). Porter (1981) further developed the model and focused on single companies as the unit of analysis, contrary to Bain and Mason, who focused on the industry (company environment). Consequently, based on industrial organization, Porter (1980) developed a five-forces framework and established the market-based view, under which the theory of industrial organization and Porter's framework can be subsumed (Rothfuss, 2009). Industrial organization "considers structural aspects of an industry, whereas work on strategic groups is largely focused on firms' groupings within an industry" (Hoskisson et al., 1999, p. 419).

For the present research, industrial organization acknowledges the influence of external drivers on the strategic management and strategic decisions of LSPs, which can also be considered as one group within an industry. This market-oriented perspective requires the analysis of an LSP's environment, namely customers,

competitors, and the industry or market in general (Schmitt, 2006). The influence of external drivers emphasizes the importance of external information for the strategic management and strategic decisions of LSPs. This is equally highlighted by Delfmann (2008), who also referred to industrial organization. A similar viewpoint was adopted by Rümenapp (2002) and Bensel (2009). However, all authors argue that an isolated consideration of market-based perspectives does not project reality, and resource-based approaches have to be taken into account. Industrial organization is primarily criticized because of its "static, equilibrium framework" (Grant, 1991, p. 114) and the lack of explanatory power regarding different performance of companies operating in the same market or the same performance in different markets (Olavarrieta and Ellinger, 1997). Hence resource-based approaches are considered complementary to market-based approaches; the integrated consideration is widely accepted and asked for in recent research (Mills et al., 2003; Olavarrieta and Ellinger, 1997; Amit and Schoemaker, 1993).

3.2.2 Knowledge-based theory of the firm

The knowledge-based theory of the firm is applied instead of the resource-based theory of the firm[39] as it explicitly focuses on knowledge or information as a resource, which is the focus of the analyses in the present research context. Resource-based approaches perceive "the firm as a unique bundle of idiosyncratic resources and capabilities where the primary task of management is to maximize value through the optimal deployment of existing resources and capabilities, while developing the firm's resource base for the future" (Grant, 1996, p. 110). The knowledge-based theory of the firm is a further development of the resource-based view, focusing on knowledge (generated from information) as the most important resource of companies for strategic decisions and to achieve competitive advantage. In this context, the characteristics of knowledge are (1) its transferability, particularly within a company; (2) its capacity for integration, implying the combination of new and existing knowledge; and (3) its appropriability, referring to its useful application (Grant, 1996).

For the present research, the knowledge-based theory of the firm acknowledges the importance of information as a fundamental strategic resource for LSPs to achieve sustainable competitive advantage. The importance of market-, customer- and competitor-information for strategic decisions of LSPs requires the creation of knowledge. This implies that information has to be transformed into the competitive

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[39] The resource-based view of the firm was mainly coined by Penrose (1959), Wernerfelt (1984), and Barney (1991).

resource knowledge. However, a major limitation of the knowledge-based theory of the firm is "the focus upon knowledge application and disregard for knowledge creation" (Grant, 1996, p. 121). Moreover, Olavarietta an Ellinger (1997) indicated the missing managerial applicability and presupposition of availability of resources. Similar to Grant, they suggest the integration of organizational learning to make up for this limitation.[40]

3.2.3 Organizational learning

Knowledge as a competitive resource cannot be taken for granted and has to be created through organizational learning. According to Choo (1996, p. 330) organizational learning is the use of information when "organizations create, organize, and process information in order to generate knowledge." Therefore, information on markets, customers, and competitors has to be considered (Panayides, 2007; Hurley and Hult, 1998; Moorman and Miner, 1998). Organizational learning supports companies in enhancing competitive advantage (Baker and Sinkula, 1999). Famous concepts of organizational learning were among others established by (1) Argyris and Schön (1978), who differentiated single- and double-loop learning – organizations learn by adapting actions to the differences between expected and obtained outcome (single), and scrutinize the results (double); (2) Crossan et al. (1999), who developed a process framework for organizational learning, focusing on intuition of information on an individual level, interpretation on a group level, and integration or institutionalization on an organizational level; and, (3) Nonaka and Takeuchi (2005), who differentiated tacit (individual) knowledge that is transferred to explicit (organizational) knowledge (and vice versa) by organizational learning. In summary, organizational learning can be explained as information acquisition, processing, interpretation, and use.

For the present research, the theory of organizational learning explains how LSPs can handle external market-, customer-, and competitor-information for its use in strategic decisions to enhance performance and achieve competitive advantage. Organizational learning describes how LSPs can transform information into the resource knowledge. The impact of organizational learning on the service and financial performance of LSPs has been shown by Shang (2009) and underlines the applicability of organizational learning theory. Nevertheless, organizational learning of LSPs is limited to the information processing capabilities of human beings – related to cognitive processes. At this point, the theory of information processing of human beings from psychological research (Miller, 1994; Simon, 1978) could be applied.

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[40] See also Grant (1991), Nonaka and Toyama (2003), and Hult et al. (2006).

However, in this research context, the capabilities of human beings are not considered. Further developed approaches consider organizations as information processing systems, but they also focus on capabilities to process information, not on the information (as a resource) itself or the generation of a competitive resource, namely knowledge (Egelhoff, 1991; Galbraith, 1984; Tushman and Nadler, 1978).

3.3 Theoretical framework for the research on the information needs of logistics service providers in strategic decisions

In Figure 8, the theoretical framework of the research on the information needs of LSPs is presented. The information needs of LSPs in strategic decisions are explained by the knowledge-based theory of the firm, focusing on knowledge as an important competitive resource of LSPs. The need for external information of LSPs in strategic decisions is acknowledged by industrial organization, stating that an LSP's performance is highly dependent on its environment. The fact that external information has to be transformed into knowledge (as a competitive resource) for its use in strategic decisions is expounded by the theory of organizational learning. Consequently, the integration of the three theoretical approaches encourages the overall research objective of the present thesis, the investigation of the information needs of LSPs in strategic decisions, and the satisfaction of this needs by available information. The combination of the three theoretical lenses in the sense of an eclectic approach enables to meet all theory requirements stated in Section 3.1.1. The selection of only one theory would lack explanatory power and design recommendations. In this context, industrial organization and the knowledge-based theory of the firm emphasize the overall research relevance, whereas organizational learning allows for more detailed investigations regarding information or knowledge.

Although some of the theories evaluated in Section 3.1.3 are not applied because their explanatory power or design implications for the present research are rather low compared to the chosen theories, they nonetheless help to structure the research context. Contingency and organizational theory can be considered as kinds of "framing theories", integrating resource- and market-based approaches. Although the former is a further development of industrial organization and is closely related to Porter's framework (which is not applied because of its specificity), the latter is the basis for the knowledge-based theory and more generic.
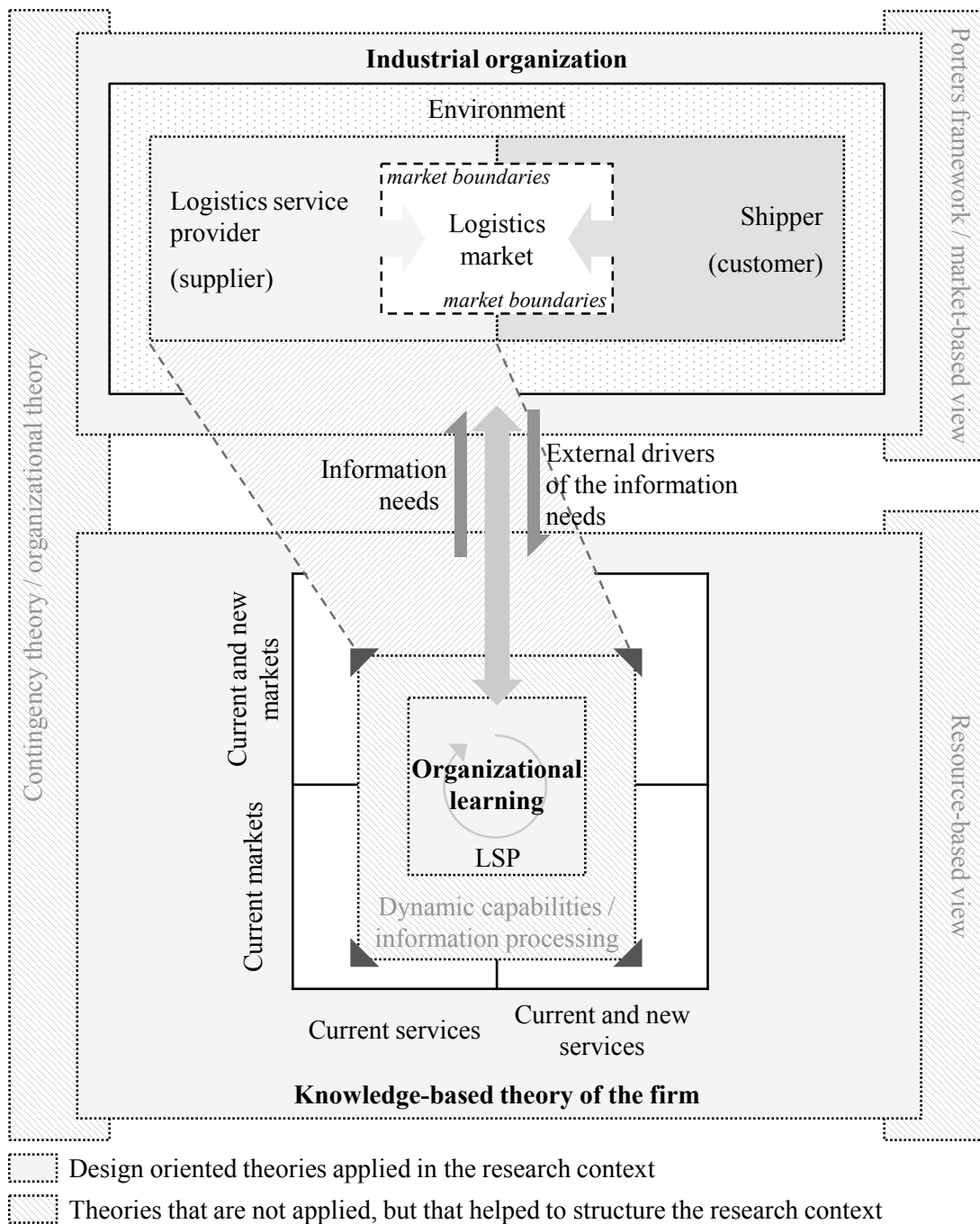
Figure 8.   Theoretical framework of the research

Dynamic capabilities and information processing (of an organization and individuals as well) insofar structure the research context, as they focus on the capabilities required for organizational learning and hence the creation of knowledge for strategic management and strategic decisions of LSPs. Lastly, capability-based approaches build the basis for achieving competitive advantage, but are not a unit of analysis of the present research, which focuses on resources instead of capabilities.

To meet the overall research objective, the research questions (Section 1.3) have to be integrated into the theoretical framework, which will be considered in Section 4.

4 Studies on the information needs of logistics service providers in strategic decisions

Based on the discussions and investigations in Section 1 - Section 3, the overall research framework is presented in Section 4.1; this section also provides a brief overview of the three studies conducted in the research context. In Section 4.2 - Section 4.4, the three studies are described in greater detail, particularly their key findings and contributions. Section 4.5 summarizes the overall contributions of the three studies on the information needs of LSPs in strategic decisions to the overall research framework, their relevance to the overall research objective, and answers the three research questions.

4.1 Overview of the research framework and methodology

Based on the managerial and theoretical relevance (Section 1), the conceptual background (Section 2) as well as the theoretical positioning (Section 3) of the research on the information needs of LSPs, the overall research framework is developed and illustrated in Figure 9.

The research framework embeds the unit of analysis in the theoretical framework and integrates the three studies conducted in the research context to answer the related research questions. The external information needs of LSPs, which are driven by environmental influencing factors, are the focus of analysis. The information needs of LSPs in general are acknowledged by the resource-based theory of the firm, highlighting knowledge as a strategic competitive advantage. The fact that the information needs are externally driven is supported by industrial organization. The circumstance that information has to be processed by LSPs into knowledge is explained by organizational learning.[41]

To address the overall research objective, the investigation of the information needs of LSPs in strategic decisions and the satisfaction of these needs by available information, three studies have been conducted. Their corresponding research objectives, related research questions, methodologies applied, data bases used, and theoretical lenses are summarized in Table 7. As illustrated in Figure 9, study A (related to RQ1) adopts a superior position over studies B (related to RQ2) and C (related to RQ3), analyzing the information needs of LSPs under consideration of the knowledge-based theory of the firm and industrial organization. The latter two studies

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[41] A detailed discussion of the theories applied in the research context is presented in Section 3.

build upon the results of study A and investigate specific, available information that can be collected for strategic decisions of LSPs, whereby the theoretical lenses of organizational learning are adopted.
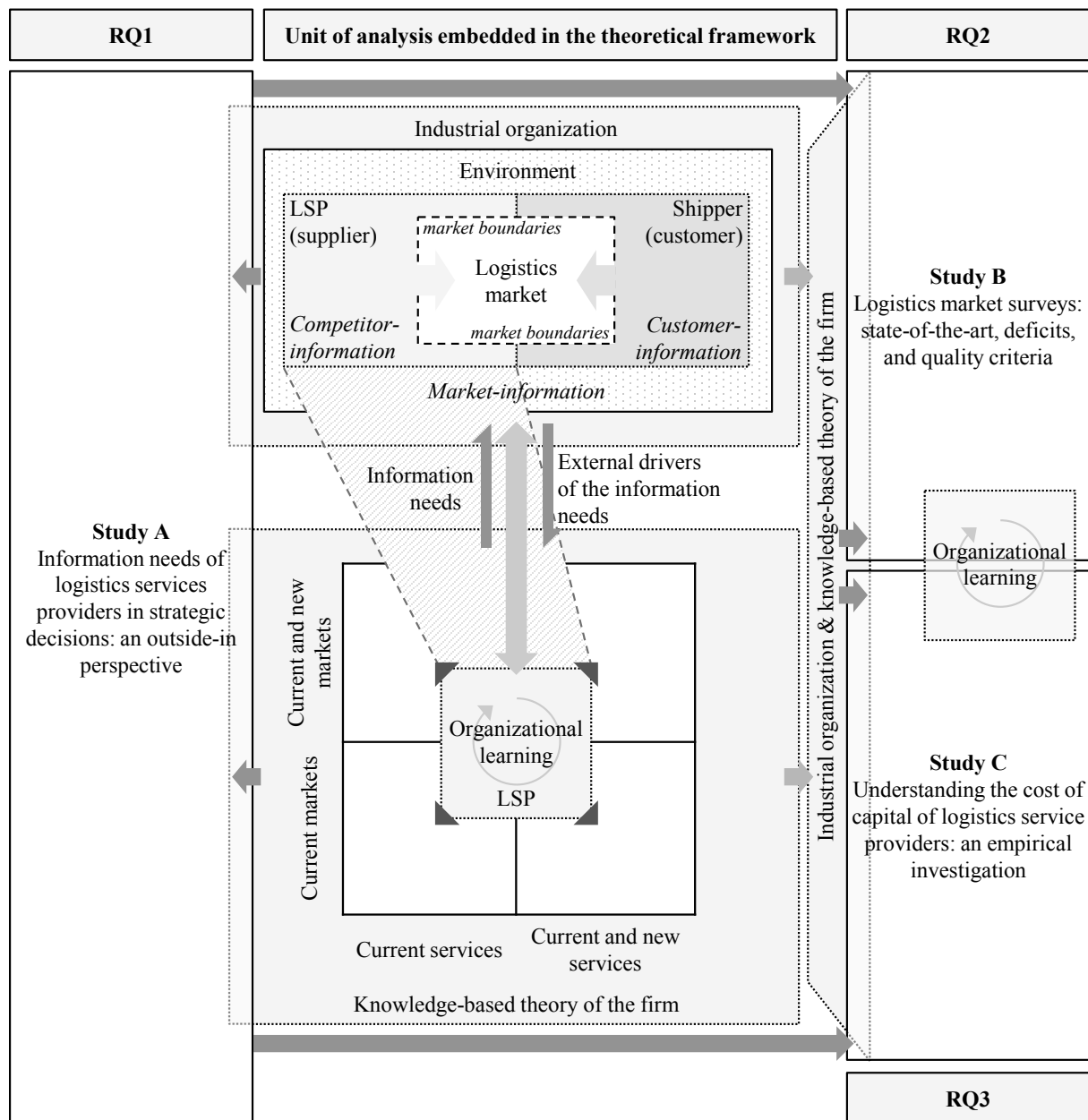
Figure 9.   Research framework

Study A investigates the information needs of LSPs in general as well as for four different strategic directions. On the one hand, the results of the study answer RQ1; on the other hand, the results build the basis for studies B and C.

Based on the identified information needs of LSPs, study B analyzes the state-of-the-art of available information that can be collected for strategic decisions of LSPs. Therefore, the focus is on LMSs, which provide a broad range of information encompassing the basic information categories required by LSPs.

Further, based on the results of study A, study C analyzes financial information of LSPs (in the sense of monetary competitor-information), to explore relatively new paths for processing financial information for strategic decisions of LSPs. Specifically, the cost of capital is analyzed, as it becomes more and more important in the strategic management of LSPs.

Table 7.   Overview of the three studies conducted in the research context

	Study A	**Study B**	**Study C**
Title	Information needs of logistics services providers in strategic decisions: an outside-in perspective	Logistics market surveys: state-of-the-art, deficits, and quality criteria	Understanding the cost of capital of logistics service providers: an empirical investigation
Research objective	Identification of the most important external information categories for strategic decisions of LSPs, their relationships and dependencies of the size of LSPs and the market segment(s) they are operating in	Identification of the most established indicators for surveying logistics markets, their deficits, and quality criteria	Analysis of the influence of company, industry, and market characteristics on the cost of capital of LSPs
Related research question	*RQ1:* Which external information is required in strategic decisions, from a logistics service provider's viewpoint (particularly in specific strategic directions)?	*RQ2:* How can logistics service providers use available information (particularly provided in the form of logistics market surveys) in their strategic decisions?	*RQ3:* How can financial information be used in strategic decisions of logistics service providers (particularly the cost of capital)?
Methodology	• Literature review • Multiple-Grey-based decision-making trial and evaluation laboratory (DEMTAL)	• Literature review • Content analysis	• Literature review • Multiple linear regression analysis
Data basis	17 questionnaires of / interviews with LSPs	35 logistics market surveys (LMS)	Financial data on 702 quoted LSPs
Theoretical positioning	• Industrial organization • Knowledge-based theory of the firm	• Industrial organization • Knowledge-based theory of the firm • Organizational learning	• Industrial organization • Knowledge-based theory of the firm • Organizational learning

The methodologies applied in the three studies have been chosen to adequately answer the research questions. Given the immaturity of the present research field, the three studies follow an exploratory research approach that enables the structuring of the information needs of LSPs. For this purpose, on the one hand, primary data is

collected by surveying LSPs. This approach allows for the initial identification of the information needs (related to RQ1). On the other hand, the insights from primary data collection are deepened and extended by analyzing quantitative and qualitative secondary data. This allows for investigations concerned with "how" available information (in the form of LMSs and financial information) can be used in strategic decisions of LSPs (related to RQ2 and RQ3). This aspect could also have been addressed by empirical investigations. However, as the focus is on available information and, in the case of study C, to explore relatively new paths for processing information (both investigations do not necessarily presuppose that the information is already used in practice), analyses of secondary data are conducted.

In the following sections, a general overview of the three studies is provided, and the methodologies applied are investigated. The key findings of each study and their managerial and theoretical contributions are in the focus of the following elucidations, which will be summarized in Section 4.5, with regard to the overall research objective and related research questions. The full studies are provided in the Appendices A - C.

4.2   Study A: Information needs of logistics service providers in strategic decisions: an outside-in perspective

The following sections describe the design of study A (Section 4.2.1) and present its key findings (Section 4.2.2). The full study is provided in Appendix A.

4.2.1   Research overview and methodology

Despite the importance of external information on customers, competitors, and markets in general for strategic decision-making, logistics-related research paid only little attention to the information needs of LSPs. This aspect is addressed by study A, which aims at identifying the information needs of LSPs in strategic decisions and to answer RQ1 (Table 7). While industrial organization explains the external environment of an LSP as a driver for external information needs, the integration of the knowledge-based theory of the firm acknowledges the importance of knowledge (generated from information) as a strategic competitive resource for LSPs.

To allow for a better investigation of strategic decisions, four different strategic directions that can be pursued by LSPs to achieve growth and competitive advantage are considered (based on Juga et al., 2008): (A) offering current services in current markets, (B) offering current services in current and new markets, (C) offering current and new services in current markets, and (D) offering current and new services in current and new markets. Information is differentiated into (1) monetary market-

information, (2) non-monetary market-information, (3) monetary customer-information, (4) non-monetary customer-information, (5) monetary competitor-information, and (6) non-monetary competitor-information.

To achieve the research objective of study A, 17 LSPs from Germany, Austria, and Switzerland were interviewed and filled out a questionnaire. To assess the importance of information categories and identify their relationships, the respondents from the (strategic) management level had to make pairwise comparisons for each information category in each strategic direction (each in total 120). For the evaluation of the questionnaires, a multiple-Grey-based DEMATEL (decision-making trial and evaluation laboratory) approach was pursued (Fontela and Gabus, 1974, 1976).[42] The approach allows for the identification of the most important criteria (in study A: information) in multi-criteria decisions and illustrates their interrelationships. Furthermore, the methodology is appropriate for generating satisfactory results despite small sample sizes and discrete data (Fu et al., 2012). The results of the study primarily focus on LSPs clusters, which involve an overall consideration of all respondents as well as their aggregation into cluster groups based on the LSP's size (turnover) and the market segment(s) they operate in (mode of transport or services[43]).

4.2.2 Key findings and contributions

The results of study A reveal that the most important categories for strategic decisions of LSPs in general are monetary customer-, competitor-, and market-information, followed by non-monetary competitor-, customer-, and market-information (in that order). Hence, the aggregated results (for all LSPs and all strategic directions) highlight the importance of monetary measures (e.g., in terms of GDP, logistics market volume, EBIT, or cost of capital) over non-monetary measures. This pattern of the importance of information is also valid when offering current services in current markets (strategic direction A), particularly with regard to the rankings of monetary information. Contrary to the aggregated consideration, the importance of non-monetary customer-information is ranked over non-monetary market-information. When entering new markets with current services (strategic direction B), contrary to all other strategic directions, monetary competitor-information is assessed as most

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[42] In contrast to other approaches, such as the Analytic Hierarchy Process (AHP) or the Interpretative Structural Modeling (ISM), DEMATEL allows "for a broader discrimination of measures and multiple directional relationships" (Zhu et al., 2011, p. 434) – it is more network-oriented. A variety of decision-making approaches presume that elements in the decision-making are interdependent, which does not represent reality (Yang et al., 2008). Moreover, approaches such as AHP and ISM require hierarchical networks, which are not required by DEMATEL. Hence, the DEMATEL approach was chosen.

[43] In this context, the term services implies value-added services.

important, followed by monetary market-information. When offering new services (in current or new markets, strategic directions C and D), the importance of non-monetary customer-information is ranked over monetary market-information. These results imply that LSPs' customers gain more importance if new services are offered, and competitors are of major relevance when entering new markets, particularly with current services.

In a more detailed consideration, the analyses show that the information needs or importance of information are largely dependent on the size of the LSP and the market segment it is operating in, respectively, as well as the strategic direction to be followed. For example, small LSPs (turnover <10 million €) in general focus on non-monetary information which can be traced back to the fact that particularly small LSPs are often owner-managed and strategic decisions are made by intuition. Medium LSPs (turnover 10-50 million €) focus on monetary market-information when entering a new market or launching new services, while competitor-information is considered most important when operating in a known environment or adopting completely new paths (new services and new markets). Large LSPs (turnover >50 million €) particularly focus on monetary competitor-information, which may be accounted for by the fact that large LSPs are more familiar with processing and using monetary information, as they themselves often have to fulfill a (financial) reporting duty. Considerations of the LSPs clustered according to the market segment(s) they are operating in also reveal several differences, which are founded not only in the correspondent market conditions − for example, the customer structure − but also in the characteristics of the appropriate LSPs, for example, the high asset intensity of LSPs in the water transportation cluster.

Further, investigations of the relationships among different information categories in strategic decisions of LSPs indicate that all types of considered information should be taken into account when taking strategic decisions. Even if (in general) monetary information is considered to be the most important, an influence of non-monetary market information (e.g., infrastructural aspects or the labor market situation) has been observed, which indicates dependencies among different information categories.

From a managerial perspective, the results offer LSPs an orientation regarding what information to collect and to focus on in strategic decisions. In particular, smaller LSPs, which represent a large part of logistics markets in general, may benefit from the results, as their strategic decisions are often unstructured. Furthermore, providers of appropriate information may profit from the results, as they become more familiar with LSPs' information needs. From a theoretical perspective, this analysis is the first

that structures the information needs of LSPs and provides a general overview. Furthermore, the Grey-based DEMTAL approach was extended to a multiple-Grey-based DEMTAL approach by combining the evaluation of four theoretically independent investigations (for each strategic direction).

4.3   Study B: Logistics market surveys: state-of-the-art, deficits, and quality criteria

The following sections describe the design of study B (Section 4.3.1) and present its key findings (Section 4.3.2). The full study is provided in Appendix B.

4.3.1   Research overview and methodology

Based on the relatively broad information needs of LSPs, study B analyzes related available information that can be collected by LSPs for strategic decision-making. The study aims at identifying the most established indicators for surveying logistics markets and their deficits, which is also concerned with challenges in processing available information. Furthermore, quality criteria for providing rigorous and relevant information are developed on the basis of the deficits. The results contribute to answering RQ2 (Table 7). Apart from industrial organization and the knowledge-based theory of the firm, which acknowledge the general relevance of study B, organizational learning describes the process of information processing and its transformation into knowledge.

There are a variety of sources for meeting the information needs of LSPs (see Section 2.3). While general information – for example, from statistical or financial databases – have to be adapted (processed) for its use in strategic decisions of LSPs, information provided in the form of LMSs is rather "ready to use." LMSs provide a broad range of (selected) market-, customer-, and competitor-information,[44] in most cases considering a country or geographical region as a "market." In recent years, LMSs have become established as a kind of reference work, which is – apart from the broad range of provided information and its usability – a further reason for analyzing LMSs in the context of study B.

For the investigations, in total 35 LMSs from 26 countries were identified in a literature review and chosen for further analysis. To address the research objectives, a content analysis was conducted, as it allows for making "valid inferences from text" (Weber, 1990, p. 9). To identify the state-of-the-art, deficits, and quality criteria of

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[44] In the context of LMSs, customer-information is usually referred to as shipper-information, and competitor-information as information regarding LSPs. This is because LMSs are not exclusively targeted at LSPs.

LMSs, the following three basic methodological steps of content analysis were performed: (1) survey selection (which was addressed by the literature review), (2) coding, and (3) analysis and interpretation (Krippendorff, 2003; Weber, 1990). The coding ensures a structured analysis of all LMSs, for which the following superior categories were derived: context-related (e.g., definition of logistics), methodology-related (e.g., data basis, methodology), and indicator-related (e.g., logistics market volume). In total, each LMS was analyzed in terms of 33 coding categories; the interim results were collected for analysis and interpretation.

4.3.2   Key findings and contributions

The results of study B indicate that information on railroad, road, water, and air market segments and their infrastructure, trends, outlooks and forecasts, employees, market players (shippers and LSPs) and the logistics market volume or logistics cost, are most established in LMSs. Consequently, the majority of analyzed LMSs investigate related information.

Despite some similarities, analyzed LMSs reveal several differences that also lead to challenges for LSPs to process the provided information. For example, context-related deficits are missing logistics or logistics market definitions, which make the correct interpretation of results difficult, particularly when collecting and comparing information on different LMSs. Furthermore, LMSs are, in most cases, not explicitly targeted at LSPs or the target group is not defined, which would be necessary for the assessment of the usefulness of the information. Methodology-related deficits primarily concern the correct description of applied methodologies and used data bases. These aspects influence transparency, reproducibility, as well as interpretation and comparability of information. Moreover, the comparability of information is largely dependent on the indicators measured as well as the measurement units.

The results show that LMSs provide a broad range of information to meet the information needs of LSPs in strategic decisions, in the form of monetary and non-monetary measures. However, its applicability is limited by several deficits, particularly concerning comparability of information.

From a managerial perspective, the results provide an overview of available information that could be collected from LSPs for their strategic decision-making. At the same time, the deficits also reveal some aspects that should implicitly be considered by LSPs when acquiring, processing, interpreting, and using LMSs' information. On the basis of the deficits, providers of LMSs can also benefit by considering and improving these aspects in their publications. From a theoretical

perspective, the results structure the field of LMSs and the appropriate indicators analyzed.

4.4 Study C: Understanding the cost of capital of logistics service providers: an empirical investigation

The following sections describe the design of study C (Section 4.4.1) and present its key findings (Section 4.4.2). The full study is provided in Appendix C.

4.4.1 Research overview and methodology

Financial information[45] like the cost of capital is becoming increasingly important in the management of LSPs, be that on the one hand for external parties – for example, shippers deciding to outsource their logistics service – or shareholders making their investment decisions. On the other hand, financial information is an important source of information in strategic decisions of LSPs, for example, when pursuing growth strategies and establishing cooperation with other LSPs, seeking for M&A's or striving for organic growth. For these reasons, study C aims to analyze the influence of company, industry, and market characteristics on the cost of capital, to identify how financial information can contribute to the strategic management or strategic decisions of LSPs, respectively. The results shall also help to answer RQ3 (Table 7). Similar to the research on LMSs, the processing of cost of capital as a strategic resource is explained by organizational learning, whereas industrial organization and the knowledge-based theory of the firm build the basis for the research in general.

The investigation of the cost of capital as one specific type of information shall reveal new paths for collecting and processing information for strategic decisions of LSP, as the cost of capital becomes increasingly important, but particularly small LSPs that are not quoted are barely familiar with such information. Furthermore, logistics-related research made only initial efforts in this field. For this purpose, financial data on 702 quoted LSPs located globally has been analyzed. LSPs were clustered by Standard Industrial Classification (SIC): (40) Railroad Transportation, (42) Motor Freight Transportation, (44) Water Transportation, (45) Transportation by Air, (46) Pipelines, and (47) Transportation Services.[46,47]

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[45] In this context, financial information can be allocated to monetary (competitor-) information. The term financial information is used as it directly refers to financial key performance indicators of an LSP, such as turnover, EBIT, or cost of capital.

[46] In this context, the term Transportation Services stands for value-added services.

[47] The clusters are similar to those chosen with regard to the market segments in study A.

Based on a literature review and stock price analysis of the chosen LSPs, five hypotheses (H) have been derived (see Section 4.2.2). To test the hypotheses, the influence of (1) company characteristics, including microeconomic variables of the appropriate LSP related to its asset-, capital-, liquidity-, and profitability-structure (e.g., asset turnover, debt to equity ratio, current ratio, and return on equity); and (2) market characteristics, including macroeconomic variables like the GDP, oil price, inflation, employment on the cost of capital as well as the systematic risk, which is a key component of the cost of capital and a measure for stock price volatility, has been analyzed in relation to the (3) industry an LSP is operating in (on a SIC basis). The methodology followed similar approaches applied by Houmes et al. (2012), Kavussanos and Marcoulis (1997), Chen et al. (1986), and Fama and MacBeth (1973), using a multiple linear regression analysis, which allows for the evaluation of relationships between a dependent variable (cost of capital or systematic risk) and various independent variables (company, industry, and market characteristics).

4.4.2 Key findings and contributions

The main results of study C reveal that the country (market) in which an LSP's headquarters is located in does not significantly influence its cost of capital (support of H1), which indicates that the market the LSP primary operates in is crucial, not the LSPs' domicile. Furthermore, the market segment an LSP operates in, which means its industry on a SIC basis, significantly influences the cost of capital as well as the systematic risk (support of H2). This can particularly be ascribed to the financial structures of the LSP cluster, which show several differences and was also proved in a former study related to the analysis of the cost of capital of LSPs (Hofmann and Lampe, 2013). While the cost of capital of LSPs is significantly influenced by microeconomic variables (LSP-specific indicators), their systematic risk is primarily influenced by macroeconomic or market-specific variables (support of H3 and H4). Surprisingly, a further analysis of the influence of systematic risk on LSPs' cost of capital did not reveal significant results, which may be founded in the methodology chosen to calculate the cost of capital (H5 was only partly supported).[48]

From a managerial perspective, the results highlight the dependencies of strategic decision-making and the cost of capital or the systematic risk of LSPs, respectively.

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[48] In the research context, the cost of capital was calculated using the weighted average cost of capital (WACC) approach (Besley and Brigham, 2008; Copeland et al., 2000). Alternative approaches to calculate the cost of capital are the discounted cash flow method (DCF), the arbitrage pricing theory (APT), and consumption-based models (Armitage, 2005; Pratt, 2003). Not all approaches (e.g., APT) require the integration of the systematic risk for the calculation of the cost of capital.

The scope of factors like the cost of capital is often neglected in the logistics industry, as financial issues are often limited to pure cost and sales figures. The present results indicate that the financial structure of LSPs significantly influences their cost of capital. For example, before taking decisions on long-term investments, LSPs have the ability to improve their financial structure, such as their financing strategy, to influence their cost of capital.

Closely related to the overall research context of the present thesis, the analysis of the cost of capital of LSPs highlights the influence of market characteristics (particularly of the net national income and the oil price) on their systematic risk. This aspect again emphasizes the importance of external information for strategic decisions of LSPs. For example, if a strategic decision concerns markets (countries) in which to operate or expand, LSPs might consider market characteristics in order to reduce their systematic risk.

Even if only quoted LSPs have been analyzed, the results are also leading the way for smaller or non-quoted LSPs. The present outcomes can be collected by non-quoted or small LSPs in terms of a "benchmark" comparing company-specific data with the results to estimate their cost of capital and systematic risk. With this approach, conclusions on the influence of external market factors, for example, on the systematic risk, can be drawn to support strategic decisions. From a theoretical perspective, study C makes a further contribution to the recently developing field of financial research in logistics by linking business logistics- and finance-related issues.

4.5 Overall contributions of the studies on the information needs of logistics service providers in strategic decisions to the research framework

In Figure 10, the contributions of studies A - C to the overall research objective and to answer the research questions are illustrated. In summary, the results of the studies (1) show the specific information needs of LSPs in strategic decisions (study A); (2) give an overview of available information and its utility for strategic decisions of LSPs (study B); and (3) demonstrate how financial information like the cost of capital can be used for strategic decision-making of LSPs (study C).

