INFORMATION NEEDS OF LOGISTICS SERVICE PROVIDERS IN STRATEGIC DECISIONS:
AN OUTSIDE-IN PERSPECTIVE

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ABSTRACT

Purpose
To resist global competition, the strategy of logistics service providers (LSP) becomes more and more important. Strategic decisions concerning offered services or industries / markets operating in cannot be made without the appropriate financial or non-financial information regarding markets, customers or competitors of LSPs. This research aims at identifying the most important information categories required by LSPs in four different strategic decision situations based on Ansoff's product/market-matrix.

Design/methodology/approach
A grey-based decision-making trial and evaluation laboratory (DEMTAL) method was applied in order to evaluate questionnaires filled out by decisions makers of 17 LSPs from Germany, Austria and Switzerland. They were asked to make pairwise comparisons of 6 information categories for four decision situations (in total 120 pairwise comparisons per respondent).

Findings
Information needs are dependent on the size and core competency of LSPs, and the strategic decision to be made. E.g. when focusing on market penetration, financial competitor and non-financial market information is more important than customer data.

Research limitations/implications (if applicable)
The sample size is relatively small, although in most DEMATEL applications sample size is even smaller. For that reason, grey-systems theory was integrated.

Practical implications (if applicable)
On the one hand, the results help researchers to survey and provide required information. On the other hand, LSPs can use the results as a kind of guideline for what kind of information should be gathered in strategic decisions.

Original/value
This research is the first known work that focuses on the information needs of LSPs in strategic decision making. Related work primarily analyzed shippers' information needs for choosing LSPs.

Keywords: Logistics service providers, Information needs, Strategic decisions, Strategy, DEMATEL

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. 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, 2005) 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 logistics service providers 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 product, 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 about their internal and external environment provides the basis for successful 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 especially highlight the importance of external information for strategic decisions of LSPs.

External information concerns, amongst others, competitors, customers, customers' attitudes, market structures, technologies, regulations or public affairs, and other stakeholders (Citroen, 2011; 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 gathered for strategic decisions of LSPs should be balanced in terms of monetary and non-monetary information – for all three information categories (Bhimani and Langfield-Smith, 2007). But a major challenge for LSPs is to acquire the right 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. Especially 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 kinds of information. But to the present, the topics of which kind 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; Hitt et al., 2003; Choo, 2002; McNeilly, 2002) 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, especially with regard to the implementation of logistics strategies and the choice of LSPs (Stock and Lambert, 2001; McGinnis et al., 1995). 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 about 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 does the size of LSPs 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 in 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 on the basis of their size (turnover). As the importance of information was analyzed for four strategic directions, the DEMATEL method has been extended to a "multiple-DEMATEL" approach. This meant 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 decision. Furthermore, the answers of the RQs shall on the one hand help LSPs to gather the right 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 requirements.

The structure of this paper is as follows: A brief literature review is conducted in Section 2. 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 3. Section 4 presents the results of the analysis that are then discussed in Section 5. Section 6 summarizes the results under consideration of managerial implications and limitations. Furthermore, implications for future research are given.

2. THEORETICAL BACKGROUND

Strategic logistics research has mainly considered strategic directions of LSPs (e.g., Juga et al., 2008; Hertz and Alfredsson, 2003) or took a shipper's perspective (e.g., Anderson et al.,

2011; Menon et al., 1998). 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. For this reason, this research focuses on the information needs of LSPs in strategic decisions. In this context, the "outside-in" perspective on strategy was chosen. The outside-in perspective argues that companies aiming at being successful should always focus on their external environment when concerned with strategic issues (Webster, 1994). 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 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. Hence, only external information will be considered in the analyses. Based on recent literature (see, among others, Citroen (2011), Johnson et al. (2008), Hitt et al. (2003), Choo (2002)), the following information categories will be analyzed:

- Market-information:[1] Reflects the economic, social, and political environment of a 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 a 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 a 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.

For different strategic directions of LSPs (based on Juga et al., 2008), it is analyzed, how important the different information categories are. 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.

3. METHODOLOGY

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) 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

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

performing logistics activities on behalf others (Delfmann et al., 2002). The LSPs were chosen with regard to obtaining a balanced sample in terms of company size (turnover) as well as countries. 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. Due to the length of the survey, the respondents were contacted via phone calls in order to support them when filling out the questionnaire. After receiving the completed questionnaires, in some cases follow-up interviews were conducted to verify inconsistencies.

To make differentiated analyses, the LSPs were clustered on the basis of their size into small (turnover < 10 million €), medium (10 to 50 million € turnover), and large (turnover > 50 million €) LSPs. The characteristics of the LSPs are shown in Table 1.

