



Dissertation an der wirtschaftswissenschaftlichen Fakultät

Empirical Studies in Multi-Channel and Omni-Channel Retail Operations and Logistics

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Empirical Studies in Multi-Channel and Omni-Channel Retail Operations and Logistics

An Introduction to Literature

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Abstract

Purpose - This paper structures empirical contributions in retail operations and logistics on multiple channels that have been published until the year 2015 in order to develop an agenda of research in this area.

Design/methodology/approach - The methodological basis of this review is a document analysis conducted as a content analysis based on the recommendations of Seuring et al. [2005]. Three dimensions and subsequent categories are developed inductively from the selected material which is grouped accordingly.

Findings - The selected papers for the review are especially concerned with questions regarding the integration or separation of channels, the various subsystems in front- and back-end logistics on multiple channels, and criteria for performance evaluation. However, a clear route towards logistics channel integration at the individual development stages of retailers and, although crucial, the differentiation of product properties (e.g., food and non-food) is oftentimes missing.

Research limitations/implications - One limitation of this review is that only academic papers in empirical retail logistics topics were included thus excluding other fields of business and management (e.g., marketing, service management) or other methodologies (e.g., modeling, conceptual work).

Originality/value - This paper provides both academics and practitioners with an overview of research that has been conducted so far and moreover points to the areas that have not been researched before. Thus it contributes to theory development in the area of empirical retail operations and logistics.

Note: The initial literature review was conducted in 2014 and was last updated in early 2016 to include papers published in 2015.

Keywords: Omni-Channel Retailing, Retail Logistics, Empirical Work, Literature Review

1. Introduction

With the establishment of online commerce an increasing number of traditional bricks-and-mortar retailers have added an online channel to their existing business. When retailers supply goods over store outlets and directly through the internet, this is termed multi- or omni-channel retailing. Multi-channel retailing is defined as retailing, where channels are rather separated from each other. The customer can not trigger channel interaction and/or the retailer does not control channel integration. At omni-channel retailing all actions and business units (e.g., marketing, logistics) are integrated between channels, thus, the customer can trigger full channel interaction and/or the retailer controls full channel integration [Beck and Rygl, 2015]. Multi- and omni-channel retailing is of high relevance for retailers as customers spend more money and are more loyal towards a retailer when they shop on multiple channels (e.g., Danaher et al. [2003], Venkatesan et al. [2006]). Compared with industrial companies, retail logistics and operations costs (i.e., warehousing, picking, and distribution) take a higher share on total costs (between 10 to 30% of total costs) [van der Vlist, 2007]. Because retail operations and logistics costs contribute to a large extent to a retailers overall costs, they are in the focus of the retailer and also in the focus of this analysis. Furthermore a practice perspective on theory building and empirically grounded research lead to theories having greater scope [Corley and Gioia, 2011]. Moreover field research contributes to the generation of operations and supply chain management theory [DeHoratius, 2011].

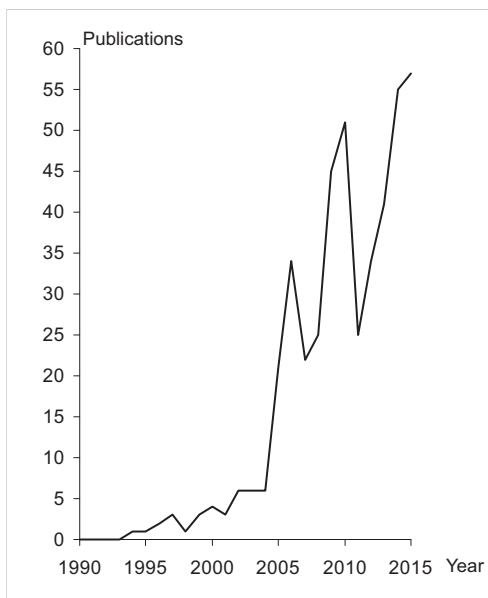


Figure 1: Publications in multiple channel retailing by year

The scope of this paper is to bring the three fields of (1) retailing on multiple channels, (2) logistics and operations management and (3) empirical studies together. Therefore, it structures empirical work in the field of multi- and omni-channel logistics and operations management. The topic of multi- and omni-channel retailing is also trending in the academic community. A search at Scopus for the words “multi-channel” and/or “omni-channel” in title and/or abstract revealed a total number of 448 publications from 1990 until 2015. The number of publications per year has risen constantly since 1990 and has reached 57 publications in the year 2015 (see Figure 1). The high relevance of the topic in academic literature is also underlined by various special issues of journals on multi- and omni-channel retailing in the last decade (e.g., Journal of

Retailing in 2015, Journal of Electronic Commerce in 2014). They are from different disciplines, including marketing (e.g., Rangaswamy and Van Bruggen [2005], Verhoef et al. [2015]), information systems (e.g., Piotrowicz and Cuthbertson [2014]) or service management (e.g., Sousa [2008]). These special issues also explain the peaks in Figure 1.