The results of study A, which reveal the importance of market-, customer-, and competitor information for strategic decisions of LSPs in general, answer RQ1. More specifically, the results indicate that monetary customer- and competitor-information is most necessary for strategic decision-making, followed by monetary market-

information and non-monetary competitor-, customer-, and market information. In a detailed investigation, the results vary according to the strategic direction to be pursued, the size of the LSP, and the market segment in which it is operating (see Section 4.2). The results specify the external information needs of LSPs, which is acknowledged by industrial organization, and indicate that monetary external information is an important competitive resource in strategic decisions, which in turn formulates the knowledge-based theory of the firm.
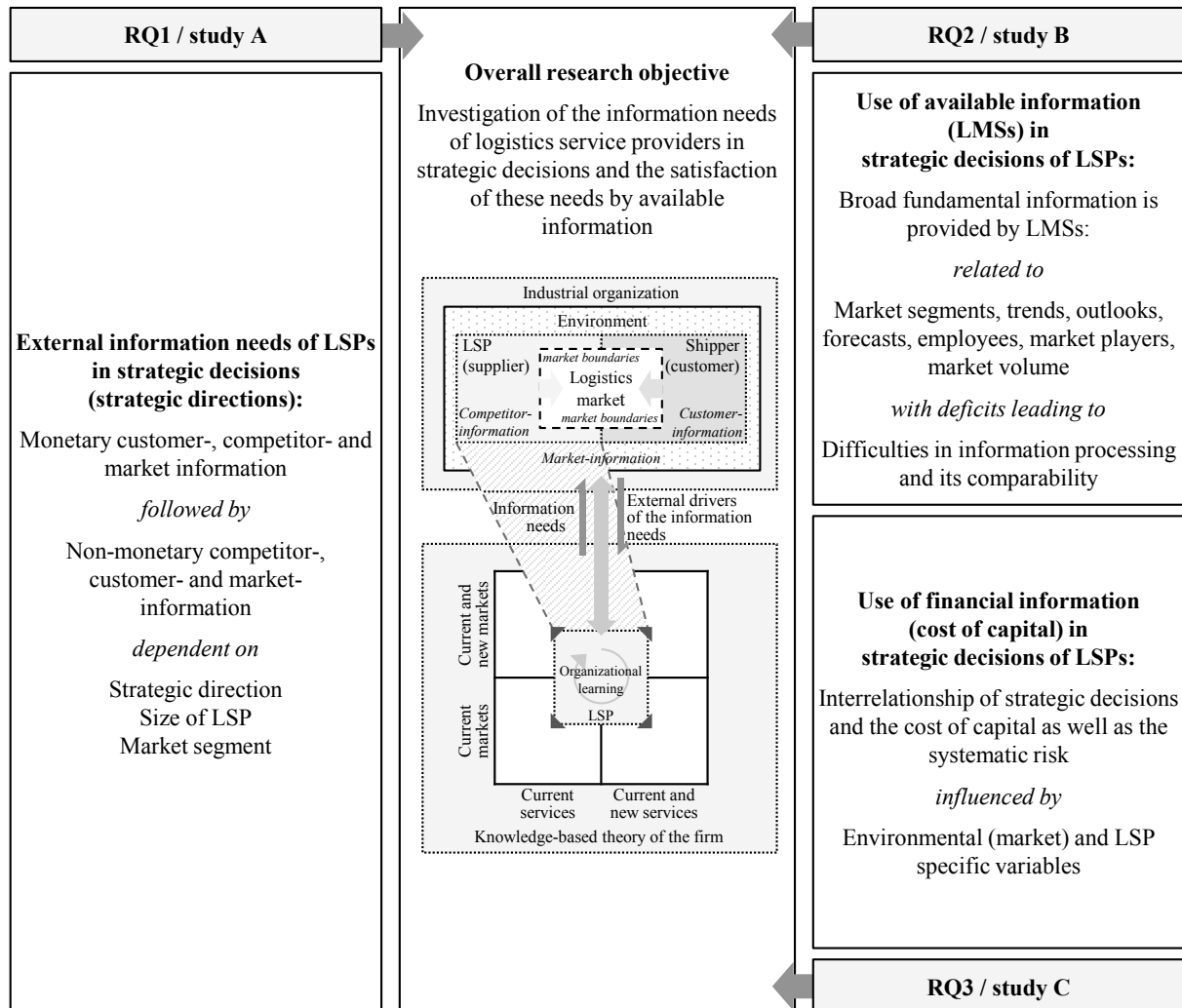
Figure 10.   Overview of the contributions of the studies A - C to the overall research objective and the research questions

The results of study B, which structure the field of available information (in terms of LMSs) that can be used for strategic decision-making of LSPs, answer RQ2. Apart from the identification of the most established indicators for surveying logistics markets, deficits of LMSs that lead to challenges in processing the information have appeared. Consequently, LSPs benefit from the information provided in the form of LMSs, as they offer a broad range of fundamental information that builds a basis to meet the information needs of LSPs in general. Nevertheless, the deficits have to be

regarded when processing the information for strategic decision-making in the context of organizational learning (see Section 4.3).

The results of study C – which emphasize the interrelationships among strategic decisions, the cost of capital, and the systematic risk of LSPs – answer RQ3. Financial information like the cost of capital has become increasingly important in strategic decision-making and is influenced by LSP-specific characteristics, the market segment(s) they operate in, and environmental market factors. Moreover, the latter significantly influences the systematic risk of LSPs, which is a further indicator for the relevance of external information in the strategic decision-making of LSPs. Considering the results of study C, LSPs can estimate their systematic risk when pursuing a specific strategic direction. Furthermore, the investigation of the cost of capital as well as the systematic risk allows for drawing conclusions on an LSP's performance (see Section 4.4). In the context of organizational learning, the results reveal new paths on the processing of financial information for an adequate use in strategic decisions of LSPs.

In summary, the three studies and the answers to the related research questions meet the overall research objective of the present thesis – to investigate the information needs of LSPs in strategic decisions and the satisfaction of these needs by available information.[49] On the one hand, the results structure the information needs of LSPs in strategic decisions (study A); on the other hand, the availability and usability of information to meet LSPs' needs is investigated (study B). Revealing the limitations of available information, new paths for the utilization of financial information in the context of strategic decisions of LSPs are demonstrated (study C).

The managerial and theoretical implications that can be derived from studies A - C and from the overall research context, as well as the related limitations of research, will be investigated in Section 5.

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[49] In this context, it has to be mentioned that the research questions (Section 1.3) presented in the overall research framework (Section 1 to Section 5) are kind of superordinated to the research questions answered in studies A - C (Appendix A - Appendix C). The critical reflection of studies A - C in the context of the overall research framework, complemented by market knowledge and input from practice, allows for answering superordinated research questions.

5 Conclusion

After illustrating the contributions of the conducted studies to the overall research objective in Section 4.5; Section 5.1 and Section 5.2 focus on the managerial and theoretical implications of the entire research. Furthermore, Section 5.3 discusses the limitations of the research, and provides implications for future research.

5.1 Managerial implications

LSPs have to survive competition and achieve business objectives such as organizational success, growth, and profitability. Strategic decision-making enables LSPs to meet these business objectives. In strategic decisions, information is inevitable and can be considered as a competitive resource. Consequently, on the one hand, the present research investigated the information needs of LSPs in strategic decisions. On the other hand, available information and its usability for strategic decisions of LSP were analyzed.

First, the research results provide an overview of the information needs of LSPs in general as well as for different strategic directions, in the context of the size of LSPs as well as the market segment(s) they operate in. In general, it can be said that in their strategic decisions, LSPs focus on monetary information (about customers, competitors, and the market, in that order) over non-monetary information (about competitors, customers, and the market, in that order). More detailed, the analysis of the importance of different information categories in different strategic directions of LSPs, as well as their (inter)relationships, helps LSPs to orient their strategic decisions, with the type of information that is collected and focus upon. On the one hand, a general orientation is given on which information to collect. On the other hand, LSPs who are already processing a specific information category and are thinking about collecting information from another category, may interpret the (inter)relationships between the information categories as a kind of decision guidance regarding the necessity of acquiring further information. Moreover, the results particularly help LSPs that do not follow a defined and compelling strategic decision process to structure this process. In summary, the investigations on the information needs of LSPs provide a kind of guidance for LSPs on which information to focus on in strategic decisions or when pursuing a specific strategic direction.

Second, the analysis of available information provided in the form of LMSs that encompass a broad range of the LSPs' information needs, provides a general overview of available logistics-related information. The results may be used as a kind of

"reference", thereby implying that LSPs can look up information on various markets. Furthermore, insights on the applied methodology and basis of data collection are given. In particular, the discussion of the latter two reveals some critical deficits of available LMSs that have to be taken into consideration when processing appropriate information. A variety of LMSs does not describe the applied methodology in detail or provides information regarding the basis of data collected or sources cited. Consequently, there is no general framework for providing logistics-related information; the LMSs also vary with regard to the appropriate indicators analyzed. These aspects particularly make the comparability and interpretation of the information difficult. Nonetheless, taking these limitations into consideration, LMSs provide a fundamental information basis for strategic decisions of LSPs. With reference to the results of study A, LMSs generally provide a variety of customer-, competitor-, and market-information. However, it must be admitted that the majority of information is non-monetary. Only little monetary information is provided, for example, the logistics market volume or costs and the turnover of LSPs. In summary, the analyses of LMS reveal the state-of-the-art of available information for strategic decisions of LSPs, emphasizing the deficits that have to be considered in its application. LMSs provide a broad information basis for strategic decisions of LSPs, whereas the monetary information needs of LSPs are only partially met.

Additionally, even if not in the focus of the present research, providers of logistics-related information, be that in the form of LMSs or other analyses, may benefit from the results stated above. On the one hand, they become more familiar with the information needs of LSPs, which have not been analyzed before. This enables them to better fit their offered information to the requirements of LSPs. On the other hand, quality criteria for preparing logistics-related information have been developed based on the deficits of LMSs. In terms of these aspects, the relevance and rigor of provided information could be improved.

Third, the analysis of financial information of LSPs, specifically the cost of capital, reveals new paths for the use of specific information in strategic decisions. The value-based management of LSPs, whose principle is to realize returns of investors' capital that exceed the cost of capital, is becoming increasingly important for the strategic decision-making of LSPs. Nonetheless, the concept of value-based management is not very common yet. Furthermore, appropriate information is easier to collect for quoted LSPs, but a variety of small and medium LSPs is not quoted. The results of the analyses show that the cost of capital of LSPs significantly differ among the market segments that the LSPs operate in (e.g., railroad transportation or motor freight

transportation) and are consequently dependent on the financial structure of LSPs.[50] Moreover, the systematic risk of LSPs, as a measure of stock price volatility and an important component of the cost of capital, is significantly influenced by macroeconomic (market) variables. LSPs can collect this information in strategic decisions to estimate their performance and systematic risk. Moreover, this type of competitor-information can be used for benchmarks with competitors in current or future markets. Further, non-quoted LSPs might benefit from the results, as they can classify themselves or their competitors into analyzed clusters and draw conclusions on their (competitors') performance; hence, the insights can be used for their strategic decision-making, similar to quoted LSPs. Referring to the results of study A, the analysis of LSPs' cost of capital reveals a possible approach to meet the monetary information needs of LSPs, particularly regarding their competitors. Focusing on specific information, such as the cost of capital, extends the general information provided by LMSs (study B), and the results can be considered as a kind of enhancement. To summarize, the analysis of the cost of capital of LSPs offers valuable insights for possible applications of financial information for strategic decision-making of LSPs. However, it must be regarded that, contrary to information provided in the form of LMSs, financial information like the cost of capital is more general and has to be evaluated and processed for appropriate use in strategic decisions. Nevertheless, the information particularly helps to meet the monetary (competitor-) information needs of LSPs.

Overall, the results of the present thesis support LSPs in their strategic decisions by (1) providing a kind of guidance on which information to focus; (2) illustrating an overview of available fundamental logistics-related information and its applicability; and (3) revealing alternative sources and approaches for processing information (acquire, process, analyze, and use) – with a focus on financial information in terms of monetary competitor-information – for strategic decision-making.

5.2 Theoretical implications

The information needs of LSPs in strategic decisions, the investigation of available information, as well as financial analyses have only found little attention in recent research. Moreover, the intensification of theoretical foundation is required.

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[50] The financial structure of LSPs significantly varies among industries, for example, the asset intensity that is rather low in the service cluster, but high in the water transportation cluster. This aspect was analyzed by Hofmann and Lampe (2013).

First, the results close the existing gap in logistics-related literature on the information needs of LSPs. In general, strategic management literature extensively considered information needs in strategic decisions (Citroen, 2011; Hitt et al., 2003; McNeilly, 2002; Day, 1981, see Section 2.3.1). Further, logistics-related literature also considered strategic issues (Juga et al., 2008; Bohlmann and Krupp, 2007; Hertz and Alfredsson, 2003; Persson and Virum, 2001, see Section 2.2.2), but information needs of LSPs were almost completely neglected, despite the specific characteristics of LSPs and the markets they operate in (see Section 2.1.1 and Section 2.1.2). The analyses of the information needs of LSPs in strategic decisions and specific strategic directions are the first to provide a general overview and structure of this aspect in a logistics context.

Second, similar to the information needs of LSPs, information that could be collected for strategic decision-making of LSPs as well as the consideration of its applicability, has been given little attention in research. The results provide a state-of-the-art of available information that could be collected by LSPs for taking strategic decisions. Furthermore, available information is assessed in terms of rigor and relevance. This particularly contributes to recent literature concerned with the measurement of single indicators for measuring logistics specific issues and their comparability (e.g., Rantasila and Ojala, 2012), also revealing the efforts that have to be made in this area. Moreover, logistics-related research concerned with information, as well as information needs, primarily took a shipper's perspective (among others Anderson et al., 2011; Menon et al., 1998; Bardi et al., 1994), and has now been extended to LSPs.

Third, recent literature asked for in-depth investigations of financial issues in the context of the strategic management of LSPs (Hofmann and Lampe, 2013; Liu and Lyons, 2011; Töyli et al., 2008). With the analysis of the cost of capital of LSPs, the present research made a further contribution to this emerging research field by linking business logistics- and finance-related issues. The analyses reveal the potential of financial data in logistics and strategic management of LSPs.

Overall, literature asks for an intensified theoretical foundation of logistics research (e.g., Olavarrieta and Ellinger, 1997). In particular, the consideration of knowledge-based approaches is required, and consequently the adaption of complementary market-based approaches (e.g., Delfmann, 2008). The present research demonstrates the high explanatory power of industrial organization and the knowledge-based theory of the firm to consolidate the external information needs of LSPs in strategic decisions. Furthermore, the integration of organizational learning again shows how to make up for the limitations of resource-based approaches. The combined integration of the three

theoretical approaches (as an eclectic approach) emphasizes that industrial organization, the knowledge-based theory of the firm, as well as organizational learning are appropriate lenses to theoretically found the present research on the information needs of LSPs in strategic decisions.

Additionally, in the context of study A (see Appendix A), the Grey-based DEMATEL approach was further developed to a multiple-Grey-based DEMATEL approach. Four theoretically independent Grey-based DEMATEL investigations have been combined and aggregated to a multiple-Grey-based DEMATEL consideration.

5.3 Limitations and future research

The present research is faced with some limitations, which will be considered in the following paragraphs for each study (A - C) as well as for the overall research context. At the same time, the limitations lead to aspects that could be regarded in future research. These aspects are discussed in line with the limitations.

First, the sample size of LSPs for study A is relatively small (17 LSPs), although Grey-based approaches are very suitable for small sample sizes and discrete data. Furthermore, the sample size is limited to LSPs from Germany, Austria, and Switzerland. Future research could conduct a similar study with a larger sample size, optionally of LSPs located globally. However, because of the fact that most of the analyzed LSPs operate worldwide or across Europe, no significant differences are expected with regard to the location of the LSPs. Moreover, the LSPs were clustered according to their size and the market segment they are operating in. Referring to the differentiation or segmentation criteria for LSPs and logistics markets (Table 1 and Table 2), other cluster groups are conceivable. Finally, the information needs of LSPs were analyzed on a much aggregated level, focusing on monetary and non-monetary customer-, competitor-, and market-information. This approach was chosen to structure the research field. Future research should build on this basis and focus on specific information (or variables), for example, the EBIT of customers.

Second, the selected surveys of study B may be exposed to a selection bias (Heckman, 1990), which implies that not all relevant publications might have been identified. Moreover, the content analysis is limited to LMSs, whereas a variety of other logistics-related studies exist, focusing on one specific issue (e.g., outsourcing). These "single-issue" studies or surveys were not analyzed, which could be addressed in future research. Furthermore, a measurement bias might have occurred (Hyslop and Imbens, 2001), thereby implying that a subjective influence of researchers during the content analysis of LMSs could not have been completely avoided. This aspect is difficult to

prevent in "manual" content analysis and can only be remedied by applying computer-based analysis (Krippendorff, 2003). Despite deriving quality criteria (on the basis of the identified deficits) as a kind of guideline for providers of LMS, future research should focus on developing a more comprehensive "frame of reference" for publishing LMSs or logistics-related information, respectively. This frame could provide implications regarding which (available) statistical data should be used, which has to be collected, and, for the latter case, how surveys or questionnaires should be designed.

Third, in the analysis of the cost of capital of LSPs (study C), only quoted LSPs were considered due to limitations of data availability. However, it is a common approach in praxis to estimate the cost of capital of unquoted LSPs via benchmarks (Koller et al., 2010). Hence, future research could build upon the present results and make similar analyses of non-quoted LSPs. Furthermore, the WACC approach was applied to calculate the cost of capital. Contrary to the WACC approach, some alternative approaches like the APT or the Fama-French three-factor model (Fama and French, 1993) do not require the systematic risk as an input variable for calculation. As previous comparisons of different approaches for the calculation of the cost of capital did not reveal reliable agreements (Pratt and Grabowski, 2010), future research could apply alternative methods in a similar research context. Finally, the analyses were conducted clustering LSPs on a SIC basis, which is quite similar to the clusters chosen in study A. In this context, also other cluster groups are conceivable.

Overall, the present research focused on the external information needs of LSPs in strategic decisions. Nevertheless, internal information (of the LSP itself) should not be disregarded. Despite the fact that internal information is easier to collect, future research could focus on specific aspects of internal information. However, as it was shown in Section 1.1, Section 1.2, and Section 2, first efforts have been made in this field. Complementary, study C revealed that the financial structure of an LSP itself (as an internal information) influences its cost of capital and consequently also strategic decisions. the study made first efforts focusing on one specific competitor-information and showed new paths for information processing for strategic decisions of LSPs. Nevertheless, the overall research focus is relatively broad, nor explicitly focusing on one specific type of LSP (e.g., 3PLs in the narrow perspective, see Section 2.1.1), nor a specific market segment (e.g., for perishable goods, see Section 2.2.2). This approach is considered appropriate as recent research has given only little attention to the field and it had to be structured first. Future research could now build upon the results, making more specific analysis. Moreover, regarding RQ3 and study C, the

focus is on financial information in the context of LSPs' competitors. Alternatively, the detailed investigation of a specific information category could also have been focused on non-monetary information or other information categories. This viewpoint was chosen because of its emerging importance in recent research and the challenges in acquiring, processing, and interpreting monetary competitor-information (see Table 4). Finally, the theoretical lenses of industrial organization, the knowledge-based theory of the firm, as well as organizational learning are adopted to acknowledge the research on the information needs of LSPs in strategic decisions, emphasizing the importance of external information and knowledge as a competitive resource and describing the transformation of information into knowledge. The theoretical foundation of the research ends on the level of the organization. However, an organization would not be able to learn and process information without its employees, who process the information. Hence future research could take the level of human beings and consider their capabilities required for organizational learning and hence the creation of knowledge. In this context, information processing theory could be integrated (Rogers et al., 1999; Sinkula, 1994; Egelhoff, 1991), focusing on capabilities. By additionally adapting the theory of dynamic capabilities (Teece et al., 1997), the focus could also be on the capabilities of organizations (LSPs). As opposed to this, the present research focuses on resources over capabilities.

Appendix

Appendix A: **Information Needs of Logistics Service Providers in Strategic Decisions: An Outside-in Perspective**

Presented in a former version at the following conference:

"Information Needs of Logistics Service Providers in Strategic Decisions: An Outside-in Perspective", 26th Annual Nordica Logistics Research Network Conference (NOFOMA), Copenhagen, June, 12-13, 2014.

Published in a former version:

Lampe, K. (2014): "Information Needs of Logistics Service Providers in Strategic Decisions: An Outside-in Perspective", *Proceedings of the 26th Annual Nordica Logistics Research Network Conference*, Copenhagen.

Appendix B: **Logistics Market Surveys: State-of-the-Art, Deficits, and Quality-Criteria**

Presented in a former version at the following conference:

"Examination of Logistics Market Surveys: A Question of Rigor and Relevance", 24th Annual Nordica Logistics Research Network Conference (NOFOMA), Turku, June, 7-8, 2012.

Published in a former version:

Lampe, K.; Hofmann, E. (2012): "Examination of Logistics Market Surveys: A Question of Rigor and Relevance", *Proceedings of the 24th Annual Nordica Logistics Research Network Conference*, Turku.

Appendix C: **Understanding the Cost of Capital of Logistics Service Providers: An Empirical Investigation**

Presented in a former version at the following conference:

"Analyzing the Systematic Risk of Logistics Service Providers: The Influence of Market, Industry and Company Effects", 25th Annual Nordica Logistics Research Network Conference (NOFOMA), Gothenburg, June, 3-5, 2013.

Published in a former version:

Lampe, K.; Hofmann, E. (2013): "Analyzing the Systematic Risk of Logistics Service Providers: The Influence of Market, Industry and Company Effects", *Proceedings of the 25th Annual Nordica Logistics Research Network Conference*, Gothenburg.

A Information needs of logistics service providers in strategic decisions: an outside-in perspective

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A.1 Introduction

As a consequence of a changing business environment and global market developments, the focus on efficiency, and increasing outsourcing activities of industry and retail companies, logistics has become a sustainable competitive advantage (Spillan et al., 2013; Bowersox et al., 2007; Stalk et al., 1992). To respond to competition, achieve organizational success, profitability, and growth by pursuing the right strategy, logistics service providers (LSP) that offer appropriate services for industry and retail companies (Lieb and Bentz, 2005b) have to understand the (logistics-) specific characteristics of both operating markets and future target markets (Rodrigues et al., 2005). "The changes in customer needs are forcing the LSPs to address several new strategic issues. They have to develop strategies to improve performance and profitability in their existing business; and, they have to develop strategies for further growth, making choices related to their products, markets and market segments, resources, and relationships and alliances" (Persson and Virum, 2001, p. 54).

To meet these challenges and find a successful and sustainable market position, LSPs can pursue growth and diversification strategies, which primarily concern the scope and the geographical range of services (Carbone and Stone, 2005). According to Grant (2002, p. 72), "the strategy of an enterprise is defined by the answers to two questions: where does the firm compete and how does it compete." LSPs have to decide which services they intend to offer in which markets. The analysis of information on their internal and external environment provides the basis for strategic decisions, meaning their formulation and implementation (Hitt et al., 2003). Referring to Ansoff (1987), "strategic decisions are primarily concerned with external, rather than internal, problems of the firm and specifically with the selection of the product mix which the firm will produce and the markets to which it will sell it." Furthermore, due to the fact that the demand for logistics services is derivative, strategic decisions of LSPs are dependent on customers' requirements. These aspects particularly highlight the importance of external information for strategic decisions of LSPs.

External information concerns, among others, competitors, customers, customers' attitudes, market structures, technologies, regulations or public affairs, and other stakeholders (Citroen, 2011; Mentzer, 2008; Hitt et al., 2003; Choo, 2002; McNeilly, 2002). This different information can be summarized into three general information categories: market-, customer-, and competitor-information. The information collected for strategic decisions of LSPs should be balanced in terms of monetary and non-monetary information – for all three information categories (Rajesh et al., 2012; Bhimani and Langfield-Smith, 2007). However, a major challenge for LSPs is to acquire the accurate information for their strategic decisions, which is also dependent on the general availability of information (McNeilly, 2002). The external information needs of LSPs are the focus of the present research. This is moreover justified by the fact that internal, company-specific information is easier to collect than external information.

There are a variety of sources for (logistics-specific) market-, customer-, and competitor-information: Official statistical databases, information of market research institutes, industry or trade journals, annual or quarterly reports, survey results and studies, to name only a few. In particular in the logistics sector, a variety of country-specific logistics market surveys exist (e.g., Lampe and Hofmann, 2012; Rantasila and Ojala, 2012) providing different types of information. However, to the present, the topics of which type of external information is actually required by LSPs in their strategic decisions and whether their information needs are met by available information have not been analyzed. On the one hand, general strategic management literature (Citroen, 2011; Mintzberg et al., 2009; Hitt et al., 2003; Choo, 2002; McNeilly, 2002; Wright et al., 1994) widely addressed information and information needs in strategic decisions. Logistics-related studies mainly focused on the information needs of shippers – meaning the customers of LSPs – in (strategic) decisions, particularly with regard to the implementation of logistics strategies and the choice of LSPs (Wang et al., 2006; Stock and Lambert, 2001; Menon et al., 1998; McGinnis et al., 1995; Langley Jr., 1985). On the other hand, the information needs of LSPs – which exhibit some specific characteristics, such as the immateriality of services offered as well as the heterogeneity of customer demand; and perform on non-transparent markets where a variety of services are offered to different customers with different requirements (Christopher, 2005) – have only found little attention in recent research.

Based on the importance of information for strategic decisions of LSPs and the missing knowledge of the relevance of different information categories, this paper aims to answer the following research questions (RQ):

- RQ1: What are the most important external information categories for strategic decisions of LSPs, and do they distinguish in different strategic directions?

- RQ2: How do the size of LSPs and the market segment(s) they are operating in influence their external information needs?

- RQ3: What are the interrelationships among the most important external information categories?

To answer the RQs, an empirical decision-making approach was applied. Data on 17 LSPs from Germany, Austria, and Switzerland were collected. Executives from the management level filled out a questionnaire and made pairwise comparisons of six information categories for four strategic directions. In total, each respondent made 120 pairwise comparisons. The questionnaires were evaluated by the application of the Grey-based decision-making trial and evaluation laboratory (DEMATEL) method. This multi-criteria decision-making model (MCDM) was chosen as it allows for identifying the most representative criteria in multiple criteria decisions as well as for illustrating interrelationships between the criteria. Contrary to other approaches (e.g., the Analytic Hierarchy Process [AHP]), it is more network oriented and was hence chosen for the present research context. The collected data were analyzed for each LSP and four different possible strategic directions that can be pursued by LSPs. Furthermore, the LSPs were clustered according to their size (turnover) and the market segments they are operating in (mode of transport or services). As the importance of information was analyzed for four strategic directions, the DEMATEL method has been extended to a "multiple-DEMATEL" approach. This implies that a combined evaluation of four theoretically independent investigations was employed. The results shall give a first structured overview of the information needs of LSPs in strategic decisions. Furthermore, the answers of the RQs shall on the one hand help LSPs to collect the accurate information for their strategic decisions and, on the other hand, benefit providers of logistics-specific information, such as research institutions, as they become more familiar with LSPs' information needs.

The structure of this paper is as follows: A literature review is conducted in Section A.2, which considers strategy in general and for LSPs in specific as well as LSPs' information needs in strategic decisions. Based on the literature review, the research gap is derived and the DEMATEL-questionnaire developed. The methodological

approach and data collection are described in Section A.3. Section A.4 presents the results of the analysis that are then discussed in Section A.5. Section A.6 summarizes the results under consideration of managerial implications and limitations. Furthermore, implications for future research are given. Additionally, the detailed methodological (calculation) steps are presented in the Appendix.

A.2 Theoretical background

A.2.1 Strategic directions of logistics service providers and their information needs

Referring to strategy content and context, a strategy answers the questions related to which services (or products) are offered (content) on which target markets (context), following Ansoff's (1957) product- / market-matrix. This "classical" approach to strategy segmentation can be visualized in a 2×2 matrix, with products on the horizontal axis and markets on the vertical axis (both divided into current and new). In their analysis of strategic positioning of LSPs, Juga et al. (2008) adapted a service- / market-based matrix from Johnston and Clark (2001), who also differentiated four strategic directions based on Ansoff's matrix. The horizontal axis of this 2×2 matrix presents the range of services (divided into narrow and wide), and the horizontal axis presents markets (divided into few and many).

Considerations of the strategic positioning of LSPs were also made referring to resource-based or competence-based approaches (Juga et al., 2008). A resource-based strategic positioning model was, for example, developed by Africk and Calkins (1994), who differentiated asset- and non-asset-based LSPs, resulting in a 2×2 matrix with management services on the horizontal axis and physical services on the vertical axis (in each case divided into low and high complexity or customization).[51] Hertz and Alfredsson (2003) pursued a competence-based strategy segmentation for LSPs and developed a 2×2 matrix with customer adaption (of LSPs) on the horizontal axis and general problem solving ability on the vertical axis (both divided into relatively high and high).[52] Furthermore, Persson and Virum (2001) developed four growth strategies for LSPs that are also based on Ansoff's product- / market-matrix, providing implications on how to pursue a strategy.[53]

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[51] Further resource-based strategic positioning approaches were also pursued by Bask (2001) and Dornier et al. (2008).

[52] Further competence-based strategic positioning approaches were also pursued by Berglund et al. (1999) as well as Halldórsson and Skjøtt-Larsen (2004).

[53] Further logistics-related variations of Ansoff's approach were also developed by Cooper et al. (1994) and Delaney (1991).

"Relevant strategic inputs derived from the analysis of the internal and external environments are necessary for strategic decision. […] Firms understand the external environment by acquiring information on competitors, customers, and other stakeholders to build their own base of knowledge and capabilities" (Hitt et al., 2003, p. 7).[54] Although information is a critical factor in strategic decisions (Citroen, 2011), the information needs of LSPs have not been analyzed thus far.

In 1997, Olavarrieta and Ellinger (1997, p. 559) stated that "ten to 15 years of theory development in strategy research has been largely neglected in the strategic logistics literature." Ten years later, Yeung et al. (2006) continued to ask for in-depth studies investigating LSPs and strategic issues. They also highlighted the challenge for LSPs in choosing a strategy – meaning markets and services – in order to achieve profitability. Logistics literature did not completely ignore strategic research, but most work has a shippers' – meaning the LSPs' customers' – perspective (Hertz and Alfredsson, 2003; Bagchi and Virum, 1998; Lieb and Randall, 1996). Studies with a shipper perspective often analyze outsourcing of logistics activities (Razzaque and Sheng, 1998; Richardson, 1995) and information (criteria) for choosing an LSP (Anderson et al., 2011; Menon et al., 1998).

A.2.2 Operationalization of the problem: theoretical model for analysis

Strategic logistics research has mainly considered strategic directions of LSPs. General management literature focuses on the importance of internal as well as external information in strategic decisions, which is widely neglected in the logistics literature regarding LSPs, despite the fact that information is an important source of competitive advantage (Hall, 1993). For this reason, the present research focuses on the information needs of LSPs in strategic decisions. In this context, the "outside-in" perspective on strategy was adopted. The outside-in perspective argues that companies aiming at being successful should always focus on their external environment when concerned with strategic issues. According to Day (1990) and Webster (1994), successful companies are market-driven and externally-oriented. They develop their strategic actions by analyzing their external environment, focusing on customers and competitors. The outside-in viewpoint in the context of this research can be justified as the demand for logistics services is derivative, meaning it is dependent on shippers' requirements and is thus market-driven (Bretzke and Barkawi, 2012). When LSPs develop new services or enter new markets, they often follow their customers. Taking

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[54] The importance of information for strategic decision-making was also highlighted by Choo (2002) and McNeilly (2002).

the customers' requirements as a starting point, LSPs can benefit from the "driven service or market development" and modify the customer-specific, newly developed services in order to offer them to other or new customers. Outside-in strategists emphasize that market and industry knowledge is crucial.

Market and industry structure, as well as the "specific demands, strengths, positions, and intentions of all major forces need to be determined. For instance, buyers must be understood, with regard to their needs, wants, perceptions, decision-making processes, and bargaining chips. The same holds true for suppliers, competitors, potential market and / or industry entrants, and providers of substitute products" (de Wit and Meyer, 2001, p. 331).[55] For these reasons, only external information will be considered in the following analysis. Moreover, internal, company-specific information is easier to collect than external information and, according to Ansoff (1987), strategic decisions are mainly concerned with the external problems of an LSP.

Based on recent literature[56], the following information categories will be analyzed:

- Market-information:[57] Reflects the economic, social, and political environment of an LSP. This information, among other types, refers to the overall economic development (e.g., GDP) or infrastructural aspects (e.g., expansion of the road network).

- Customer-information: Concerns the (potential) customers of an LSP. This information, among other types, refers to customer requirements (e.g., quality aspects) or the overall demand for logistics services (e.g., logistics market volume).

- Competitor-information: Regards the (potential) competitors of an LSP. This information, among others types, refers to the number of competitors within a market as well as their scope of services and key performance indicators (e.g., turnover).

The three information categories will be sub-divided into monetary and non-monetary information as strategic decisions require both measures.

Because of the outside-in perspective on strategy and the focus on external information, the analyses refer to the four strategic service directions developed by

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[55] See also Porter (1980, 1985).

[56] See, among others, Citroen (2011), Johnson et al. (2008), Hitt et al. (2003), Choo (2002) and McNeilly (2002).

[57] In this context, a market is considered as a country or a geographical region.

Johnston and Clark (2001), which are based on Ansoff's product- / market-matrix (1957) and adapted by Juga et al. (2008) in a logistics context.

For different strategic directions[58] of LSPs, it is analyzed, how important information on the market, customers, and competitors – differentiated into monetary and non-monetary information – is.[59] As the demand for logistics services is derivative, and LSPs are often confronted with the necessity to pursue one of the four strategic directions due to their customers' requirements, the information needs when pursuing one of the directions are analyzed, not the information needs when choosing between one of the four strategic directions.

A.3 Methodology

A.3.1 Sample selection

This research aims at analyzing the information needs of LSPs in strategic decisions from an outside-in perspective, meaning that it focuses on the importance of different information categories in different strategic directions. Furthermore, the interrelationships between information, as well as the influence of contextual factors (size of the LSP and the market segment it is operating in) on the importance of information will be analyzed. For this purpose, 17 LSPs from Germany, Austria, and Switzerland were chosen for a survey. In this context, LSPs are defined as companies performing logistics activities on behalf others (Delfmann et al., 2002). These activities can concern railroad, motor freight, and water transportation, transportation by air as well as value-added services.[60] The LSPs were chosen with regard to obtaining a balanced sample in terms of company size (turnover) as well as countries and market segments the LSPs are operating in. Furthermore, it was required that the LSPs already had experience with the four analyzed strategic directions. Consequently, the contact persons were executives from the management level, meaning CEOs or directors of strategy. The characteristics of the LSPs are shown in Table A-1.

To make differentiated analyses, the LSPs were clustered according to their size into small (turnover < 10 million €), medium (10 to 50 million € turnover), and large (turnover > 50 million €) LSPs as well as the market segments they are operating in and by mode of transport or services (railroad transportation, motor freight transportation, water transportation, transportation by air, services, only services, no

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[58] For a detailed investigation of the strategic directions, see Section A.3.

[59] In the following, the term "strategic decision" is used when investigating all four strategic directions together.

[60] In the following, the term services is referred to as value-added services.

services). It has to be noted that LSPs clustered by market segment could have been allocated to more than one cluster group. The characteristics of the analyzed LSPs are depicted in Figure A-1.