Table 1. Descriptive statistics of LSPs

LSP	Legal structure	Turnover (ca., in million €)	Employees (ca.)	Countries operating in
a	PLC	750	3'325	D, IT, CH
b	Corp.	490	1'500	worldwide
c	PLC	6'680	29'240	D, IT, CH
d	PLC	15	30	worldwide
e	PLC	200	450	worldwide
f	PLC	20	265	26 countries
g	PLC	300	1'895	CH, B, IT, L, SE, SK
h	PLC	155	800	CH, D
i	PLC	60	210	Europe
j	PLC	20	55	CH, IT
k	PLC	130	125	CH, IT, D
l	PLC	150	20	worldwide
m	Ltd.	(n.a.)	160	worldwide, focus East-Europe
n	Ltd	2	10	F, B, L, NL, IT, AT, CH, E, DK, SE, FIN, N
o	Ltd	(n.a.)	(n.a.)	AT
p	PLC	15	100	D, CH
q	Ltd	155	270	worldwide

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

Information categories

Our research focuses on the importance of three information categories – 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**): E.g., gross domestic product (GDP), fuel prices.
- Non-monetary market-information (**I2**): E.g., infrastructural aspects, labor market.
- Monetary customer-information (**I3**): E.g., earnings before interest and taxes (EBIT), logistics market volume.
- Non-monetary customer-information (**I4**): E.g., requirements, outsourcing quote.
- Monetary competitor-information (**I5**): E.g., turnover, cost of capital.
- Non-monetary competitor-information (**I6**): E.g., number of competitors, services.

The assessment of the six information categories, is conducted for four different strategic decisions of LSPs based on Juga's (2008) service-/market-matrix (which is in turn based on Ansoff's (1957) product-/market-matrix):

- Current services in current markets (**A**): E.g., a LSP strives for growth in its known environment with current services.
- Current services in current and new markets (**B**): E.g., a LSP strives for growth by entering new markets with established services.
- Current and new services in current markets (**C**): E.g., a LSP strives for growth by offering new services in its known environment.
- Current and new services in current and new markets (**D**): E.g., a LSP strives for growth by offering new services in newly entered markets.

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.

DEMATEL is a multi-criteria decision-making model (MCDM). Multi-criteria decision-making is characterized by multiple criteria (attribute 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). 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 gathered 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 for decision-making are interdependent, which does not represent reality (Yang et al., 2008). 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; Deng, 1989) by transforming respondents' discrete linguistic answers into grey numbers. A grey-number is "a number whose exact value is unknown but a range within the value lines is known" (Liu and Lin, 2006).Whereas some authors state that Grey-systems are equal to fuzzy sets, 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).

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 ten 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 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).

The general limitations of the chosen methodology are the costly and exhausting efforts for the respondents, who had to make 120 pairwise comparisons. 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.

4. RESULTS

Following the methodological steps of multiple-Grey-based DEMATEL, 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 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 (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) with a lower and an upper bound. 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 in order to allow for evaluations based on the specific characteristics of LSPs. 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 3 – the two values indicate the lower and the upper bound of each grey number.

Table 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

Notes: N is no importance, VL is very low importance, L is low importance, H is high importance, and VH is very high importance.

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

	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	.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
	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	.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

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 4 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.

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. 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 5.

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 ($E_i<0$).

Table 4. Aggregated total-relation matrices for all LSPs

	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	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
	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	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

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

This means that if a LSP focuses on an information category with $E_i<0$, it should also consider information category 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 7). From Table 4 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 ($E_i>0$, see Table 7), they should also be taken into consideration when a LSP focuses on the processing of I3.

Table 5. Aggregated prominence and net effect values for all LSPs

	Current services in current markets (A)				Current and new services in current markets (C)			
IC	$\mathbf{R_i}$	$\mathbf{D_j}$	$\mathbf{P_i}$ ($R+D$)	$\mathbf{E_i}$ (R-D)	$\mathbf{R_i}$	$\mathbf{D_j}$	$\mathbf{P_i}$ ($R+D$)	$\mathbf{E_i}$ (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

The prominence-causal digraphs (Figure 2) illustrate the prominence and net effect of each information category. The vertical axis divides information categories into cause and net effect groups.