Existing literature reviews are concerned with bricks-and-mortar retail logistics and its subsystems (e.g., de Koster et al. [2007]) as well as online logistics, even touching some points of multi-channel retail operations (i.e., Swaminathan and Tayur [2003], Agatz et al. [2008]). Swaminathan and Tayur [2003] describe major issues in traditional supply chain management and present an overview of analytical research models for e-commerce supply chains. They either apply a supply chain perspective or treat the topic of multiple channels in the sense of two separate areas. Agatz et al. [2008] present various logistics planning areas in a multi-channel environment. They structure these into sales and delivery planning and supply chain management, covering a broad set of individual logistics issues. For each planning area they formulate chances and challenges, discuss multiple channels, and therefore contribute with some initial insight into integration of fulfillment. However, most of the planning models presented do not consider the interplay between distance and bricks-and-mortar retailing. To sum up, both papers lack a clear focus on empirical contributions.

In this paper multi- and omni-channel retailing and empirical operations management research is brought together in a literature review. Therefore, this review is concerned with questions in multi- and omni-channel logistics and operations management that is grounded in an empirical methodology. It contributes by structuring and grouping the field into dimensions and categories to define what is already researched and identifying meaningful gaps in literature for future research. Therefore, the goal is to uncover research areas in multi- and omni-channel retail operations and logistics that are not elaborated and analyzed yet empirically.

In the following sections the methodology for conducting this literature review is presented, the results are displayed, future areas of research are derived, and conclusions are drawn.

2. Methodology

The paper is based on the methodological guidelines by Seuring et al. [2005] on conducting a literature review. Criteria for categorization of relevant literature are chosen and displayed which lay the groundwork for the structured analysis and generalization [Mayring, 2007]. A qualitative content analysis is used by applying a systematic procedure which involves the steps of material collection, descriptive analysis, category selection and material evaluation.

Material collection. First, the literature collected is defined. It also includes the delineation of other fields of research and describing the filter used for selecting the papers.

Descriptive analysis. Afterwards, formal aspects of the resulting literature are assessed. This includes frequency of assent statistics, year of publication, focus of journal, or methodology used. It forms the background upon which the theoretical analysis is conducted.

Category selection. Dimensions and categories are selected in which the contributions can be analyzed. They are used to structure the field and thus the selected contributions. The literature is analyzed within the dimensions which form the major topics of analysis. The structural dimensions were developed inductively from the material by means of generalization [Seuring et al., 2005]. During the analysis of the material the places of finding were denoted and information directly extracted from the source. They were revised multiple times until the final dimensions emerged.

Material evaluation. Finally, the literature is evaluated based on the before selected dimensions and categories. This allows the interpretation of results and emerging issues. As a key component of the review, future areas of research are derived from the analysis.

In the following this process is used for analyzing and evaluating empirical studies in multi- and omni-channel retail operations and logistics.

3. Literature review

In this section the conceptual content of the field of multi- and omni-channel retail logistics and operations management with an empirical methodology is identified, the research field is structured accordingly, and future areas of research are derived.

3.1. Material collection

With rising online sales, the topic of retailing on multiple channels has attracted attention in the specialized press [Retail Gazette, 2015]. Yet the number of empirical-academic publications in the intersection between multi- and omni-channel retailing and retail logistics is still limited. Against this background and since it is a relatively new topic, a full analysis of all relevant academic work published is feasible. It is appreciated that on the one hand text books exist which focus on empirical results from supply chain- and operations management topics in the retailing sector (e.g., Fernie and Sparks [2014], Agrawal and Smith [2015]). On the other hand conceptual papers

exist, which develop models in specific subsystems of multi- and omni-channel operations. They are concerned with inventory management and control (e.g., Mahar et al. [2009], Liu et al. [2010], Schneider and Klabjan [2013]), assortment and capacity planning (e.g., Bhatnagar and Syam [2013], Xie et al. [2014]), and distribution systems (e.g., Alptekinoglu and Tang [2005]). Furthermore empirical papers exist in both pure bricks-and-mortar retail logistics (e.g., Kuhn and Sternbeck [2013]) and pure online retail logistics (e.g., Esper et al. [2003]). However, the scope of this paper is to structure empirical work in the field of multi- and omni-channel operations and especially logistics management. It is therefore neither concerned with modeling in multi- and omni-channel operations nor with pure online or pure bricks-and-mortar retail operations. Thus, the material for this review is focused on academic literature from the very beginning of online commerce to the year 2015 on the topic of multi- and omni-channel retail operations and logistics where the methodology is at least in parts empirical.

Different search engines for academic publications were used, including Scencedirect, Google-scholar, and Scopus for a full search. Scopus was chosen as a main source for data collection because it has twice as many titles and over 50% more publishers listed than any other database instead of focusing, e.g., only Elsevier articles. It includes abstracts, references and bibliographical elements of over 57 million articles from over 21,000 peer-reviewed journals of 5,000 publishers (including, e.g., Elsevier, Emerald, Sage, Springer, Taylor & Francis, Wiley-Blackwell). A cross-check with other search engines revealed no further results. The keywords for the search were “omni-channel”, “retail”, “operations” and “empirics” with all its related terms. A full list of keywords and the code from the Scopus search can be found in Appendix I.