Table A-1. Descriptive statistics of LSPs

LSP	Legal structure	Turnover (ca., in million €)	Employees (ca.)	Countries operating in	Market segment by mode of transport or services					Own fleet	Market segment by cargo / service characteristics								
					Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services		Tank and silo	Bulk	Heavy cargo	Full truck load	Break bulk	Courier, express, parcel	Mail services	Contract logistics	Terminal / warehousing services
a	PLC	750	3'325	D, IT, CH	x					Yes	x	x		x					
b	Corp.	490	1'500	worldwide			x			Yes					x	x	x		
c	PLC	6'680	29'240	D, IT, CH	x				x	Yes	x	x		x	x		x		x
d	PLC	15	30	worldwide		x	x	x		(n.a.)				x					x
e	PLC	200	450	worldwide		x	x	x	x	Yes		x		x	x			x	x
f	PLC	20	265	26 countries		x			x	Yes				x	x			x	x
g	PLC	300	1'895	CH, B, IT, L, S, SK		x			x	Yes				x	x			x	x
h	PLC	155	800	CH, D		x				Yes						x			
i	PLC	60	210	Europe		x				Yes						x			
j	PLC	20	55	CH, IT		x	x	x	x	Yes		x	x	x	x	x		x	x
k	PLC	130	125	CH, IT, D	x					Yes		x		x					
l	PLC	150	20	worldwide					x	No						x	x		
m	Ltd.	(n.a.)	160	worldwide, focus East-Europe		x			x	Yes		x		x				x	x
n	Ltd	2	10	F, B, L, NL, IT, AT, CH, E, DK, S, FIN, N		x				Yes				x					
o	Ltd	(n.a.)	(n.a.)	AT		x				Yes				x				x	
p	PLC	15	100	D, CH		x			x	Yes				x	x			x	x
q	Ltd	155	270	worldwide					x	No				x	x			x	

Note: PLC stands for public limited company (in German AG), Ltd. stands for limited (in German GmbH).

A.3.2 Information categories

The research focuses on the importance of three information categories (IC) – each divided into monetary and non-monetary information – in different strategic directions of LSPs. The information categories are derived from the management literature:

- Monetary market-information (**I1**): For example, gross domestic product (GDP), fuel prices.

- Non-monetary market-information (**I2**): For example, infrastructural aspects, labor market.

- Monetary customer-information (**I3**): For example, earnings before interest and taxes (EBIT), logistics market volume.

- Non-monetary customer-information (**I4**): For example, requirements, outsourcing quote.

- Monetary competitor-information (**I5**): For example, turnover, cost of capital.

- Non-monetary competitor-information (**I6**): For example, number of competitors, services.

The assessment of the three information categories, divided into monetary and non-monetary information, is conducted for four different strategic decisions of LSPs based on Juga's (2008) service- / market-matrix:

- Current services in current markets (**A**): For example, an LSP strives for growth in its known environment with current services.

- Current services in current and new markets (**B**): For example, an LSP strives for growth by entering new markets with established services.

- Current and new services in current markets (**C**): For example, an LSP strives for growth by offering new services in its known environment.

- Current and new services in current and new markets (**D**): For example, an LSP strives for growth by offering new services in newly entered markets.

To evaluate the information needs of LSPs in each of the four strategic directions, the questionnaire was structured as shown in Figure A-1.

		Current services in current markets	Current services in current and new markets	Current and new services in current markets	Current and new services in current and new markets
Market-information	Monetary	**Example**	*According to the example*	*According to the example*	*According to the example*
	Non-monetary	*According to the e...*	*According to the...*	*According to the...*	*According to the...*
Customer-information	Monetary	*Acco...*			
	Non-monetary	*Acco...*			
Competitor-information	Monetary	*Acco...*			
	Non-monetary	*Acco...*			

Strategic direction
Current services in current markets

The importance of **monetary market-information** compared to…

	no importance (N)	very low (VL)	low (L)	high (H)	very high (VH)
…**non-monetary market-information** is					
…**monetary customer-information** is					
…**non-monetary customer-information** is					
…**monetary competitor-information** is					
…**non-monetary competitor-information** is					

Figure A-1. Structure of the questionnaire used to evaluate information in strategic directions of LSPs

A.3.3 Background of the multiple-Grey-based DEMATEL approach

For the evaluation of the questionnaires, and hence to assess the importance of the different information categories in the strategic directions or decisions of LSPs, and furthermore to identify their interrelationships, a Grey-based DEMATEL approach was followed. Moreover, to compare the assessments of different respondents or cluster groups, an Euclidean distance approach was applied.

DEMATEL is a multi-criteria decision-making model (MCDM). Multi-criteria decision-making is characterized by multiple criteria (attributes or objectives) that may conflict with each other and have diverse measurement units. MCDM aims at finding the most suitable alternative(s) among existing (Pedrycz et al., 2011).

The DEMATEL approach was developed at the Geneva Research Centre of the Battelle Memorial Institute (Fontela and Gabus, 1974, 1976). It allows for the illustration of the interrelationships between criteria, to identify the most representative criteria and to avoid "overfitting for evaluation" (Liou et al., 2007, p. 1029). Hence, it also helps to minimize the number of elements to be collected in decision-making. Contrary to other approaches, such as the Analytic Hierarchy Process (AHP) or the Interpretative Structural Modeling (ISM), DEMATEL allows for "a broader discrimination of measures and multiple directional relationships" (Zhu et al., 2011, p. 434) – it is more network-oriented. A variety of decision-making approaches presumes that elements in the decision-making are not interdependent, which does not represent reality (Yang et al., 2008). Hence, the DEMATEL approach was chosen for the research.

The result of the DEMATEL approach is a visual depiction (DEMATEL prominence-causal digraph) of complicated causal relationships. In the diagraph, the strength of interrelationships is illustrated (Zhu et al., 2011). The assumption of the DEMATEL approach is a system with related elements that can be assessed pairwise.

As the importance of information was analyzed for each of the four strategic directions, the DEMATEL method was extended to a "multiple-DEMTAL" approach. In general, one multiple-criteria decision problem is analyzed by the application of DEMATEL. In this research context, four theoretically independent decision problems (for each of the four strategic directions) are analyzed. The results are then aggregated, meaning a combined evaluation is conducted.

The integration of Grey-systems theory was carried out as the sample size is relatively small and the data are discrete. Grey-systems theory helps to generate satisfactory results despite a small sample size and variability (Fu et al., 2012; Li et al., 1997; Deng, 1989) by transforming respondents' discrete linguistic answers into grey numbers. Whereas some authors state that Grey-systems are equal to fuzzy sets (Deschrijver and Kerre, 2003; Dubois et al., 2000), an important difference and advantage of Grey-systems towards fuzzy sets are the "low requirements on sample data and flexible capability in pattern identification" (Yang and John, 2003, p. 194).

A.3.4 Steps of the multiple-Grey-based DEMATEL approach

The applied multiple-Grey-based DEMATEL approach is based on the research of Fu et al. (2012) and Zhu et al. (2011). The integrated and combined "multiple-Grey-based DEMATEL" approach follows eleven steps:

- *Step 1:* Derivation of the direct-relation matrix based on a linguistic direct-relation matrix; input from respondents' assessments of six information categories for each of the four strategic directions of LSPs.

- *Step 2:* Derivation of the grey direct-relation matrix X based on the direct-relation matrix; translation of the numbers of the direct-relation matrix into grey numbers.

- *Step 3:* Normalization of grey numbers for a better comparability.

- *Step 4:* Calculation of normalized crisp values Y and crisp direct-relation matrix Z for aggregation purposes.

- *Step 5:* Derivation of the normalized direct-relation matrix N as basis for the total-relation matrix.

- *Step 6:* Derivation of the total-relation matrix (T).

- *Step 7:* Calculation of the direct and indirect effects between information categories.

- *Step 8:* Determination of the overall importance (prominence) and net effect of information categories.

- *Step 9:* Determination of the DEMATEL prominence-causal digraph.

- *Step 10:* Determination of aggregated results (for all or clustered LSPs, strategic decisions in general, or the four strategic directions).

- *Step 11:* Determination of Euclidean distances.

Step 11, the calculation of Euclidean distances, was conducted additionally to the multiple-Grey-based DEMATEL approach in order to identify differences between respondents or aggregated results (Grimm, 2013). Steps 1-11 and the related mathematical operations are detailed in the Appendix.

The general limitations of the chosen methodology are the costly and exhausting efforts for the respondents, who had to make 120 pairwise comparisons (five pairwise comparisons for each of the six information categories for the four strategic directions). Fu et al. (2012) also emphasized the fact that most studies applying DEMATEL use the measure "influence" of elements on each other to evaluate their importance. The former limitation could only be mitigated by sensitizing the respondents, and by conducting personal telephone calls or one-on-one interviews as well as follow-up interviews to verify inconsistencies. The latter limitation was resolved by directly asking for the importance of one information category (element) in comparison to another in a specific strategic direction.

A.4 Results

Following the methodological steps of the multiple-Grey-based DEMATEL approach, a linguistic direct-relation matrix was drawn for each of the 17 responding LSPs, for each of the four strategic directions. As an example, the linguistic direct-relation matrix of LSP q is shown in Table A-2. The respondent of LSP q assessed non-monetary market-information as very important as opposed to all other information categories (IC) when striving for growth in current markets with current services. In total, 68 linguistic direct-relation matrices were derived (Step 1).

On the basis of the direct-relation matrices, grey direct-relation matrices were calculated. For that purpose, linguist values were translated into grey numbers (Step 2).

Table A-2. Example of the linguistic direct-relation matrices for LSP q

	Current services in current markets (A)						Current and new services in current markets (C)					
IC	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	N	VH	H	H	L	L	N	H	L	L	H	H
I2	N	N	L	L	L	H	VL	N	L	L	H	H
I3	L	L	N	H	L	VH	L	H	N	VH	VH	VH
I4	L	L	H	N	L	VH	VL	H	VH	N	VH	VH
I5	H	H	H	VL	N	H	VL	L	VH	H	N	H
I6	H	H	H	VL	L	N	VL	L	VH	H	H	N
	Current services in current and new markets (B)						Current and new services in current and new markets (D)					
IC	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	N	VH	H	H	H	H	N	H	H	L	H	H
I2	H	N	H	H	H	H	H	N	L	L	H	H
I3	L	H	N	VH	H	H	H	H	N	H	H	H
I4	L	H	L	N	H	H	H	H	L	N	H	H
I5	H	H	H	H	N	H	H	H	L	H	N	H
I6	L	H	H	H	H	N	H	H	L	H	H	N

Note: IC is information category, N is no importance, VL is very low importance, L is low importance, H is high importance, and VH is very high importance.

Additionally, the grey direct-relation matrices for the four strategic directions of each responding LSP were summarized by calculating the arithmetic mean of the grey numbers for each pairwise comparison. Furthermore, the LSPs were aggregated into different clusters (see Section A.3) in order to allow for evaluations based on the specific characteristics of LSPs.[61] For that reason, arithmetic means of the grey-numbers of the appropriate LSPs for each strategic direction and the aggregation of all four strategic directions were calculated. The aggregated grey direct-relation matrices for all LSPs differentiated into the four strategic directions are shown in Table A-3.

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[61] The determination of aggregated results is an anticipation of Step 10.

Table A-3. Aggregated grey direct-relation matrices for all LSPs

IC	Current services in current markets (A)						Current and new services in current markets (C)					
	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	.00 .00	.25 .5	.62 .87	.43 .68	.51 .76	.5 .75	.00 .00	.32 .57	.56 .81	.47 .72	.5 .75	.46 .71
I2	.29 .51	.00 .00	.5 .75	.44 .68	.44 .69	.47 .71	.35 .6	.00 .00	.47 .71	.49 .74	.47 .72	.47 .71
I3	.22 .47	.22 .47	.00 .00	.37 .62	.38 .63	.35 .6	.28 .51	.19 .43	.00 .00	.41 .66	.38 .63	.37 .62
I4	.16 .4	.18 .43	.4 .65	.00 .00	.34 .59	.31 .54	.22 .47	.18 .41	.4 .65	.00 .00	.35 .59	.38 .63
I5	.28 .53	.24 .49	.54 .79	.4 .65	.00 .00	.46 .71	.29 .53	.19 .43	.53 .78	.46 .71	.00 .00	.35 .6
I6	.18 .43	.16 .4	.44 .69	.35 .59	.37 .62	.00 .00	.21 .46	.18 .41	.44 .69	.38 .63	.34 .59	.00 .00
IC	Current services in current and new markets (B)						Current and new services in current and new markets (D)					
	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	.00 .00	.32 .57	.47 .72	.41 .66	.46 .71	.44 .69	.00 .00	.32 .56	.49 .74	.44 .69	.47 .72	.38 .63
I2	.41 .66	.00 .00	.44 .69	.4 .63	.43 .68	.46 .71	.4 .65	.00 .00	.46 .71	.44 .69	.43 .68	.4 .65
I3	.31 .56	.29 .54	.00 .00	.34 .59	.34 .59	.34 .59	.34 .59	.26 .51	.00 .00	.38 .63	.32 .56	.35 .6
I4	.31 .56	.24 .49	.41 .66	.00 .00	.32 .56	.32 .57	.29 .54	.29 .54	.4 .65	.00 .00	.35 .59	.38 .63
I5	.38 .63	.29 .54	.51 .76	.37 .62	.00 .00	.4 .65	.35 .6	.29 .54	.5 .75	.44 .69	.00 .00	.35 .6
I6	.29 .54	.24 .47	.4 .65	.35 .6	.38 .63	.00 .00	.29 .54	.28 .53	.43 .68	.43 .68	.41 .66	.00 .00

The aggregated grey direct-relation matrix for all LSPs and all strategic directions is shown in Table A-4.

Table A-4. Aggregated grey direct-relation matrix for all LSPs and all strategic directions

IC	All strategic directions					
	I1	I2	I3	I4	I5	I6
I1	.00 .00	.31 .55	.53 .78	.44 .69	.49 .74	.44 .69
I2	.36 .61	.00 .00	.47 .71	.44 .68	.44 .69	.45 .69
I3	.29 .53	.24 .49	.00 .00	.38 .63	.36 .6	.35 .6
I4	.25 .49	.22 .47	.4 .65	.00 .00	.34 .58	.35 .6
I5	.33 .57	.25 .5	.52 .77	.42 .67	.00 .00	.39 .64
I6	.24 .49	.21 .45	.43 .68	.38 .63	.38 .63	.00 .00

Based on the grey direct-relation matrices, Steps 3 to 5 were conducted. These calculations can be considered as intermediate steps; hence, the results are not illustrated in the following. Consequently, the total-relation matrices for each strategic decision were derived for each LSP and the cluster groups (Step 6). Table A-5 shows the aggregated total-relation matrices for all LSPs and each of the four strategic directions. The bold and underlined values indicate significant relationships between the appropriate information categories. The significant relationships exceed the threshold value that is calculated based on the standard deviations within each total-relation matrix.

Table A-5. Aggregated total-relation matrices for all LSPs

IC	Current services in current markets (A)						Current and new services in current markets (C)					
	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	0.46	0.57	**0.97**	**0.83**	**0.85**	**0.85**	0.55	0.59	**1**	**0.94**	**0.89**	**0.89**
I2	0.55	0.42	**0.89**	**0.79**	**0.78**	**0.8**	0.68	0.45	**0.95**	**0.93**	**0.87**	**0.88**
I3	0.45	0.44	0.58	0.65	0.65	0.64	0.54	0.44	0.62	0.74	0.69	0.7
I4	0.4	0.39	0.66	0.45	0.58	0.58	0.5	0.42	0.73	0.56	0.65	0.67
I5	0.53	0.5	**0.85**	0.73	0.58	0.75	0.57	0.47	**0.85**	0.8	0.59	0.73
I6	0.42	0.41	0.71	0.62	0.62	0.49	0.49	0.42	0.75	0.71	0.65	0.53
IC	Current services in current and new markets (B)						Current and new services in current and new markets (D)					
	I1	I2	I3	I4	I5	I6	I1	I2	I3	I4	I5	I6
I1	1.17	1.18	**1.58**	**1.42**	**1.44**	**1.45**	1.47	1.5	**1.97**	**1.91**	1.79	1.75
I2	1.34	1.04	**1.58**	**1.42**	**1.44**	**1.46**	1.64	1.37	**1.98**	**1.92**	1.79	1.77
I3	1.1	0.99	1.16	1.18	1.19	1.2	1.39	1.28	1.52	1.62	1.5	1.5
I4	1.08	0.95	1.3	1.02	1.16	1.17	1.4	1.31	1.7	1.5	1.54	1.54
I5	1.26	1.11	**1.52**	1.34	1.19	1.37	1.54	1.42	**1.88**	**1.82**	1.53	1.66
I6	1.11	0.98	1.33	1.19	1.21	1.07	1.46	1.36	1.79	1.74	1.62	1.44

Note: Bold and underlined values indicate significant relationships between the appropriate information categories.

The aggregated total-relation matrix for all LSPs and all strategic directions is shown in Table A-6. In total, 28x5 (=140) total-relation matrices were derived: four strategic directions and their aggregation for the 17 responding LSPs and 11 cluster groups.

Table A-6. Aggregated total-relation matrix for all LSPs and all strategic directions

IC	All strategic directions					
	I1	I2	I3	I4	I5	I6
I1	0.78	0.84	**1.26**	**1.15**	**1.12**	**1.12**
I2	0.91	0.69	**1.22**	**1.13**	**1.09**	**1.1**
I3	0.75	0.67	0.85	0.93	0.89	0.9
I4	0.71	0.65	0.97	0.75	0.86	0.87
I5	0.84	0.75	**1.14**	1.04	0.85	1.01
I6	0.73	0.66	1.01	0.93	0.9	0.76

Note: Bold and underlined values indicate significant relationships between the appropriate information categories.

The row (R_i) and column (D_j) sums for each total-relation matrix were calculated in the next step (Step 7). The values describe the direct and indirect influence of an information category I_i on another (Zhu et al., 2011). Based on the row and column sums, the prominence (overall importance) (P_i) and the net effect (E_i) of each information category (for each strategic decision, their aggregation, each responding LSP, and the cluster groups) are calculated (Step 8). The aggregated row and column values as well as prominence and net effect for all LSPs are shown in Table A-7 and

Table A-8, aggregated for all strategic directions. The prominence value of an information category indicates its overall importance in contrast to the other categories under consideration. The net effect indicates whether an information category is a net cause ($E_i>0$) or a net effect ($E_i<0$). This implies that if an LSP focuses on an information category with $E_i<0$, it should also consider information categories with $E_i>0$ that are directly influencing the appropriate information. For example, for the strategic direction A, I3 is very important ($P_i=8.067$) but is a net effect ($E_i=-1.246$, see Table A-7). From Table A-5 it can be derived that I1 ($t_{1,3}=0.97$) and I2 ($t_{2,3}=0.89$) have a significant relationship with I3. As they are both cause effects ($E_i>0$), they should also be taken into consideration when an LSP focuses on the processing of I3.

Table A-7. Aggregated prominence and net effect values for all LSPs

IC	Current services in current markets (A)				Current and new services in current markets (C)			
	R_i	D_j	P_i (R+D)	E_i (R-D)	R_i	D_j	P_i (R+D)	E_i (R-D)
I1	4.535	2.812	7.347	1.722	4.869	3.326	8.195	1.543
I2	4.231	2.734	6.965	1.497	4.748	2.781	7.529	1.967
I3	3.410	4.657	8.067	-1.246	3.728	4.900	8.629	-1.172
I4	3.063	4.064	7.126	-1.001	3.522	4.680	8.202	-1.158
I5	3.952	4.062	8.014	-0.110	4.018	4.349	8.368	-0.331
I6	3.252	4.114	7.366	-0.862	3.544	4.392	7.936	-0.848
	Current services in current and new markets (B)				Current and new services in current and new markets (D)			
	R_i	D_j	P_i (R+D)	E_i (R-D)	R_i	D_j	P_i (R+D)	E_i (R-D)
I1	8.229	7.069	15.298	1.159	10.404	8.890	19.294	1.514
I2	8.281	6.257	14.537	2.024	10.473	8.258	18.730	2.215
I3	6.829	8.467	15.297	-1.638	8.800	10.840	19.640	-2.039
I4	6.681	7.554	14.235	-0.874	8.989	10.511	19.500	-1.523
I5	7.797	7.620	15.416	0.177	9.842	9.773	19.615	0.069
I6	6.874	7.723	14.597	-0.849	9.417	9.653	19.070	-0.236

Results aggregated for all strategic directions (Table A-8) can be interpreted as an "overall ranking" of the importance of information categories in strategic decisions of LSPs.

Table A-8. Aggregated prominence and net effect values for all LSPs and all strategic directions

IC	All strategic directions			
	R_i	D_j	P_i (R+D)	E_i (R-D)
I1	6.266	4.718	10.984	1.548
I2	6.143	4.257	10.401	1.886
I3	4.998	6.443	11.441	-1.446
I4	4.810	5.929	10.739	-1.118
I5	5.622	5.715	11.336	-0.093
I6	4.981	5.758	10.739	-0.777

The prominence-causal digraphs (Figure A-2 and Figure A-3) illustrate the prominence and net effect of each information category. The vertical axis divides information categories into cause and net effect groups.
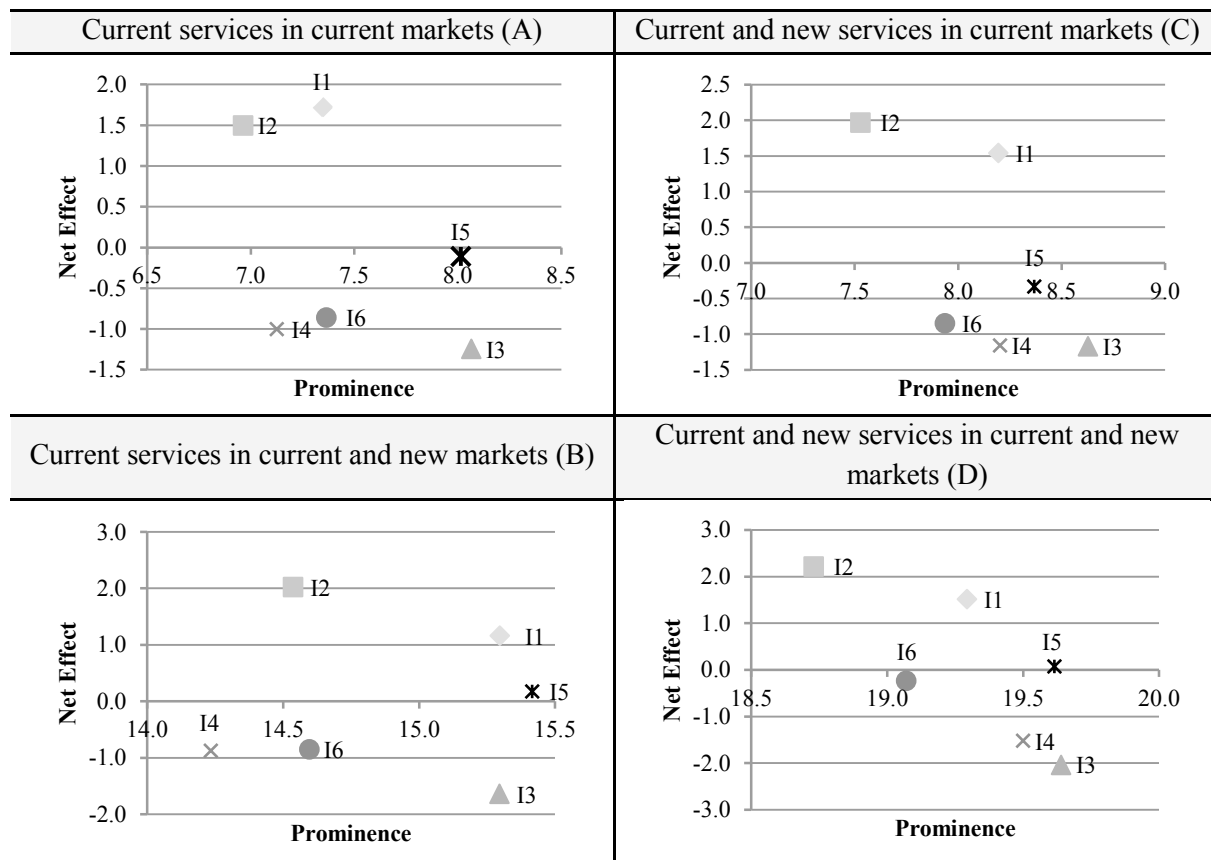
Figure A-2. Aggregated DEMATEL prominence-causal digraph for all LSPs
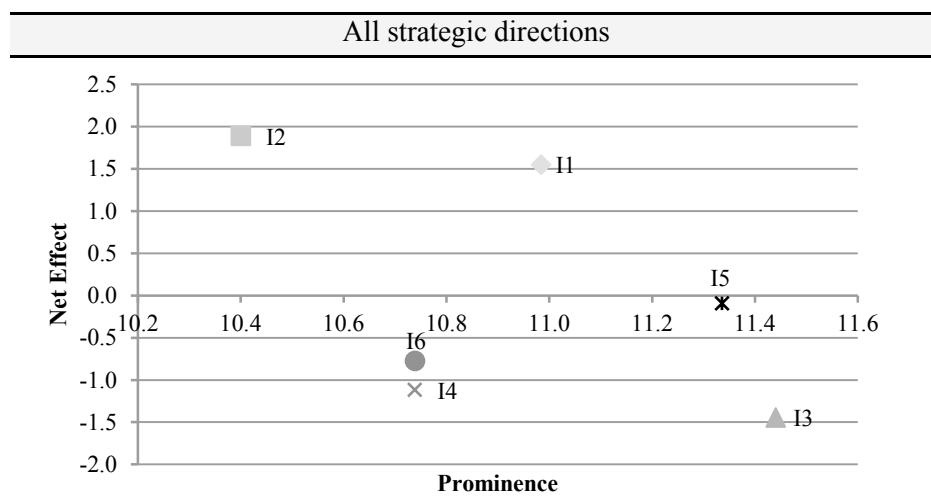
Figure A-3. Aggregated DEMATEL prominence-causal digraph for all LSPs and all strategic directions

Because the results of the analyses allow for various combined and differentiated considerations, the discussion of the results in Section A.5 will be conducted regarding

the following structure of LSP cluster groups, in order to ensure a compelling approach: [62]

- All LSPs in all strategic directions (strategic decisions in general): All LSPs and the strategic directions A to D are aggregated.

- All LSPs in different strategic directions: All LSPs are aggregated; each strategic direction is considered separately (A, B, C, D).

- LSPs clustered according to size in all strategic directions (strategic decisions in general): Small, medium, and large LSPs are separately analyzed; the strategic directions A to D are aggregated.

- LSPs clustered according to size in different strategic directions (if appropriate): Small, medium, and large LSPs are separately analyzed; each strategic direction is considered separately (A, B, C, D).

- LSPs clustered according to market segment in all strategic directions (strategic decisions in general): LSPs from the railroad transportation, motor freight transportation, water transportation, transportation by air, services, only services, and no services cluster are separately analyzed; the strategic directions A to D are aggregated.

- LSPs clustered according to market segment in different strategic directions (if appropriate): LSPs from the railroad transportation, motor freight transportation, water transportation, transportation by air, services, only services, and no services cluster are separately analyzed; each strategic direction is considered separately (A, B, C, D).

A.5 Discussion

A.5.1 Importance of information categories

Regarding the aggregated results for all LSPs and all strategic directions (Table A-9, second column), the overall importance of the different information categories for strategic decisions of LSPs can be derived. LSPs assessed monetary customer-information as most important, followed by monetary competitor-information and monetary market-information. Rank four is taken by non-monetary competitor-information, followed by non-monetary customer- and non-monetary market-

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[62] Due to relevance, the results of each single responding LSP or cluster are not presented.

information. Considering the different possible strategic directions (for all LSPs aggregated), only slight differences can be observed.

More obvious differences can be noted when considering the importance of information according to the size of the LSPs:

- *Small LSPs:*[63] Regarding strategic decisions in general, most significant is that small LSPs focus on non-monetary information (which is ranked low by all other LSPs). For strategic directions A to C, they favor non-monetary market-information. This viewpoint completely differs from that of medium and large LSPs, who all assess non-monetary market-information as less important (rank 5 or 6). Only in strategic direction D (new markets and new services), non-monetary customer-information is assessed as most important. The general importance of non-monetary information can be traced back to the fact that particularly small LSPs are often owner-managed, and strategic decisions are then taken by intuition. Hence "soft", non-monetary information may appear to be more appropriate to decision makers. To summarize, small LSPs focus on market-information when strategic decisions concern current services (A, B), closely followed by customer- and competitor-information. When entering new markets with current services (C), the focus is more on market and customer-information, whereas competitor-information becomes more important when additionally offering new services (D).

- *Medium LSPs:* Regarding strategic decisions in general, medium LSPs focus on monetary-information, contrary to small LSPs, but similar to large LSPs. The importance of information differs in each strategic direction. In the decisions concerning current markets and current services (A), medium LSPs focus on monetary customer- and competitor-information, which indicates that they seem to be more familiar with the characteristics of their competitors in the markets they are already operating in. For entrance in new markets (B), customer-information is ranked only 3; here, monetary market- and competitor-information is most important. When offering new services (C), apart from monetary market-information, monetary customer-information is required, which is obvious, as new services have to meet customer demands. When entering new markets with new services (D), information on the customers is assessed to be most important, followed by monetary market- and competitor-

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[63] Only one small LSP is included in the sample. This aspect has to be taken into account when interpreting the appropriate results.

information. To summarize, medium LSPs focus on customer-information when operating in a known environment (A) or taking completely new paths (D). When entering a new market or launching a new service (B, C), monetary market-information is considered most important.

- *Large LSPs:* Regarding strategic decisions in general, large LSPs obviously focus on monetary competitor- and customer-information. Differentiating between the four strategic directions, similar to medium LSPs, large LSPs focus on monetary customer- and competitor-information when decisions concern current markets and current services. In contrary to small and medium LSPs, large LSPs assess monetary competitor-information as most important in strategic directions that concern a new market (B, D). This may be ascribed to the fact that large LSPs are more familiar with processing and using monetary information on their competitors, as large LSPs themselves often have to fulfill a (financial) reporting duty. When intending to offer new services (C), large LSPs focus on monetary customer-information, followed by monetary competitor-information. To summarize, large LSPs primarily focus on their competitors and customers when taking strategic decisions. When entering new markets (B, D), monetary competitor-information is assessed to be most important, while decisions in a known environment (A, C) require monetary customer-information. Market-information is rather less important for large LSPs, which indicates that they are familiar with the general market environment and conditions.

Table A-9. Importance (prominence) of information categories according to size of LSP (turnover)

IC	All				A				B				C				D			
	All LSPs	Small LSPs	Medium LSPs	Large-LSPs	All LSPs	Small LSPs	Medium LSPs	Large-LSPs	All LSPs	Small LSPs	Medium LSPs	Large-LSPs	All LSPs	Small LSPs	Medium LSPs	Large-LSPs	All LSPs	Small LSPs	Medium LSPs	Large-LSPs
I1	3	6	2	4	4	6	3	5	2	6	1	3	4	6	1	5	4	4	2	4
I2	6	1	6	6	6	1	5	6	5	1	6	5	6	1	6	6	6	3	6	6
I3	1	4	1	2	1	2	1	1	3	2	3	2	1	2	2	1	1	6	1	2
I4	5	2	4	5	5	2	6	4	6	2	5	6	3	4	4	3	3	1	4	5
I5	2	3	3	1	2	2	2	2	1	2	2	1	2	4	3	2	2	2	3	1
I6	4	5	5	3	3	5	4	3	4	2	4	4	5	3	5	4	5	5	5	3

Note: Importance is ranked from 1 (highest importance, dark grey shaded) to 6 (lowest importance, light grey shaded).

Considering the importance of information for all strategic directions but differentiating LSPs according to their primarily used mode of transport or the offer of

value-added services, further differences can be observed; there is no homogeneous picture of the importance of information (Table A-10).

Table A-10. Importance (prominence) of information categories according to market segment (mode of transport or services) for all strategic directions

IC	All LSPs	Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services	Only services	No services
I1	3	5	3	1	1	3	6	6
I2	6	1	6	5	5	6	5	5
I3	1	3	1	2	2	1	3	3
I4	5	2	4	4	4	5	4	2
I5	2	4	2	3	3	2	2	1
I6	4	6	5	6	6	4	1	4

Note: Importance is ranked from 1 (highest importance, dark grey shaded) to 6 (lowest importance, light grey shaded).

The differentiated consideration of the four strategic directions reveals further differences (Table A-11):

- *Railroad transportation:* In strategic decisions in general and in each strategic direction (A to D), LSPs of the railroad transportation cluster focus on non-monetary market-information, contrary to all other LSPs. This may be founded in the fact that rail transports are to a large extent dependent on infrastructural aspects, such as the available rail network. While (non-) monetary customer-information is the second most important category, competitor-information does play a minor role. This may be traced back to the facts that the railroad transportation market is rather transparent with regard to its major actors and that in most countries one large operator dominates the market (e.g., DB in Germany, SBB in Switzerland, OEBB in Austria).

- *Motor freight transportation:* Regarding strategic decisions in general, LSPs of the motor freight transportation cluster assess the importance of information quite similar to the general picture that is drawn by all LSPs, implying they focus on monetary customer-, competitor-, and market-information (in that order). In the decisions concerning current markets and current services (A), LSPs of the motor freight transportation cluster focus on monetary competitor-information, followed by monetary customer-information. When taking

completely new paths (D), the importance is vice versa. The motor freight transportation segment is very diverse, and hence the consideration of customers and competitors is of major relevance. When entering new markets (B) or offering new services (C), customer-information is most important but followed by monetary market-information.

- *Water transportation* and *air transportation:*[64] The water and air transportation cluster show various similarities. This may be traced back to the fact that their business and hence the LSPs themselves are very asset-intensive, furthermore, both modes of transport are primarily used to overcome long distances, usually transnational. Regarding strategic decisions in general, LSPs of these clusters focus on monetary information on the market, customers, and competitors (in that order). This may be traced back to the facts that the competitor situation in the water and air market is more transparent than in other segments and that general market development plays an important role for strategic decisions, particularly when focusing on investments that are very high in these segments. The order of the importance of the different information categories is valid for all strategic directions regarding new services and / or new markets (B to D). Decisions concerning the known environment (A) require monetary customer- and competitor-information, followed by market-information, indicating that LSPs of the water and air transportation cluster are familiar with general environmental conditions.

- *Services:*[65] LSPs that offer value-added services in addition to "classical transportation services" focus on monetary customer- and competitor-information in their strategic decisions. LSPs that offer only services, prefer (non-) monetary competitor-information over customer-information. The former group of LSPs primarily focuses on monetary customer-information in different strategic directions (A, C, D), which is obvious as services have to be oriented towards customers. Only when entering new markets with current services (B), competitor-information is assessed as most important. LSPs that offer only services also focus on customer-information, particularly when decisions concern current markets (A, C). When entering new markets, monetary (B) and non-monetary (D) competitor-information is most important. LSPs that do not offer any value-added services show various similarities to the

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[64] Because the water and air transportation cluster have many similarities, they are analyzed collectively.

[65] This paragraph also pertains to the clusters „only services" and „no services" as well.

motor freight transportation cluster. This can be ascribed to the fact that the majority of the appropriate LSPs that does not offer services operates in the motor freight transportation market.[66]

Table A-11. Importance (prominence) of information categories according to market segment (mode of transport or services)

IC	Current services in current markets (A)								Current and new services in current markets (C)							
	All LSPs	Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services	Only services	No services	All LSPs	Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services	Only services	No services
I1	4	6	3	3	3	3	4	6	4	5	2	1	1	2	6	6
I2	6	1	6	4	5	6	6	5	6	1	6	5	5	6	5	5
I3	1	2	2	1	1	1	1	3	1	2	1	2	2	1	1	3
I4	5	3	5	6	6	5	3	4	3	3	4	4	4	4	4	2
I5	2	4	1	2	2	2	5	1	2	4	3	3	3	3	3	1
I6	3	5	4	5	4	4	2	2	5	6	5	6	6	5	2	4

IC	Current services in current and new markets (B)								Current and new services in current and new markets (D)							
	All LSPs	Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services	Only services	No services	All LSPs	Railroad transportation	Motor freight transportation	Water transportation	Transportation by air	Services	Only services	No services
I1	2	4	2	1	1	1	4	6	4	2	4	1	1	3	3	5
I2	5	1	5	4	4	4	3	5	6	1	6	5	5	6	2	2
I3	3	6	1	2	2	3	6	1	1	3	1	3	3	1	6	6
I4	6	2	6	6	6	6	5	2	3	4	3	2	2	4	5	1
I5	1	3	3	3	3	2	1	4	2	6	2	4	4	2	4	4
I6	4	5	4	5	5	5	2	3	5	5	5	6	6	5	1	3

Note: Importance is ranked from 1 (highest importance, dark grey shaded) to 6 (lowest importance, light grey shaded).

