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Dynamics in Logistics

Proceedings of the 8th International Conference LDIC 2022, Bremen, Germany

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Preface

Since 2007, the biennial International Conferences on Dynamics in Logistics (LDIC) offers researchers and practitioners from logistics, operations research, and engineering as well as from mathematics and computer science an opportunity to meet and discuss the latest developments in logistics and related domains. From February 23–25, 2022, the eighth LDIC was held online and hosted by the University of Bremen. This time, the conference featured the "International Diginomics-Log*Dynamics* PhD Field Day" as a satellite event as well as a virtual tour through the Log*Dynamics* Lab of the Bremen Research Cluster for Dynamics in Logistics (Log*Dynamics*). Similar to its seven predecessors, the Log*Dynamics* Research Cluster organized this conference in cooperation with the BIBA—Bremer Institut für Produktion und Logistik, which is an engineering research institute affiliated to the University of Bremen.

The LDIC 2022 comprised of empirical, theoretical, methodological, and practice-oriented contributions addressing the modeling, planning, optimization and control of processes in supply chains, logistic networks, production systems, and material flow systems and facilities.

LDIC 2022 provided a forum for the discussion of advances in that matter. The conference program considered three invited keynote speeches, 54 talks, and 39 scientific papers selected by a double-blind reviewing process. All selected papers are arranged within these LDIC 2022 proceedings. By this, the proceedings give an interdisciplinary outline on the state of the art of research in dynamics in logistics as well as identify challenges and solutions for logistics today and tomorrow. The volume is organized into the following main areas:

- Supply chain management,
- Maritime logistics and port operations,
- Transportation networks and vehicle routing,
- Production planning and scheduling,
- Socio-technical systems.

There are many people whom we have to thank for their help in one or the other way. For pleasant and fruitful collaboration, we are grateful to the members of the international program committee:

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Carrying the burden of countless reviewing hours, we wish to thank our Bremen Log*Dynamics* colleagues Frank Arendt, Michael Beetz, Matthias Burwinkel, Gralf-Peter Calliess, Rolf Drechsler, Hans-Dietrich Haasis, Otthein Herzog, Hans-Jörg Kreowski, Walter Lang, Michael Lawo, Burkhard Lemper, Daniel Schmand, Klaus-Dieter Thoben, Yilmaz Uygun, Hendro Wicaksono as well as numerous other colleagues from all over the world for their help in the selection process.

We are also very grateful to Aleksandra Himstedt, Ingrid Rügge, Matthias Burwinkel, Nicolas Kassel, Angelika Gühr, and Yasmin Sakhr for their support in the local organization and the technical assistance during the virtual conference. Moreover, we would like to acknowledge the financial support by the BIBA. Finally, we appreciate the excellent cooperation with Springer, which continuously supported us regarding the proceedings of all LDIC conferences.

February 2022

Michael Freitag
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The Linkage Between Macro Logistics Capabilities and Micro Firm Performance Towards Framework Development for Supply Chain Performance Measurement

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Abstract. Technological advancements, increased globalization, political, social, and environmental concerns are changing the world we live in. Firms applying a global strategic management approach to enter a new country have to dynamically assess and align their performance objectives and micro capabilities with the changing macro logistics higher-order capabilities and resources at the regional or country level, and vice versa. Higher-order capabilities are present in a specific location and emerge over time as a result of systematic interactions across firms and institutions, whereas micro capabilities and performance objectives are firm-wide. Previous research on logistics and supply chain performance measurement hasn't precisely addressed this macro-micro perspective with a global strategic management view. Furthermore, this aspect associating macro and micro capabilities and performance has been only projected with the help of case study-based empirical investigation within the previous research. To investigate the magnitude of this association, this research uses an integrative literature review strategy that includes a qualitative content analysis of the most important/cited supply chain performance measurement literature.

With the help of a macro-micro supply chain performance measurement framework adapted from the supply chain performance measurement literature, the findings bring out the link between various macro logistics higher-order resources and capability elements (input) such as collaboration, knowledge sharing between logistics partners, transportation mode and energy efficiency and the strategic firm performance objectives and dynamic micro capabilities (output) such as sustainability and process innovation. It also extends framework propositions to guide future supply chain performance measurement research with a particular emphasis on global supply chain decision-making.