A total of 55 contributions were found. Eliminating conference papers and focusing only on impact factor journals in English language this came down to 49. A further six papers were eliminated due to the lack of business and management related fields, e.g., eliminating papers with an engineering background where the wording “multi-channel” was used once. Topics that did not fit the scope of retail, e.g., real estate and retail banking were eliminated as well. Furthermore, 16 papers focusing solely on customer behavior, marketing, brand and innovation, sustainability, strategy, or entrepreneurship research without actual aspects of logistics or operations structures were eliminated. As the analysis aims at scientific publications with clear empirical content, further four papers were eliminated due to their lack of empirical contribution. The empirical work could be qualitative (e.g., interviews, focus groups, observations) or quantitative (e.g., surveys, experiments, simulations). Finally because of the focus on multiple channel retailing and not pure online- or pure bricks-and-mortar activities, another six papers were eliminated.

Reading the papers, cited references were used as a secondary source. They did not yield

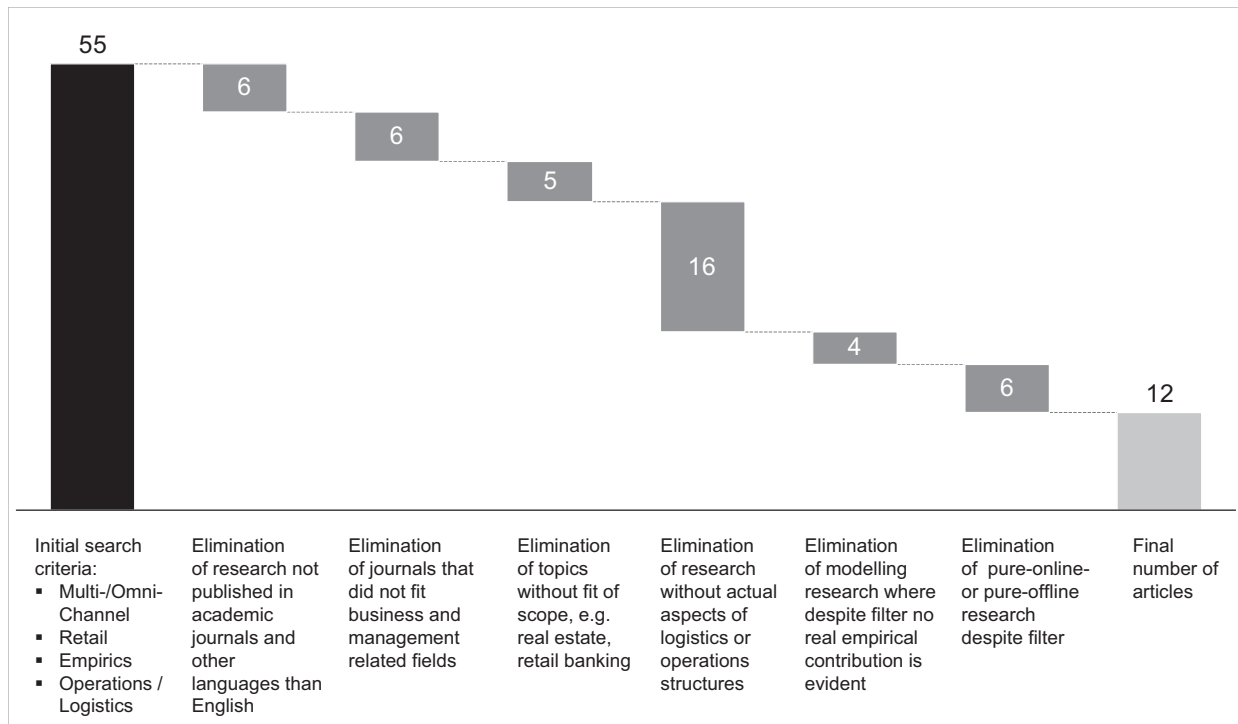


Figure 2: Overview of material collection and selection process

additional papers in scope, which can be seen as a proof for the validity of the search. On top, selected papers are clearly based on each other which is also an indicator that papers researching the same topics were selected. A total of 12 contributions remained for further analysis (see Figure 2).

3.2. Descriptive analysis

In a first step of the analysis, descriptive parameters were used to classify the papers. This includes the distribution of papers along the years, the empirical methodology applied, and the journal that published the results.

Publication date. The selected papers are distributed from 2001 to 2015 (see Figure 3a). Although a full search without a bottom limit in terms of year of publication was performed, no article before 2001 was found. This is not surprising because before the emergence of the internet in commercial retail in the late 1990s, traditional brick-and-mortar retailers could not supply goods also via the internet.