Because the results of the analyses allow for various combined and differentiated considerations, the discussion of the results in Section 5 will be conducted regarding all LSPs or clustered by size, in all strategic decisions in general (strategic directions A to D are aggregated) as well as for each strategic direction. [2]

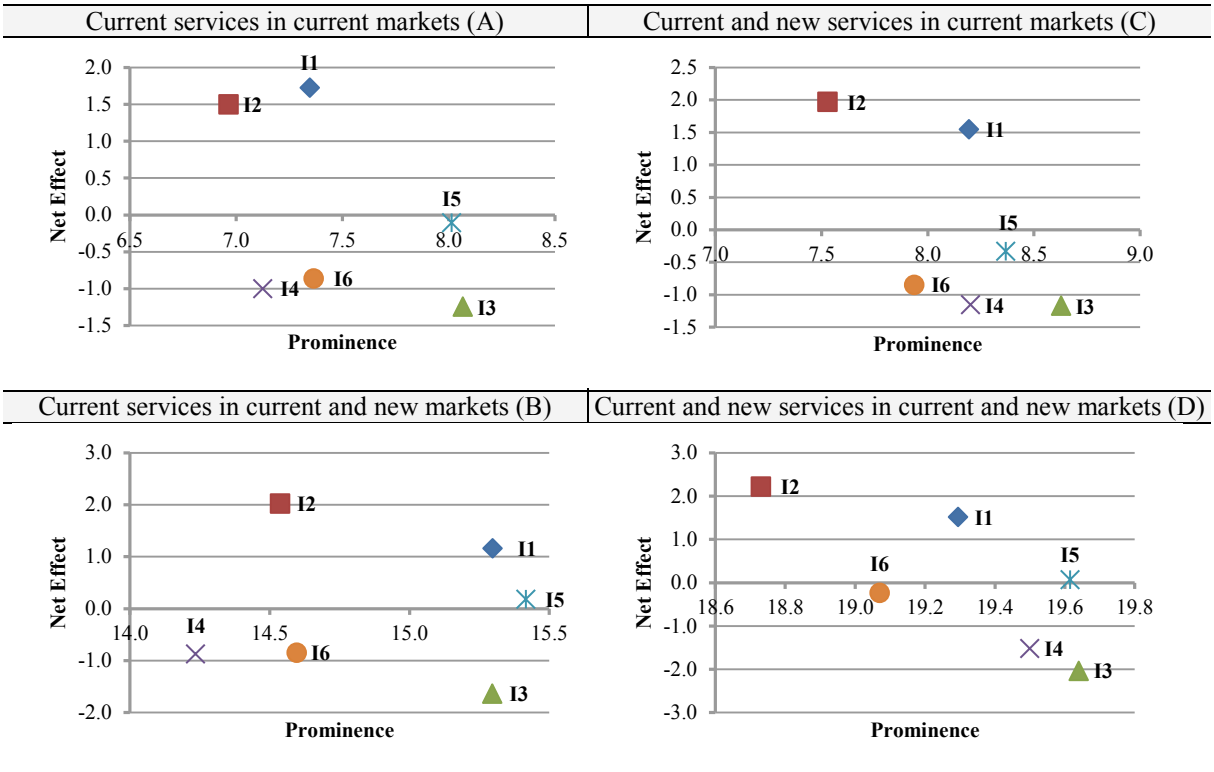


Figure 1. Aggregated DEMATEL prominence-causal digraph for all LSPs

5. DISCUSSION

Importance of information categories

Regarding the aggregated results for all LSPs and all strategic directions (Table 6, 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

[2] Due to relevance and space limitations, the results of each single responding LSP or cluster are not presented.

taken by non-monetary competitor-information, followed by non-monetary customer- and non-monetary market-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 based on the size of the LSPs:

- *Small LSPs*:[3] 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 especially small LSPs are often owner-managed, and strategic decisions are often made by intuition. Hence "soft", non-monetary information may appear to be more appropriate to decision makers.
- *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. For 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), besides 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 about the customers is assessed to be most important, followed by monetary market- and competitor-information.
- *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 about 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.

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). But the importance of each information category is largely dependent on the strategic direction to be followed and the characteristics of the appropriate LSP.

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

Table 6. Importance (prominence) of information categories in dependency of the size of LSP

	All				A				B				C				D			
IC	**All LSPs**	**Small**	**Medium**	**Large**	**All LSPs**	**Small**	**Medium**	**Large**	**All LSPs**	**Small**	**Medium**	**Large**	**All LSPs**	**Small**	**Medium**	**Large**	**All LSPs**	**Small**	**Medium**	**Large**
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)

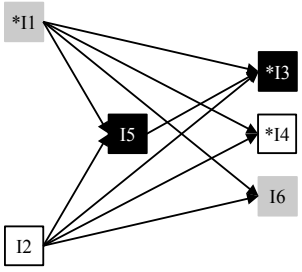
Interrelationships among information categories

Based on the total-relation matrix (Table 4) and the prominence-causal digraph (Figure 2), structural models can be derived. They illustrate the net causes and net effects for the most significant relationships (bolded and underlined in Table 4). Table 7 presents structural models for all LSPs as well as clustered by size in all strategic directions (strategic decisions in general).[4]

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.