These elucidations also answer RQ1 and RQ2. In general, the most important information categories for strategic decisions of LSPs are monetary customer-, competitor-, and market-information (in that order). However, the importance of each information category is largely dependent on the strategic direction to be followed and

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[66] For that reason, a detailed discussion is not conducted; it is referred to the paragraph "motor freight transportation."

the characteristics of the appropriate LSP or the primary market segment(s) they are operating in.

A.5.2 Interrelationships among information categories

For all LSPs and strategic decisions in general, monetary and non-monetary market-information are net cause factors (I1, I2) and monetary and non-monetary customer- as well as monetary and non-monetary competitor-information are net effect factors (I3, I4, I5, I6). The allocation of information categories into net cause and net effect of all LSP clusters and for all strategic directions is summarized in Table A-12.

Table A-12. Allocation of information categories into net cause and net effect, according to LSP clusters and strategic directions
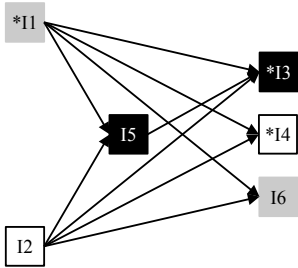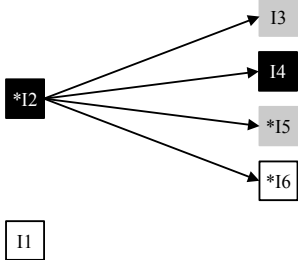
LSP cluster | strategic direction	Net cause	Net effect
All LSPs | all, B, D		
Medium LSPs | all, B, C, D		
Large LSPs | A, B		
Motor freight transportation | all A, B, C, D		
Water transportation | D	I1, I2, I5	I3, I4, I6
Transportation by air | all, D		
Services | all, B, C, C		
Only services | all		
No services | all A, B, C, D		
All LSPs | A, C		
Small LSPs | all, A, B, C		
Medium LSPs | A		
Large LSPs | all, C	I1, I2	I3, I4, I5, I6
Railroad transportation | all A, C		
Transportation by air | A, C		
Only services | B, C		
Small LSPs | D	I2, I5, I6	I1, I3, I4
Large LSPs | D		
Railroad transportation | B	I1, I2, I6	I3, I4, I5
Railroad transportation | D	I2, I6	I1, I3, I4, I5
Water transportation | A	I5	I1, I2, I3, I4, I6
Water transportation | all, C		
Transportation by air | B	I1, I2, I3, I5	I4, I6
Services | A	I1, I5	I2, I3, I4, I6
Only services | A	I1, I2, I4, I5	I3, I6
Only services | D	I1, I2, I5, I6	I3, I4

Despite some differences in the allocation into net cause and net effect, I1, I2, and I5 are in most cases net cause factors. Consequently, the majority of LSPs considers these three information categories as influencing the other ones. So, if an LSP focuses, for

example, on monetary customer-information (I3), it should also regard market- (I1, I2) and monetary competitor-information (I5).

Based on the total-relation matrix (for all LSPs, see Table A-5 and Table A-6) and the prominence-causal digraph (for all LSPs see Figure A-2), structural models can be derived. They illustrate the net causes and net effects for the most significant relationships (bolded and underlined in Table A-5 and Table A-6). Table A-13 presents structural models for all LSPs as well as clustered by size or by market segment in all strategic directions (strategic decisions in general), and for all LSPs in each of the four strategic directions (A to D).[67]

Table A-13. Structural models for information categories

All LSPs | all strategic directions	
	The overall picture emphasizes a general relevance of all information categories for LSPs taking strategic decisions. In particular, the high influence of market-information (I1, I2) reveals that general market conditions, for example, infrastructural aspects, which play a crucial role for LSPs or the labor market situation, must not be disregarded. This can be ascribed to the fact that logistics markets or segments are embedded in the general economic environment and may not be considered isolated. Hence, it is obvious that market-information influences customer- and competitor-information and not vice versa (this is also valid for the following considerations).

LSPs by size | all strategic directions	
Small LSPs | all strategic directions	
	The fact that non-monetary market-information (I2) is most important for small LSPs and influences all customer- and competitor-related information, may be ascribed to the fact that their strategic decisions often concern markets they are already operating in. The fact that they are often owner-managed and take decisions by intuition explains the need for "soft", non-monetary information.

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[67] Not all structural models are presented due to space limits. Nonetheless, the models show the obvious differences between clusters, which also vary for each strategic direction.

Medium LSPs | all strategic directions
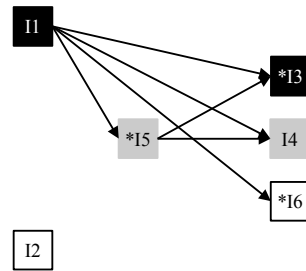
The relationships of information in the medium LSP cluster are similar to those of all LSPs, except of non-monetary market-information (I2) and the stronger net causes of monetary competitor-information (I5) on customer-information (I3, I4). A majority of LSPs can be allocated to the group of medium LSPs. Hence, the information on customers and competitors is of major importance to survive competitively. Market potential can be derived from general monetary market-information (I1), which explains the insignificant relationship of non-monetary market-information.

Large LSPs | all strategic directions
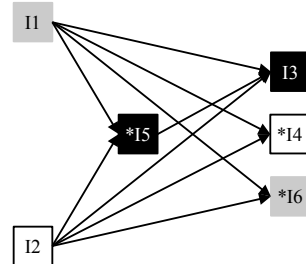
The similarities of the group of large LSPs to all LSPs can be ascribed to the fact that this group represents the largest of the whole survey sample (~60%). In contrary to all LSPs, large LSPs focus more on monetary competitor-information, which may be ascribed to the fact that they are more familiar with monetary information and may have realized the potential of collecting this type of information.

All LSPs | strategic directions A to D

All LSPs | strategic direction A: current services in current markets
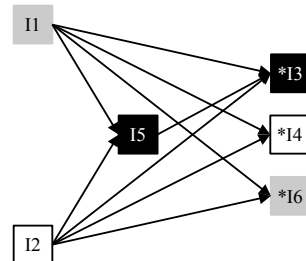
When acting in a known environment, meaning in current markets or the offer of current services (A to C), relationships between the different information categories of all LSPs are similar, merely the importance of single information categories differs. General market conditions (I1, I2) have to be considered when focusing on customers and competitors as well. Monetary customer-information (I3) is also influenced by monetary competitor-information (I5), which indicates the relevance of market- and competitor information when focusing on costumers. I5 may influence customer information, as customer requirements (e.g., asking prices or their logistics costs) may be influenced by (former) relationships with LSPs. Customer-information (I3, I4) as well as non-monetary competitor-information (I6) do not influence any other information. This may be ascribed to the fact that customers, and also LSPs themselves (I6, I5), are actors in logistics markets that are primarily influenced by environmental and hence general market-information (I1, I2).

All LSPs | strategic direction B: current services in current and new markets
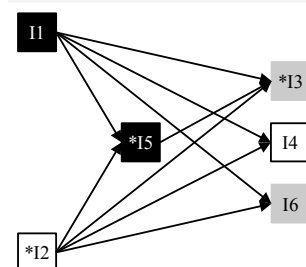
When entering new markets (B), financial information on competitors (I5) and the market in general (I1) is more important than customer information (I3), which implies that in case of a new market entry, the general and competitive environment has to be analyzed. This can also be ascribed to the fact that LSPs often follow their customers and are informed about their requirements, for example, related to services or quality.

All LSPs | strategic direction C: current and new services in current markets
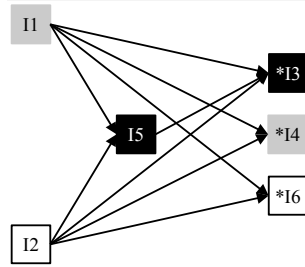
When offering new services in current markets (C), similar to strategic direction A, customer-information is most important, which is obvious as new services have to be adopted according to customers' requirements. Relationships among information categories are similar to strategic directions A and B.

All LSPs | strategic direction D: current and new services in current and new markets
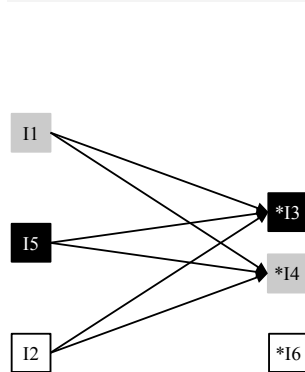
When offering new services in new markets (D), the relationships of information categories differ. As in all cases, customer-information (I3, I4) is influenced by general market- (I1, I2) and monetary competitor-information (I5). The fact that I5 is not influenced by I1 and I2 may be ascribed to the fact that when LSPs enter a new market, considerations of the market environment and competitors are made separately. When taking completely new paths, an integrated investigation could be too complex and not targeted. This is also underscored by the fact the non-monetary competitor-information (I6) does not reveal significant relationships: LSPs in strategic direction D might focus on the most important "hard" facts, for example, on the turnover of competitors. Then, customers are of major relevance.

LSPs by market segment | all strategic directions

Railroad transportation | all strategic directions
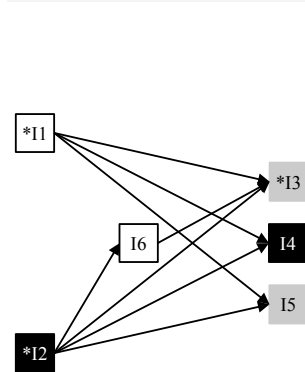
The most obvious difference in the railroad transportation market from previous considerations is the influence of non-monetary competitor-information on customer- (I3, I4) as well as monetary competitor-information. This may be ascribed to the fact that the railroad transportation market is rather transparent with regard to its major actors. Potential for differentiation can be used, on the one hand, in terms of the costs of services, which explains the higher importance of monetary competitor-information (I5) compared to non-monetary (I6). On the other hand, differentiation can be achieved by the type of services offered or their quality, respectively, which again influences monetary measures and hence explains the influence on customers (I3), for example, considering their logistics costs.

Motor freight transportation | all strategic directions
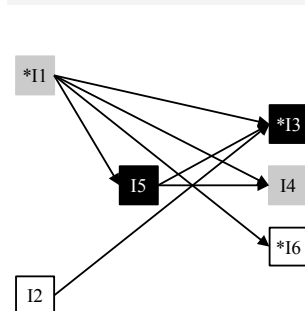
The relationships of information categories in the motor freight transportation cluster are relatively similar to those of all LSPs in all strategic directions (strategic decisions in general). Non-monetary market-information (I2) influences only monetary customer-information (I3), which may be ascribed to the fact that the market is very diverse with a variety of actors in it (competitors), and where primarily "hard" monetary information is of relevance. An explanation for the influence of I2 on I3 might be the current challenge of the shortage of skilled labor, which directly influences customers' (financial) performance.

Water transportation | all strategic directions
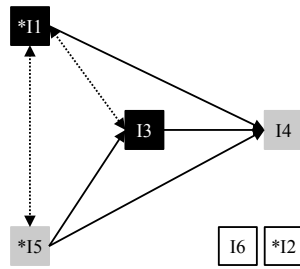
The water transportation segment reveals a totally different picture. Non-monetary information plays a minor role, and non-monetary market- and competitor information (I2, I6) do not show any significant relationships. This may be traced back to the fact that the market is rather transparent, but currently fiercely competitive. This also explains the converse interrelationships between monetary customer- as well as competitor-information (I3, I5) and monetary market-information (I1). LSPs (and their competitors) as well as customers act on a transnational market and are hence influenced by general market developments.

Transportation by air | all strategic directions
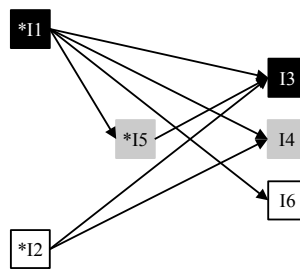
The relationships among information categories in the transportation by air cluster are quite similar to those in the motor freight transportation cluster or LSPs in all strategic directions. As a difference from the motor freight transportation cluster, non-monetary market-information (I2) also influences non-monetary customer-information (I4). This may be ascribed to the fact that regulations, which are partly very restrictive in the air transportation sector, may also influence customers' attitude toward this mode of transport or requirements, respectively. The high influence of monetary market-information (which is at the same time the most important category) can be ascribed to the fact that this segment is significantly dependent on overall economic developments.

Services | all strategic directions
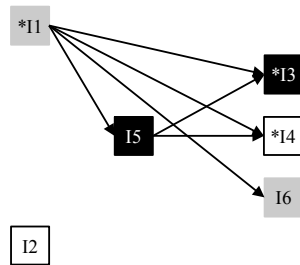
Services have to fulfill customer needs, but this is only realizable when also taking competitors' performance into consideration. This explains the influence of monetary competitor-information (I5) on customer-information (I3, I4). The focus on customers and competitors also explains the insignificant relationship of non-monetary market-information (I2). However, monetary market-information again can be interpreted as the overall influencing environmental factor.

Only services | all strategic directions
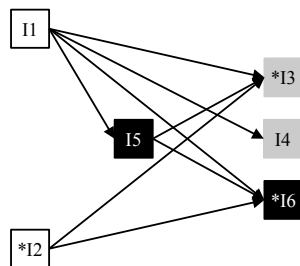
Contrary to the cluster services, which encompasses all LSPs that are offering services, the LSPs of the only services cluster do not operate on other market segments. As a further difference, they are non-asset-based which means that their competitive resources are rather intangible, for example, knowledge. Hence, non-monetary market-information (I2), for example, regarding the labor market, seems to be more important. The influence on monetary customer-information (I3) can be traced back to the fact that a customer's performance is dependent on the services offered by LSPs, which are in this cluster largely dependent on the potential of the labor market. The influence on non-monetary competitor-information (I6) underlies the assumption that, for example, the investigation of competitors' services and deliberations on "own" services also have to include the potential of the labor market.

No Services | all strategic directions

The relationships in the case of LSPs that do not offer services (in terms of value-added services), differ only slightly from the relationships of information categories of all LSPs in all strategic directions. Monetary competitor-information (I5) does not influence any other information categories, and monetary market-information (I1) does not influence non-monetary competitor-information (I4). If no services are offered, customer- and competitor information should be considered in equal shares with regard to general market conditions (I1, I2).

| ■ Importance ranked 1 | ■ Importance ranked 2 | ⁎ Importance ranked 3 | ▢ Importance ranked 4 | ⁎ Importance ranked 5 | ▢ Importance ranked 6 |

The structural models indicate that LSPs have to consider different information categories in different strategic directions. In this context, not only the importance (prominence) of each information category is crucial, but also the net effect, indicating whether the information category is a net cause or net effect factor.

For example, all LSPs assess I3, I5, and I1 (in that order) as the most important information categories for strategic decisions in general (all strategic directions). However, when an LSP focuses on monetary customer-information (I3), it should also take monetary competitor- (I5) and market-information (I1, I2) into consideration. This implies, although non-monetary market-information (I2) has a low overall importance, it should be regarded when taking strategic decisions because it influences customers and competitors or their information, respectively. Which information should be taken into consideration by which type of LSP (according to its size) and in which strategic direction can hence be derived from the structural models in Table A-13. Furthermore, interpretations of the relationships are provided.

These elucidations also answer RQ3. There are strong and significant relationships among the most important information categories. Focusing on all LSPs and strategic decisions in general (all strategic directions), the first graph in the first row of Table A-13 indicates that monetary as well as non-monetary market-information influence all other information categories, whereas monetary competitor-information also influences monetary and non-monetary customer-information as well as non-monetary competitor-information. Similar to the importance (prominence) of information categories, the relationships are largely dependent on the strategic direction to be followed and the characteristics of the appropriate LSPs or the primary market segments they are operating in.

A.5.3 Overall comparison of the assessments of information categories

Grimm (2013) was the first to introduce Euclidean distance calculation in the context of DEMATEL analyses. The consideration of Euclidean distances allows for comparisons of the assessments of the information categories by each LSP or cluster groups, respectively. Consequently, similarities and differences of the different LSPs or cluster groups can be derived by comparing prominence ($R+D$) and net effect ($R-D$) (Step 11, for detailed steps of the calculation, see Appendix). Figure A-4 shows the Euclidean distances for small, medium, and large LSPs, in each case compared to all LSPs, for strategic decisions in general (all strategic directions aggregated).
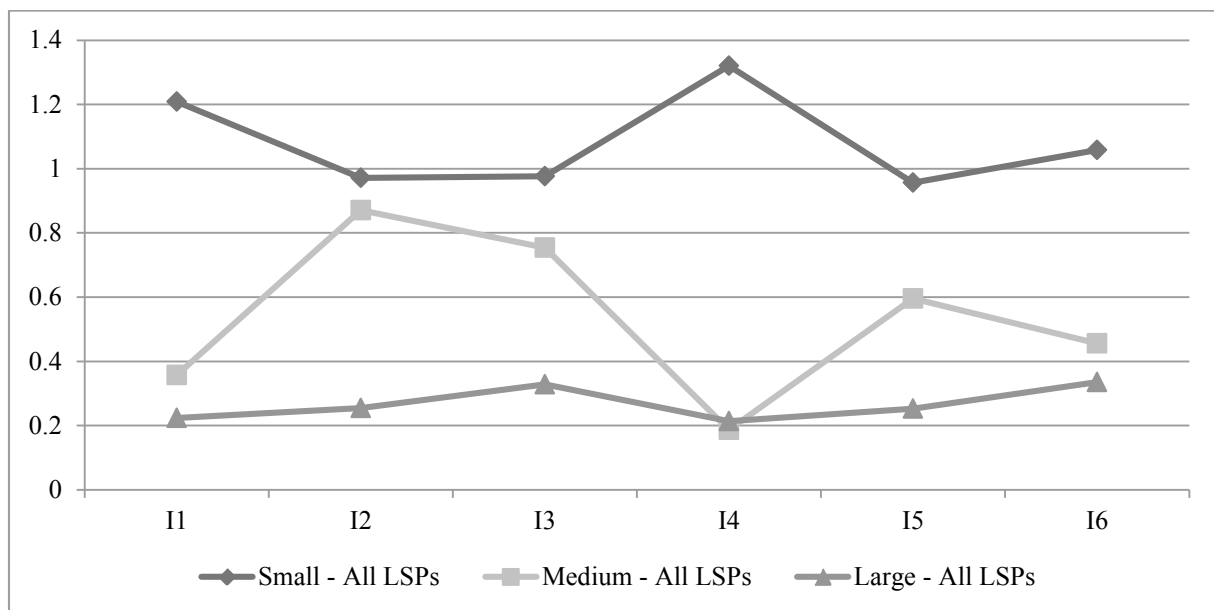
Figure A-4. Euclidean distances of the assessments of the information categories of LSPs according to size (turnover)

Overall, the graphs indicate that large LSPs represent the overall assessments of all LSPs as the Euclidean distances for all information categories (I1 to I6) are relatively low. Furthermore, medium LSPs and all LSPs have very few differences in the assessment of non-monetary customer-information (I4). The depiction also allows for the conclusion that the assessment of non-monetary customer-information (I4) by medium and large LSPs is relatively similar as the Euclidean distances for I4 for medium and all LSPs as well as large and all LSPs are almost the same. Related conclusions can be drawn for small and medium LSPs for non-monetary market-information (I2). The Euclidean distances should be considered in combination with the overall importance of the information categories (Figure A-3 and Table A-9) as well as their relationships (Table A-13). The fact that I4 is similarly assessed by medium, large and all LSPs does not imply that it is the most important information

category. It was ranked 4 or 5 by the appropriate LSPs – the Euclidean distances only allow for conclusions on similar or different evaluations of information categories.

A more detailed and differentiated picture shows the consideration of the Euclidean distances of LSPs clustered according to market segment and compared to all LSPs, for strategic decisions in general (Figure A-5).
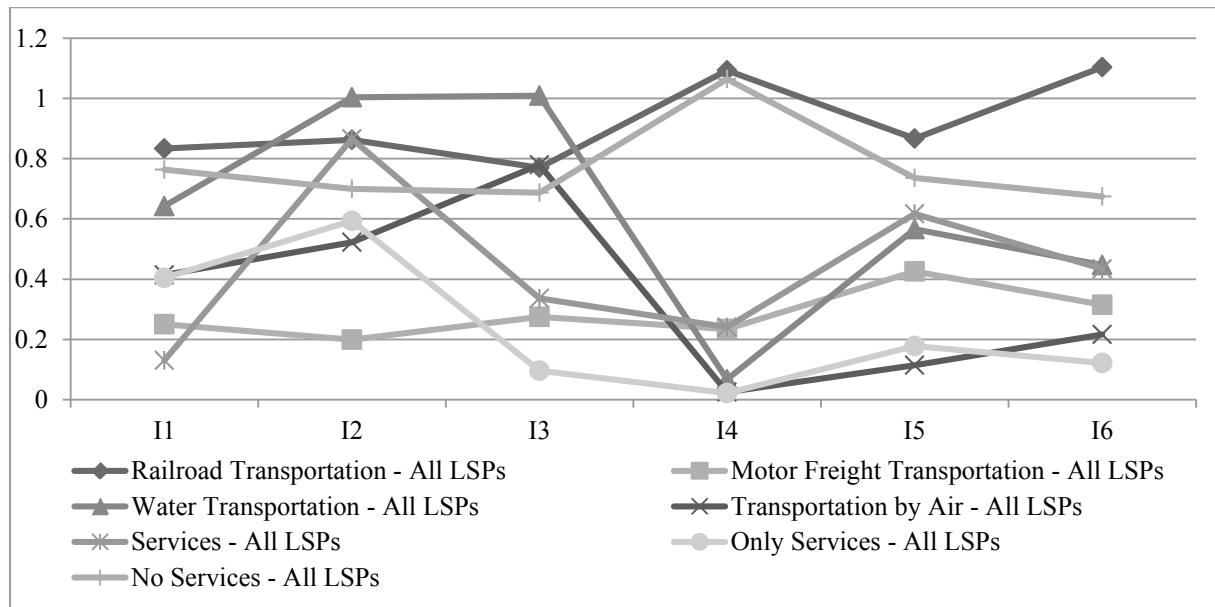
Figure A-5. Euclidean distances of the assessments of the information categories of LSPs according to market segment (mode of transport or services)

Overall, the assessments of the information categories according to the different LSP clusters are very heterogeneous. Most accordance is for non-monetary customer-information (I4), except for the railroad transportation and no services clusters (which in turn agree with their assessments for I4). Further accordance can be observed, for example, for monetary customer-information (I3) by the railroad transportation, transportation by air, and no services clusters.

Figure A-6 shows the Euclidean distances for the different strategic directions. For that purpose, the assessments of the information categories by all LSPs, differentiated for each strategic direction, were compared.

The investigation of the Euclidean distances of the different information categories highlights the differences in the assessments of the importance of the information categories in different strategic directions by all LSPs. Most similarities reveal the assessments of the information categories related to strategic directions A and C as the Euclidean distances are comparatively low. In general, the results in Figure A-6 indicate very heterogeneous assessments by the LSPs.
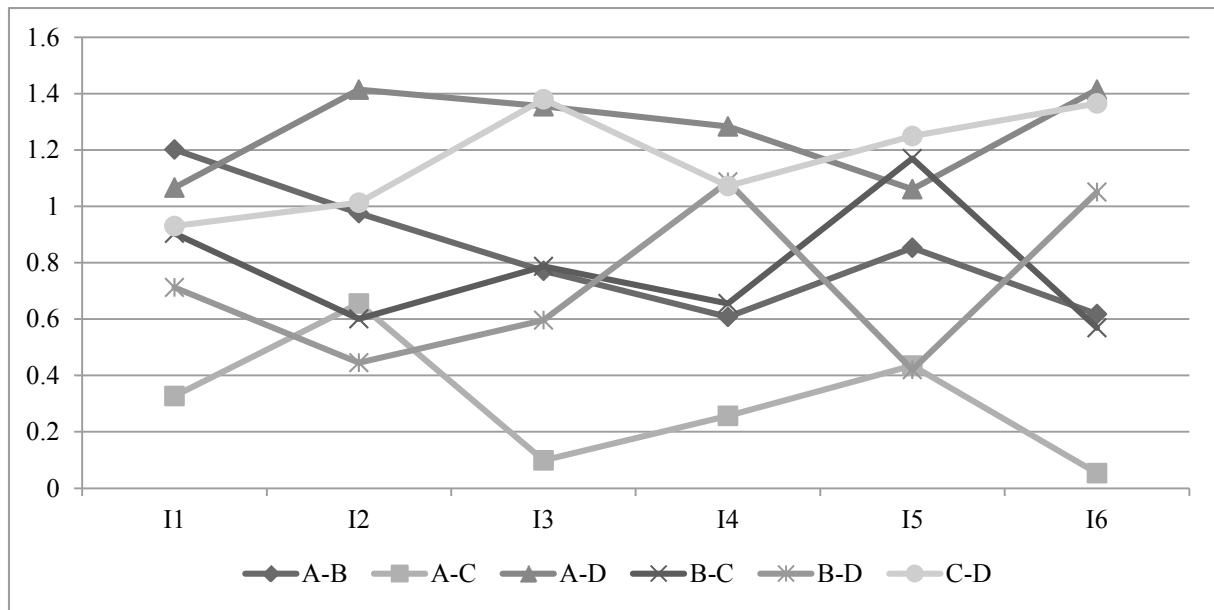
Figure A-6. Euclidean distances of the assessments of the information categories of all LSPs for each strategic direction (A to D)

To summarize, the considerations of Euclidean distances again emphasize the different information needs of different types of LSPs for strategic decision-making or different strategic directions, respectively.

A.6 Conclusion

A.6.1 Summary

The present research analyzed the information needs of LSPs in strategic decisions. Thereby, an outside-in perspective on strategy was adopted, which is why the focus of the analyses is on external information. Despite the awareness of the importance of external information for strategic decisions, and to achieve competitive advantage, recent logistics literature has investigated only a few aspects of the strategic management of LSPs. By applying a multiple-Grey-based DEMATEL approach, the information needs of LSP were investigated. The main results are as follows:

- The most important information categories in strategic decisions of LSPs are monetary customer-, competitor-, and market-information (in that order), hence, monetary information is more important than non-monetary information.

- The importance of each information category is largely dependent on the strategic direction to be followed, the size of LSPs, and the market segment they are operating in.

- Large LSPs focus on monetary competitor-information when entering new markets. Medium LSPs focus on monetary-information, but the specific

information category significantly depends on the strategic direction to be followed. Small LSPs generally focus on non-monetary information.

- LSPs of the railroad transportation cluster focus on monetary customer-information when offering new services or entering new markets, whereas in decisions concerning current markets and services, the focus is on their competitors.

- LSPs of the motor freight transportation cluster focus on monetary customer-information, but when operating in a known environment, monetary competitor-information is most important.

- LSPs of the water and air transportation cluster focus on monetary market-information, but when operating in a known environment, monetary customer-information is most important.

- LSPs that offer value-added and transportation services primarily focus on monetary customer-information, whereas LSPs that exclusively offer services also focus on their competitors, particularly when entering new markets.

- There are strong relationships among the information categories. Even if one information category is considered to be most important in strategic decisions or for pursuing a specific strategic direction, other influencing information categories also should be taken into consideration.

- Information on the general market environment, both in monetary and non-monetary measures, should generally be taken into consideration when taking a strategic decision.

- Similar to the overall importance (prominence) of information categories, their relationships are largely dependent on the strategic direction to be followed, the size of LSPs, and the market segment they are operating in.

A.6.2 Implications

For management practice, the results provide implications about which information to collect in strategic decisions. The results help LSPs to adjust in their strategic decisions and offer a kind of guideline regarding which external information should be collected or which information should additionally be collected if already focusing on a specific information category.

Furthermore, the results may particularly encourage small LSPs to structure their strategic decision-making processes. By conducting accompanying interviews with

different LSPs, it appeared that small LSPs in particular tend not to follow a structured strategic decision-making process and often take decisions by intuition. For this reason, most of the small LSPs were not able to answer the structured questionnaire. Consequently, the results give implications for small LSPs regarding which information in general to focus on when taking strategic decisions.

Finally, the results give a first structured overview of the information needs of LSPs in strategic decisions. These insights may also be useful for providers of logistics-specific information, such as scientific or market research institutions. With the knowledge of LSPs' information requirements, they may better fit their provided information (e.g., in the form of market studies or reports) to LSPs.

A.6.3 Outlook

Despite all efforts, the present research is faced with some limitations that directly lead to implications for future research.

First, although the Grey-based DEMATEL approach is very suitable for small sample sizes, it has to be admitted that the sample size for this study is relatively small and limited to LSPs from Germany, Austria, and Switzerland. Future research could adapt the present research structure and collect a larger sample size to validate the results. As the majority of the analyzed LSPs operate across Europe or worldwide (Table A-1), it is expected that the limitation to LSPs from Germany, Austria, and Switzerland does not have a significant impact on the information needs of LSPs or the results, respectively.

Second, the LSPs were clustered according to their size (turnover) and the market segments (mode of transport or services) they are operating in. Even if these clusters allow for further conclusions, such as the asset intensity of an LSP, other cluster groups are conceivable. These may, for example, be based on the legal structure they are operating under or the number of countries they are operating in.

Third, information needs were analyzed at a very high level, meaning market-, customer-, and competitor-information, and were divided into monetary and non-monetary measures. The results provide a first structural approach and the basis for possible future investigations. Focusing on the most important information category (or categories) for strategic decisions of LSPs, future research could analyze specific indicators required, such as the EBIT of customers or the cost of capital of competitors. Accompanied by detailed analyses of specific indicators, it should be considered how the information can be acquired, processed, interpreted, and used by LSPs for taking strategic decisions.

Appendix

Detailed presentation of methodology – Grey-based DEMATEL and Euclidean distances

The methodological approach follows commonly accepted research approaches applied among others by Grimm (2013), Fu et al. (2012), Zhu et al. (2011) and Tzeng et al. (2007). All approaches are based on the work of Fontela and Gabus (1974, 1976) who developed the DEMTAEL method at the Geneva Research Centre of the Batelle Memorial Institute.

In the following, the single steps of the Grey-based DEMATEL methodology will be described in detail, including mathematical operations. Each step is conducted for each respondent of the survey and for aggregated groups (e.g., "all respondents") as well.

Step 1: Derivation of the direct-relation matrix based on a linguistic direct-relation matrix

The respondents were asked to assess the interrelationships between six information categories I $I=\{I_i \mid i=1\ldots6\}$, using the following linguistic scale: "no importance" (N), "very low importance" (VL), "low importance" (L), "high importance" (H), and "very high importance" (VH). The assessment each was made for four strategic directions: "current services in current markets" (A), "current services in current and new markets" (B), "current and new services in current markets" (C) and "current and new services in current and new markets" (D). In total, 4 direct-relation matrices for each respondent were derived. To derive a numerical direct-relation matrix, the linguistic scale is translated as depicted in Table A-14.

Table A-14. Translation of linguistic scale into numbers and grey numbers

Linguistic term	Number	Grey numbers
No importance (N)	0	[0.00,0.00]
Very low importance (VL)	1	[0.00,0.25]
Low importance (L)	2	[0.25,0.50]
High importance (H)	3	[0.50,0.75]
Very high importance (VH)	4	[0.75,1.00]

The linguistic direct-relation matrix for LSP q is shown in Table A-2.

All diagonal elements were set 0 or "no importance" (N), respectively.

Step 2: Derivation of the Grey-direct-relation matrix X based on the direct-relation matrix

Grey-systems theory has established for systems with incomplete information (Deng, 1989) and is suitable for investigations with small sample data. The application of Grey-systems theory allows for the transformation of the numerical or linguistics direct-relation matrix into a Grey-direct-relation matrix X.

A grey number $\otimes x$ is an interval with a defined upper $\overline{\otimes}x$ and lower bound $\underline{\otimes}x$, but the information for x is unknown within the interval (Deng, 1989). The mathematical definition of a grey number is:

$$\otimes x = \left[\underline{\otimes}x, \overline{\otimes}x\right] = \left[x' \in x | \underline{\otimes}x \leq x' \leq \overline{\otimes}x\right] \tag{1}$$

By translating the numerical / linguistic elements of the direct-relation matrix into grey numbers (Table A-14), the grey direct-relation matrix X^r is obtained. The importance of information I_i on I_j assessed by each respondent r is displayed by the grey numbers $\otimes x_{ij}^r \in X_{grey}^r$ for each of the four strategic directions. The grey direct-relation matrix X^r has the following structure:

$$X^r = \begin{matrix} I_1 \\ I_2 \\ \vdots \\ I_n \end{matrix} \begin{bmatrix} [0,0] & \otimes x_{12}^r & ... & \otimes x_{1n}^r \\ \otimes x_{21}^r & [0,0] & ... & \otimes x_{2n}^r \\ \vdots & \vdots & \ddots & \vdots \\ \otimes x_{n1}^r & \otimes x_{n2}^r & ... & [0,0] \end{bmatrix} \tag{2}$$

Table A-4 shows the aggregated grey direct-relation matrix for all LSPs and all strategic directions.

Step 3: Normalization of grey numbers

Before calculating the total-relation matrix T, steps 3 - 5 have to be conducted. These steps are part of the "converting fuzzy data into crisp scores" defuzzication method (Wu and Lee, 2007; Opricovic and Tzeng, 2003).