Empirical methodology. Four empirical research methodologies can be differentiated: Interview/case study, web analysis, survey, and simulation (see Figure 3b). With 42% of all articles, interviews were used most frequently followed by web analysis and surveys, with 25% of articles each. When

case studies were used, they mostly present single cases and are rather descriptive. This is not surprising for a new field of research where exploratory studies are best suited [Yin, 2014].

Journal. Journals who publish this research have either a focus on retail or on operations and logistics (see Figure 3c). The articles appeared mainly in the International Journal of Physical Distribution and Logistics Management (IJPDLM) as well as the International Journal of Retail and Distribution Management (IJRDM). Other journals where only one article was published include Journal of Business Logistics (JBL), Journal of Operations Management (JOM), and Management Science (MS).

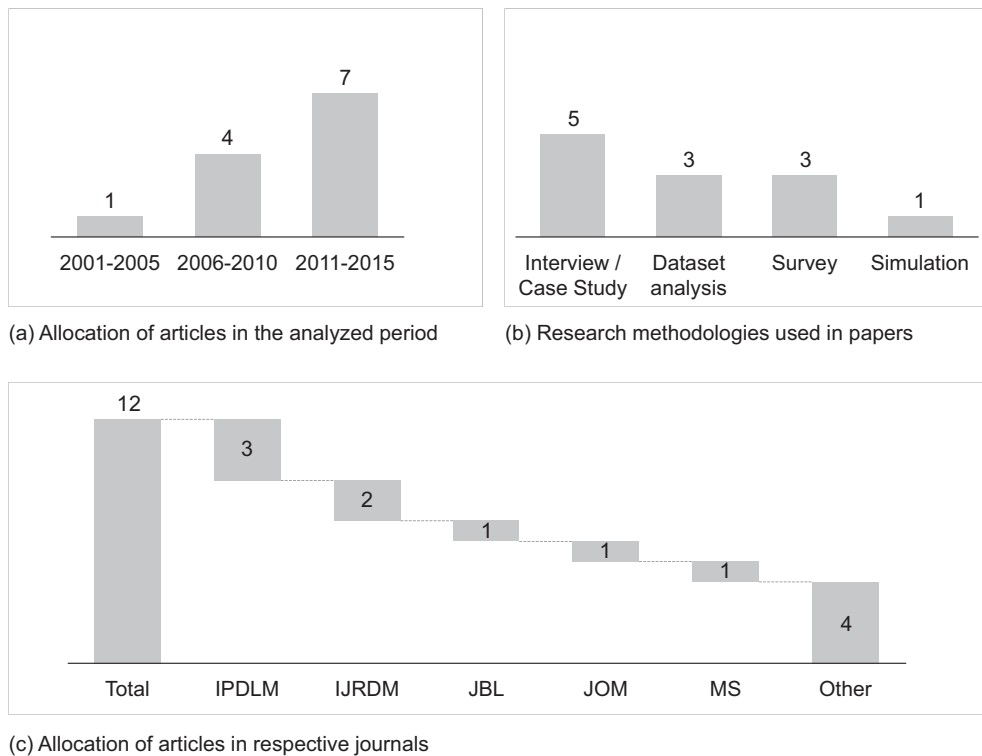


Figure 3: Descriptive analysis

So far, all authors published only once in this specific field. A total of five authors come from the United States, two each from the United Kingdom and France and the rest mainly from other European countries.

3.3. Category selection

For a first structuring content analysis, the papers were grouped in three different dimensions and subsequent categories. The dimensions emerging from literature are concerned with (1) the integration and separation of channels, (2) the front- and back-end of retail operations, and (3) criteria for performance evaluation. Afterwards the three dimensions are discussed in the light of the selected literature.

1. Consideration of integrated or separated channel structures: Does the paper focus on integrated channels or an online channel that is separated from traditional retail structures?

One crucial decision is whether or not the channels stay separated or are integrated. Based on the definition of multi- and omni-channel retailing that was provided in the introduction, despite the inclusion of retailing on multiple channels, the papers either see the online channel as a new channel that needs to be operated separately or as a channel that needs to be integrated into the existing bricks-and-mortar channel structures.

2. Retail operations and retail logistics: Does the paper focus on front- and/or back-end dimensions in operations and logistics?

Three categories were defined, where the focus of the paper, was on (1) back-end related- (i.e., inventory management, picking, warehousing, IT), (2) front-end related- (i.e., delivery, return) or (3) both, front- and back-end related logistics and operations issues. This is not against the applied filter for the review, that they should deal with multiple channel retail operations and logistics as a whole and not only with one specific subproblems, because still front- and back-end as categories have various subproblems to research.

3. Performance criteria in retail operations and logistics: Does the paper define and measure performance criteria for multi- and omni-channel retail operations and logistics?

The impact of logistical changes when opening a second channel on firms overall performance and specifically on the operational performance is addressed in the selected papers. Two categories were defined because performance criteria were either (1) explored or (2) tested with an empirical data set.