Keywords: Supply chain performance measurement · Higher-order capabilities · Macro logistics capabilities · Micro firm performance

1 Introduction

The rapid globalization of developing economy multinational companies (MNCs), as well as their ambition to enter and seek strategic resources in foreign markets, provides an

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opportunity to other corporations to learn about the capabilities of these businesses and offer advice to other MNCs beginning on this transformative path. MNCs from emerging economies invest abroad not just to obtain resources, but also to contribute their own experience and knowledge base. Taking a strategic management view, firms entering a new country must be dynamic in determining which firm performance objectives or dynamic micro/firm capabilities may be bolstered by the higher-order macro logistics capabilities and resources, and vice versa. This combination of macro higher-order capabilities, such as a collective invention or knowledge-sharing in R&D networks or government environmental and technological advancement policies, and dynamic micro firm capabilities, which are determined by the knowledge residing in individual firms on how to produce, distribute, or market goods, always determines how effectively a firm performs. Rather than companies per se, here macro higher-order capabilities are characterized by regional advantage, shared capabilities that develop from recurring interactions among geographically confined enterprises and the external infrastructural, institutional, and technological elements, and the business environment in which the company works.

Towards this notion, macro logistics higher-order capabilities developed within the country like infrastructure, institutional and other external environmental regularities drive the micro-level firm´s strategic direction, optimizing the firm´s performance objectives such as cost or responsiveness (Barney et al. 2021). Wiengarten et al. (2014) highlight the positive effect of the logistics capabilities of a country on the firm´s integration and operations. A good case in point for country logistics performance assessment is the LPI (Logistics Performance Index) used by the World Bank since the year 2007 also points towards the same direction. This notion taking a macro-micro perspective has been also reposited within the resource-based view and dynamic capability theory.

Research constraining supply chain has failed to show this linkage and hence, this aspect needs to be investigated even more. Studies by Hasegan et al. (2018); Irfani et al. (2019) have explicated the methodological boundaries of this linkage with the help of empirical investigation but have not fully extrapolated the theoretical boundary. A holistic theoretical footing is yet to be nurtured in terms of elucidating which macro logistics higher-order capabilities support organizations in enhancing their firm capabilities, which in turn evolve towards performance targets optimization. Adapting a macro-micro perspective framework developed by Rouse and Putterill (2003), this paper aims to explore the extent of this notion within the supply chain performance measurement literature. The research also proposes theoretical notions towards this to guide future supply chain performance measurement research and emerging economy organizations towards leveraging logistics higher-order capabilities for optimizing firm performance with an acute implication on global strategic management and supply chain decision making.

The following research questions are developed:

RQ1: How are macro logistics higher-order capabilities linked to micro firm capabilities and performance in supply chain performance measurement research?

RQ2: What can be learned towards developing a supply chain performance measurement framework that integrates macro capabilities and micro firm performance?

The structure of the paper follows as such: the following section elucidates the theoretical foothold of macro higher-order capabilities and dynamic firm capabilities and performance considering dynamic capability view. Next, the approach of the research integrating macro-micro perspective conceptualization is broadened within the supply chain performance measurement literature where an established framework by Rouse and Putterill (2003) is defined and reformed towards attaining the main objective of the paper. Following that, the methodological overview is presented, which explains the content analysis strategy to developing the categories that would answer the research questions. Finally, the results and discussion section connects and elucidates the many macro logistics higher-order capabilities and micro firm capabilities and performance objectives, which are backed up by certain framework propositions.

2 Macro Higher-Order Capabilities and Firm Capabilities Towards Performance Optimization: A Dynamic Capability View

A large account of literature developing the linkage between macro or higher-order capabilities and firm capabilities towards sustained performance and competitive advantage has been invariably associated with resource-based theory and dynamic capability theory (Akhtar et al. 2020; Foss 1996). This notion has been postulated towards the ability to integrate, build, and reconfigure internal and external resources, capabilities and competencies to attain a superior competitive advantage and firm performance (Teece et al. 1997). These capabilities and resources are either embedded within the organization and its practices (micro) or reside in the region (macro) emerging from systematic firm interactions or external institutional factors to address rapidly changing contextual environments.

The idea of macro or higher-order capabilities (Barney and Clark 2007, Foss 1996; Akhtar et al. 2020) develops from macro and meso perspectives where geographical boundedness is emphasized. This helps to explain why a firm's origin in terms of location or country has such a strong influence on its global performance and gives comparative and competitive advantages to firms. Higher-order capabilities are non-proprietary and intangible assets that are shared across a group of enterprises and are developed from external institutional support. Examples of higher-order capabilities may include, for example, standards, knowledge-sharing in R&D networks, collective invention, shared behavioral norms, government policies, quality indicators, legal requirements, technology and economic capability, market requirements, economic capabilities (Foss 1996; Akhtar et al. 2020).

Firm or dynamic micro capabilities advances the heterogeneity in what firms can accomplish and how well they can do it in terms of developing capabilities. Excess physical, human, and organizational resources are a common occurrence in firms. To some extent, this is a matter of indivisibility. More importantly, it's a matter of learning and experience impacts, which are a result of the firm's normal operations - notably within the management team. The significant learning impacts are shown in abilities, which fundamentally differentiate firms and codetermine their opportunity sets or the range of profitable actions that the company can recognize and exploit. It encompasses

human dynamic capabilities (e.g., human resource knowledge), physical dynamic (e.g., businesses' geographical position and specialized equipment), and organizational, strong internal corporate governance and control, all of which may be used to implement value-enhancing corporate strategies.