Normalization of lower bound:

$$\underline{\otimes}\widetilde{x_{ij}^r} = \left(\underline{\otimes}x_{ij}^r - \min_j \underline{\otimes}x_{ij}^r\right)/\triangle_{min}^{max} \tag{3}$$

Normalization of upper bound:

$$\overline{\otimes}\widetilde{x_{ij}^r} = \left(\overline{\otimes}x_{ij}^r - \min_j \overline{\otimes}x_{ij}^r\right)/\triangle_{min}^{max} \tag{4}$$

Where $\triangle_{min}^{max} = \max_j \overline{\otimes}x_{ij}^r - \min_j \underline{\otimes}x_{ij}^r \tag{5}$

The normalized grey direct-relation matrix $\widetilde{X^r}$ has the following structure:

$$\bar{X}^r = \begin{array}{c} I_1 \\ I_2 \\ \vdots \\ I_n \end{array} \begin{bmatrix} [0,0] & [\underline{\otimes}\widetilde{x_{12}^r}, \overline{\otimes}\widetilde{x_{12}^r}] & \cdots & [\underline{\otimes}\widetilde{x_{1n}^r}, \overline{\otimes}\widetilde{x_{1n}^r}] \\ [\underline{\otimes}\widetilde{x_{21}^r}, \overline{\otimes}\widetilde{x_{21}^r}] & [0,0] & \cdots & [\underline{\otimes}\widetilde{x_{2n}^r}, \overline{\otimes}\widetilde{x_{2n}^r}] \\ \vdots & \vdots & \ddots & \vdots \\ [\underline{\otimes}\widetilde{x_{n1}^r}, \overline{\otimes}\widetilde{x_{n1}^r}] & [\underline{\otimes}\widetilde{x_{n2}^r}, \overline{\otimes}\widetilde{x_{n2}^r}] & \cdots & [0,0] \end{bmatrix} \tag{6}$$

Step 4: Calculation of normalized crisp values Y and crisp direct-relation matrix Z

Normalized crisp values:

$$Y_{ij}^r = \frac{\left(\underline{\otimes}\widetilde{x_{ij}^r}(1-\underline{\otimes}\widetilde{x_{ij}^r})+(\overline{\otimes}\widetilde{x_{ij}^r}\times\overline{\otimes}\widetilde{x_{ij}^r})\right)}{(1-\underline{\otimes}\widetilde{x_{ij}^r}+\overline{\otimes}\widetilde{x_{ij}^r})} \tag{7}$$

The normalized crisp value matrix Y has the following structure:

$$Y^{kr} = \begin{array}{c} I_1 \\ I_2 \\ \vdots \\ I_n \end{array} \begin{bmatrix} 0 & Y_{12}^r & \cdots & Y_{1n}^r \\ Y_{21}^r & 0 & \cdots & Y_{2n}^r \\ \vdots & \vdots & \ddots & \vdots \\ Y_{n1}^r & Y_{n2}^r & \cdots & 0 \end{bmatrix} \tag{8}$$

Crisp values for all values in crisp direct-relation matrix Z:

$$z_{ij}^r = \min_j \underline{\otimes} x_{ij}^k + Y_{ij}^k \triangle_{min}^{max} \tag{9}$$

As in the direct-relation matrix (Step 1) all diagonal values were set 0 or "no importance" (N), for all cases (10) is valid:

$$\min_j \underline{\otimes} x_{ij}^r = 0 \text{ that is } \otimes x_{ij} = [0,] \text{ when } i = j \tag{10}$$

The crisp direct-relation matrix Z has the following structure:

$$Z^r = \begin{array}{c} I_1 \\ I_2 \\ \vdots \\ I_n \end{array} \begin{bmatrix} 0 & Z_{12}^r & \cdots & Z_{1n}^r \\ z_{21}^r & 0 & \cdots & Z_{2n}^r \\ \vdots & \vdots & \ddots & \vdots \\ Z_{n1}^r & Z_{n2}^r & \cdots & 0 \end{bmatrix} \tag{11}$$

Step 5: Derivation of the normalized direct-relation matrix N

The normalized direct-relation matrix N can be calculated through (12) and (13):

$$N = s * Z \tag{12}$$

$$s = \frac{1}{\max_{1 \le i \le n} \sum_{j=1}^n z_{ij}}, i, j = 1, 2, \dots, n \tag{13}$$

Step 6: Derivation of the total-relation matrix (T)

$$T = N + N^2 + N^3 + \cdots = \sum_{i=1}^{\infty} N^i = N(I - N)^{-1} \tag{14}$$

Where I is an $n \times n$ identity matrix:

$$I = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1 \end{bmatrix} \tag{15}$$

Table A-6 shows the aggregated total-relation matrix for all LSPs and all strategic directions.

As all elements (information I_i) of matrix T have any relationship, a threshold value θ is set to exclude elements with minor effects. One approach to define the threshold value is to gather the mean standard deviation of all values t_{ij} from the total-relation matrix T plus one standard deviation (Fu et al., 2012; Zhu et al., 2011).

$$\theta = mean(T) + \sigma_T \tag{16}$$

Where   *mean(T)*   is the arithmetic mean of all values t_{ij} from matrix T

and σ_T is one standard deviation.

If $t_{ij} > \theta$, the importance or net effect of I_i on I_j is considered significant.

In Table A-6, all significant elements are bolded and underlined. Figure A-3 shows the aggregated DEMTAEL prominence-causal digraph for all LSPs and all strategic directions.

Step 7: Calculation of the direct and indirect effects between information categories

The row (R_i) and column (D_i) sums from the total-relation matrix T explain the overall direct and indirect importance of an information I_i on other information.

$$R_i = \sum_{j=1}^{n} t_{ij} \quad \forall i \tag{17}$$

$$D_j = \sum_{i=1}^{n} t_{ij} \quad \forall j \tag{18}$$

Step 8: Determination of the overall importance / prominence and net effect of information categories

The overall importance (P_i) and net effect (E_i) are calculated using expressions (18) and (19).

$$P_i = \{R_i + D_j | i = j\} \tag{19}$$

$$E_i = \{R_i - D_j | i = j\} \tag{20}$$

P_i is an indicator for the importance of information I_i in relationship to the other information. The larger P_i the greater the importance of information I_i. If $E_i > 0$, I_i is a net cause, if $E_i < 0$, a net effect (Fu et al., 2012).

The aggregated overall prominence and net effect values for all LSPs and all strategic directions are shown Table A-8.

Step 9: Determination of the DEMTAEL prominence-causal digraph

The values for the overall importance (prominence) and the net effect (Step 7) can be visualized in a digraph (DEMATEL prominence-causal digraph) with the horizontal axis "Prominence" (R_i+D_j) and the vertical axis "Net effect" ($R_i\text{-}D_j$). The horizontal axis indicates the importance of each information category I_i, the vertical axis divides information into cause and effect groups (Wu and Lee, 2007).

Step 10: Determination of aggregated results

As the respondents were asked to assess the importance or interrelationships between six information categories for four strategic directions, for each respondent in total four direct-relation matrices were derived. On the one hand, the results can be aggregated for each responding LSP (summarizing all four strategic directions to one), on the other hand, for all LSPs (for each strategic direction or summarized) or selected cluster (e.g., according to company size (turnover) or the market segment they operate in (mode of transport or services).

For that purpose, the arithmetic means of the grey numbers from matrices X are calculated for the appropriate respondents and / or strategic directions. All respondents were expected to have the same relevance, hence the arithmetic means (Fu et al., 2012; Zhu et al., 2011) were chosen for calculation. After calculating the appropriate arithmetic means, Steps 3 to 8 have to be repeated for each aggregated group.

Step 11: Determination of Euclidean distances

Based on the work of Grimm (2013), an Euclidean distance calculation was applied in order to determine evaluation distances between respondents or aggregated groups (Step 9). P_i and E_i of each respondent or aggregated groups represent one point (P_i, E_i) in the DEMTAL prominence-causal digraph. By calculating the distances between two points of respondents or aggregated groups A (P_{Ai}, E_{Ai}) and B (P_{Bi}, E_{Bi}), the individual evaluation values can be compared.

Before making the comparison, the values for P_i and E_i of each respondent or aggregated group should be normalized:

$$\widetilde{P_\iota} = \frac{(P_i-\min_i P_i)}{\max_i P_i-\min_i P_i} \tag{21}$$

$$\widetilde{E_\iota} = \frac{(E_i-\min_i E_i)}{\max_i E_i-\min_i E_i} \tag{22}$$

Then the Euclidean distance for two respondents or aggregated groups A and B is calculated as follows in (23):

$$dist\left(\left(\widetilde{P_i^A}, \widetilde{E_i^A}\right), \left(\widetilde{P_i^B}, \widetilde{E_i^B}\right)\right) = \sqrt{\left(\widetilde{P_i^A} - \widetilde{P_i^B}\right)^2 + \left(\widetilde{E_i^A} - \widetilde{E_i^B}\right)^2} \tag{23}$$

Figure A-4, Figure A-5, and Figure A-6 show the Euclidean distances for LSPs clustered according to size (turnover), market segment they operate in (mode of transport or services) and for each strategic direction.

B Logistics market surveys: state-of-the-art, deficits, and quality criteria

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B.1 Introduction

In the times of a changing business environment, logistics has become a sustainable and competitive advantage for industry and retail companies (Spillan et al., 2013; Bhatnagar and Teo, 2009; Stalk et al., 1992). In particular, since globalization and labor division have led to significant and increasing activities in firms all over the world. In order to survive competition, handle the global flow of goods and information, and take the right strategic decisions so as to achieve growth, profitability, and organizational success (Fugate et al., 2008), companies have to understand the logistics-specific characteristics of both markets operating in and future target markets (Rodrigues et al., 2005). Hence, industry, retail companies, and logistics service providers (LSP) "have to develop strategies to improve performance and profitability in their existing business, and, they have to develop strategies for further growth, making choices related to their products, markets and market segments, resources and relationships and alliances" as well (Persson and Virum, 2001, p. 54). The selection of an attractive industry and a competitive position within the industry are key issues to consider for achieving high profitability (Porter, 1980).

Information on the external and internal environment of LSPs is inevitable when taking strategic decisions (Citroen, 2011), referring to the LSP itself (internal information), the market structure, competitors, customers, and regulations (external information) (Choo, 2002). According to Ansoff (1987), "strategic decisions are primarily concerned with external, rather than internal problems of the firm and specifically with the selection of the product mix which the firm will produce and the markets to which it will sell." External information can primarily be classified into the general environment (e.g., demographic, economic, infrastructural information), the industry environment (e.g., customer information), and the competitor environment (e.g., information on the direct competitors and their performance) (Hitt et al., 2003) of an LSP.

As a consequence of the increased importance of logistics, specific information is of major importance for strategic decision of LSPs, whose core competency is offering logistics services (Lieb and Bentz, 2005b), but also for industry and retail companies

that may gain competitive advantages through excellent logistics. In addition, politics, associations, and scientific institutions also require logistics-specific data for their information and decision-making processes. More detailed, decisions can, for instance, concern transport and location planning, contract placing, and make-or-buy decisions, while further information is used for market analysis, marketing, and consulting activities, among others (Stock and Lambert, 2001).

There are a variety of sources for logistics-specific information required for (strategic) decision-making. One source of information is logistics market surveys (LMS) that intend to provide relevant logistics market information (in their context, a market is generally considered as a geographical region or country), referring to the general, industry, and competitor environment. The distribution of LMSs, or studies and reports, has remarkably grown within the last decade. Whilst a simple Google search for the terms "logistics market survey", "logistics market study", and "logistics market report" only led to a few results prior to the year 2000, nowadays the search leads to about 1 million hits. This is to say that an own market has developed for LMSs. Despite the awareness of the increasing importance of information in logistics, recent research did not analyze LMSs as information sources. Research did more to focus on the information needs in general (Stock and Lambert, 2001), customer perspectives (Bienstock, 2002), or information system support (Daugherty et al., 2002) in logistics.

Many LMSs are available and show a lot of differences, for example, concerning the kind of editor, the context, the analyzed market, the pursued approach, the data basis and the methodology, the indicators analyzed, as well as the potential target groups. While several surveys deal with one specific issue (e.g., outsourcing, logistics service providers), a multitude of LMSs follow a broader approach, offering general market- and industry-related information, including information on shippers and LSPs. [68]

Due to the differences in several LMSs, there are some challenges facing the task of processing the published information. Users of LMSs – particularly companies, politics, industry associations, or scientific institutions – ask for different information and are thereby confronted with the application and interpretation of data. Moreover, editors and authors of LMSs contend with unavailable data to provide appropriate, utilizable information (Rodrigues et al., 2005; Bowersox et al., 2003). Researchers in the field of logistics often refer to LMSs in order to classify their problems and findings into "market segments" and also as references. However, an overview of

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[68] In dependency of the processor of the information, for example, an LSP, information on shippers can be interpreted as customer-information, about LSPs as competitor-information.

available LMSs, the indicators measured, and their rigor, is unavailable, which would facilitate research efforts and structure the field of the logistics market information provided in the form of LMSs, meaning the state-of-the-art in surveying logistics markets.

According to the importance of logistics-specific information in decision-making, and the challenges in providing and processing this information, our article aims to answer the following research questions (RQ):

- RQ1: What are the most established indicators for surveying logistics markets (state-of-the-art)?

- RQ2: What are the deficits in surveying logistics markets?

- RQ3: What are "quality criteria" for surveying logistics markets?

With these research questions, we aim to "bring some light into the jungle" of published LMSs. *First,* a literature review, complemented by a content analysis, shall demonstrate the state-of-the-art of LMSs, focusing on the most established indicators. The analysis will include further aspects, such as the target group, used data, and applied methodology. *Second,* the results of the content analysis are investigated in order to identify the deficits in surveying logistics markets, regarding information providing and processing, meaning the editors' and authors' as well as the users' challenges. *Third,* based on the identified deficits, "quality criteria" for surveying logistics markets will be derived. Thereby, a kind of guidance for potential editors and authors will be provided that also offers valuable information for users (readers of LMSs) processing the logistics market information.

An additional contribution of this analysis is the elaboration of the comparability of information provided by LMSs. For example, when strategic decisions concern further growth and the development of new markets (countries), comparability of information is a prerequisite for cross-national comparisons between different markets (Berry, 1980). In general, LMSs providing a broad range of information (related to the market and industry in general, shippers, and LSPs) focus on the analysis of one country. So if the users of LMSs strive for comparable information on several markets, they have to acquire the results from different LMSs. Country-specific LMSs are the unit of analysis of this work.

In total, 35 surveys were analyzed with regard to the RQs. As briefly broached before, LMSs in the context of this work refer to surveys that provide a broad range of information that is not focused on one specific topic. Furthermore, general-, industry-,

and competitor-related information of each survey refers to one country for the given survey.

The examination of LMSs can also be considered as a kind of qualitative meta-analysis. The combined evaluation of different, independent LMSs using various methods and data sets allows for deeper insights and higher explanatory power than focusing on the analysis of one single LMS or a separate investigation of different LMSs (Stanley, 2001). In order to conduct our analysis, content analysis is applied (Krippendorff, 2003; Weber, 1990), focusing on context-, methodology-, and indicator-related categories (Section B.2). The results shall help the user groups to process the information provided by LMSs and give implications for future research in the field of surveying logistics markets. To answer the RQs, the first step is to identify LMSs' state-of-the-art by conducting a brief literature review.

The outline of our paper is as follows: The methodological approach will be described in Section B.2, which also includes a description of the content analysis process. This is then applied to analyze LMSs in detail and to identify the most established indicators for surveying logistics markets, used data, applied methodologies, etc. The results of the content analysis are described in Section B.3, while Section B.4 discusses the results of analysis with regard to the RQs, including the limitations of research. Section B.5 summarizes the results and gives implications for future research.

B.2 Methodology

The research is inspired by the content analysis process adapted from Krippendorff (2003) and Weber (1990), which was also applied by Spens and Kovács (2006) to analyze research approaches in logistics. The first step in conducting a content analysis in the context of this work was the formulation of research questions (see Section B.1), followed by the identification of relevant texts (*survey selection*). To analyze the identified surveys, a codebook was developed in an iterative process (*coding)*. Since several researchers conducted the content analysis, recording instructions were defined to train the several researchers (coders) in order to ensure the validity of their coding results. To answer research questions, coding results are analyzed (*analysis and interpretation*), under the consideration of deficiencies (*limitations*).The steps of the content analysis process (Figure B-1) will be detailed in the following paragraphs and

illustrated using the example of the *Swiss Logistics Market Survey* (*Logistikmarktstudie Schweiz* [32][69]).
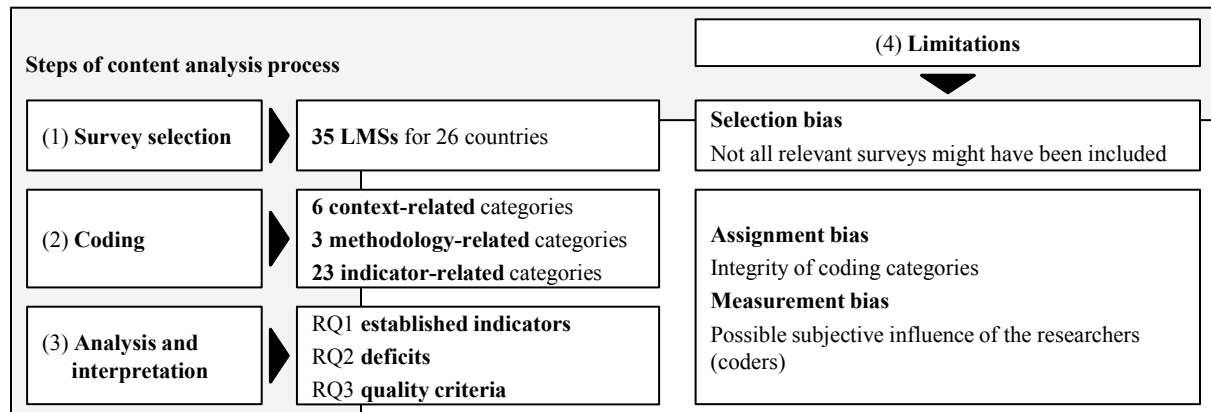
Figure B-1. Methodology applied – steps of content analysis process

(1) Survey selection (locating relevant texts): LMSs have been selected by Google / Google scholar search process and they are the units of analysis (sampling units) used for the content analysis. "Classical" scientific databases (e.g., EBSCOhost) have been excluded, since LMSs are usually not published in academic journals.

For integrity, it should be mentioned that the understanding of logistics within this paper follows the definition of the Council of Supply Chain Management Professionals (2010), where logistics is defined as "the process of planning, implementing and controlling procedures for the efficient and effective transportation and storage of goods including services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements." Furthermore, a market in the context of LMSs and this research paper is understood as a geographical location (on country basis), where customers (shippers) are served by suppliers (LSPs) (Samuelson and Nordhaus, 1985). Since transport is not stationary, transnational transport (import, export, transit) affecting the country of analysis also pertain to the appropriate country.

LMSs for the top 40 countries, based on a total GDP ranking (The World Bank, 2012), have been searched according to the following keyword combinations: "*corresponding country* AND logistics", "*corresponding country* AND logistics AND market" as well as "*corresponding country* AND logistics AND survey." Limiting the research to the top 40 countries per GDP was applied because these countries account for more than 90 percent of the total world GDP, and therewith the most important countries were included. Only surveys with a broad content related to general market- and industry-

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[69] All LMSs analyzed in this paper are listed in the Appendix and are numbered in square brackets. All references to LMSs within this research paper then have the following format: [*number of LMS*].

information as well as to shippers and LSPs, referring to one country, were selected. The selected surveys had to encompass a broad spread of issues, but not necessarily of all three external information classes. Commercial surveys of market research institutions were excluded, since they are mainly commissioned works and not generalizable. Since most LMSs are not published in academic journals or conference proceedings, the general Google database was used for a survey search. To not entirely exclude LMSs published in academic journals, the Google scholar search process was also conducted. The period of time for the searches was 1999-2011. For 26 of the top 40 GDP ranked countries, LMSs were identified, while for 11 countries two or more surveys were available. In total, 35 LMSs were analyzed, which are listed in the Appendix.

Example: Google search for "Switzerland AND logistics AND market" leads to the *Swiss Logistics Market Survey*. The survey analyzes the Swiss logistics market in a macroeconomic context, furthermore, political regulations and infrastructural aspects (general environment), shippers' requirements (industry environment / customer-information[70]), and the main LSPs (competitor environment[70]), and was hence selected for further analysis.

(2) Coding (developing categories and recording instructions): To conduct content analysis, coding categories[71] were created. They enable a repeatable research process and the applicability of the same analysis structure to all analyzed text. To ensure a complete investigation of the units of analysis, these categories have to be exhaustive and mutually exclusive. The former means that no recording units (units distinguished for coding) have to be excluded because of deficient categories, while the latter refers to the clear distinction of the categories. The coding itself has been executed as an iterative process. For the initial category selection, variables for estimating logistics expenditures, prepared by Heskett et al. (1973) as well as Bowersox and Calantone (2003), were chosen for the primary category-outline. These categories were supplemented by adding contextual and methodological issues. In the second step, the content of all LMSs was examined to see if it could be allocated to one of the primary coding categories. If this was not possible, a new category was added. Iteratively, the primary categories were adapted and extended to provide a complete set of categories, allowing for all the LMSs' content to be classified. The categories shown in Table B-1 were finally chosen.

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[70] From the viewpoint of an LSP.

[71] Coding categories are also referred to as codebook (Neuendorf, 2002; Weber, 1990).

Example: The *Swiss Logistics Market Survey* analyzes what type of goods (and which amount and value) are imported and exported. This information could not be allocated to one of the primary coding categories. As a consequence, the category "foreign trade: type of goods" was added.

Table B-1.   Categories used for content analysis

Context-related	
Category	**Definition**
Country analyzed	Name of the country analyzed.
Title	Title of the survey.
Year	Year(s) in which the survey was published.
Editor(s)	Name of editor(s).
Author(s)	Name of author(s).
Definition of logistics	Is the understanding of logistics in the context of the survey defined?
Target group	Are specific target groups explicitly defined?
Methodology-related	
Category	**Definition**
Cycle of publication	Is the survey published regularly, infrequently or only once?
Data basis	Is secondary or primary data used, are the sources quoted, is the data available in time series?
Methodology	Which general methodology is applied (e.g., quantitative or qualitative analysis)?
Indicator-related	
Category	**Definition**
Market volume / logistics costs	Depending on the definition of the logistics market, for example, the logistics cost as a percentage of GDP or the logistics market volume as absolute value.
Domestic transport	Is any information on domestic transport given? The summary of the single mode of transports (road, rail, maritime, air, pipeline).
Transportation / infrastructure: road	All information concerning the corresponding mode of transport. For example, information on the share of modal split, freight volume (in tons, tons kilometer or value), emissions, infrastructure expenditures, empty runs, fleet investments, loading factors, use of alternative fuels, advantages and disadvantages.
Transportation / infrastructure: rail	
Transportation / infrastructure: maritime	
Transportation / infrastructure: air	
Transportation / infrastructure: pipeline	
Transportation / infrastructure: others	For example, information concerning intermodal transport.
Foreign trade	Is any information on foreign trade given? Summary of the type of goods, geographical regions, and mode of transport.

Category	Definition
Foreign trade: type of goods	Is foreign trade information according to the type of goods given? For example, freight volume in tons or value.
Foreign trade: geographical regions	Is foreign trade information according to the geographical region (country of origin or destination) given? For example, freight volume in tons or value.
Foreign trade: mode of transport	Is foreign trade information according to the mode of transport given? For example, freight volume in tons or value.
Logistics service providers	All information concerning LSPs, for example, turnover, major players, performance, profit margin, challenges, services offered.
Shippers	All information concerning shippers (customers), for example, locations, logistics costs, requirements, assets, average time of flow of goods.
Industrial sectors	All information concerning industrial sectors (shippers clustered into industries), for example, logistics costs, competencies, KPIs.
Employees	All information concerning employees in the logistics sector, for example, number of employees, skills, requirements, shortages in staff.
Salary	All information concerning the salary of the employees in the logistics sector, for example, labor cost, salary adjustment or development.
Outsourcing	All information concerning the outsourcing of logistics activities, for example, outsourcing degree, volume, propensity to (not) outsource.
Warehousing and inventory	All information concerning the warehousing and inventory, for example, demand, infrastructure and capacity, warehouse costs, average inventory days.
Real estates	Information on the rental costs for logistics real estates.
Sustainability	Is any information on social, economic, ecological sustainability given?
Trends, outlooks and forecasts	All information concerning trends and the future, for example, forecasts.
Others	Other issues not covered by the other categories, for example, mergers and acquisitions, exchange rates, logistics decision-making rules.

Since several researchers undertook the content analysis, the researchers were trained in order to reduce the impact of subjective valuations in analysis. This implies that all researchers are aware of the meaning of each coding category and work accurately, by following the same scheme.

(3) Analysis and interpretation: To critically examine the analyzed surveys, a quantitative evaluation of the coded categories (Table B-1) was conducted for each LMS. The evaluation gives a state-of-the-art of LMSs and allows for the comparison of the analyzed LMSs, considering context- and methodology-related issues, and to identify the most established indicators for surveying logistics markets, and deficits as well. The analysis builds the basis for answering the RQs and deriving "quality criteria" for surveying logistics markets. These criteria shall help editors and authors to

draft LMSs and users to process or interpret the information. The detailed analyses are presented in Section B.3.

> Example: The *Swiss Logistics Market Survey* addresses a majority of the indicator-related categories (in total 21). However, warehousing and inventory as well as sustainability issues are not encompassed.

The results of the above mentioned investigations are furthermore used for the analysis of the cross-national comparability of the LMSs. The discussion of the latter is closely linked to the challenges concerning the available LMSs and our RQs.

(4) Limitations: Despite the thoroughly applied method, some limitations have to be addressed. During the process of the survey selection, not all available LMSs may have been identified or analyzed due to variety of foreign languages. Only surveys published in the English, French, German, Italian, or Spanish language were analyzed. Despite the most careful development, the integrity of the coding categories cannot be completely ensured. Moreover, for all researchers' alignment, their subjective influence cannot be completely excluded either. A detailed discussion of the limitations is conducted in Section B.4.

> Example: The *Swiss Logistics Market Survey* analyzes the number of employees, as well as their salary, where the latter is only found in the appendix of the survey, which is in a separate document. Unobservant researchers might miss this fact, which could lead to biased results.

B.3 Results

B.3.1 Context-related categories

Detailed information on the LMSs that were analyzed (title of publication, country analyzed, editor and author and year) is listed in the Appendix. In total, 35 LMSs for 26 countries were analyzed, for 11 countries more than one survey is available. The editors or the authors of the LMSs belong to consultancies (C), federal institutions (FI), inter-trade-organizations (ITO), or scientific institutions (SI), and in a few cases, industrial companies (others) also publish LMSs themselves. About 50% of the LMS are published by editor collaborations, implying that the editors of one survey belong to more than one institution or organization, for example, consultancy and federal institution (C and FI).

In total, eleven different "editor-groups" were identified (Table B-2). These can be differentiated into two main groups: at least one scientific institution is an editor and

no scientific institution is involved. 16 (46%) of the analyzed LMSs are published by (or with the collaboration of) a scientific institution (Table B-2, grey-shaded).

Table B-2.   Structure of editors and authors of logistics market surveys

Editors / authors of surveys	Total	Surveys without authors named		Surveys with authors named	
Consultancy (C)	17% (6)	14%	[9, 10]	19%	[11, 18, 19, 20]
Federal institution (FI)	3% (1)	7%	[15]		
Inter-trade-organization (ITO)	11% (4)	21%	[1, 18, 7]	5%	[35]
Scientific institution (SI)	23% (8)			38%	[4, 6, 12, 13, 16, 21, 28, 31]
C and FI	3% (1)	7%	[33]		
C and ITO	9% (3)	21%	[2, 24, 34]		
FI and ITO	6% (2)	14%	[22, 23]		
FI and SI	3% (1)			5%	[14]
ITO and SI	17% (6)			29%	[5, 8, 25, 29, 30, 32]
C, ITO and SI	3% (1)			5%	[3]
Others (companies)	6% (2)	14%	[26, 27]		
Total	**35**	**40% (14)**		**60% (21)**	

Note: in round brackets (): absolute number, in squared brackets []: LMS, see Appendix; grey-shaded: published by or with the collaboration of a scientific institution.

Asking for the names of the LMSs' authors, the reader will only find them in 21 (60%) of the LMSs, since the remaining do not provide any information on the authors' names. This would be interesting in case of further inquiries. By naming the authors, the responsibility of the published results can be ascribed to specific persons. In case of not trusting the results, there is at least a responsible person to appeal to. A comparison of the main editor groups and the authors shows that if a scientific institution is one of the editors, the authors are always named.

Only 12 LMSs (34%) [1, 13, 14, 15, 16, 21, 22, 23, 24, 29, 31, 32] define their understanding of logistics or a logistics market. This becomes important when interpreting or comparing the results (see Section B.4). Target groups are defined by 14 (40%) surveys [1, 2, 7, 11, 14, 16, 17, 18, 19, 20, 23, 30, 31, 32]. In general, the target groups can be distinguished into industry, politics, investors, research, and consulting. 11 (31%) of the LMSs are explicitly targeted at industry.

B.3.2 Methodology-related categories

The majority of analyzed surveys has only been published once (25, 71%), 3 (9%) are published yearly [30, 32, 35], 6 (17%) every two years, infrequently or in longer

intervals [2, 13, 14, 16, 23, 26], while one is supposed to be released regularly [34, first edition].

If the LMSs give information on the used data basis (Table B-3), then the results become more comprehensible and transparent. The majority of the LMSs refer to secondary data, 22 exclusively. Thereof, 17 (77%) are not published by a scientific institution. 11 (69%) of all the surveys published by a scientific institution collect primary data. Supplementary to primary data, most LMSs also refer to secondary data. The surveys that are published without scientific contribution do not combine primary and secondary data bases. Except for one survey [17], all give information on the used data basis. The majority of LMSs (66%) offer data in time series [1, 2, 6, 7, 8, 9, 10, 13, 14, 16, 17, 18, 22, 23, 24, 25, 26, 29, 30, 32, 33, 34, 35], 5 of these 23 surveys do this predominantly. Data in absolute dimensions can be found in all surveys.

On a more detailed level, considering primary data, a variety of techniques for data collection are applied. For example, all the LMSs that are collecting primary data, use surveys (paper and web-based), but most of the LMSs do not offer more details about the survey conducted (e.g., questions asked). 5 LMSs (14%) also use interviews as a data collection technique [3, 4, 27, 31, 32], whereas 2 (6%) conduct telephone interviews [27, 31].

Table B-3.   Relation between survey editor and data basis of logistics market surveys

	No sources	Secondary data	Secondary & primary data	Primary data
At least one scientific institution involved		14% (5)	26% (9)	6% (2)
		[5, 6, 8, 21, 25]	[4, 12, 13, **14**[1], **16**[1], 28, 29, **30**[1], **32**[1,2,4]]	[3, **31**[1]]
No scientific institution involved	3% (1)	48% (17)		3% (1)
	[**17**[1]]	[**1**[1,2], **2**[1], **7**[1,2], 9, 10, **11**[1], 15, **18**[3], **19**[3], **20**[3], 22, **23**[1,2], 24, 26, 33, 34, 35]		[27]
Total	**3% (1)**	**62% (22)**	**26% (9)**	**9% (3)**

Note: **bold**: *information on the target group of the survey is specified and available:* [1]*industry,* [2]*politics,* [3]*investors,* [4]*research/consulting; in round brackets (): absolute number, in squared brackets []: LMS, see Appendix.*

Regarding the general methodology applied by the LMSs, three main forms were identified. *Quantitative analysis* comprises the evaluation of primary or secondary data, whereas *qualitative analysis* means the detailed interpretation or the discussion of data or results. The methodology of the LMSs that do not interpret, evaluate, or collect data is declared as *depiction*. The LMSs use either one methodology or combine two

or more. Also at this point, a relation between the editor group, methodology, and description of methodology can be observed (Table B-4).

Table B-4.   Relation between editor, methodology, and description of methodology of logistics market surveys

Methodology	Methodology description		No methodology description	
	At least one scientific institution involved	No scientific institution involved	At least one scientific institution involved	No scientific institution involved
Depiction				9% (3)
				[17, 18, 19]
Quantitative analysis	3% (1)			
	[28]			
Qualitative & depiction	3% (1)	9% (3)	9% (3)	20% (7)
	[29]	[1, 15, 34]	[5, 6, 25]	[9, 10, 11, 20, 24, 26, 33]
Quantitative & depiction				3% (1)
				[2]
Qualitative & quantitative	17% (6)	3% (1)		6% (2)
	[3, 4, 12, 13, 16, 31]	[27]		[7, 35]
Qualitative, quantitative & depiction	11% (4)		3% (1)	6% (2)
	[14, 21, 30, 32]		[8]	[22, 23]
Total	**34% (12)**	**11.5% (4)**	**11.5% (4)**	**43% (15)**

Note: in round brackets (): absolute number, in squared brackets []: LMS, see Appendix.

A simple depiction of secondary data without interpretation or discussion was noticed in 3 LMSs (9%) that were published without scientific involvement [17, 18, 19]. As a consequence, the methodology was not described either. The majority of LMSs (14) combine qualitative analysis and the depiction of secondary data (40%), whereas 10 belong to the group of editors without any scientific institution involved (71%). The LMSs published by the editor groups that include at least one scientific institution, primarily apply a combination of qualitative and quantitative analysis (13, 38%) or the combination of all three methodologies (9, 25%). Quantitative analysis (exclusive or in combination), and therewith the evaluation of primary or secondary data, is applied by 17 LMSs (49%), while 12 surveys (71%) were published by at least one scientific editor. A description of the methodology, meaning the way of proceeding information, data basis, and the evaluation of the data is provided by 46% of all analyzed LMSs. Whereas 75% of the LMSs that were published by the editor groups with scientific involvement provide more detailed information on the methodology, surveys from the editor groups without scientific involvement only do this in 21% of all cases.

B.3.3 Indicator-related categories

Apart from the context- and methodology-related categories, the indicators analyzed in LMSs were investigated. Which group of indicators is addressed by which LMSs is summarized in Table B-5. The analysis of these indicator groups with regards to the editor group (with or without scientific collaboration) and the data basis (primary or secondary data) does not show any relation.