Dimension I. Regarding the first dimension two papers see advantages in separating channels logistics wise. For example channel integration requires large investments in warehousing, inventory control, logistics, fusing and standardizing data about customers and interactions with them from different channel systems, which may be individually efficient but not inter operable [Chatterjee, 2010]. Furthermore the operation of the online channel could be outsourced to a logistics-service-provider as a whole because the most crucial part is here the last mile delivery [Rao et al., 2009]. While five papers do not address the integration topic, another five papers see advantages in the logistics integration in terms of, e.g., inventory pooling [Hübner et al., 2015] or customer convenience [Colla and Lapoule, 2012].

Dimension II. Regarding the second dimension the majority of papers (7) dealt with both, back-end- and front-end logistics issues in multiple channel retailing. Three papers focused predominantly on warehousing and network structures, picking, inventory holding, and IT problems (e.g., Kull

et al. [2013]) whereas the two remaining papers focused solely on the topics of delivery and return management (e.g., Xing et al. [2010]).

Dimension III. In the third dimension, papers were grouped on the basis of how they deal with logistical performance in their results. Half of the papers explored performance criteria for evaluating multi- and omni-channel retail logistics, while the other half tested criteria developed in former research. On the one hand, e.g., Gallino and Moreno [2014] follow the research from Chatterjee [2010] and test the impact of fulfilling online orders to a store for pick-up on store sales using an empirical data set for analysis. On the other hand, e.g., Lang and Bressolles [2013] explore five economic firm performance indicators for order preparation and delivery to the customer on multiple channels through interviews with logistics directors.

An overview of all papers assigned to the respective dimensions and categories can be found in Table 1.

<i>Authors</i>	<i>Dimension I: Integration vs. separation of channels</i>	<i>Dimension II: Back-end- vs. front-end focus</i>	<i>Dimension III: Performance criteria</i>	<i>Predominant empirical method</i>
Kotzab and Madlberger [2001]	—	Back-end and front-end	Explored	Dataset analysis
Kennedy and Coughlan [2006]	Integration	Back-end and front-end	Explored	Interviews
Rao et al. [2009]	Separation	Back-end and front-end	Tested	Dataset analysis
Chatterjee [2010]	Separation	Back-end and front-end	Tested	Survey
Xing et al. [2010]	—	Front-end	Tested	Survey
Colla and Lapoule [2012]	Integration	Back-end and front-end	Explored	Interviews
Oh et al. [2012]	Integration	Back-end	Tested	Survey
Lang and Bressolles [2013]	—	Back-end and front-end	Explored	Interviews
Kull et al. [2013]	—	Back-end	Tested	Simulation
Gallino and Moreno [2014]	—	Front-end	Tested	Dataset analysis
Lewis et al. [2014]	Integration	Back-end and front-end	Explored	Interviews
Hübner et al. [2015]	Integration	Back-end	Explored	Interviews

Table 1: Literature assigned to dimensions and categories

3.4. Material evaluation and propositions for future research

The literature review is especially interesting for identifying research gaps that reveal fields that have not yet been elaborated on before. The following propositions for future empirical research in multiple channel retail operations and logistics emerge from the analysis. They are grouped accordingly in the identified dimensions.

Dimension I. Although a channel integrated view on the logistical structures sees more proponents among authors than a separated view, a clear approach for channel integration is missing. Further research is needed for traditional bricks-and-mortar retailers in terms of integrating an online channel into existing bricks-and-mortar systems (see also Fisher [2013]). First approaches for integration and development of channel systems exist but contributions like, e.g., Lewis et al. [2014]

are rather descriptive in a single case study. A bigger sample size with more generalizable results and theoretical development of propositions for logistics integration depending on the development stage of retailers could be a first step in this direction. Then, a next step could be to research how retailers can use the integrated channels to their advantage in terms of customer management, i.e., making the most of integrated channels.

Dimension II. In the back-end the key role that information systems play in aligning the operations and logistics structures of both channels could be further analyzed, especially because information sharing between channels is seen critical by nearly all papers (e.g., Kennedy and Coughlan [2006]). Furthermore, a full analysis and comparison of the different fulfillment and delivery types for retailers operating multiple channels, i.e., different types of home delivery and pick-up services (e.g., Chatterjee [2010], Colla and Lapoule [2012], Gallino and Moreno [2014]) should be completed. Regarding the front-end delivery part, the role of in- and outsourcing of the online logistics could be part of future research. Here various factors, also apart from pure logistical parameters, are relevant, e.g., the brand of traditional bricks-and-mortar retailers that is available for leveraging trust also onto delivery services. Still, initial investments and the competence of traditional bricks-and-mortar retailers for direct customer delivery have to be discussed critically (see also, e.g., Rao et al. [2009], Xing et al. [2010]).