This paper examines micro-level dynamic capability both at the individual and organizational levels, as an extension of the Resource-based View (RBV) theory. Looking at micro-level dynamic capabilities in isolation has the disadvantage of not explaining why certain businesses maintain a competitive edge in dynamic contexts while others do not, despite having identical resources. Understanding how micro-and macro-level capabilities interact to achieve higher organizational performance necessitates addressing both at the same time. The whole notion linking macro logistics higher-order capabilities and micro firm capabilities and performance can be assimilated within a chain process within the strategic decision-making sphere. Towards this, macro capabilities influence the decisions of the firms in terms of what internal competencies firms want to enhance. This impacts the firm decision towards enhancing their performance goals and creating competitiveness (McIvor 2013). For eg, if in a country, the government stability and support are quite high, then firms have to decide whether they would want to invest in the collaboration capabilities which can enhance the firm goal such as sustainability and resilience. Also, within the strategic management literature, location capabilities require that international firms build and reconfigure competencies through understanding the host country's environment and performing actions to leverage it (Pe'er et al. 2008). These capabilities can be a source of advantage and as a consequence a determinant of survival for internationalizing firms.

Similarly, the link between decision-making effectiveness and organizational performance is further supported by studies on strategic decision-making. For example, companies with comprehensive and precise information on the anticipated link between choices and outcomes can increase strategic decision effectiveness and strategic decision-making indicates favorable future firm performance.

3 Approach

3.1 Framework for Linking Macro-micro View Towards Supply Chain Performance Measurement

Coming back to RQ1, it is possible to conceptualize that there is a strong link between the value, rarity, inimitability of macro capabilities and firm performance and the relationship is mediated by the strategic decision-making effectiveness of the firm. This macro-micro view has been typically established through the lens of a superior logistics performance assessment structure. Superior logistics performance manifests resourceful cross-border operations enabled by countries in terms of efficient and consistent mobility (Roy and Schoenherr 2020). From Kinra et al. (2020), it can be postulated that there is a direct influence of the macro-level country´s logistics capabilities on the micro firm´s performance and its managerial decision-making countenance. For example, logistics infrastructural factors such as ports and transportation mode quality or institutional factors such as customs balance the firm´s strategic performance objectives responsiveness.

Rouse and Putterill (2003) have provided a framework for linking macro and micro capabilities and performance objectives and outcomes within the supply chain performance measurement literature. The framework (Fig. 1) extended by (Rouse and Putterill 2003 and Bititci et al. (2000) have the following aspects:

Aspect 1: It is not static and evaluation of different dimensions takes place flowing through time in different levels and changing environments.

Aspect 2: It shows a linkage as to how the macro capabilities and resource requirements (processes drivers) lead towards the desired strategic performance directions (performance objectives).

Aspect 3: It can distinguish between measurements of improvement and measures of control where the planning and evaluation of control processes take place.

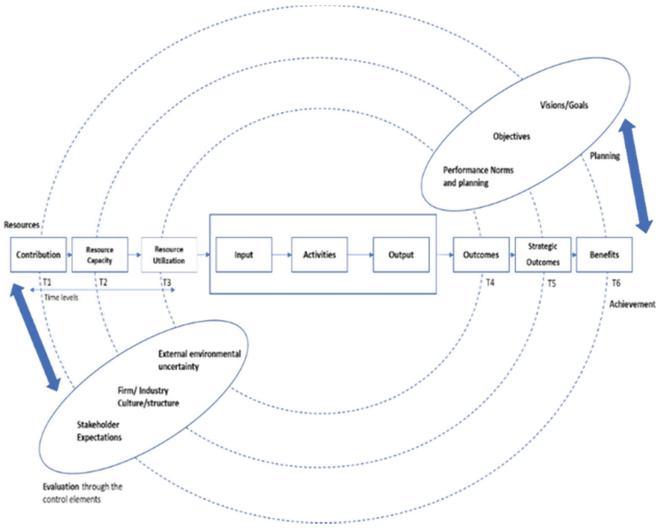

Fig. 1. Macro-micro organizational view within supply performance measurement. Adapted from Rouse and Putterill (2003).

Within the literature on country logistics performance assessment, performance measurement has also been suggested in the form of a linked structure connecting the cause (macro resources and capabilities) and result (micro firm performance objectives) determinants (e.g. Bookbinder and Tan 2003; Bowersox et al. 2003), taking a macro-micro organizational view. Anchoring on the RQ1 and RQ2, the study adopts this theoretical framework to see how the macro logistics capabilities can be connected to micro firm performance and provide some propositions towards macro capability-micro performance framework development for future research in supply chain performance measurement.