Table B-5.   Addressed indicator groups of logistics market surveys

Indicator group	Addressed by survey	% (#)
Market volume / logistics costs	[1, **8**, 9, **13***, **14***, 15, **16***, 17, 18, 24, **25, 27***, **28***, **30***, **31***, **32***, 33, 35]	51% (18)
Domestic transport (tons, tkm, value)	[1, 2, **5**, **6**, **8**, 10, **12***, **13***, **14***, 15, 16*, 17, 19, 22, 23, 25, 26, **29***, **30***, **32***, 33, 35, 35]	66% (23)
Transportation / infrastructure: road	[1, 2, **3***, **5**, **6**, **8**, 9, 10, **12***, **13***, **14***, 15, **16***, 18, 19, **21,** 22, 23, **25,** 26, **29***, **30***, **31***, **32***, 33, 34, 35]	77% (27)
Transportation / infrastructure: rail	[1, 2, **3***, **5**, **6**, **8**, 9, 10, **13***, **14***, 15, **16***, 18, 19, **21,** 23, 24, **25, 26**, **29***, **30***, **31***, **32***, 33, 34, 35]	74% (26)
Transportation / infrastructure: maritime	[1, 2, **3***, **5**, **6**, 7, **8**, 9, 10, **13***, **14***, 15, **16***, 17, 18, 19, **21,** 22, 23, **25,** 26, **29***, **30***, **31***, **32***, 33, 34, 35]	80% (28)
Transportation / infrastructure: air	[1, 2, **3***, **5**, **6**, **8**, 9, 10, **13***, **14***, 15, **16***, 17, 18, 19, **21,** 22, **25,** 26, **29***, **30***, **31***, **32***, 33, 34, 35]	74% (26)
Transportation / infrastructure: pipeline	[2, **5**, **6**, 9, **13***, **16***, 22, **29***, **32***, 35]	29% (10)
Transportation / infrastructure: others	[22, **29***, **32***, 33]	11% (4)
Foreign trade (tons, tkm, value)	[1, 2, **3***, **6**, 7, **14***, 17, **21,** 22, 23, **25,** 26, **29***, **32***, 33]	43% (15)
Foreign trade: type of goods	[15, 21 22, 25, **32***]	14% (5)
Foreign trade: geographical regions	[2, **3***, **5**, **6**, 7, 15, **21,** 22, **25, 32***, 33]	31% (11)
Foreign trade: mode of transport	[1, **14***, 17, 22, 23, **32**, 33]	20% (7)
Logistics service providers	[1, 2, **3***, **4***, **5**, **6**, 7, **8**, 9, **12***, **13***, **14***, 15, **16***, 18, 19, **21,** 22, 23, 24, **25,** 27*, **29***, **31***, **32***, 33, 34, 35]	80% (28)
Shippers	[**3***, 12, 14*, 16*, 25, **29***, **32***]	20% (7)
Industrial sectors	[1, **4***, 7, **8**, **12***, **13***, **14***, **16***, 27*, **28***, **29***, **31***, **32***]	37% (13)
Employees	[1, 2, **3***, 7, **8**, **12***, **13***, 15, **16***, 17, 22, **25,** 26, **30***, **31***, **32***, 33, 34, 35]	54% (19)
Salary	[2, 7, **13***, **16***, **32***, 34]	17% (6)
Outsourcing	[1, **3***, **4***, **6**, 7, **12***, **14***, **16***, 18, 19, 22, 23, 24, **30***, **31***, **32***]	46% (16)
Warehousing and inventory	[2, **6**, 7, **14***, 15, 18, 19, **25,** 26, **29***, **30***, 35]	34% (12)
Real estates (rental costs)	[2, 22, **25, 26**, **32***]	14% (5)
Sustainability	[1, 2, 7, 15, **30***]	14% (5)

Indicator group	Addressed by survey	% (#)
Trends, outlooks and forecasts	[1, 2, **3***, **4***, **5**, **8**, 10, 11, **13***, **14***, 15, **16***, 19, 22, 24, 27*, **30***, **32***, 33, 34]	57% (20)
Others (e.g., communication infrastructure, mergers & acquisitions)	[1, **5**, **6**, **8**, **13***, **14***, 15, **16***, 18, 19, 20, **25,** 26, **30***, **31***, **32***, 33*, 34*]	51% (18)

*Note: **bold**: editor group with at least one scientific institution involved, *survey using primary data; in round brackets (): absolute number, in squared brackets []: LMS, see Appendix.*

10 (44%) of the indictor groups are analyzed by more than half of the LMSs. An in-depth analysis of these groups is shown in Figure B-2. The sub-categories (illustrated in bars) are only declared if they are addressed by more than two surveys. The modes of transport (maritime, road, rail and air) are almost equally often analyzed by the LMSs. In detail, the specific sub-categories or indicators within these groups vary, as well as the number of LMSs analyzing the sub-categories. The differences in the sub-categories are primarily grounded in the underlying measurement unit.
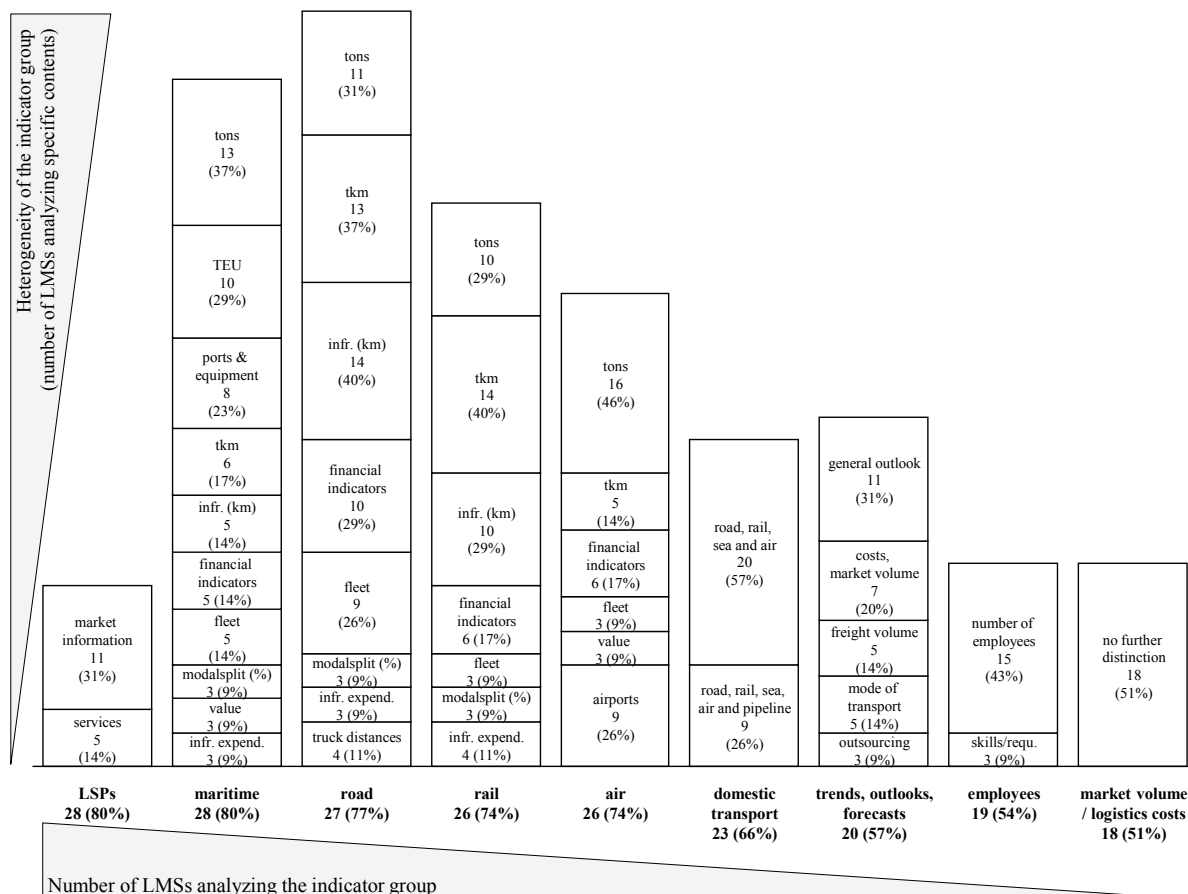
Note: in round brackets (): percentage of LMS, expend.: expenditures; infr.: infrastructure; outs.: outsourcing; requ.: requirements.

Figure B-2.   Specification of the indicators analyzed most by logistics market surveys

The following characteristics were identified when analyzing the LMSs:

- LSPs: 11 surveys give information on the major market players, while 6 offer more detailed information on their turnover. Moreover, 5 LMSs analyze the services offered by LSPs.

- Maritime: 13 surveys give information on the freight volume in tons, 10 in TEU (twenty-foot equivalent unit), 6 in tkm. 8 LMSs provide information on the ports of the analyzed country (e.g., capacities), 6 on the length of navigable waterways (infrastructure km). Financial indicators, such as the costs for transportation, are given by 5 surveys, as well as fleet information (e.g., the size of deep sea fleet). Each 3 surveys give information on the share of maritime transport in the modal split, the value of transported goods, and the expenditures for infrastructure expansion.

- Road: 11 surveys give information on the freight volume in tons, 13 in tkm. 14 LMSs provide information on the length of the road network (infrastructure km), 9 on the fleet (e.g., the number of trucks per day on a specific stretch of road). Financial indicators such as the costs for transportation are given by 10 surveys. Each 3 surveys give information on the share of road transportation in the modal split, and expenditures for infrastructure expansion. 4 surveys analyze the distances covered by each truck.

- Rail: 10 surveys give information on the freight volume in tons, 14 in tkm. 10 LMSs provide information on the length of the rail network (infrastructure km), 3 on the fleet (e.g., the number of trains per day on a specific stretch of rail). Financial indicators such as the costs for transportation are given by 6 surveys. Each 3 surveys give information on the share of rail transportation in the modal split, 4 on expenditures for infrastructure expansion.

- Air: 16 surveys give information on the freight volume in tons, 5 in tkm. Financial indicators, such as the costs for transportation, are given by 6 surveys, 3 LMSs analyze fleet-related information (e.g., the number of flights per day and airport). The value of transported goods is addressed by 3 LMSs, and 9 provide information on the airports of the analyzed country (e.g., capacities).

- Domestic transport (summary of the modes of transport): 20 LMSs address the four modes of transport road, rail, sea, and air, whereas 9 additionally offer information on pipeline transportation.

- Trends, outlooks, and forecasts: 11 surveys give a general outlook on the overall economic development. 7 specify on the logistics market development (logistics cost), 5 on the general transport volume. 5 LMSs specify the information on single modes of transport and 3 surveys consider the development of outsourcing activities.

- Employees: 15 surveys analyze the number of employees in logistics specific professions and 3 LMSs focus on the employees' skills and requirements on the behalf of the recruiting companies.

- Market volume / logistics cost: just above the half of LMSs give information on logistics market volume or cost.

B.4 Discussion

B.4.1 State-of-the-art in surveying logistics markets – most established indicators

The most established indicators in the context of our analysis are defined as those that have been analyzed by more than 50% of the LMSs. These are the groups of information concerning LSPs; maritime-, road-, rail-, and air-transportation or infrastructure (summarized as domestic transport); trends, outlooks, forecasts, employees, and the market volume or logistics costs (see Table B-5). Considering the specific indicators analyzed within these categories (Figure B-2), a variety of differences between the surveys were observed.

In general, information on transportation and infrastructure is provided by most of LMSs (80%). 28 (80%) focus on maritime-transportation, 27 (77%) on road-, each 26 (74%) on rail- and air-transportation, and 10 surveys (29%) on pipeline-transportation. Regarding the modes of transport, the main measurement parameters are tons and tons kilometer (tkm), in the case of maritime transports, TEU.

Information on LSPs also ranks among the most established indicator groups. The level of detail of this provider-oriented information varies from a mere depiction of the major players' names to the declaration of their turnover. By contrast, the information on shippers, meaning the customers of LSPs, belongs to the at least established indicators. This fact could be interpreted as an indicator that the LMSs are primarily targeted at shippers that demand information on LSPs. This is supported by the fact that 11 (31%) of the analyzed LMSs are explicitly targeted at industry, whereby it has to be regarded that only 14 (40%) of the LMSs define their target group.

The comparability of information provided by LMSs is particularly important when the users of this information consider more than one country in their decision process.

Regarding the cross-national comparability of the LMSs, three forms of equivalence should be taken into account (Craig and Douglas, 2000): (i) construct equivalence, (ii) measurement equivalence and (iii) equivalence in data collection techniques. First, the construct equivalence refers to the interpretation by individuals due to different countries and cultures. The editors or authors of LMSs originate from different countries, which may also lead to a different understanding of an issue that is supposedly the same. For example, the intermodal transport may be considered as a separate indicator or in the context of a single mode of transport, such as road- or rail-transportation. Second, the measurement equivalence refers to translation, calibration, and metric equivalence. While the former is less relevant for our analysis, the latter two show up in the in-depth analysis of the most analyzed indicators: Even if the same indicator groups are analyzed, their units of measurement and scale differ between the LMSs, which hinder comparability and correct interpretation. Third, the equivalence in data collection techniques refers to applied methodologies and used data bases. A description of the methodology is offered by about 45% of the analyzed LMSs, whereas a variety of methodologies are applied and the equivalence in data collection techniques cannot be observed. Moreover, only 12 surveys (34%) define logistics or a logistics market within the context of their work. This fundamental aspect can also be ascribed to the construct equivalence that is required to compare different LMSs. If no definition of the analyzed field (logistics or logistics market) is given, this actually encompasses the whole survey, making comparisons almost impossible.

In summary, indicators concerning the logistics market volume or costs, and the modes of transport road, rail, maritime, and air, can be interpreted as the most established indicators when surveying logistics markets. Furthermore, information on LSPs, whose function is, among others, the coordination of transportation activities by using the different modes of transport, employees in the logistics markets, and trends, outlooks and forecasts are of major relevance. These insights also answer RQ1. As a critical point, it must be considered that the analyzed logistics market information is not fully selective. For example, the logistics market volume or costs have to be classed as industry information, since they reflect the demand for logistics services. Specific indicators related to the single modes of transport can, on the one hand, be classified as general information (e.g., length of infrastructure), on the other hand to industry information (e.g., transport volume, which also reflects the demand for logistics services). The same is valid for the indicators referring to employees and trends, outlooks, and forecasts as well. If, for example, the number of employees is given for the entire national economy, the information refers to the general

environment. If only given for the logistics sector, it refers to the industry environment. Depending on one's perspective, information on LSPs has to be considered as competitor or industry information. If the user of a LMS is, for example, an LSP, then the LSPs information concerns its competitor. If the user is an industry company, the LSPs information would be classified as industry- or competitor-information, respectively. Despite the fact that LSPs, and shippers as well, are the main actors in logistics markets, the LMSs primarily give information on LSPs, and not about shippers, although shippers could benefit from competitor information, for example, when striving to optimize their in-house-logistics.

B.4.2 Deficits in surveying logistics markets

Derived from analysis, some deficits in surveying logistics markets have been identified (Figure B-3), wherewith RQ2 is answered. 40% of all analyzed LMSs do not name the authors of the survey. In the case there are any queries of the information's user, there is no contact person to appeal to, and removing the ambiguities in processing the information is hence prevented.

Deficits in surveying logistics markets	Deficits in processing logistics market information
Context-related	
Author information	Missing contact person
Definition of logistics and market demarcation	Interpretation of results
Definition of target groups	Appropriate information
Methodology-related	
Description of methodology	Reproducibility of results
Uniform data basis	Interpretation / comparability of information
Reliable source citation	Transparency of results
Indicator-related	
Matched to target groups	Appropriate information
Homogenized measurement of indicators	Comparability of information
Standardized set of indicators	Comparability of core statements

Figure B-3.   Deficits in surveying logistics markets and processing related information

Moreover, 65% of all the analyzed surveys do not define their understanding of logistics or a logistics market. This aspect makes a correct interpretation of the information difficult. For example, if the logistics understanding includes

transportation, transshipment, and warehousing, then logistics market volume or cost would have another meaning, as if also value-added services and administration would be included.

The last aspect referring to context-related deficits is the missing definition of the target groups of approximately 60% of the analyzed LMSs. The definition of target groups helps on the one hand providing the most relevant information for an appropriate group, on the other hand, possible users of the survey can easily figure out if the survey and its related information is targeted, and thus, relevant to them.

According to Bartunek et al. (2006), the description of the methodology makes an analysis understandable and reproducible in sum, and increases visibility. Furthermore, the choice of methodology has an effect on "how good" the issues of a survey are addressed (Mentzer, 2008). Around 46% of the analyzed LMSs provide a more detailed description about the applied methodology. Moreover, no kind of "trend" towards the application of one kind of methodology can be observed. This complicates the interpretation and comparability of the results. Both are also affected by the choice of the used data basis. In fact, almost all the analyzed surveys give information on the used data basis, but certain homogeneity cannot be observed. Additionally, a reliable source citation enhances the transparency of results.

The indicator-related deficits can only be discussed on a comparative general level. It would be desirable to match the information provided to specific target groups, since this aspect comes along with the fact that most of the LMSs do not define their target groups. A specification would then enable to better fit the provided information to the appropriate users. Furthermore, a standardized set of indicators and homogenized measurements, referring to a similar data basis (in an ideal situation), would improve the applicability and comparability of the information and core statements. It is remarkable that particularly LMSs published without the collaboration of a scientific editor, in about half of the cases, do not provide any methodology description and almost exclusively use secondary data.

The identified deficits lead to some suggestions for "good practices" in surveying logistics markets.

B.4.3 Quality criteria for surveying logistics markets

When developing a LMS, considering a few simple points enables both editors and authors to improve their work in terms of applicability and practical utility. Naming the authors increases the reliability of the survey, whereas defining logistics, or a logistics market, sets the context of the survey and improves the interpretability of the

given information. Addressing a specific target group, or at least defining target groups of the survey, also enhances utility and helps to meet the users' expectations. The description of the methodology makes the analyses more rigorous and allows for better comparisons and interpretations of the results. Using a uniform data basis is indeed desirable, but it would probably be hard to realize. As well as for the idea of a standardized set of indicators, both suggestions would require a kind of generalized framework to survey logistics markets. Admittedly, such a framework could be developed, but convincing editors and authors to follow such guidelines, seems to be a difficult challenge.

The users of LMSs should always be aware of the facts discussed above. They should have a clear idea of their understanding of logistics, market demarcation and required information. If in any way possible – regarding the deficits of surveying logistics markets – these preconditions should be matched with the specifications (if given) of the appropriate LMSs. For example, the lack of information on the methodology and the data basis always has to be kept in mind when processing the provided information.

The discussed "quality criteria" for editors, authors, and users of LMSs are also the answer to RQ3 as well.

B.4.4 Limitations of the research

When discussing the results, some limitations have to be considered. First, the selection criteria for LMSs can lead to a *selection bias* (Heckman, 1990). Not all relevant publications might have been included in the analysis. In particular, scientific publications that are predominantly concerned with single indicators have been excluded. For example, future research might focus on the most established indicators (and include scientific publications investigating these (single) indicators). Furthermore, not all available LMSs could have been analyzed due to linguistic issues. Second, a *measurement bias* might have occurred while conducting content analysis (Hyslop and Imbens, 2001), despite training the researchers. A subjective influence of coders cannot be completely avoided. Third, an *assignment bias*[72] must be considered (Gravetter and Forzano, 2010). Categories for analyzing the LMSs were defined as described in section B.2. Nonetheless, further categories and criteria are supposable.

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[72] This is also referred to as confounding bias.

B.5 Conclusion

B.5.1 Summary

We analyzed the context-, methodology-, and indicator-related content of LMSs. LMSs provide important information for market analysis, marketing, consulting, and (strategic) decisions of different user groups, for example LSPs, shippers, consultancies, or federal institutions. Despite the high availability of LMSs at this time, providing and processing logistics-specific information is faced with some major challenges. Our research aimed at "bringing some light into the jungle" of LMSs. The main results are:

- There are a variety of indicator groups or specific indicators encompassed by LMSs. Information on the logistics market volume or costs; the modes of transport by road, rail, maritime, and air; information on LSPs (as one main market player); employees; and trends, outlooks and forecasts, are the most established indicators for surveying logistics markets.

- Deficits in surveying logistics market are, among others, the fact that only one third of the analyzed LMSs define their understanding of logistics or a logistics market. A variety of LMSs do not provide information on the applied methodology. Furthermore, neither a uniform or similar data basis is used, nor a standardized set of indicators analyzed. All of these deficits complicate the interpretation and comparability, generally speaking, the processing of information. Moreover, most of the LMSs do not define a target group. This hinders the user groups identifying if appropriate information is provided for their purposes. Despite a supposed uniformity concerning the most established indicator groups, the given information is only partly comparable. Moreover, the units of measurement often differ between the analyzed LMSs, no "standard" has been established.

- Considering a few basic "quality criteria" when providing and processing LMSs' information, helps to improve the applicability and practical utility of LMSs.

B.5.2 Implications

The main implication of our research for management practice is a state-of-the-art of LMSs, implying what range of information is provided by LMSs. On the one hand, in most cases, LMSs offer a broad range of information referring to one specific country. On the other hand, most LMSs only provide little information concerning the context

of their analysis. Hence, the users of LMSs have to consider some aspects when processing the information provided by LMSs. Our research examines these aspects and gives a kind of guideline on how to use LMSs. At the same time, implications for editors and authors of LMSs are also given.

B.5.3 Outlook

Future research should focus on developing a more comprehensive "frame of reference for LMSs", on how to compile LMSs. This guideline should focus on indicators to be measured, methodologies to be applied, and data to be used and collected. The former necessitates the identification of the user requirements (e.g., LSPs, shippers, federal institutions) on logistics-specific information and its application. The requirements could be ascertained by conducting interviews or surveys among user groups of LMSs. Among the editors and authors of LMSs, a common understanding of "good practices" should be established. Even if the establishment of such a "good practice" guideline might be difficult, it would be a first approach.

Appendix

[#]	Country/ region analyzed	Authors	Editors	Title	Year
[1]	Australia	Anonymous	Committee of the Freight Transport Logistics Industry (i)	Freight Logistics in Australia: An Agenda for Action Research	2002
[2]	Australia	Anonymous	Logistics Association of Australia Ltd. (i) and Logistics Bureau (c)	Supply Chain Report: 2009	2009
[3]	Austria	Engelhardt-Nowitzki, C,. Jezusek, M., Küster, D., Rohde, D., Schürer, S., Süssenguth, W., Wewers, F., Wibbe, C. and Wilbers, M.	FH Steyr (s), Verein Netzwerk Logistik (i), Wirtschaftskammern Österreich (f) and Miebach Consulting GmbH (c)	Österreich in Europa - Chancen und Stärken der inländischen Produktion und Logistik	2011
[4]	Baltic Sea Region	Ojala, L., Solakivi, T., Hälinen, H.-M., Loretz, H. and Hoffmann, T. M.	Turku School of Economics (s)	State of Logistics in the Baltic Sea Region	2007
[5]	Benelux	Bourgard, T., Linster, M. and Satjin, S.	Flanders Institute for Logistics (s), CSCMP (i),	Global Perspectives Benelux	2008
[6]	Brazil	Fleuri, P. and Hijjar, M. F.	Instituti de Logística e Supply Chain, University of Rio de Janeiro (s)	Logistics Overview in Brazil 2008	2008
[7]	Canada	Anonymous	Industry Canada (i), Supply Chain & Logistics Association Canada (i) and Canadian Manufacturers and Exporters (i)	State of Logistics: The Canadian Report 2008	2008
[8]	China	Wang, C. G.	Research Center for Logistics and Supply Chain Management China Development Institute Shenzhen (s) and CSCMP (i)	Global Perspectives China	2006
[9]	China	Anonymous	KPMG (c)	Logistics in China	2008
[10]	China	Anonymous	KPMG (c)	Transport in China	2008
[11]	China	Goh, M.-F., Wang, T., Gan, C.W., Li, J. and Yu, Z.	A.T. Kearney (c)	China 2015: Transportation and Logistics Strategies	2010
[12]	Denmark	Larson, P.D. and Gammelgaard, B.	Iowa State University (s) and Copenhagen Business School (s)	Logistics in Denmark: A Survey of the Industry	2001

[#]	Country/ region analyzed	Authors	Editors	Title	Year
[13]	Europe	Klaus, P., Hartmann, E. and Kille, C.	Fraunhofer ISL (s)	The TOP 100 in European Transport and Logistics Services 2009/2010	2009/ 2010
[14]	Finland	Solakivi, T., Ojala, L., Töyli, J., Hälinen, H.-M., Lorentz, H., Rantasila, K. and Naula, T.	Turku School of Economics and Ministry of Transport and Communications (f)	Finland State of Logistics 2009	2009
[15]	France	Anonymous	Ministére de l'écologie, de l'énergee, du développement durable et de la mer (f) and Ministére de l'économie, de l'industrie et de l'emplici (f)	La logistique en France: indicateurs territoriaux	2009
[16]	Germany	Klaus, P. and Kille, C.	Fraunhofer ISL (s)	Die Top 100 der Logistik 2008/2009	2008
[17]	Hong Kong	Anonymous	LOGSCOUNCIL (i)	The Hong Kong Logistics Development Council Report	2007
[18]	India	Bhattacharjya, S.	KPMG (c)	Logistics in India Part 1	2010
[19]	India	Bhattacharjya, S.	KPMG (c)	Logistics in India Part 2	2010
[20]	India	Bhattacharjya, S. and Mistry, G.	KPMG (c)	Logistics in India Part 3	2010
[21]	Indonesia, Malaysia, Thailand	Banomyong, R.	Centre for Logistics Research, Faculty of Commerce & Accountancy, Thammasat University (s)	Logistics Development Study of the Indonesia-Malaysia-Thailand Growth Triangle	no date
[22]	Italy	Anonymous	Confederazione generale italiana die trasporti e della logistica (f) and Confetra (i)	Il Mercato Italia di Servizi Logistici e di Trasporto negli Anni '90	1999
[23]	Italy	Anonymous	Confederazione generale italiana die trasporti e della logistica (f) and Confetra (i)	La Fattura Italia di Servizi Logistici e del Transporto Merci	1999
[24]	Italy	Anonymous	Confretra (i) and A.T. Kearney (c)	La Logistica Italiana	2011
[25]	Mexico	Carranza, O.C.	Universidad Panamericana (s) and CSCMP (i)	Global Perspectives Mexico	2007

[#]	Country/ region analyzed	Authors	Editors	Title	Year
[26]	Netherlands	Anonymous	CBRE (o)	Understanding Logistics in the Netherlands	2011
[27]	Nordic Region	Anonymous	Posten Logistics (o)	Nordic Logistics Barometer	2008
[28]	Norway	Hovi, I.B. and Hansen, W.	Institute of Transport Economics (s)	Logistics Costs in Norway : Survey, Results, Calculations and International Comparison	2011
[29]	Poland	Tumasz, M.R.	Institute of Logistics and Warehousing (s)	The Logistics Market in Poland before and after the Accession to the EU	2004
[30]	South Africa	King, D.	Centre for Supply Chain Management, University of Stellenbosch (s) and Council for Scientific and Industrial Research (i)	7th Annual State of Logistics Survey for South Africa 2010	2010
[31]	Spain	Sachon, M. and Orozco, J.A.	IESE Business School, Universidad de Navarra (s)	Barometro de la Logistica en España	2008
[32]	Switzerland	Stölzle, W., Hofmann, E. and Lampe, K.	Chair of Logistics Management, University of St.Gallen (s), and GS1 Switzerland (i)	Logistikmarktstudie Schweiz	2011
[33]	Turkey	Anonymous	Republic of Turkey Prime Ministry (f) and Deloitte (c)	Transportation & Logistics Industry Report	2010
[34]	United Kingdom	Anonymous	Freight Transport Association (i) and PWC (c)	The Logistics Report 2011	2011
[35]	United States of America	Wilson, R.	CSCMP (i)	22th Annual State of Logistics Report	2011

Note: s=scientific institution, f=federal institution, i=inter-trade organization, c=consultancy, o=others.

C Understanding the cost of capital of logistics service providers: an empirical investigation

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C.1 Introduction

In consequence of global market developments, increasing outsourcing activities, and the quest for efficiency, logistics has become a competitive advantage and key factor in the success of industry and retail companies (Bowersox et al., 2007). Logistics service providers (LSP) perform logistics activities for companies whose core competency is not logistics (Lieb and Bentz, 2005b). To resist in the global economy, LSPs have to understand their operating markets, general economic developments, competitors, and have to be aware of their internal resources and capabilities. They then make several strategic decisions within the competitive environment in order to achieve business objectives such as profitability, organizational success, and growth (Fugate et al., 2008).

A strategy should aim at achieving returns over the cost of resources or capital, respectively. The success of LSPs' strategic decisions is hence largely dependent on their capability to make profit that exceeds its cost of capital (CoC) (Grant, 1991). Apergis et al. (2011, p. 589) observed that "one of the key decisions a firm has to reach is the fundamental determination of its cost of capital. This has substantial impact on both the composition of the firm's operations and its profitability." The CoC supports company valuation and strategy formulation (Ogier et al., 2012), and allows for an integrated consideration of yield expectations and risks.

Regarding the challenges of LSPs, to respond to competition, achieve business objectives, and make the right strategic-decisions, the CoC is becoming increasingly important (Easley and O'hara, 2004). Moreover, the CoC of LSPs' competitors becomes of major relevance for strategic decisions that are, for example, concerned with mergers and acquisitions (M&A), or cooperation partners (Häkkinen et al., 2004), as it allows for assessing competitors or potential takeover targets, respectively.

Despite the relevance of CoC, recent research has only made little efforts in the financial analysis of LSPs. Initial research efforts were made by Hofmann and Lampe (2013), who analyzed the financial structure of LSPs, Liu and Lyons (2011), who investigated the relationship between the financial performance and service capabilities of LSPs. Comparable analyses were made by Töyli et al. (2008),

Panayides (2007), Panayides and So (2005), and Ellinger et al. (2003). The analyses revealed that the performance (e.g., in terms of profitability) of LSPs is largely dependent on the industry an LSP is operates in, and that appropriate LSPs also show a heterogeneous financial structure. However, the cost of capital in the specific has not found attention in logistics related research.

Based on the importance of the CoC for LSPs, this paper aims to answer the following research question (RQ): To what extent is the cost of capital of LSPs dependent on company, industry, and market characteristics? As recent research has shown, on the one hand, LSPs financial structure is very heterogeneous, which justifies the analysis of company characteristics (microeconomic variables in terms of resource-based considerations). On the other hand, the profitability, but also the financial structure of LSPs, is largely dependent on the industry they operate in, which is in turn embedded in an overall economic context. This underlines the importance of external characteristics (macroeconomic variables in terms of market-based considerations) when examining the CoC of LSPs.

Apart from the CoC, also the stock price development of LSPs and their systematic risk, which is the sensitivity of stock prices to changes in the market, will be considered in the research context.[73] CoC, systematic risk, and stock price reveal a close relationship that is among others based on their methods of calculation, which requires a consideration of all aspects.

The analysis of the influence of company, industry, and market characteristics, particularly on stock price and systematic risk in general, has a long tradition in recent research. These factors were among others analyzed by Daugherty et al. (2011), Elyasiani et al. (2011), Driesprong et al. (2008), Huang et al. (2008), Abugri (2006), Rapach et al. (2005), Cavaglia et al. (2000), Sadorsky (1999), Kavussanos and Marcoulis (1997), Kaneko and Lee (1995), Fama and French (1992), Ross (1976) and King (1966).[74] At present, it is unknown whether the appropriate findings of previous studies are also valid for LSPs or whether specific patterns can be observed. Hence, the objective of the present analysis is to show the leverage of company, industry, and market characteristics on the CoC of LSPs. For that purpose, financial data on over 700 LSPs for a period of 10 years is analyzed. An initial analysis of the stock price development of quoted LSPs shall give first implications for the development of

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[73] Short definitions of LSPs, cost of capital, and systematic risk for a better understanding in the research context are given in Section C.1.

[74] For a more detailed investigation of literature, see Section C.1.

hypotheses concerned with the influencing factors of LSPs' CoC and systematic risk, respectively. The influence of company, industry, and market characteristics is then investigated by conducting multiple linear regression analyses. From a managerial perspective, our results explain how external, but also internal characteristics of an LSP influence its cost of capital. The insights provide important input for strategic decisions of LSPs.

This paper is structured as follows: Section C.2 gives some brief basic definitions and an overview of the literature concerned with determinants of stock price, systematic risk, and CoC, from a general and logistical point of view. Based on this review, the analytical model and hypotheses are derived (Section C.3). Section C.4 describes the methodology and data collection. Section C.5 presents the results of the analysis, which are discussed in Section C.6, in addition to the limitations of research. Section C.7 summarizes the results, discusses the managerial implications, and makes recommendations for future research.

C.2 Basic definitions and literature review

C.2.1 Basic definitions: logistics service providers, cost of capital and systematic risk

Logistics service providers

The understanding of LSPs in the context of this work is broad: it includes carriers (offering basic services related to transportation using different modes of transport) as well as contract logistics providers, offering bundled and customized services. All analyses conducted in this research context are based on the Standard Industrial Classification (SIC). Analyses based on the SIC have found various applications in related logistics research (e.g., Elyasiani et al., 2011; Kavussanos and Marcoulis, 1997, 1998). Nevertheless, it has to be mentioned that the SIC only allows for an industry differentiation regarding the primarily used mode of transport or the offer of value-added services. A further differentiation in terms of carriers, third party logistics (3PL) or fourth party logistics (4PL) LSPs is not possible (Chen et al., 1986).

Cost of capital

CoC refers to the cost of a company's fund (both debt and equity). It may be seen as the required rate of return on capital from an investor's point of view (shareholders), in which the expected return on (invested) capital under a certain risk must be greater than the CoC. A company's securities typically include both debt and equity. Although

calculating the cost of debt is a relatively simple task, calculating the cost of equity entails major challenges (Pratt, 2003).

Systematic risk

A key component of the CoC and also in the focus of this work, is the systematic risk of a company (Brigham and Houston, 2011). The systematic risk is also known as beta (β). According to Levy (1974, p. 61), "beta is a measure of stock price volatility – that is, the sensitivity of each stock's price to changes in the market. Beta represents the percentage performance of the stock which has historically accompanied a one per cent move in the market." It is in so far linked with the CoC that a high systematic risk generally means high cost of capital and vice versa.

C.2.2 Literature review on the determinants of stock price, systematic risk and cost of capital

Determinants of stock price, systematic risk, and CoC can be distinguished by (i) company, (ii) industry, and (iii) market characteristics (Cavaglia et al., 2000; Kavussanos and Marcoulis, 1997; King, 1966). Various general analyses have been conducted in the past.

Determinants of stock price

The influence of microeconomic variables related to firm size and equity ratios (company characteristics) on stock price was among others analyzed by Kavussanos and Marcoulis (1997) and Fama and French (1992). The two latter took a general financial perspective and analyzed the relationship between size and book-to-market equity (among other microeconomic variables), stock returns (and the systematic risk), concluding that average stock returns are not positively related to systematic risk. In a logistical context, Kavussanos and Marcoulis (1997) investigated the stock market perception of different LSP industries (on a SIC basis) based on an analysis of microeconomic variables like the equity ratio. As a key result, they found out that the influence of microeconomic variables on stock returns varies among the LSP industries.

On their analysis of industry characteristics on stock price returns from a general perspective, Isakov and Sonney (2002) found out that the industry a company is operating in is becoming increasingly explanatory power for stock price returns than the country where the company is located in. They investigated ten industries, but not logistics in the specific. Similar investigations were also made by Baca et al. (2000) and Cavaglia et al. (2000). The influence of an industry an LSP operates in (on a SIC

basis) on their financial statement was analyzed by Hofmann and Lampe (2013). They revealed that an industry an LSP is operates in largely influences its financial structure, which is also closely linked to their stock price and the CoC.

The influence of macroeconomic variables (market characteristics) on stock price is considered in various disciplines, particularly in finance. The influence of macroeconomic variables (e.g., inflation, exchange rate, interest rate, money supply, industrial production, unemployment rate, and oil price) was addressed by Elyasiani et al. (2011), who analyzed the influence of oil price shocks on different industry sectors (on a SIC basis), among others in the transportation industry. In most industries, they observed a significant relationship between oil-future return and industry returns. Comparable analyses were conducted by Driesprong et al. (2008), Huang et al. (1996), and Sadorsky (1999).

However, the results of previous analyses were not homogeneous. The results varied or even indicated the contrary, depending on the analyzed period and industry. Huang et al. (1996), for example, identified a positive correlation between oil price development and stock returns for companies in the transportation sector, but not for S&P 500 companies in general.

Determinants of systematic risk

Regarding the determinants of systematic risk, recent research has primarily focused on microeconomic variables (company characteristics). Iqbal and Shah (2012) identified a negative correlation between liquidity, leverage, operating efficiency, dividend payout, market value of equity, and systematic risk; and a positive correlation between profitability, firm size, growth, and systematic risk of companies from the non-financial sector. Hong and Sarkar (2007) focused on the correlation between systematic risk and leverage ratio, earnings volatility, market price of risk, growth options (positive correlation) as well as earnings growth rate, tax rate, and investments in expansion (negative correlation) in general, without differentiating between industries. Other analyses regarding both micro- and macroeconomic variables were conducted by Arfaoui and Abaoub (2010) and Martikainen (1991), also revealing the influence of both set of variables on the systematic risk. In a logistical context, Houmes et al. (2012) analyzed the influence of the financial structure of trucking companies on their systematic risk and showed among others a positive influence of operating leverage on systematic risk. A similar analysis was conducted by MacArthur et al. (2008). Lu and Chen (2010) proved that the systematic risk of LSPs is significantly dependent on the oil price risk, but varying between different industry

sectors (e.g., water or air transportation). Based on their analysis of the influence of industry characteristics on stock price, Kavussanos and Marcoulis investigated the systematic risk in the water transportation industry and found out that its systematic risk is comparatively low. Allen et al. (1990) showed that the deregulation of the U.S. airline industry decreased as a result of deregulation (as a kind of market characteristic).