Dimension III. Performance related variables can be explored and evaluated, to define an optimal fulfillment system for front- and back-end logistics for retailers on multiple channels. On top, a trade-off analysis of logistics cost for opening and integrating another channel and customer service level optimization can be completed (see also Lewis et al. [2014]). Moreover, the integration of channels but also the logistics performance criteria are mostly developed from a traditional bricks-and-mortar retailers perspective. Another perspective would be the one of an online retailer going “offline” and his operational challenges with the new bricks-and-mortar channel. In online repositories of scholarly research, which can be an indicator of what might be submitted to impact factor journals shortly, it is a trending topic in empirical omni-channel retail operations management (see, e.g., Bell et al. [2015])

Further research directions. In terms of the empirical methodology, the general research direction should be more into qualitative- and exploratory work because of the still new research area which requires theory development before theory testing. However, the sample selection is not in all cases given enough attention. Product characteristics play a role in evaluating and analyzing retail logistics systems, e.g., in picking or delivery. A distinction between food and non-food items is

therefore recommended but, although mentioned, rarely implemented by authors (e.g., Rao et al. [2009], Hübner et al. [2015]).

4. Conclusion

This paper structures empirical works in multi- and omni-channel retail operations and logistics in the years until 2015. It provides both academics and practitioners with an overview of research that has been conducted so far and moreover points to the areas that have not been researched before. Thus it contributes to theory development in the area of empirical retail operations and logistics. The selected papers for the review are especially concerned with questions regarding the integration or separation of channels, the various subsystems in front- and back-end logistics on multiple channels, and criteria for performance evaluation. However, among other areas, a clear route towards logistics channel integration as well as the individual development stages of retailers and, although crucial, the differentiation of product properties (e.g., food and non-food) is oftentimes missing.

One limitation of this review is that only academic papers in empirical multi- and omni-channel logistics topics were included thus excluding other fields of business and management (e.g., marketing, service management) or other methodologies (e.g., modeling, conceptual work).

Appendix

Appendix I

Scopus initial search code for 55 documents (January 2016).

(TITLE-ABS-KEY (multi channel) OR TITLE-ABS-KEY (multichannel) OR TITLE-ABS-KEY (omni channel) OR TITLE-ABS-KEY (omnichannel) OR TITLE-ABS-KEY (cross channel) OR TITLE-ABS-KEY (crosschannel) OR TITLE-ABS-KEY (dual channel) OR TITLE-ABS-KEY (dualchannel) OR TITLE-ABS-KEY (clicks-and-mortar) OR TITLE-ABS-KEY (bricks-and-clicks) OR TITLE-ABS-KEY (stationary retailers web) OR TITLE-ABS-KEY (stationary retailers online)
AND TITLE-ABS-KEY (logistics) OR TITLE-ABS-KEY (logistical) OR TITLE-ABS-KEY (operations) OR TITLE-ABS-KEY (supply chain management) OR TITLE-ABS-KEY (picking) OR TITLE-ABS-KEY (pick) OR TITLE-ABS-KEY (distribution) OR TITLE-ABS-KEY (delivery) OR TITLE-ABS-KEY (fulfilment) OR TITLE-ABS-KEY (fulfillment) OR TITLE-ABS-KEY (return) OR TITLE-ABS-KEY (inventory) OR TITLE-ABS-KEY (technology-related) OR TITLE-ABS-KEY (information technology)

AND TITLE-ABS-KEY (empirical) OR TITLE-ABS-KEY (empirics) OR TITLE-ABS-KEY (exploratory) OR TITLE-ABS-KEY (exploring) OR TITLE-ABS-KEY (explorative) OR TITLE-ABS-KEY (interview) OR TITLE-ABS-KEY (survey)

AND TITLE-ABS-KEY (retail) OR TITLE-ABS-KEY (retailing))

AND SUBJAREA (mult OR arts OR busi OR deci OR econ OR psyc OR soci))