3.2 Qualitative Integrative Reviews

The study adopts a qualitative integrative review (Cooper1989) as similar to Ojo (2019). For which a content analysis research approach is used for the systematic qualitative

description of the evident content of the literature in supply chain performance measurement (Staudt et al. 2015). In convention with the design of integrative research review, the review is based on the following stages: (a) defining the topic and research questions that will lead the integrative research review (b) determination of a data-gathering strategy and the selection of numerous channels to avoid coverage bias (c) data evaluation and selection, including deciding which data to include in the review using selection criteria (d) Analysis and interpretation of the reviewed literature, including source statistics, a number of retrievals, and lastly reviewed literature (e) presenting the findings. Integrative reviews have many benefits within research. But the main motivation to apply this method has been mainly to evaluate the strength or the extent of the scientific evidence, between related areas of work and identify the learnings and direction for future research. Figure 2 illustrates the process map for the overall research design including research databases, search terms, inclusion and exclusion criteria and the utilized approach for data analysis.

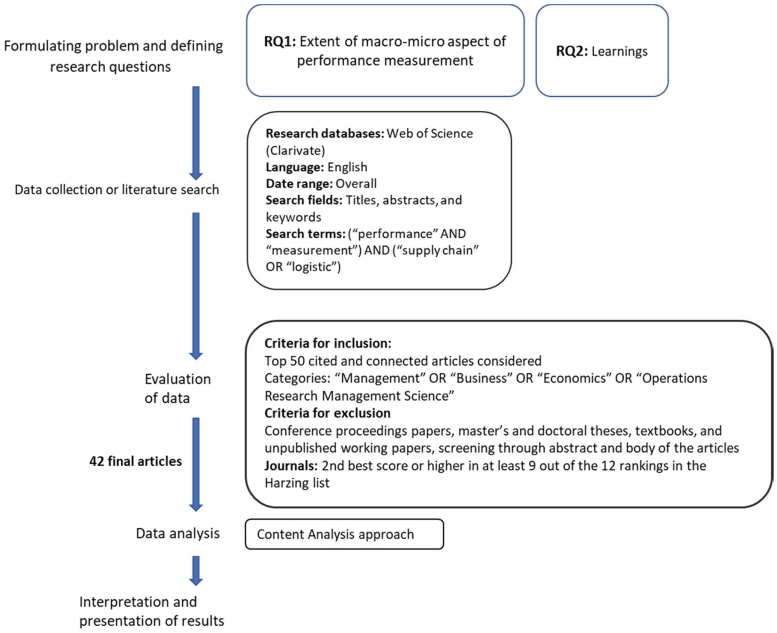

Fig. 2. Process map

As it can be illustrated from Fig. 2, for answering **RQ1** and **RQ2**, a literature review is conducted on the 50 most cited and connected papers overall and then a content analysis approach to applied to classify the 42 articles according to seven major categories: (i) Boundary of the research (ii) nature of paper: empirical or normative (iii) extent of macro-micro view (iv) Macro logistics higher-order capabilities (v) Micro firm performance objectives and capabilities (iv) Content segment.

The paper shows the classification according to the different literature in terms of the various macro-level capabilities factors developing to the micro firm performance objectives. Citations have long been the primary parameter used by academia to assess the impact or significance of research (Aksnes 2006). Hence, only the most cited and connected papers are included as per bibliographic analysis on histcite application based on the metric LCS (local citation score), which is provided to the highest cited articles within a specific search sample. As journals are widely used in academia for gathering information, the conference proceedings papers, master and doctoral thesis and unpublished working papers are excluded. Finally, to enhance the quality of the review, the 35 best journals evaluated from the Harzing list are considered.

4 Findings and Discussion

4.1 Linkages Between Macro Logistics Higher-Order Capabilities and Micro Firm Performance Objectives and Capabilities

In reference to the RQ1, Table 1 elucidates the extent of the macro-micro view in supply chain performance measurement fulfilling the different aspects (page 5) within the literature. Within the table, a categorization of the content in terms of which macro logistics higher-order capabilities are linked to micro firm capabilities and performance objectives is anticipated. After reviewing the 42 short-listed papers 8 relevant linkages were identified, which were then described using the content analysis approach.

Table 1. Macro capabilities and micro performance objectives linkages from supply chain performance measurement literature.