Determinants of the cost of capital

Despite the close relationship between stock price, systematic risk, and the CoC, little recent research has analyzed the determinants of CoC, particularly in a logistical context. Bancel and Mittoo (2004) analyzed the correlation between debt policy and CoC, and found out that it is influenced by their institutional environment and their international operations. Sudarsanam (1992) examined "the impact of the structural attributes of the industries on the cost of capital […] within the capital asset pricing model" (Sudarsanam, 1992, p. 189). He showed that company characteristics like the capital intensity (which was also considered on an aggregated level on industry basis) significantly influence the systematic risk and the cost of capital of companies.

As the elucidations show, most research has considered the influence of industry, company and market characteristics on the stock price development and systematic risk, primarily on a general level. Despite the close link between the systematic risk and cost of capital, only few investigations considering its determinants have been made in recent research. In particular in logistics and transportation-oriented literature, this aspect has almost been completely neglected.

C.3 Background and theoretical model

C.3.1 Background of the research on the cost of capital of logistics service providers

Recent research has not sufficiently considered LSPs from a fiscal perspective and relevant characteristics and determinants of the CoC have been ignored. First, is the supposed irrelevance of an LSP's headquarters. The territorial principle, not the "nationality principle" has been deemed valid. For example, the countries in which an LSP (e.g., conducting maritime transports) offers its services is an appropriate indicator of the level of systematic risk, not the vessel's flag. Second, LSPs do not form a homogeneous group of companies. Both performance and risks (and hence the CoC) vary. For example, aircraft carriers are more dependent on the oil price or global

economy development than railway companies are. Third, LSPs show a completely different financial structure (Table C-1 and Table C-2).

Index (Year 2000=100)
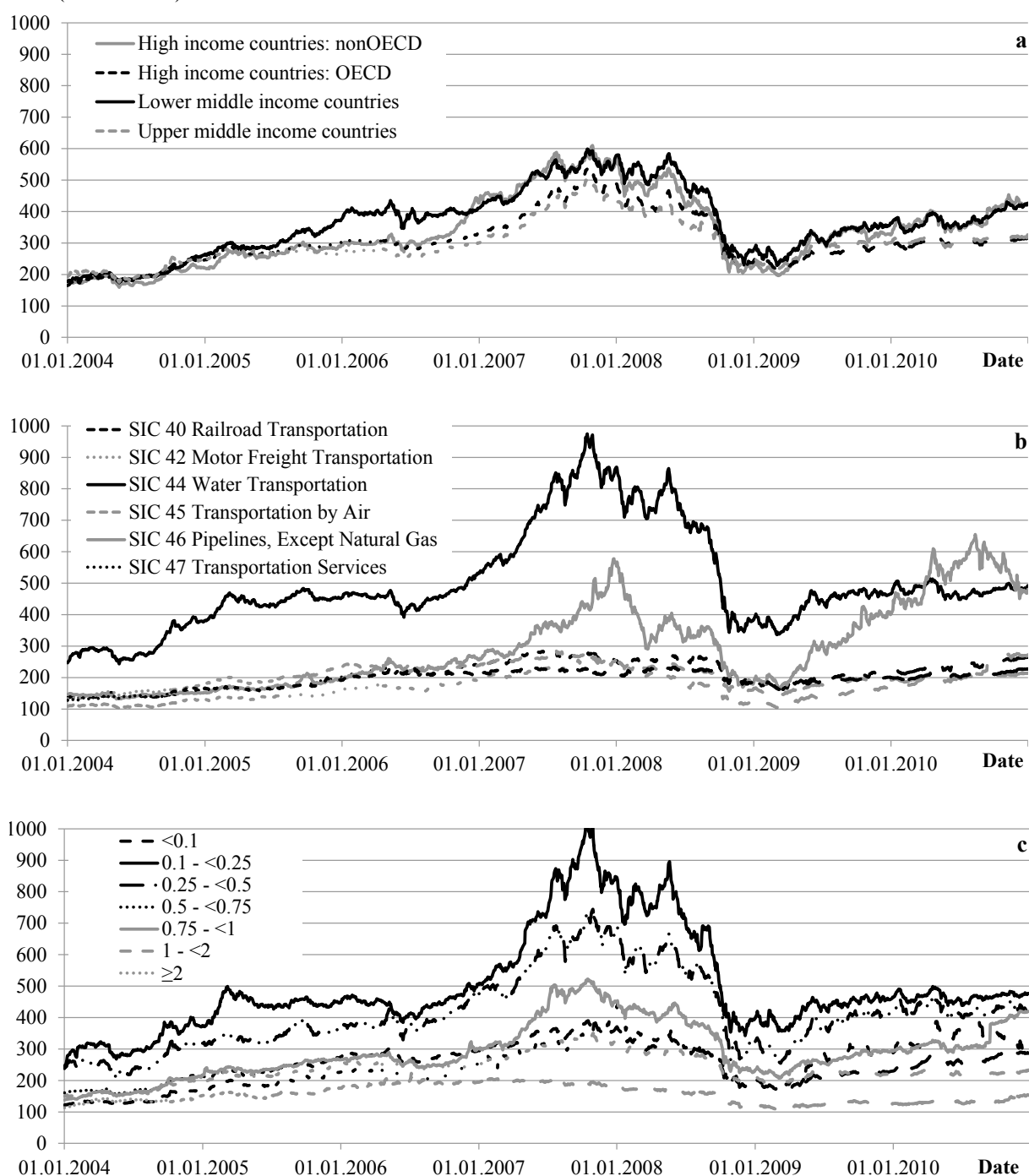
Note: Only LSPs that have been continuously quoted since January 2000 have been included in analysis (in total 503 LSPs).

Figure C-1. Stock price developments of LSPs (2000-2010), clustered according to (a) headquarters location (countries' income level), (b) industry classification (SIC code), and (c) asset turnover (annual turnover to total assets)

To underline our first propositions, and with regard to previous research efforts, we primarily analyze the stock price development of quoted LSPs, according to market (e.g., the country in which the LSP's headquarters is located), industry (on a SIC basis), and company characteristics (e.g., asset turnover). Graphs a, b, and c in Figure C-1 show obvious differences in the stock price developments of LSPs since the year 2000, according to their cluster aggregation (e.g., countries, SIC codes, and level of asset turnover). Although classifying LSPs according to the location of their headquarters (Figure C-1a) does not reveal significant differences in stock price development, classifying them according to their industry (Figure C-1b) or level of asset turnover (Figure C-1c) does. All three graphs have the same underlying values and differ only in categorizing the LSPs to different clusters.

The descriptive results of the analysis of the stock prices of LSPs indicate that the stock price of an LSP depends on the industry sector in which the LSP operates as well as its capital structure. The country in which the LSP's headquarters is located seems to be less important. These initial insights will be captured for the development of our main hypotheses.

C.3.2 Theoretical model of the analyses

As the literature review has shown, specific analyses of factors influencing the CoC and systematic risk of LSPs have received little attention. Therefore, our research focuses on the impact of micro- and macroeconomic variables and industry characteristics on the CoC and systematic risk – as a key component of the CoC – of LSPs. The theoretical model for the analyses conducted in this paper is presented in Figure C-2.

The model was inspired by contingency theory, including contingency variables (context and response variables) that influence the performance of LSPs (Sousa and Voss, 2008). Contingencies represent the size, strategy, and environment of an LSP. As Grant (1991) stated, analysis at the business level strategy can consider external influences (like market characteristics) as well as a company's resources (company characteristics). A resource-based consideration of the CoC of LSPs is conducted by analyzing the influence of microeconomic variables (company characteristics) on LSPs' performance in terms of the CoC or the systematic risk. Complementary, a market-based consideration acknowledges the dependency of a company's performance on its external (industry) environment. For this reason, the influence of macroeconomic variables (market characteristics) on LSPs' performance is also

analyzed. Contingency theory allows for the integration of market- and resource-based considerations and structures the theoretical model for analysis.

Apart from market and company characteristics, also industry characteristics influence the significance of determinants on stock price, cost of capital or systematic risk. For this reason, also the differences between LSP industries (on a SIC basis) will be investigated.
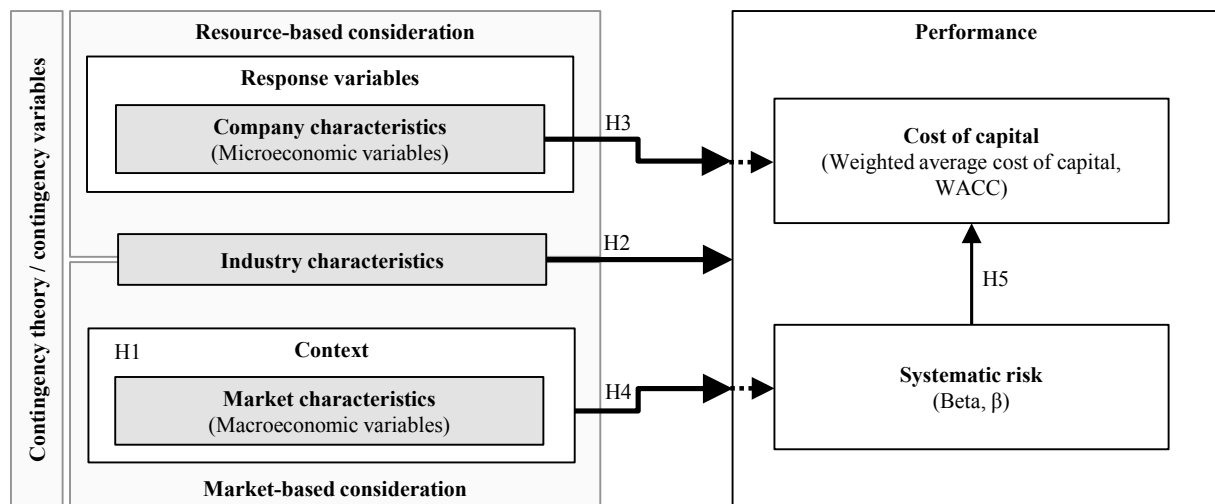
Figure C-2. Theoretical model used for the analysis of market, industry, and company characteristics on the performance of LSPs

C.3.3 Hypotheses on the influence of contingency variables on the cost of capital

According to Eiling et al. (2004, p. 2), "traditionally, country factors have been considered to be the dominant driving forces for international equity returns." Increasing globalization, general agreements, large trade areas (e.g., the European Union), and increased economic policy coordination have led to the decreased importance of country factors regarding performance, portfolio risk, and hence investment decisions (Brooks and Catão, 2000; Cavaglia et al., 2000). Brooks and Del Negro (2005), Isakov and Sonney (2002), as well as Baca et al. (2000) stated that country factors have lost importance and explanatory power, while industry factors are becoming more and more important. Based on these findings, we assume that the country in which an LSP is located has minor importance for its profitability in terms of the CoC. This assumption is also supported by the results of the analysis of the stock prices of LSPs (Figure C-1), as well as the "territorial principle." Based on this assumption, the first hypothesis states:

H1: The country in which an LSP's headquarters is located has minor importance for the cost of capital and systematic risk of the LSP.

Moreover, we expect that the industry in which an LSP operates in has a significant influence on its performance. The industry is related to the LSP cluster, that is, the type of LSP (e.g., railroad or water transportation), not the customer branches for which the LSP mainly works. This assumption is also supported by the results of the analysis of the stock prices of LSPs (Figure C-1). Based on this, the second hypothesis states:

H2: The cost of capital and systematic risk of LSPs are significantly influenced by industry-specific characteristics (in terms of the type of LSP).

The CoC is calculated as the weighted sum of the cost of debt and cost of equity. Because the cost of debt and equity of LSPs are closely correlated with their financial structure, we suppose that microeconomic variables have a higher influence on the CoC than on the systematic risk of LSPs. The minor influence of microeconomic variables on systematic risk was shown by Iqbal and Alisha (2012), Rapack et al. (2005), and Martikainen (1991). Based on this assumption, the third hypothesis states:

H3: Microeconomic variables influence both the systematic risk and the cost of capital of LSPs, but affect the latter (cost of capital) more significantly.

Beta is calculated as the covariance of a company's stock price (R_i) and market index (R_m) divided by the variance of a market index (Fama and MacBeth, 1973). Based on the direct influence of a market index, we suppose the higher influence of macroeconomic variables on the systematic risk than on the CoC of LSPs. Furthermore, Abugri (2006) found that variables, such as exchange, interest rates, and money supply, significantly influence market returns, which are in turn closely related to systematic risk. Similar results were presented by Chen et al. (1986). The influence of oil price on industry return and stock market activity and systematic risk has also been analyzed by several authors (Elyasiani et al., 2011; Lu and Chen, 2010; Driesprong et al., 2008; Sadorsky, 1999; Huang et al., 1996), which led to partly significant results. We therefore state the fourth hypothesis as:

H4: Macroeconomic variables influence both the systematic risk and the cost of capital of LSPs, but affect the former (systematic risk) more significantly.

Expected return on equity (r_e) is obligatory in calculating the CoC, as follows: $r_e = r_f + \beta \cdot (r_m - r_f)$, where r_f is the risk-free interest rate and r_m the expected return on the market portfolio. Based on this method of calculation, we assume the direct influence of systematic risk on the CoC of LSPs. Based on this assumption, the fifth hypothesis states:

H5: Systematic risk influences the cost of capital of LSPs, but not as strongly as other microeconomic variables do.

C.4 Methodology

C.4.1 Methodology and variables

A common conceptualization of CoC, the WACC represents "the average cost of each dollar of financing" (Besley and Brigham, 2008, p. 460). It is also considered as a performance benchmark tool (Copeland et al., 2000). It is calculated as follows:

$WACC = \frac{D}{D+E} \cdot r_d \cdot (1-t) + \frac{E}{D+E} \cdot r_e$, where D is debt, E is equity, r_d is the expected return on debt (or interest rate), t is the corporate tax rate, and r_e is the expected return on equity.

A key component of the WACC is the systematic risk of a company (Brigham and Houston, 2011) and is therefore also in the focus of this work. It describes the relation of stock price to market index volatility and the relation of the assumed market risk to an investment or financing measure.

The methodology applied in this paper follows the work of Houmes et al. (2012), Kavussanos and Marcoulis (1997), Chen et al. (1986), and Fama and MacBeth (1973), all of which used very similar approaches. Data for the WACC were adapted from the Thomson Datastream (a financial database that is accepted as valid and reliable); the systematic risk of the analyzed LSPs had to be calculated. Beta is the slope of the linear regression of stock price returns to the return of a market index (Levy, 1974) and is calculated as follows: $\beta_i = \text{cov}(R_i, R_m) / \sigma^2(R_m)$, where β_i is beta (systematic risk), R_i is stock price return, and R_m is the return of a market index.

Data on daily stock prices and market indices for a period of five years are used to calculate beta. For example, when calculating beta for the year 2010, daily data from 2006 to 2010 are used. The S&P 500 index is referred to as the market index. In this five-year span, the daily stock returns of each analyzed LSP are regressed on the corresponding returns for the S&P 500.

To analyze the influence of micro- and macroeconomic variables on CoC and systematic risk, multiple linear regression analyses were conducted (for each hypothesis and corresponding clusters), where WACC or beta are the dependent variables and the micro- or macroeconomic variables the independent variables. A stepwise regression was applied in order to identify the most significant variables influencing CoC and systematic risk (Weiers et al., 2008). In total, two "sets" of

variables were used for the analyses, which were chosen based on the literature review:

- *Microeconomic variables:*[75] (a) related to asset structure: intensity of investment, asset intensity 1, continuous intensity, asset intensity 2, asset turnover, current asset turnover; (b) related to capital structure: debt to equity ratio, equity ratio, debt ratio; (c) related to liquidity structure: quick ratio, current ratio, cash flow / sales; (d) related to profitability structure: return on equity (ROE), return on assets (ROA), net profit margin.

- *Macroeconomic variables:*[76] labor force (total), gross capital formation (US$), GNI (US$), GDP (US$), CO_2-emissions (kilotons), inflation (GDP deflator, annual %), employment to population ratio, adjusted net national income (US$), money supply (money and quasi money M2, % of GDP), and market capitalization (US$) as well as the mean oil price (US$).

Data of the year 2010 were used for the analyses of the influence of microeconomic variables. All LSP-specific data, such as microeconomic variables and stock prices, were obtained from Thomson Datastream.

The LSPs are analyzed as one group. In addition, the LSPs are classified according to industry sector in order to analyze the dependency on industry characteristics, and the geographical location of their headquarters. LSPs with the following primary SIC codes were clustered and analyzed (by 2-place SIC code): SIC 40 Railroad Transportation; SIC 42 Motor Freight Transportation; SIC 44 Water Transportation (except SIC 448, Water Transportation of Passengers); SIC 45 Transportation by Air (except SIC 458 Airports, Flying Fields, and Airport Terminal); SIC 46 Pipeline, except Natural Gas; and SIC 47 Transportation Services (except SIC 472 Arrangement of Passenger Transportation and SIC 474 Rental of Railroad Cars) (U.S. Department of Labor, 2013). The country clusters are based on the World Bank's country classification by income group (The World Bank, 2013): high income: non-OECD, high income: OECD, lower middle income, and upper middle income. The understanding of LSPs in the context of this work includes carriers and 3PL LSPs as well. In this context it must be regarded that the SIC code classification does not allow an exact distinction of carriers and 3PL LSPs. The primary SIC code refers to the most

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[75] The selection of the microeconomic variables is oriented towards the works of Hofmann and Lampe (2013), Iqbal and Shah (2012) as well as Martikainen (1991). Their definitions or calculations can be found in Table C-9 in the Appendix.

[76] The selection of the macroeconomic variables is oriented towards the works of Abugri (2006), Kaneko and Lee (1995) as well as Chen et al. (1986).

offered service by an LSP. Hence 3PL LSPs that primarily offer motor freight transportation services using their own assets have the SIC code 42. Otherwise, non-asset based 3PL LSPs are allocated to the Transportation Services cluster (SIC 47). Because of the availability of data related to our data set, the regression analyses of WACC and macroeconomic variables refer to the period from 2006 to 2010; the regression analyses of systematic risk and macroeconomic variables refer to the period from 2000 to 2010. Macroeconomic data of the entire world and different country clusters were obtained from the World Bank's database (except oil price development). Oil price development is the mean of Brent Crude and WTI crude oil price development (Statista, 2013). For conducting the regression analyses, the mean values of WACC and beta of LSPs were used for each year, depending on the correspondent cluster group. The mean WACC and beta values of the SIC code clusters were analyzed against the values of macroeconomic variables that were valid for the whole world. The following regression equation was used: $Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ... + \alpha_j X_j + e$, where α_0 is the constant term, α_j the regression coefficients, and e an error term. In contrast to the usual terms of regression quotations, where β defines the regression coefficient, in this case α was chosen in order to avoid confusing systematic risk (β) with the regression coefficient. In all tables depicting the results (Table C-3 to Table C-6; Appendix Table C-10 to Table C-13), standardized regression coefficients are shown in order to enable the comparison of the coefficients in the same model.

C.4.2 Sample selection

We analyzed 702 LSPs from 70 countries all over the world. The LSPs have been chosen according to their primary SIC code and data availability. Because of data disposability, some distinctions are made regarding each analysis:

- For the analysis of stock price quotations (Figure C-1), only LSPs that were quoted since January 2000 (at least until December 2010) were included in analysis: 503 LSPs.

- Data for the CoC (here WACC) of LSPs is used for the regression analyses of CoC and microeconomic variables. Values for the WACC and the appropriate microeconomic variables were available for 437 out of the 702 LSPs. The characteristics (microeconomic variables) of these LSPs for the year 2010 are shown in Table C-1.

- LSPs with the appropriate SIC code and activity since at least 2006 were chosen for the analysis of systematic risk and microeconomic variables. An active

period from 2006 to 2010 was required in order to calculate beta. Values for beta (own calculation) and the appropriate microeconomic variables were available for 702 LSPs. The characteristics (microeconomic variables) of these LSPs (those shown in Table C-1 are also included) for the year 2010 are shown in Table C-2.

- For the regression analyses of CoC and macroeconomic variables, because of data availability, the period from 2006 to 2010 was analyzed: 226 LSPs. For the regression analyses of systematic risk and macroeconomic variables, the period from 2000 to 2010 was analyzed. Hence, only LSPs that have been active since at least 1996 (to calculate beta) were considered: 416.

The regression analyses are not presented in Section C.5 for LSPs classified according to the geographical location of their headquarters, because the first analyses of stock price development (Figure C-1) do not indicate for significant differences between the country clusters. This suggestion was verified by conducting the regression analyses. The results are presented in the Appendix.

C.4.3 Descriptive statistics

No uniform financial structure of LSPs exists. The Railroad Transportation and Transportation Services clusters often show extreme values, such as the highest or lowest mean values. ROE and ROA are the only ratios that are very close together for all LSPs. On the contrary, cash flow per sales, asset intensity 1, and asset intensity 2 show the highest variations. These observations are valid for both analyzed samples: the large sample of 702 LSPs for regression analyses with beta as dependent variable (Table C-2) as well as the abstracted smaller sample of 437 LSPs (Table C-1) for regression analyses, with WACC as the dependent variable.

Table C-1. Descriptive statistics of LSPs used for regression analyses with WACC as dependent variable

Cluster description	ALL LSPs	Railroad Transportation	Motor Freight Transportation	Water Transportation	Transportation by Air	Pipeline, except Natural Gas	Transportation Services
Cluster (SIC code)	ALL LSPs	SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	437	32	130	189	78	12	20
Absolute (US$)	Mean value *(standard deviation in parentheses)*						
Cash flow per share	11.88 *(127.05)*	9.74 *(22.37)*	4.76 *(26.89)*	17.53 *(182.23)*	1.97 *(3.36)*	85.12 *(270.49)*	0.88 *(1.26)*
Total current assets	682'548 *1'728'497*	991'216 *(1'348'184)*	267'256 *(610'315)*	521'210 *(1'431'305)*	1'551'589 *(2'781'161)*	1'481'335 *(3'752'412)*	545'411 *(763'291)*
Total current liabilities	597'972 *(1'631'135)*	1'394'112 *(2'605'827)*	222'152 *(505'617)*	359'395 *(1'110'059)*	1'548'504 *(2'788'790)*	564'038 *(1'052'075)*	360'704 *(533'985)*
EBIT	231'398 *(800'431)*	791'722 *(1'331'242)*	48'929 *(80'829)*	170'711 *(804'435)*	427'093 *(890'772)*	620'671 *(1'641'845)*	95'258 *(174'311)*
EBITDA	356'620 *(1'190'820)*	1'232'314 *(2'069'551)*	82'227 *(136'233)*	257'116 *(1'202'655)*	675'109 *(1'278'491)*	858'553 *(2'293'070)*	122'382 *(192'264)*
Long term debt	896'831 *(2'922'373)*	3'864'981 *(8'180'265)*	154'824 *(294'732)*	650'100 *(1'639'072)*	1'532'985 *(2'559'488)*	2'207'659 *(5'140'766)*	49'133 *(86'143)*
Net income	134'728 *(445'570)*	386'382 *(683'963)*	28'797 *(60'526)*	99'044 *(370'261)*	271'204 *(617'791)*	415'383 *(1'075'462)*	56'946 *(107'299)*
Net sales / turnover	2'080'307 *(5'999'574)*	4'008'797 *(6'327'785)*	903'188 *(1'931'426)*	1'303'391 *(4'742'154)*	5'068'722 *(10'822'010)*	2'698'204 *(4'348'997)*	2'014'019 *(2'710'452)*
Operating income	210'896 *(770'553)*	790'968 *(1'333'413)*	45'420 *(75'525)*	148'610 *(794'780)*	368'497 *(787'769)*	593'360 *(1'533'302)*	99'351 *(174'578)*
Property, plant & equipment	1'809'203 *(5'777'290)*	8'757'473 *(15'597'523)*	386'647 *(696'792)*	1'180'317 *(3'544'595)*	2'867'700 *(4'477'604)*	4'358'604 *(10'930'187)*	174'127 *(275'023)*
Total assets	2'949'463 *(7'949'340)*	10'413'775 *(17'595'469)*	820'756 *(1'518'989)*	2'075'357 *(5'691'152)*	5'530'127 *(9'364'225)*	6'335'425 *(14'766'495)*	986'179 *(1'426'701)*
Total capital	2'006'143 *(5'513'969)*	7'222'339 *(12'818'106)*	522'274 *(933'753)*	1'620'807 *(4'349'689)*	3'127'830 *(4'708'630)*	5'259'803 *(12'343'758)*	582'645 *(870'767)*
Total debt	1'064'594 *(3'259'394)*	4'279'212 *(8'894'715)*	222'679 *(428'368)*	777'017 *(1'886'739)*	1'914'840 *(3'188'635)*	2'265'442 *(5'233'062)*	103'329 *(180'688)*
Total shareholder's equity	1'056'706 *(2'835'223)*	3'310'941 *(5'197'831)*	357'984 *(696'848)*	891'261 *(2'640'409)*	1'541'210 *(2'695'078)*	2'949'482 *(6'916'945)*	510'867 *(792'456)*
Ratios - outliers outside (3 standard deviations)	Mean value *(standard deviation in parentheses)*						
Beta coefficient	0.31 *(0.50)*	0.50 *(0.55)*	0.16 *(0.47)*	0.33 *(0.51)*	0.33 *(0.41)*	0.43 *(0.23)*	0.58 *(0.50)*
Cash flow / sales	17.67 *(15.45)*	19.97 *(10.60)*	11.07 *(10.21)*	24.37 *(17.79)*	12.88 *(10.01)*	28.32 *(18.58)*	5.19 *(4.26)*
Quick ratio	1.47 *(1.51)*	2.08 *(2.20)*	1.30 *(1.36)*	1.54 *(1.51)*	1.40 *(1.52)*	1.28 *(0.43)*	1.19 *(0.93)*
Current ratio	1.69 *(1.56)*	2.36 *(2.40)*	1.56 *(1.65)*	1.70 *(1.36)*	1.63 *(1.54)*	1.62 *(0.59)*	1.57 *(1.03)*
Intensity of investment	0.53 *(0.25)*	0.69 *(0.20)*	0.49 *(0.24)*	0.59 *(0.24)*	0.47 *(0.24)*	0.59 *(0.24)*	0.21 *(0.19)*
Asset intensity 1	3.33 *(4.39)*	6.23 *(4.96)*	2.63 *(3.67)*	4.12 *(5.04)*	1.78 *(1.49)*	5.54 *(6.52)*	0.59 *(0.97)*
Continuous intensity	0.32 *(0.20)*	0.20 *(0.18)*	0.33 *(0.18)*	0.28 *(0.18)*	0.38 *(0.21)*	0.25 *(0.21)*	0.58 *(0.21)*
Asset intensity 2	1.48 *(3.10)*	0.56 *(1.20)*	1.45 *(2.98)*	0.93 *(1.88)*	2.37 *(4.72)*	0.59 *(0.76)*	5.54 *(4.28)*
Asset turnover	0.86 *(0.69)*	0.61 *(0.35)*	1.10 *(0.73)*	0.59 *(0.53)*	1.09 *(0.67)*	0.59 *(0.49)*	1.81 *(0.69)*
Current asset turnover	3.00 *(1.68)*	3.48 *(1.35)*	3.49 *(1.67)*	2.30 *(1.45)*	3.38 *(1.56)*	3.21 *(2.42)*	4.14 *(1.67)*
Debt to equity ratio	0.91 *(0.99)*	1.18 *(1.04)*	0.75 *(0.76)*	0.95 *(1.03)*	1.13 *(1.20)*	0.91 *(0.76)*	0.32 *(0.56)*
Equity ratio	0.67 *(0.24)*	0.57 *(0.20)*	0.73 *(0.19)*	0.64 *(0.24)*	0.63 *(0.26)*	0.66 *(0.22)*	0.84 *(0.25)*
Debt ratio	0.43 *(0.29)*	0.49 *(0.27)*	0.43 *(0.30)*	0.42 *(0.25)*	0.48 *(0.34)*	0.37 *(0.25)*	0.22 *(0.26)*
ROE	0.11 *(0.09)*	0.12 *(0.09)*	0.09 *(0.08)*	0.11 *(0.09)*	0.15 *(0.10)*	0.13 *(0.10)*	0.11 *(0.10)*
ROA	0.05 *(0.04)*	0.05 *(0.04)*	0.04 *(0.03)*	0.05 *(0.04)*	0.05 *(0.04)*	0.05 *(0.02)*	0.05 *(0.05)*
Net profit margin	0.10 *(0.13)*	0.10 *(0.08)*	0.07 *(0.10)*	0.15 *(0.16)*	0.07 *(0.09)*	0.13 *(0.09)*	0.03 *(0.03)*
WACC	0.0838 *(0.0783)*	0.0814 *(0.0568)*	0.0703 *(0.0632)*	0.0832 *(0.0842)*	0.1033 *(0.0764)*	0.0746 *(0.0715)*	0.1125 *(0.1202)*

Table C-2. Descriptive statistics of LSPs used for regression analyses with beta as dependent variable

Cluster description	Railroad Transportation	Motor Freight Transportation	Water Transportation	Transportation by Air	Pipeline, except Natural Gas	Transportation Services
Cluster (SIC code)	ALL LSPs	SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	702	48	187	337	140	23	25
Absolute (US$) Mean value *(standard deviation in parentheses)*							
Cash flow per share	9.21 *(107.45)*	6.54 *(18.71)*	1.46 *(57.74)*	12.11 *(138.86)*	8.24 *(67.11)*	48.33 *(199.66)*	0.75 *(1.18)*
Total current assets	611'463 *(1'673'788)*	833'810 *(1'221'419)*	214'594 *(529'906)*	427'359 *(1'247'787)*	1'457'307 *(2'826'401)*	1'046'246 *(2'890'201)*	440'570 *(714'312)*
Total current liabilities	561'216 *(1'643'365)*	1'123'661 *(2'246'278)*	179'729 *(441'518)*	308'133 *(947'317)*	1'524'440 *(2'967'761)*	568'284 *(1'150'455)*	294'013 *(496'098)*
EBIT	158'989 *(663'820)*	620'750 *(1'189'785)*	35'612 *(75'501)*	106'245 *(620'160)*	265'244 *(765'348)*	379'730 *(1'221'440)*	76'518 *(160'361)*
EBITDA	269'234 *(978'624)*	949'368 *(1'807'999)*	64'433 *(121'863)*	178'426 *(924'607)*	503'247 *(1'082'513)*	538'949 *(1'702'025)*	99'178 *(178'178)*
Long term debt	816'868 *(2'557'209)*	2'901'161 *(6'860'048)*	159'940 *(454'107)*	586'662 *(1'537'707)*	1'502'034 *(2'741'534)*	1'730'225 *(3'943'672)*	42'301 *(78'686)*
Net income	84'968 *(386'495)*	309'690 *(652'096)*	18'608 *(59'577)*	55'049 *(295'080)*	149'305 *(550'644)*	228'952 *(806'471)*	43'835 *(99'740)*
Net sales / turnover	1'789'260 *(5'430'791)*	3'000'226 *(5'448'536)*	717'058 *(1'692'502)*	1'031'210 *(3'942'464)*	4'438'789 *(9'514'687)*	2'950'100 *(6'064'315)*	1'645'841 *(2'536'230)*
Operating income	144'827 *(630'634)*	621'057 *(1'157'978)*	33'306 *(71'129)*	94'772 *(608'884)*	220'337 *(670'597)*	367'708 *(1'142'348)*	79'751 *(160'997)*
Property, plant & equipment	1'569'333 *(4'911'056)*	6'646'942 *(13'332'655)*	367'438 *(893'623)*	1'018'166 *(2'918'269)*	2'699'078 *(4'690'264)*	3'154'995 *(8'232'728)*	147'637 *(252'629)*
Total assets	2'579'179 *(7'092'887)*	8'168'849 *(15'160'763)*	710'062 *(1'488'464)*	1'739'855 *(4'803'834)*	5'085'045 *(9'367'922)*	4'669'999 *(11'247'478)*	802'815 *(1'328'270)*
Total capital	1'734'691 *(4'769'033)*	5'786'458 *(11'049'612)*	466'030 *(1'029'773)*	1'355'365 *(3'668'587)*	2'788'102 *(4'672'656)*	3'800'373 *(9'332'690)*	474'392 *(808'711)*
Total debt	973'137 *(2'883'166)*	3'241'108 *(7'462'934)*	215'592 *(527'176)*	705'274 *(1'765'481)*	1'848'680 *(3'352'426)*	1'830'115 *(4'062'999)*	87'670 *(165'016)*
Total share-holder's equity	872'530 *(2'466'281)*	2'840'442 *(4'861'755)*	298'170 *(659'711)*	706'458 *(2'123'467)*	1'238'929 *(2'542'922)*	1'984'269 *(5'183'103)*	413'981 *(734'967)*
Ratios - outliers outside (3 standard deviations) | Mean value *(standard deviation in parentheses)*							
Beta coefficient	0.32 *(0.63)*	0.38 *(0.50)*	0.18 *(0.45)*	0.33 *(0.73)*	0.41 *(0.61)*	0.38 *(0.28)*	0.52 *(0.48)*
Cash flow / sales	13.99 *(35.02)*	19.47 *(14.36)*	8.84 *(23.05)*	18.66 *(43.00)*	9.86 *(14.31)*	24.66 *(23.85)*	-7.73 *(69.83)*
Quick ratio	1.45 *(1.48)*	2.08 *(2.11)*	1.21 *(1.19)*	1.47 *(1.47)*	1.51 *(1.55)*	1.55 *(1.56)*	1.28 *(1.02)*
Current ratio	1.70 *(1.64)*	2.37 *(2.27)*	1.44 *(1.43)*	1.73 *(1.67)*	1.76 *(1.62)*	1.79 *(1.58)*	1.65 *(1.07)*
Intensity of investment	0.54 *(0.26)*	0.68 *(0.20)*	0.49 *(0.24)*	0.60 *(0.24)*	0.48 *(0.24)*	0.59 *(0.28)*	0.27 *(0.27)*
Asset intensity 1	3.63 *(4.61)*	5.97 *(4.66)*	2.72 *(3.78)*	4.40 *(5.10)*	2.18 *(3.07)*	6.38 *(6.64)*	0.83 *(1.45)*
Continuous intensity	0.30 *(0.20)*	0.20 *(0.17)*	0.34 *(0.18)*	0.26 *(0.18)*	0.37 *(0.20)*	0.24 *(0.25)*	0.53 *(0.23)*
Asset intensity 2	1.37 *(2.93)*	0.49 *(1.00)*	1.32 *(2.39)*	0.99 *(2.35)*	2.06 *(4.19)*	0.95 *(1.90)*	5.22 *(4.50)*
Asset turnover	0.75 *(0.63)*	0.55 *(0.34)*	0.99 *(0.70)*	0.51 *(0.46)*	1.02 *(0.62)*	0.51 *(0.50)*	1.65 *(0.84)*
Current asset turnover	2.83 *(1.78)*	3.20 *(1.55)*	3.23 *(1.86)*	2.26 *(1.56)*	3.28 *(1.63)*	3.05 *(2.35)*	4.35 *(2.03)*
Debt to equity ratio	1.18 *(2.79)*	1.21 *(1.88)*	0.79 *(2.07)*	1.21 *(2.67)*	1.72 *(3.77)*	0.95 *(3.99)*	0.87 *(2.09)*
Equity ratio	0.64 *(0.51)*	0.57 *(0.26)*	0.71 *(0.33)*	0.63 *(0.60)*	0.54 *(0.56)*	0.61 *(0.29)*	0.81 *(0.25)*
Debt ratio	0.51 *(0.69)*	0.51 *(0.35)*	0.47 *(0.63)*	0.54 *(0.74)*	0.56 *(0.79)*	0.51 *(0.44)*	0.29 *(0.35)*
ROE	0.07 *(0.30)*	0.05 *(0.21)*	0.06 *(0.30)*	0.06 *(0.29)*	0.10 *(0.28)*	0.04 *(0.15)*	0.18 *(0.55)*
ROA	0.02 *(0.09)*	0.03 *(0.05)*	0.02 *(0.10)*	0.02 *(0.10)*	0.03 *(0.07)*	0.03 *(0.05)*	0.04 *(0.08)*
Net profit margin	0.03 *(0.34)*	0.06 *(0.17)*	0.02 *(0.30)*	0.03 *(0.45)*	0.02 *(0.13)*	0.04 *(0.14)*	0.04 *(0.07)*

C.5 Results

C.5.1 Regression of cost of capital and microeconomic variables

The regression analysis of CoC and microeconomic variables (Table C-3) shows a general set of variables that significantly influences the CoC of all LSPs.