References

- Agatz, N. A. H., Fleischmann, M., van Nunen, J. J. A. E. E., 2008. E-fulfillment and multi-channel distribution – a review. *European Journal of Operational Research* 187 (2), 339–356.
- Agrawal, N., Smith, S. A., 2015. *Retail Supply Chain Management: Quantitative Models and Empirical Studies*. Vol. 223. Springer.
- Alptekinoglu, A., Tang, C. S., 2005. A model for analyzing multi-channel distribution systems. *European Journal of Operational Research* 163 (3), 802–824.
- Beck, N., Rygl, D., 2015. Categorization of multiple channel retailing in multi-, cross-, and omni-channel retailing for retailers and retailing. *Journal of Retailing and Consumer Services* 27, 170–178.
- Bell, D. R., Gallino, S., Moreno, A., 2015. Offline showrooms and customer migration in omni-channel retail. Available at SSRN 2370535.
- Bhatnagar, A., Syam, S. S., 2013. Allocating a hybrid retailer’s assortment across retail stores: Bricks-and-mortar vs online. *Journal of Business Research* 67 (6), 1293–1302.
- Chatterjee, P., 2010. Causes and consequences of ‘order online pick up in-store’ shopping behavior. *The International Review of Retail, Distribution and Consumer Research* 20 (4), 431–448.
- Colla, E., Lapoule, P., 2012. E-commerce: exploring the critical success factors. *International Journal of Retail & Distribution Management* 40 (11), 842–864.
- Corley, K. G., Gioia, D. A., 2011. Building theory about theory building: What constitutes a theoretical contribution? *Academy of Management Review* 36 (1), 12–32.
- Danaher, P. J., Wilson, I. W., Davis, R. A., 2003. A comparison of online and offline consumer brand loyalty. *Marketing Science* 22 (4), 461–476.
- de Koster, R. B. M., Le-Duc, T., Roodbergern, K. J., 2007. Design and control of warehouse order picking: A literature review. *European Journal of Operational Research* 182 (2), 481–501.
- DeHoratius, N., 2011. Field research in operations and supply chain management. *Journal of Operations Management* 29 (5).
- Esper, T. L., Jensen, T. D., Turnipseed, F. L., Burton, S., 2003. The last mile: An examination of effects of online retail delivery strategies on consumers. *Journal of Business Logistics* 24 (2), 177–203.
- Fernie, J., Sparks, L., 2014. *Logistics and retail management: emerging issues and new challenges in the retail supply chain*. Kogan Page Publishers.
- Fisher, M., 2013. Foreword: Special issue on retail operations. *Production and Operations Management* 22 (4), 755–757.
- Gallino, S., Moreno, A., 2014. Integration of online and offline channels in retail: The impact of sharing reliable inventory availability information. *Management Science* 60 (6), 1434–1451.
- Hübner, A., Holzzapfel, A., Kuhn, H., 2015. Operations management in multi-channel retailing: An exploratory study. *Operations Management Research* 8 (3), 84–100.
- Kennedy, A., Coughlan, J., 2006. Online shopping portals: An option for traditional retailers? *International Journal of Retail & Distribution Management* 34 (7), 516–528.
- Kotzab, H., Madlberger, M., 2001. European retailing in e-transition? an empirical evaluation of web-based retailing - indications from austria. *International Journal of Physical Distribution & Logistics Management* 31 (6), 440–462.
- Kuhn, H., Sternbeck, M. G., 2013. Integrative retail logistics: An exploratory study. *Operations Management Research* 6 (1-2), 2–18.
- Kull, T. J., Barratt, M., Sodero, A. C., Rabinovich, E., 2013. Investigating the effects of daily inventory record inaccuracy in multichannel retailing. *Journal of Business Logistics* 34 (3), 189–208.
- Lang, G., Bressolles, G., 2013. Economic performance and customer expectation in e-fulfillment systems: A multi-channel retailer perspective. *Supply Chain Forum* 14 (32), 16–26.
- Lewis, J., Whysall, P., Foster, C., 2014. Drivers and technology-related obstacles in moving to multichannel retailing. *International Journal of Electronic Commerce* 18 (4), 43–68.
- Liu, K., Zhou, Y., Zhang, Z., 2010. Capacitated location model with online demand pooling in a multi-channel supply chain. *European Journal of Operational Research* 207 (1), 218–231.

- Mahar, S., Bretthauer, K. M., Venkataramanan, M. A., 2009. The value of virtual pooling in dual sales channel supply chains. *European Journal of Operational Research* 192 (2), 561–575.
- Mayring, P., 2007. On generalization in qualitatively oriented research. *Forum: Qualitative Social Research* 8 (3), 1–9.
- Oh, L.-B., Teo, H.-H., Sambamurthy, V., 2012. The effects of retail channel integration through the use of information technologies on firm performance. *Journal of Operations Management* 30 (5), 368–381.
- Piotrowicz, W., Cuthbertson, R., 2014. Introduction to the special issue information technology in retail: Toward omnichannel retailing. *International Journal of Electronic Commerce* 18 (4), 5–16.
- Rangaswamy, A., Van Bruggen, G. H., 2005. Opportunities and challenges in multichannel marketing: An introduction to the special issue. *Journal of Interactive Marketing* 19 (2), 5–11.
- Rao, S., Goldsby, T. J., Iyengar, D., 2009. The marketing and logistics efficacy of online sales channels. *International Journal of Physical Distribution & Logistics Management* 39 (2), 106–130.
- Retail Gazette, 2015. Omni-channel at its best, available at <http://bit.ly/1ldvvon>, accessed on 2015-10-16.
- Schneider, F., Klabjan, D., 2013. Inventory control in multi-channel retail. *European Journal of Operational Research* 227 (1), 101–111.
- Seuring, S., Müller, M., Westhaus, M., Morana, R., 2005. Conducting a literature review—the example of sustainability in supply chains. In: Kotzab, H., Seuring, S., Müller, M., Reiner, G. (Eds.), *Research methodologies in supply chain management*. Springer, Heidelberg.
- Sousa, R., 2008. Editorial to the special issue on: Quality in multi-channel services employing virtual channels. *International Journal of Internet and Enterprise Management* 5 (4), 295–297.
- Swaminathan, J. M., Tayur, S. R., 2003. Models for supply chains in e-business. *Management Science* 49 (10), 1387–1406.
- van der Vlist, P., 2007. Synchronizing the retail supply chain. *Synchroniseer de retail supply chain*. Rotterdam: Erasmus Research Inst. of Management (ERIM) (ERIM Ph.D. series research in management, 110).
- Venkatesan, R., Mehta, K., Bapna, R., 2006. Understanding the confluence of retailer characteristics, market characteristics and online pricing strategies. *Decision Support Systems* 42 (3), 1759–1775.
- Verhoef, P. C., Kannan, P., Inman, J. J., 2015. From multi-channel retailing to omni-channel retailing: Introduction to the special issue on multi-channel retailing. *Journal of Retailing* 91 (2), 174–181.
- Xie, W., Jiang, Z., Zhao, Y., Hong, J., 2014. Capacity planning and allocation with multi-channel distribution. *International Journal of Production Economics* 147 (1), 108–116.
- Xing, Y., Grant, D. B., McKinnon, A. C., Fernie, J., 2010. Physical distribution service quality in online retailing. *International Journal of Physical Distribution & Logistics Management* 40 (5), 415–432.
- Yin, R. K., 2014. *Case study research: Design and methods*, 5th Edition. Sage, Los Angeles, CA.