Boundary	References	Nature of paper	Macro logistics higher-order capabilities and resources	Micro firm performance objectives and capabilities	Extent of macro-micro view in supply chain performance measurement
Green supply chain and sustainability (3)	Mollenkopf et al. (2010)	Normative	Collaboration, knowledge sharing between logistics partners	Sustainable competitive advantage	**Medium:** The time aspect has not been addressed
	Hassini et al. (2012)	Normative and Empirical	Transportation mode and energy efficiency	Environmental sustainability, time and cost, competitive advantage	**High:** All three aspects fulfilled

(*continued*)

Table 1. (*continued*)

Boundary	References	Nature of paper	Macro logistics higher-order capabilities and resources	Micro firm performance objectives and capabilities	Extent of macro-micro view in supply chain performance measurement
	Chiou et al. (2011)	Empirical	Collective learning capabilities and technological advancement within logistics services	Process innovation, green innovation	**High:** All three aspects fulfilled
Supply chain integration (1)	Nyaga et al. (2010)	Empirical	Firm collaboration	Satisfaction (Trust and commitment)	**High:** All three aspects fulfilled
Supply chain strategy (2)	Gunasekaran et al. (2004)	Empirical	Operational level and tactical level strategies of firms	Strategic level outcomes	**Low:** Doesn´t clearly define what are the capabilities or what are the control elements
	Gunasekaran et al. (2004)	Normative			
Humanitarian supply chain (1)	Beamon & Balcik, (2008)	Normative and empirical	Annual cost recovery (resources)	Response time (Outcome)	**Medium:** The time aspect has not been addressed
Humanitarian supply chain (1)	Beamon (1999)	Normative	Cost-effectiveness (resources)	Customer responsiveness (Outcome)	**High:** All three aspects fulfilled

As it can be seen from Table 1, only 8 articles within the search, which provide evidence towards this linkage were identified. However, out of these 8, 6 of them are showing a high extent of this view as they incorporated at least two out of three aspects for the macro-micro performance view (Refer to aspects, Page5). This evidently shows that this aspect is present within the logistic and supply chain performance measurement literature but the pattern has not been accounted for enough. The different process drivers (macro logistics capabilities) and firm performance objectives and capabilities have been categorized within the table.

4.2 Future Research on the Development of Macro Capability-Micro Performance Framework

A prominent account of this view has been grasped within the domain of green supply chain and sustainability with three articles (Chiou et al. 2011; Hassini et al. 2012; Mollenkopf et al. 2010) followed by the discipline of supply chain strategy and integration. Various collaborative capabilities such as cooperation, coordination, collective learning and information technology within logistics services of the firms have been considered as the input macro or higher-order capabilities elements for green supply chain performance improvement. This directed the rising amount of research in the adoption of collaborative capabilities by the organizational stakeholder for attaining sustainable performance objectives within the supply chain. This is specifically in line with Wilkinson et al. (2001) demonstrating the responsibilities played by governments and companies in achieving sustainability, with a focus on operations management competencies and human resource management. Towards this, several organizational goals and strategic objectives have also been accounted such as green innovation or sustainable environmental competitive advantage. Network theory which takes inter-organizational collaboration into account at a higher/global level has been suggested for investigation, even more for firms adapting sustainability objectives towards a green and lean global supply chain. The boundary of supply chain integration (Nyaga et al. 2010) has also shown this trait of inter-organizational collaboration as the main capability factor. In the light of answering RQ2 and taking all these notions into account, the following propositions can be formulated for future research towards framework development for supply chain performance measurement integrating logistics macro capabilities and micro firm performance:

Proposition 1: Macro inter-organizational collaborative capabilities such as cooperation, coordination, collective information technology and learning should be considered as main capability factors for enhancing a firm´s sustainability performance towards global supply chain strategic decision making.

Proposition 2: Logistics and supply chain performance measurement for designing a global supply chain network must relate to optimizing multiple organizational performance goals and strategies.

Proposition 3: Network theory which involves inter-firm and inter-functional collaboration as macro logistics capability between multiple actors should be investigated for firms adapting to green and lean global supply chain involved in a continuously emerging and evolving dynamic environment.

Extending to this notion of global supply chain network, Teece (2019) suggest that the difference in the growth and performance of the nation is directly affected by the capabilities within firms, their collaboration and countries as a whole. According to the business insolvency outlook (2020), countries such as India and Canada have the highest organizational insolvencies and bankruptcies in the year 2020. One of the major reasons for this is a lack of capability or resilience in terms of innovation, asset orchestration, market creation, knowledge sharing and resource adaptation within the industries.

Considering a macro logistics higher-order capability, Hassini et al. (2012) have developed a framework for sustainable supply chain management and performance measures within a global context. It demonstrated that the macro logistics capability such as the transportation mode and energy efficiency have a high impact on environmental sustainability, timeliness and cost performance objectives in a global distribution network. Value proposition has been taken as the control measure within the study as there is always a trade-off between cost and customer acceptance within sustainable supply chain management. Towards this, two propositions are developed:

Proposition 4: Firms within the same supply chain having conflicting strategies in a global distribution network faces difficulties to align their capabilities.

Proposition 5: Assessment of supply chain performance within a global distribution network not only relates to time optimization as a performance objective but is also dependent on coordination between the different roles of the supply chain players.