Table C-3. Results of regression analyses of CoC and microeconomic variables

			Dependent variable: WACC				
	All LSPs	**Railroad Transportation**	**Motor Freight Transportation**	**Water Transportation**	**Transportation by Air**	**Pipeline, except Natural Gas**	**Transportation Services**
		SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	437	30	120	184	74	11	18
R^2	0.87	0.919	0.69	0.809	0.707	0.843	0.998
Ratios	Standardized slope of regression (t-value in parentheses)						
(Constant)	-(3.295)	-(1.716)	(4.653)	-(1.031)	(1.997)	-(0.311)	(2.701)
Current ratio						-0.385 ** -(2.461)	-0.440 *** -(3.602)
Intensity of investment	0.046 ** (2.285)		-0.125 ** -(2.334)				
Continuous intensity						0.751 *** (4.841)	
Asset intensity 2		0.142 ** (2.273)					
Asset turnover				0.155 *** (3.289)	-0.153 ** -(2.227)		
Debt to equity ratio	-0.114 *** -(4.281)						
Equity ratio	0.163 *** (5.707)	0.205 *** (3.345)					
ROE	1.099 *** (49.845)	0.865 *** (15.159)		0.265 *** (3.829)			0.996 *** (80.132)
ROA	-0.357 *** -(15.525)		0.729 *** 13.617	0.655 *** (9.629)	0.741 *** (8.919)	0.532 *** (3.509)	-0.080 *** -(6.504)
Net profit margin				-0.115 ** -(2.176)	0.166 ** (2.006)		
Beta	-0.054 *** -(3.065)		-0.267 *** -5.077				-0.028 ** -(2.251)

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.*

These microeconomic variables are as follows: intensity of investment, debt to equity ratio, equity ratio and ROE, ROA, and beta. The overall explanatory power of the model (coefficient of determination, R^2) is very high (0.87), which means that 87% of the variance could be explained by the appropriate microeconomic variables. Regarding the remaining LSP clusters (the industry sector in which the LSPs operate), some differences can be observed. Not all microeconomic variables influence the CoC of the different LSP clusters to the same extent. Nevertheless, all regression models show high explanatory power. For example, the current ratio is the only liquidity ratio that shows a significant influence on the CoC, but only in the Pipeline and

Transportation Services cluster. All other ratios come under the asset, capital, or profitability structure.

C.5.2 Regression of systematic risk and microeconomic variables

Similar to the regression analysis of the effect of microeconomic variables on the CoC, the regression analysis of systematic risk and microeconomic variables reveals a set of variables significantly influencing the systematic risk of all LSPs (Table C-4).

Table C-4. Results of regression analyses of systematic risk and microeconomic variables

	Dependent variable: beta (β)						
	All LSPs	**Railroad Transportation**	**Motor Freight Transportation**	**Water Transportation**	**Transportation by Air**	**Pipeline, except Natural Gas**	**Transportation Services**
		SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	702	43	164	321	131	20	23
R^2	0.034	-	0.03	0.077	0.044	0.874	-
Ratios	Standardized slope of regression (t-value in parentheses)						
(Constant)	(10.458)		(0.602)	(11.169)	(6.445)	(2.147)	
Current ratio						0.433 *** (4.523)	
Asset intensity 1						-0.392 *** -(3.376)	
Continuous intensity	-0.193 *** -(4.055)			-0.278 *** -(5.171)			
Asset turnover	0.132 *** (2.777)						
Current asset turnover			0.174 ** (2.245)			0.731 *** (6.470)	
Debt to equity ratio	0.089 ** (2.375)				0.209 ** (2.426)		
Equity ratio						-0.311 ** -(2.515)	

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level*

These microeconomic variables are as follows: continuous intensity, asset turnover, and debt to equity ratio, regarding asset and capital structure. In contrast to the analyses of CoC and microeconomic variables, the model – as well as the models considering the single industry cluster – show very low overall explanatory power (R^2). While the systematic risk of the Railroad Transportation and Transportation Services clusters is not significantly influenced by the microeconomic variables, the other clusters show obvious differences. In particular, the Pipeline cluster shows differences. Its systematic risk is significantly influenced by four ratios: current ratio, asset intensity 1, current asset turnover, and equity ratio. Furthermore, the regression model is the only one that shows a very high explanatory power (0.874).

C.5.3 Regression of cost of capital and macroeconomic variables

The regression analyses of CoC and macroeconomic variables (Table C-5) do not reveal a general set of macroeconomic variables that influences the CoC of LSPs. The CoC is influenced by money supply (M2) in the Railroad Transportation cluster, by the employment to population ratio in the Water Transportation cluster, by CO_2 in the Transportation by Air cluster, and by GDP in the Transportation Services cluster. The explanatory power of the models or variables (only one variable in each cluster was included) is nevertheless relatively high.

Table C-5. Results of regression analyses of CoC and macroeconomic variables

	Dependent variable: WACC, year 2006-2010						
	All LSPs	**Railroad Transportation**	**Motor freight Transportation**	**Water Transportation**	**Transportation by Air**	**Pipeline, except Natural Gas**	**Transportation Services**
		SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	226	19	73	87	31	8	8
R^2	-	0.824	-	0.895	0.93	-	0.88
Macroeconomic variables	Standardized slope of regression (t-value in parentheses)						
Constant		(-3.499)		(5.086)	(-4.506)		(-1.652)
Money supply (M2) as % of GDP		0.908 ** (3.744)					
Employment to population ratio				-0.946 ** (-5.046)			
CO_2 (kt)					0.964 *** (6.316)		
GDP							0.938 ** (4.691)

Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.

C.5.4 Regression of systematic risk and macroeconomic variables

In contrast to the results of the regression analyses of CoC and the macroeconomic variables, the regression analysis of systematic risk and macroeconomic variables (Table C-6) reveals a set of macroeconomic variables that influences the CoC of all LSPs (adjusted net national income and the mean oil price). Regarding the single industry clusters, CO_2-emissions significantly influence the systematic risk of the Railroad and Water Transportation, Pipeline and Transportation Services cluster. Market capitalization is relevant in the Railroad and Motor Freight Transportation clusters; the Transportation by Air cluster is the only one whose CoC is influenced by money supply and gross capital formation. The explanatory power (R^2) of all models is in all clusters higher than R^2 of the analyses of CoC and macroeconomic values.

Table C-6. Results of regression analyses of systematic risk and macroeconomic variables

				Dependent variable: beta, year 2000-2010			
	All LSPs	**Railroad Transportation**	**Motor Freight Transportation**	**Water Transportation**	**Transportation by Air**	**Pipeline, except Natural Gas**	**Transportation Services**
		SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47
Number of LSPs	416	33	123	175	69	5	11
R^2	0.993	0.98	0.932	0.983	0.956	0.862	0.974
Macroeconomic variables	Standardized slope of regression (t-value in parentheses)						
Constant	(33.006)	(19.977)	(15.583)	(9.942)	(7.637)	(8.150)	(22.628)
Adjusted net national income	-1.366 *** (-15.209)						
Mean oil price	0.406 *** (4.519)						
CO_2 (kt)		-0.827 *** (-10.473)		-1.660 *** (-6.337)		-0.929 *** (-7.078)	-0.987 *** (-17.176)
Market capitalization		-0.208 ** (-2.639)	-0.966 *** (-10.51)				
GNI				0.690 ** (2.632)			
Money supply (M2) as % of GDP					-0.607 *** (-5.073)		
Gross capital formation					-0.463 *** (-3.646)		

Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.

C.6 Discussion

C.6.1 Discussion of the hypotheses 1 to 5

Hypothesis 1: The regression analyses of microeconomic and macroeconomic variables and CoC as well as systematic risk concerning the location of the LSPs' headquarters did not lead to notably significant results (see Appendix, Table C-10 to Table C-13). Only the regression analyses of CoC and microeconomic variables showed significant variables influencing the CoC of LSPs whose headquarters were located in the "high income OECD cluster." Thus, our analyses support H1: the country in which an LSP's headquarters is located has minor importance in explaining the CoC and systematic risk of LSPs. The results confirm the adequacy of the "territorial principle" that is, the country in which the LSP operates is crucial, not the country in which an LSP's headquarters is located (in contrast to the "nationality principle"). This finding is particularly valid for globally linking LSPs, such as those allocated primarily to the Railroad or Water Transportation, Transportation by Air, and Pipeline clusters. Furthermore, the results of recent financial research have revealed the increasing importance of industry factors in contrast to country locations (see Galati and Tsatsaronis, 2003; Cavaglia et al., 2000) or their growing explanatory

power (Brooks and Del Negro, 2005; Isakov and Sonney, 2002; Baca et al., 2000). Therefore, H1 is supported.

Hypothesis 2: The regression analyses showed significant differences between the different LSP industry clusters (Table C-3 to Table C-6). This finding supports the recent financial research mentioned in the discussion of H1. Our results showed no homogenous set of variables influencing the CoC and systematic risk of LSPs. The analysis of CoC and microeconomic variables indeed led to a set of variables influencing the CoC of all LSPs. Nevertheless, this set of variables was not valid for all industry clusters. A similar pattern was observed in the regression analyses of systematic risk and microeconomic variables (Table C-4) and of the systematic risk and macroeconomic variables. Therefore, H2 is supported.

The differences in the LSP industry clusters are provided in the discussions of hypotheses 3 and 4.

Hypothesis 3: The results indicated that a variety of microeconomic variables influence the CoC of all analyzed LSPs: intensity of investment, debt to equity ratio, equity ratio, ROE, ROA, and systematic risk.

The influence of debt to equity ratio and equity ratio is obvious because the factors of debt and equity have been included in the calculation of the WACC. The equity ratio showed a positive influence on the CoC, implying that the more LSPs are funded by equity, the higher their CoC. Consequently, the debt to equity ratio had a negative influence on the CoC, which implies that the CoC decreases when LSPs strengthen their debt funding. Because all analyzed LSPs show a relatively high equity ratio (Table C-1), they could take advantage of better credit conditions (while interest payments are tax exempt), which would lead to lower CoC (Ross et al., 2008). This result supports Modigliani and Miller's (1958) classic theorem and related studies on LSPs. An optimal debt to equity ratio minimizes a company's CoC, but CoC also increases if the equity ratio exceeds a specific barrier.

The intensity of investment showed a positive influence on the CoC of all LSPs, indicating that a higher intensity of investment leads to higher CoC. All LSP clusters, except Transportation Services, are asset based (Table C-1), which means that they have several tangible resources (property, plants, and equipment), and their capital is tied up and not available at short notice. Hence, the asset flexibility of LSPs (except of Transportation Services) is low, which is also indicated by the intensity of investment: the higher this ratio, the lower the asset flexibility and consequently the higher the CoC.

The variables of ROE and ROA are related to the profitability structure of LSPs. ROE and ROA are performance indicators that reveal whether the operation of an LSP is profitable (Horngren et al., 2012). Similar to the equity ratio, the ROE had a positive influence on the CoC, which means that the more that LSPs are funded by equity, the higher their CoC. The fact that the CoC of LSPs decreases if they strengthen their debt funding must not be confounded with a relatively high equity ratio, which may lead to better credit conditions at the same time. The equity ratio does not imply that all equity is used for investments. On the contrary, ROA had a negative influence on the CoC, that is, the higher the ratio of earnings to assets used, the lower the CoC.

Surprisingly, systematic risk also showed a negative influence on the CoC. A positive influence was expected, which would result in higher CoC if systematic risk would increase. This result could be ascribed to the methodology used to calculate the CoC.[77] The influence was negative in combination with the influence of the other microeconomic variables, as discussed above. Furthermore, the standardized slope of the regression showed only a low value compared to the slope of the other significant ratios.

Regarding the single industry clusters of LSPs, no clusters showed the same set of variables influencing the CoC:

- Railroad Transportation: The CoC of the Railroad Transportation cluster was positively influenced by asset intensity 2, equity ratio, and ROE. Hence, for this non-current asset-based cluster, lower non-current assets or higher current assets would lead to higher CoC. Furthermore, CoC increased with higher equity ratio and hence ROE. This result could be ascribed to the fact that railroad companies are characterized by the lowest mean equity ratio and the highest debt to equity ratio. A rise in equity would fundamentally change the (optimal) financial structure of this cluster and lead to increasing CoC.

- Motor Freight Transportation: The CoC of the Motor Freight Transportation cluster was negatively influenced by intensity of investment and systematic risk and positively influenced by ROA. The Motor Freight companies show a relatively low asset intensity 1. If, in the case of the Motor Freight Transportation cluster, LSPs' share of non-current assets decreased (intensity of investment), CoC would then increase. A certain amount of non-current assets is inevitable to ensure the operation of an LSP. As described for all LSPs,

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[77] Alternative approaches to calculate the CoC are the discounted cash flow method (DCF), the arbitrage pricing theory (APT), and consumption based models (Armitage, 2005; Pratt, 2003).

systematic risk also negatively influenced the CoC in this cluster. The positive influence of ROA on the CoC is surprising but, compared with the other clusters, it could be ascribed to the general asset structure of the LSPs.

- Water Transportation: The CoC of the Water Transportation cluster was negatively influenced by net profit margin and positively influenced by asset turnover, ROE, and ROA. Regarding the net profit margin of LSPs in this cluster, the more profitably they operate, the lower their CoC. On the contrary, ROE and ROA positively influenced this cluster's CoC. This result could be ascribed to the capital and asset structure of this cluster. On the one hand, the cluster shows the lowest mean value for asset and current asset turnover, indicating the ratio of annual turnover and total or current assets, respectively. On the other hand, the cluster reveals the highest mean net profit margin, which could explain the negative relationship.

- Transportation by Air: The CoC of the Transportation by Air cluster was negatively influenced by asset turnover and positively influenced by ROA and net profit margin. The results are kind of surprising: The higher the profitability of this cluster, the higher the CoC. This result cannot be explained and warrants further investigation.

- Pipelines except Natural Gas: The CoC of the Pipeline cluster was negatively influenced by the current ratio and positively influenced by continuous intensity and ROA. The ability to pay current liabilities (indicated by a current ratio of approximately 150 percent [Horngren et al., 2012]) showed major significance for this cluster, negatively influencing its CoC. The higher the ratio of current assets to total assets, the higher the Pipeline cluster's CoC. The cluster shows the lowest mean values for asset intensity 2 and asset turnover.

- Transportation Services: The CoC of the Transportation Services cluster was negatively influenced by current ratio, ROA, and systematic risk, and positively influenced by ROE. In this cluster, the ability to pay current liabilities was also significant for the CoC. The asset structure of this cluster sharply differs from the other clusters, which may explain the negative influence of ROA on CoC. The positive influence of ROE was obvious because this cluster reveals the highest mean value of the equity ratio. The results showed that CoC increased if the equity ratio exceeded a specific barrier.

The comparison of the LSP clusters indicates only a few similarities. The current ratio negatively influenced the CoC of the Pipeline and the Transportation Services cluster.

Although both clusters have a "healthy" value for their ability to pay current liabilities, the results showed that this ratio was of major importance for the CoC. Furthermore, the ROE positively influenced the CoC of the Railroad and Water Transportation and the Transportation Service clusters. This result demonstrates the positive influence of a high equity ratio on the CoC of LSPs. The ROA had a positive influence on the CoC of all LSP clusters, except the Railroad Transportation cluster. The ROA had a negative influence on the CoC of the Transportation Service cluster. This result could be ascribed to the completely different asset structures of the analyzed clusters.

The results of the regression analyses of systematic risk and microeconomic variables (Table C-4) revealed that some variables significantly influenced the systemic risk of LSPs. However, regarding the explanatory power of all clusters, R^2 was somewhat low. Therefore, a detailed discussion of the influence of each variable is not included in this discussion. Hypothesis 3 is supported.

Hypothesis 4: The results showed that a variety of macroeconomic variables influenced the systematic risk of LSPs. The systematic risk of all LSPs was negatively influenced by adjusted national income and the mean oil price. Consequently, the higher the performance of the national economy is, the lower the systematic risk of LSPs. Furthermore, the higher the mean oil price, the higher the systematic risk of LSPs. This result is obvious, indicating that LSPs are very dependent on oil prices because the byproducts (e.g., kerosene and other fuel) are indispensable in transportation services, particularly for the big clusters of Motor Freight Transportation, Water Transportation, and Transportation by Air. These clusters comprised almost 90% of all LSPs analyzed for macroeconomic variables and systematic risk.

We obtained the following characteristics per LSP cluster:

- Railroad Transportation: This cluster's systematic risk was negatively influenced by CO_2-emissions and market capitalization. The negative influence of CO_2-emissions could be ascribed to the fact that decreased CO_2-emissions imply reduced transports and hence a poor market development for LSPs. Market capitalization can also be considered as a national economic indicator. The lower the market value of all listed companies, the higher the systematic risk.

- Motor Freight Transportation: This cluster's systematic risk was only negatively influenced by market capitalization. This result indicates the high dependency of the cluster on the development of the overall economy. The

services are primarily demanded for short distance transports directly to or from the customer that is, at the end or the beginning of a transport chain. The high dependency on market development seems an additional characteristic.

- Water Transportation: This cluster's systematic risk was negatively influenced by CO_2-emissions and positively influenced by GNI. The influence of CO_2-emissions overcompensates the influence of GNI.

- Transportation by Air: Most notably, the cluster's systematic risk was negatively influenced by money supply and gross capital formation. Except inflationary or deflationary developments, a lower money supply could also imply fewer economic activities and hence lead to increasing systematic risk for LSPs. The same could be implied by gross capital formation.

- Pipeline, except Natural Gas: This cluster's systematic risk was only negatively influenced by CO_2-emissions, which seems the most important indicator for the development of the transportation services market.

- Transportation Services: This cluster's systematic risk was also negatively influenced by CO_2-emissions.

Our analysis highlights only a few common macroeconomic influencing factors. CO_2-emissions had the highest influence on the systematic risk of LSPs. This variable seems to be the most important indicator for the development of the transportation services market. Although the global economy has striven to reduce CO_2-emissions, a decrease in CO_2-emissions still implies a recessionary market for logistics services.

The regression analyses of CoC and macroeconomic variables (Table C-5) led to some significant results. In contrast to the influence of macroeconomic variables on systematic risk, no uniform set of variables influenced the CoC of all LSPs. However, because the CoC of only four clusters was influenced by one macroeconomic variable, a detailed discussion is not provided. Hypothesis 4 is supported.

Hypothesis 5: The correlation of systematic risk and CoC of LSPs is most of all founded in the calculation of the WACC. As Table C-3 shows, the CoC of all LSPs was influenced by systematic risk. However, the comparison of the standardized slope of the regression showed that it was not as strong as the other significant microeconomic variables were. Although a positive correlation was expected, the correlation was negative. This unexpected result could be ascribed to the method of calculating the CoC in terms of the WACC within the CAPM. The variable of systematic risk is not necessary in all methods to calculate the CoC (Pratt, 2003), such

as the arbitrage pricing theory (APT) (Copeland et al., 2005) and the Fama-French three-factor model (Fama and French, 1993), which is a limitation of this research. Therefore, hypothesis 5 is partly supported.

C.6.2 Limitations of the research

First, only quoted LSPs were considered in the analyses because in calculating the CoC or systematic risk of an LSP, a variety of financial information is necessary, but was unavailable for unquoted LSPs. In practice, a common approach is to estimate the CoC of unquoted LSPs via benchmarks of similar LSPs regarding the financial structure and the field of activity (Koller et al., 2010). Based on this common approach, we expect no significant differences when analyzing the CoC of non-quoted LSPs.

Second, the approach of the WACC within the context of the CAPM was used to calculate the CoC. Alternative approaches for calculating the CoC are the DCF method, the APT, and consumption based models (Armitage, 2005; Pratt, 2003). The variable of systematic risk is not necessary in all methods used to calculate the CoC (Pratt, 2003), such as the APT (Copeland et al., 2005) and the Fama-French three-factor model (Fama and French, 1993). Although several studies analyzed the differences in different methods used to calculate the CoC, the results were not in agreement (Pratt and Grabowski, 2010). Surprisingly, our results showed that systematic risk negatively influenced the CoC of LSPs. Perhaps the importance of systematic risk for the CoC of LSPs is not very high. Further analyses applying alternative methods for calculating the CoC could prove this assumption.

Third, the S&P 500 market index was chosen for calculating beta. Because stock market indices often correlate (DeFusco et al., 2011), we do not expect significant differences when using another market index for calculating beta.

Fourth, the CoC is an important consideration in decisions on how to invest capital, and particularly which strategy to follow (Koller et al., 2010). Hence, CoC is a future-oriented variable. We analyzed the influence of micro- and macroeconomic variables, which are variables oriented to the past, on the CoC. In our analyses, we intended to identify the influence of these variables on the CoC, not to predict the development of the CoC of LSPs (this also verifies the application of a stepwise multiple linear regression). Nonetheless, the results allow conclusions on which significantly influential variables to consider when analyzing the CoC of LSPs.

Fifth, even if we adopted a broad understanding of LSPs as basic, meaning carriers, 3PL, and 4PL LSPs as well, this established distinction of LSPs is not met by the SIC.

This fact does not influence the results, nevertheless future research could consider other clusters.

C.7 Conclusion

C.7.1 Summary

We investigated the CoC from the perspective of LSPs. The CoC is an important variable to consider in strategic decisions of LSPs, because financial information has become more and more important. Based on the importance of systematic risk – as a key component of the CoC (if calculated using the WACC) – the influence of company, industry, and market characteristics on both the CoC and the systematic risk, was analyzed. The main results answer the research question and are as follows:

- The country in which an LSP's headquarters is located has no significant influence on the LSP's CoC. This fact could also be ascribed to the territorial principle, which holds that the country or countries in which the LSP operates in is crucial, not the country in which the LSP's headquarters is located.

- The CoC and the systematic risk significantly differ among the different LSP industry clusters. The industry clusters show several differences in the financial structure of appropriate LSPs.

- The CoC of LSPs is significantly influenced by microeconomic variables, which are company-specific, while macroeconomic variables do not show a significant influence. In particular, the asset and profitability structure of LSPs explains the close correlation to the CoC of LSPs (Table C-7).

- The systematic risk of LSPs is significantly influenced by macroeconomic variables, which are market-specific variables, while the influence of microeconomic variables is lower. In particular, the amount of CO_2-emissions seems to be an important indicator for the market development of LSPs and their systematic risk (Table C-8).

- There is no direct influence of the systematic risk on the CoC. The regression analyses showed a negative influence of systematic risk on CoC. This result could be ascribed to limitations such as the methodology used to calculate the CoC.

C.7.2 Implications

The main implication for management is the specific interdependencies of strategic decision-making and CoC. Particularly in the logistics industry, financial issues are often limited to sales and cost figures, thus neglecting the scope of other factors.

Table C-7. Summary of results related to microeconomic variables

		All LSPs	Railroad Transportation	Motor Freight Transportation	Water Transportation	Transportation by Air	Pipeline, except Natural Gas	Transportation Services	# positive correlations	# negative correlations
			SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47		
Dependent variable: WACC										
Explanatory power	R^2	0.9	0.9	0.7	0.8	0.7	0.8	>0.9		
Asset structure	Asset intensity 2		+						1	
	Intensity of investment	+		-						1
	Asset turnover				+	-			1	1
	Continuous intensity						+		1	
Capital structure	Equity ratio	+	+						1	
	Debt to equity ratio	-								
Liquidity structure	Current ratio						-	-		2
Profitability structure	ROE	+	+		+			+	3	
	ROA	-		+	+	+	+	-	4	1
	Net profit margin				-	+			1	1
Systematic risk	beta	-		-				-		2
Dependent variable: beta										
Explanatory power	R^2	<0.1	-	<0.1	<0.1	<0.1	0.9	-		
Asset structure	Asset intensity 1						-			1
	Asset turnover	+								
	Continuous intensity	-			-					1
	Current asset turnover			+			+		2	
Capital structure	Equity ratio						-			1
	Debt to equity ratio	+				+			1	
Liquidity structure	Current ratio						+		1	

Note: + stands for a positive correlation, - stands for a negative correlation.

Our results imply that the financial structure of LSPs, but also the market environment they operate in, significantly influences their CoC or systematic risk, respectively. The CoC is an important criterion in strategic decisions that, for example, concern future investments or M&A's and cooperation. The CoC allows for an assessment of potential takeover targets. The results of this study give first implications how the CoC and also the related systematic risk vary in different LSP industries and to what extend they are influenced by market and company characteristics. Thus the results on the one

hand facilitate the assessment of LSP's competitors' performance or profitability. On the other hand, LSPs can estimate to what extend their CoC and systematic risk will change if specific strategic decisions are taken and the appropriate market or industry characteristics are known. These insights are also helpful if strategic decisions are moreover related with investment decisions, as for example, conclusions on the CoC and systematic risk – when investing within a specific market or industry – can be drawn.

Although our analyses focused on quoted LSPs, non-quoted LSPs may also benefit from these insights. It is common to use data of quoted LSPs to estimate the CoC and systematic risk of non-quoted LSPs. Hence, non-quoted LSPs could compare their company-specific data with the results of this study in order to estimate their CoC as well as systematic risk. They then can identify potential for optimization (e.g., concerning the asset structure). Furthermore, if non-quoted LSPs have determined their CoC and systematic risk by the application of benchmarks, they may use this information for the same strategic decisions like quoted LSPs, for example, concerning M&A's or cooperation as well as investment decisions. Moreover, they can also estimate the influence of specific strategic decisions, for example, expanding into a new market, on their CoC.

Table C-8. Summary of results related to macroeconomic variables

		All LSPs	Railroad Transportation	Motor Freight Transportation	Water Transportation	Transportation by Air	Pipeline, except Natural Gas	Transportation Services	# positive correlations	# negative correlations
			SIC 40	SIC 42	SIC 44	SIC 45	SIC 46	SIC 47		
Dependent variable: WACC										
Explanatory power	R^2	-	0.8	-	0.9	0.9	-	0.9		
Macroeconomic variables	Money supply (M2)		+						1	
	Employment to population ratio				-					1
	CO_2 (kt)					+			1	
	GDP							+	1	
Dependent variable: beta										
Explanatory power	R^2	>0.9	>0.9	>0.9	>0.9	>0.9	0.9	>0.9		
Macroeconomic variables	Adjusted net national income	-								
	Mean oil price	+								
	CO_2 (kt)		-		-		-	-		4
	Market capitalization		-	-						2
	GNI				+				1	
	Money supply (M2)					-				1
	Gross capital formation					-				1

Note: + stands for a positive correlation, - stands for a negative correlation.

C.7.3 Outlook

Although if we do not expect significant differences when analyzing non-quoted LSPs, a case study or survey-based research analyzing the CoC of non-quoted LSPs could prove this assumption. Additionally, conducting analyses by using different methods to calculate the CoC of LSPs (particularly methods that do not include systematic risk) would be of interest. This would show possible differences in the results when different methodologies were used. Hence, a best-practice methodology for LSPs could be developed, and the partially answered question of the influence of systematic risk on the CoC could perhaps be resolved. Conducting time displayed analyses would also allow conclusions on future developments of the CoC dependent on microeconomic variables. Furthermore, an empirical field research that would focus on the relation between strategic decisions of LSPs and the consideration of CoC in these decisions could lead to interesting LSP-specific insights. In combination with an analysis of how rating agencies evaluate LSPs, the research recommended here could lead to an evaluation model specified to LSPs.

Appendix

Table C-9. Definition / calculation of microeconomic variables

Microeconomic variable	Definition / calculation
Asset structure	
Intensity of investment	Non-current assets / total assets
Asset intensity 1	Non-current assets / current assets
Continuous intensity	Current assets / total assets
Asset intensity 2	Current assets / non-current assets
Asset turnover	Annual turnover / total assets
Current asset turnover	Annual turnover / current assets
Capital structure	
Debt to equity ratio	Debt / equity
Equity ratio	Equity / total capital
Debt ratio	Debt / total capital
Liquidity structure	
Quick ratio	(Current assets - inventories) / current liabilities
Current ratio	current assets / current liabilities
Profitability structure	
Return on equity (ROE)	Net income / shareholders' equity
Return on assets (ROA)	Net income / total assets
Net profit margin	Net income / turnover

Table C-10. Results of regression analyses of CoC and microeconomic variables

	Dependent variable: WACC			
	High income: non OECD	**High income: OECD**	**Lower middle income**	**Upper middle income**
Number of LSPs	47	248	49	92
R^2	0.691	0.935	0.871	0.713
Ratios	Standardized slope of regression (t-value in parentheses)			
(Constant)	(2.301)	(-2.377)	(1.554)	(-1.180)
Cash flow / sales		0.127 *** (3.950)		-0.226 *** (-3.727)
Continuous intensity	-0.256 ** (-2.370)			
Asset turnover	0.359 *** (3.263)			
Debt to equity ratio		-0.181 *** (-7.218)		
Equity ratio		0.088 *** (3.688)		0.202 ** (2.360)
ROE		1.163 *** (52.517)	0.335 *** (2.960)	0.580 *** (4.866)
ROA	0.737 *** (8.399)	-0.324 *** (-13.334)	0.692 *** (5.912)	0.323 *** (2.648)
Net profit margin		-0.106 *** (-3.052)	-0.210 *** (-3.296)	
Beta		-0.050 *** (-2.859)	-0.116 ** (-2.105)	

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.*

Table C-11. Results of regression analyses of systematic risk and microeconomic variables

	Dependent variable: beta			
	High income: non OECD	**High income: OECD**	**Lower middle income**	**Upper middle income**
Number of LSPs	78	361	80	181
R^2	0.091	0.184	-	-
Ratios	Standardized slope of regression (t-value in parentheses)			
(Constant)	(6.587)	(12.582)		
Current ratio	0.261 ** (2.492)			
Continuous intensity	-0.339 *** (-3.242)			
Debt to equity ratio		0.184 *** (3.554)		

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.*

Table C-12. Results of regression analyses of CoC and macroeconomic variables

	Dependent variable: WACC			
	High income: non OECD	**High income: OECD**	**Lower middle income**	**Upper middle income**
Number of LSPs	21	148	17	40
R^2	0.774	-	-	-
Ratios	Standardized slope of regression (t-value in parentheses)			
(Constant)	(-2.778)			
Labor force	0.880 ** (3.208)			

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.*

Table C-13. Results of regression analyses of systematic risk and macroeconomic variables

	Dependent variable: beta			
	High income: non OECD	**High income: OECD**	**Lower middle income**	**Upper middle income**
Number of LSPs	28	252	34	100
R^2	0.929	0.986	0.961	0.883
Ratios	Standardized slope of regression (t-value in parentheses)			
(Constant)	(5.974)	(32.281)	(15.249)	(7.820)
CO_2 (kt)	-2.272 *** (-4.067)	-0.993 *** (-23.347)	-0.98 *** (-14.069)	
Adjusted net national income	1.362 ** (2.439)			
Money supply (M2)				-0.940 *** (-7.778)

*Note: ***significant at 1% level, **significant at 5% level, *significant at 1% level.*

I   Categorization of theories[78]

Theory category	Related categories
Competitive	B-to-B relationship theory, cluster theory, competitive advantage, contingency theory, core competency, dynamic capabilities, information-based logistics orientation, knowledge-based view, market-based logistics orientation, modularity theory, natural resource-based view, porters framework, process orientation, process-based logistics orientation, relational view, resource advantage theory, resource-based view, strategic behavior theory, strategy-structure-performance, structure-conduct-performance, supply chain orientation, supply-demand strategy matrix, theory of production competence, time-based competition theory, work design
Decision	Auction theory, centralized decision theory, cost minimization, decentralized decision theory, decision support, decision theory, negotiation theory, supplier selection decision theory, vehicle routing problem optimization
Innovation	Creative distraction, diffusion of innovation, innovation adoption, innovation theory, theory of logistics innovation
Institutional	Institutional theory, ecocentric view, labor theory, political economy, social costs, social welfare
Inventory	Continuous review, economic order quantity, general inventory theory, periodic review, portfolio effect, square root law
Marketing	Alliance, asset specificity, buyer-supplier relationships, collaboration, collaborative advantage paradigm, comparative advantage, competitor orientation, consumer-based brand equity, cost orientation, customer focus, customer orientation, dependence theory, disconfirmation theory, exchange theory, information search, internal marketing, market orientation, means-end theory, reciprocity theory, relationship management, relationship marketing, relationship orientation, strategic choice, substitute – delay – leave, theory of channel behavior, trust theory
Microeconomic	Agency theory, coordination cost theory, diversification, fuzzy set theory, game theory, principal-agent theory, resource dependence theory, transaction cost economics, transfer pricing theory, utility theory, Williamson's failure framework
Other social psychological theories	Actors approach, behavioral decision theory, communication theory, conflict theory, consumer culture theory, cultural differences, employee turnover, human communication theory, media richness theory, relational theory, social penetration theory, social resource theory, theory of choice, theory of planned behavior, theory of prejudices, theory of reasoned action, training
Psychological theories of individuals	Attribution theory, cognitive dissonance, developmental theory, power dependence, rational choice theory, response to disaster
Social exchange	Balance theory, firm-specific factors, social capital, social exchange theory, social network theory,

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[78] Adapted from Defee et al. (2010, pp. 409–410).

Theory category	Related categories
Systems	3D concurrent engineering theory, bullwhip effect, business process systems engineering, general systems theory, input output choice, inter-organizational conditions, multiple attribute utility theory, network optimization, network theory, normal accident theory, pricing, risk management, supply chain risk, system dynamics, theory of constraints, total cost, total cost of ownership
Theories of organizations	Attraction theory, collaborative supply chain framework, competing values theory, configuration, constituency-based theory, coordination theory, integration, interdependence theory, interorganizational relationship theory, Lewin's three phase force field, manager behavior, managerial control, organization response to disaster, organizational change framework, organizational citizenship behavior, organizational learning, organizational theory, social identity, stakeholder influence, strategic orientation, theory of organizational design, value congruence
Other	Activity-based costing, adaptive cycle theory, bonding theory, causal chain approach, chaos theory, corporate social responsibility, crime displacement theory, free cash flow model, individual effects model, information processing, information quality theory, integrated strategic positioning process, logistics social responsibility, measurement theory, path-goal theory, population ecology, probabilistic choice framework, situational crime prevention theory, target costing theory, technology-market positioning portfolio, theory of insurance, unified integration model

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Professional experience

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Education

10/2010 – 05/2014	*Ph.D. Studies in Business Administration at the University of St.Gallen, Switzerland*
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	Thesis: "Verbesserung der Rückverfolgbarkeit in Supply Chains durch den Einsatz moderner Informations- und Kommunikationstechnologien bei Spediteuren"
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