Table 7. Structural models for information categories (LSPs by size, all strategic directions)

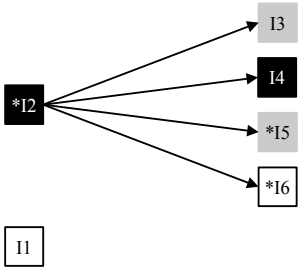
All LSPs | all strategic directions



The overall picture emphasizes a general relevance of all information categories for LSPs making strategic decisions. Especially the high influence of market-information (I1, I2) reveals that general market conditions, e.g., 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

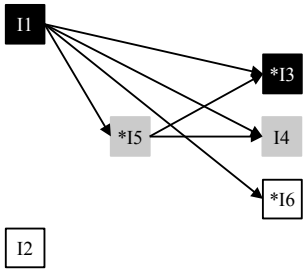
Small LSPs | all strategic directions



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 make decisions by intuition explains the need for "soft", non-monetary information.

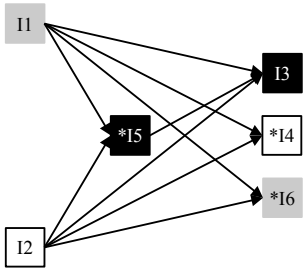
[4] Not all structural models are presented due to space limits. Nonetheless the models show the obvious differences between clusters, which also vary for each strategic direction.

Medium LSPs | all strategic directions

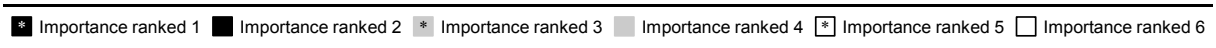


The relationships of information categories regarding the medium LSP cluster are similar to those of all LSPs, except the role of non-monetary market-information (I2) and the stronger net causes of monetary competitor-information (I5) on customer-information (I3, I4). A majority of LSPs operating in logistics markets in general can be allocated to the group of medium LSPs. Hence, the information about 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, among others reasons, 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 gathering this kind of information.



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). But when a LSP focuses on monetary customer-information (I3), it should also take monetary competitor- (I5) and market-information (I1, I2) into consideration. This means although non-monetary market-information (I2) has low overall importance, it should be regarded when making strategic decisions because it influences customers and competitors or their information, respectively. Which information should be taken into consideration by which kind of LSP (based on its size) and in which strategic direction can hence be derived from the structural models in Table 13. Furthermore, interpretations of the relationships are provided.

The elucidations also answer RQ3. There are significant relationships amongst 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 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.

6. CONCLUSION

The present research analyzed the information needs of LSPs in strategic decisions. Thereby, an outside-in perspective on strategy was taken, which is why the focus of the analyses is on external information. Despite the awareness of the importance of external information for successful strategic decision-making and to achieve sustainable 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 requirements of different LSP clusters were investigated. The main results are as follow:

- 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 as well as the size of LSPs.
- 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.
- There are strong relationships amongst 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 about the general market environment, both in monetary and non-monetary measures, should generally be taken into consideration when making a strategic decision.
- Similar to the overall importance of information categories, their relationships are largely dependent on the strategic direction to be followed as well as the size of LSPs.

For management practice, the results provide implications about which information to gather in strategic decisions. The results help LSPs adjust in their strategic decisions and allow orienting. On the one hand, a general orientation is given on which information to collect. On the other hand, LSPs who are already processing specific information category, may interpret the (inter)relationships between the information categories as a kind of decision guidance regarding the necessity of acquiring further information. Furthermore, the results may especially 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 make 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 making strategic decisions. Finally, the results give a first structured overview of the information needs of LSPs in strategic decisions in general. 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 to LSPs.

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. Due to the length of the survey, not all requested LSPs participated the survey. Those who filled in the questionnaire completed the whole survey, by what survey results might not have been negatively affected. Future research could adapt the present research structure and gather a larger sample size to validate the results. As the majority of the analyzed LSPs operate across Europe or worldwide (Table 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 on the basis of their size (turnover). Even if these clusters allow for further conclusions, 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 making successful strategic decisions. Moreover, only external information has been investigated. Nevertheless, internal information is of similar relevance, future research might focus on specific aspects of internal information, which is generally easier to collect than external.

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