A significant aspect was also shown by Beamon (1999); Beamon and Balcik (2008) within the manufacturing and humanitarian supply chain performance measurement. Framework involving categorization and transformation of performance metrics from resource level to output level has been demonstrated. The time and environmental uncertainty constraints have also been projected in the literature, with flexibility being considered and adopted as a control measure, such as volume or response flexibility, which pertains to the evaluation of a supply chain responding to change in an uncertain environment. Taking this into account, this is the final proposition:

Proposition 6: Flexibility should be taken as a very important control measure for improved organizational supply chain performance in an uncertain and evolving environment.

5 Conclusion and Limitations

Answering the first research question, the study projected the firms' behavioral propensity toward collaborative capabilities in the development of a sustainable and green supply chain. Decision-makers gain a broad understanding of macro logistics capability factors such as government regulations, infrastructure, and political conditions, as well as inter-organizational collaborative capabilities, and will no longer be able to ignore their impact when dealing with strategic global and cross-national activities. After that, the paper was able to profile six propositions that contribute to supply chain operations and performance measurement literature for framework development that elaborates the context of understanding logistics macro capabilities while also linking it to specific decision-making aspects at the micro firm level.

However, the study lacks an expert-based validation of the different propositions and the linkages provided within the study. Moreover, the study is only limited to a literature review based on a limited critical number of studies which is not enough for implications within such a huge research area, supply chain performance measurement. In the future, this needs to be investigated even more and a pattern based on the various research discipline within logistics and supply chain management needs to be developed.

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Integrating Regional Food Manufacturers into Grocery Retail Supply Chains in Germany

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Abstract. This paper examines the integration of regional food manufacturers into the supply chains of large grocery retailers. It discusses the current integration problems and challenges of those supply chain concepts which are presently used in the food retail sector. In this paper, we assessed direct delivery, milkrun and intermediate stations with regard to their suitability for integrating regional food manufacturers into the structures of large grocery retailers and used an Analytical Hierarchy Process (AHP) approach for the evaluation. The results of the AHP show that milkruns with an intermediate station are best suited for this type of supplier integration.

Keywords: Regional food manufacturer · Grocery retail · Milkrun · AHP

1 Introduction

More than a 37 million consumers in Germany prefer to purchase regional products [1]. When it comes to the major reasons for buying regional food, German consumers indicate the support of regional economy, the better freshness of products, the positive effects for the environment as well as lower emissions [2–4].

Also, supermarket chains offer more and more regional products in their shelves, whereby the two largest German grocery retailers (in terms of sales volume) have an advantage as they operate their store networks with local independent retailers as opposed to those retailers with a centrally controlled store network [5, 6]. The Bavarian Edeka-South-Group increased the sales of their regional private label by nearly 20% within one year [7].

Besides the potential positive effects of shorter supply chains and thus an improved environmental footprint, a higher share of regional products in the grocer retailers' product assortment brings some challenges to their efficiency-driven high-volume purchasing strategies. Regional food producers though face a change in their distribution systems, which were traditionally organized as direct yard sales where consumers have to come to the yard in order to purchase the items. As consumers may not be willing to drive to the yards, producers could either deliver to the consumers' homes or integrate with large grocery retailers.

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In this paper we are interested to see which conceptual concept large grocery retailers can use to integrate regional food manufactures in their supply chain. We approach this question by examining the identified concepts and assess their supply chain integration suitability with an Analytical Hierarchy Process (AHP) approach.

In order to solve our research problem, we first define the term 'regionality' and discuss further the challenges of regional supply chain integration. Afterwards we analyze current supplier structures of large grocery retailers (in terms of sales volume) and assess the attributes and indicators that are applicable for our evaluation and comparison of supply chain integration concepts.

2 Regionality and Retailing

2.1 Regional Food

There is no common understanding on regional food as it is difficult to define regionality. According to Hausladen [8], the definition of the term 'region' includes criteria regarding geography, economy, culture or climate in order to come up with a unified spatial understanding of a region. Ermann [9] extends this by subjective aspects by using relations and/or the identification with an area.

When it comes to regional food, the information that the product is from a certain region is crucial as Wegmann [10] points out. Besides the origin of the product, consumers also want to know how the respective region is defined [10]. Therefore, the European Union [11] refers to two seals of approval, the protected designation of origin and the protected geographical indication. However, there are additional seals, e.g. the regional window (Regionalfenster) in Germany, that shows from where the products come from, where it was processed as well as the share of regional ingredients [12].

For the purpose of this paper, we follow Buxel [13] and define regional food as food that stems from a radius of up to 50 km for the place of production.

2.2 Grocery Retail

Retailing as such can be defined from a functional as well as institutional perspective [14]. Retailing from a functional perspective refers to the procurement and distribution of final products without further processing and focuses on the value-adding processes only. In case of defining retailing from an institutional point of view, it focuses on the firm that executes these functions [15]. Following an institutional understanding, different forms of retailers exist, depending whether they operate with physical stores, hybrid store formats or without stores (stationary, ambulant, non-stationary).

When it comes to grocery retailers, stationary retail formats such as supermarkets, discount stores or hypermarkets are still dominating the sector [16]. The more than 34,000 food retailers in Germany represent a sales volume of nearly 200 billion Euro. The largest players in this sector are Edeka with a market share of more than 25% followed by Rewe-Group, Schwarz Group and Aldi-Group. These structures remained stable for the last 10 years [17].

2.3 Trends in Grocery Retail

Single-Households. The development of the German population shows an aging of society, where more and more people tend to live in urban environments as well as in single households. Due to time pressure, there is less time for preparing meals, thus ready-made products, restaurant visits or food delivery services are becoming more popular [18].

Convenience Products. As a consequence, the market share of convenience products which are easy to prepare and to serve increases. Luetticken [19] differs hereby between five stages between basic stage (e.g. fruit or vegetables) to ready-to-eat (e.g. ready-made salad).

Food Markets. These are either fixed or mobile locations that offer at small space a comprehensive choice of fresh-prepared food (e.g. food trucks) especially for the lunch break in city-office areas [20]. Such markets are also found as shopping islands in stationary grocery retail stores such as the bakery station or a sushi bar [18].

Importance of Regionality When Buying Food. The share of regional foods of grocery retail sales is around 20 per cent, which is larger than the share of organic food [21]. Wegmann [22] indicates the increasing importance of regionality for consumers who are also willing to pay more for regional food. However, this importance depends on the food category.

3 Developing a Frame of Reference for Regional Supply Chain Concepts for Regional Food Manufacturers

In this section, we present the supply chain concepts as well as the attributes and indicators with which these concepts will be assessed.

3.1 General Structure of Grocery Retail Supply Chains

Grocery Retail Supply Chain Structure. Nietsche and Fiegel [23] indicate that grocery retailers depend on efficient and reliable supply chains. These retailers operate a network of physical stores and distribution facilities and purchase their products mainly in bulk from manufacturers and ship them to their distribution facilities. From there, products are further delivered to the stores. The large assortments lead to various product requirements that need to be considered, grocery retailers apply a combination of different sourcing, delivery, and storage concepts.

Sourcing. Grocery retailers use global as well as local sourcing strategies [24, 25]. The overall goal with global sourcing is to procure products on an international level in order to achieve low purchase prices due to economies of scale. Local sourcing reduces transportation costs, however purchasing prices may be higher as purchasing volumes are lower. Depending on the number of suppliers from which a certain product is procured, we can differ between single and multi-sourcing [25].

Delivery. Direct delivery is chosen if transport capacity can be fully exploited and if grocery retailers do not have problems to handle the large incoming flows. In case of smaller transport volumes, consolidation can be achieved by utilizing milk runs [27].

Storage. Hereby we can differ between central and regional distribution center networks or cross docking facilities, depending whether products are intermediately stored and later distributed or only processed for break-bulk and/or consolidation processes and immediately transported to the stores [27].

3.2 Integration Challenges

A large grocery retailer who wants to increase its share of regional food is facing challenges in sourcing as well as the regional food manufacturer in distribution [23]. Furthermore, there are challenges for both parties when integrating their information flow systems.

Sourcing. The required quantity of products may not be sourced from one supplier, but from many, who need to guarantee a high product quality on a continuous level [28]. Thereby, seasonality issues may negatively impact this goal, so that there might be times where there are no products offered at all [23]. Another issue refers to purchasing cycles and delivery times that need to be due in time so that products are made available in the stores [28]. The German Rewe Group has therefore implemented a special regional supplier collaboration program [29]. Finally, traceability is also an important issue to be considered as there is a legal requirement to provide information about the origin to authorities [30].

Distribution. The distribution of regional food from a manufacturer to a retail store can either be executed by the manufacturer or by a logistics service provider. This depends more or less on the distributed quantities with which transport capacity can be fully utilized. This also depends on other product requirements such as cooling that needs special vehicles [31]. This goes also in line with storage requirements depending on product type which may hinder a consolidated transport and/or storage [23].

Information Flow. It is necessary to provide transparency in regards of product origin and supplier structures also in order to fulfill traceability issues [27]. In addition, there are integration aspects when linking the various IT systems of large grocery retailers with small regional food manufacturers that can negatively impact the compatibility of the involved system structures [27].

3.3 Final Model of Alternatives

Based on the previously presented notions as well as an analysis of literature that documents some empirical evidence on how regional food manufacturers organize their supply chains, following Fig. 1 summarizes the supply chain concepts that will be further evaluated on their integration suitability with the supply chains for large grocery retailers.

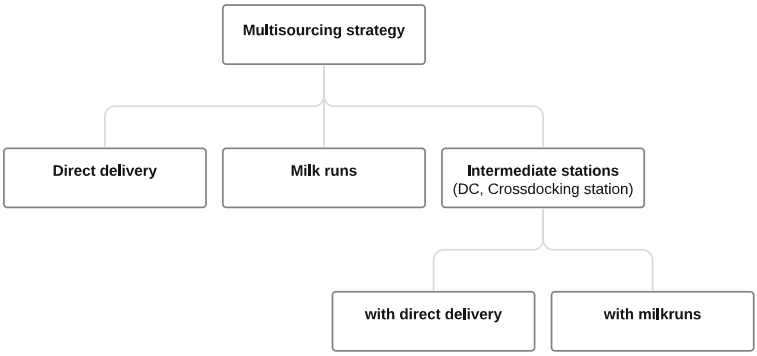

Fig. 1. Final model of supply chain concepts

The practical case evidence showed a focus on a multisourcing strategy where the product quantities of many regional food manufacturers are consolidated in order to meet the desired demand. Thus, we excluded the single sourcing strategy as the quantities of one regional food manufacturer may not be sufficient to meet the complete demand of a retailer for this particular product.

Even though regional food manufacturers execute their supply chain operations in many different ways, the basic structure can be condensed to direct deliveries, milkruns and intermediate stations in combination with either direct delivery or milkrun. For the purpose of this paper, we made no difference whether the intermediate station is operated by the food manufacturer or by the retailer.

3.4 Attributes and Indicators for Decision Making

The different possibilities will be assessed by using a mix of following attributes which refer to economic, technical as well as logistical indicators [32–34]:

- Economic indicators:
  - o Low current costs as additional costs cannot be easily transferred to end-user prices
  - o Low investment costs as the existing logistics systems shall be easily adapted to include regional products
- Technical indicators:
  - o Reliable traceability to assure the regional character of products and their origin
  - o Consideration of storage conditions to deal with the different storage conditions of the products
- Logistical indicators:
  - o Provision of sufficient quantity of regional products as a retailer want to offer these in all stores within a certain area

- o Adherence to delivery times to guarantee frictionless logistics processes as well as full shelves
- o Efficient management of transport distances and routes in order to cope with small supplier structures

These attributes and indicators will be used to compare the previously presented supply chain concepts.

4 AHP-Methodology

We consider the integration of regional food manufactures into large grocery retail supply chains as a complex decision problem as the assessment of the various requirements refers to qualitative characteristic. Thus, a method is required that is able to cope with these qualitative and subjective evaluation issues. Consequently, we use the AHP as this approach is applicable for a multi-criteria decision problem, where the problem and its decision criteria are divided into sub problems and sub criteria so that a superordinate group can only be influenced by a subgroup (see Saaty 1990 or Goepel 2018). According to Vargas and Saaty (2012), our decision model is divided as outlined in Fig. 2.

The decision problem at hand refers to the selection of a suitable supply chain concept that is able to integrate regional food manufacturers with the supply chains of large grocery retailers. The chosen decision criteria and respective sub criteria refer to the identified decision indicators, which were presented in the previous Sect. 3.3. The chosen alternatives include supply chain concepts as outlined in Fig. 1. Following the notions of Saaty (1994), we made pairwise comparisons of the relative evaluation for each criterion. Then the pairwise comparison results were aggregated to priorities and calculated a total priority result in order to identify the integration suitability of the selected supply chain concepts. We used the AHP Online System (AHP-OS) to perform the AHP (Goepel 2018) with secondary data.

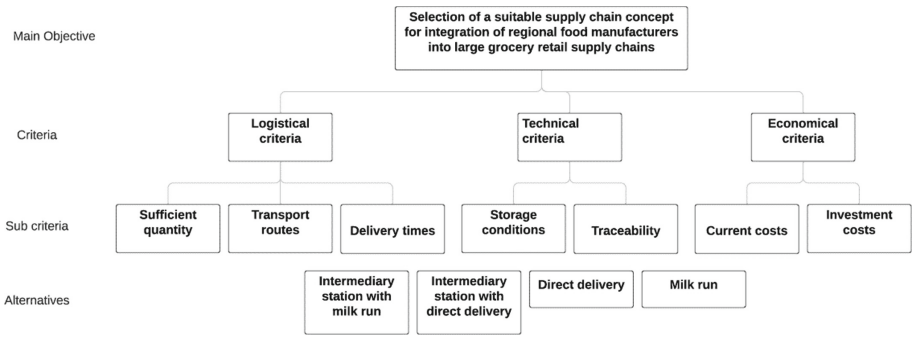

Fig. 2. Hierarchical structure of the decision problem