Retail Logistics in Transition from Multi-Channel to Omni-Channel

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Abstract

Purpose - Online retailing changes all retail systems significantly. The growing importance of online sales requires the creation of new fulfillment models. The purpose of this paper is to investigate how retailers develop from separate multi-channel (MC) to integrated omni-channel (OC) fulfillment. OC retailing has an integrated perspective, with seamless interactions between online and bricks-and-mortar channels.

Design/methodology/approach - More than 60 internationally active retailers and experts from Germany participated in an exploratory survey. With a response rate of 40 percent the authors achieved the goal to adequately depict the German MC and OC retail market. It is currently the largest empirical study of MC and OC fulfillment.

Findings - It is the first study to comprehensively analyze the logistical development options open to retailers for integrated fulfillment. The authors discuss the conceptual development options and formulate propositions for an advanced OC fulfillment approach. OC retailers aim to pool their organizational units for fulfillment via different channels. Retailers with multiple channels develop their warehouse systems toward channel-integrated inventory enabling flexible and demand-driven inventory allocation. Retailers with channel-integrated inventory also organize their picking procedures in one common zone. The higher the outlet density, the more it becomes beneficial for retailers to introduce pick-up services.

Research Limitations/implications - The research is based on insights from retailers and experts from companies based in Germany.

Practical implications - The findings provide an insight into designing OC fulfillment and distribution structures. The concepts themselves, archetypes, challenges and development paths are analyzed. Identified logistics levers can be adjusted to pinpoint the steps required to advance integration.

Originality/value - The authors contribute by deriving propositions and a framework for transitioning from basic MC to integrated, extended OC logistics. Because this research area is still comparatively young, the authors take a more comprehensive, exploratory view of OC fulfillment.

Keywords: Multi-Channel, Omni-Channel, Fulfillment, Retail Logistics, Warehouse Operations

1. Introduction

There is an increasing overlap of online and bricks-and-mortar (B&M) retailing, mainly due to the fact that B&M retailers are expanding into e-commerce, thus increasing online turnover. Global e-commerce sales doubled from 2008 to 2013 and are forecasted to continue to grow even faster [PwC, 2013; Planet Retail, 2014]. Due to these changes in the retail landscape with the emergence of a strong online channel, there has been a major transformation in retail logistics over the last decade. Managing these changes requires significant investments in infrastructure, processes and capabilities for warehousing and distribution. The integration of B&M and online retail channels is a very recent phenomenon. The challenge is to implement it in the most efficient way, rather than deciding whether or not to do so (see Bell et al. [2014]; Gallino and Moreno [2014]). While marketing and service aspects in channel integration have been given considerable attention in recent literature, operations and logistics integration require more in-depth consideration [Brynjolfsson et al., 2013; Kozlenkova et al., 2015; Verhoef et al., 2015].

This is especially relevant as the growing number of channels also increases the complexity from a logistics point of view. For B&M retailers, the growing importance of online sales means creating new operations and logistics models to replenish not only stores, but also to serve customers directly, whereas some distance retailers are going a different route of opening B&M stores. Retailers are faced with the challenges of fulfilling both store shopping and direct shipments to customers, and of redesigning their processes to build a seamless shopping experience. This requires boundless logistics across channels and the expansion of service functions. Therefore, retailers merge operations from isolated multichannel (MC) structures - where direct-to-customer shipments and store supply are mostly operated independently in parallel - to unified omni-channel (OC) logistics systems with comprehensively conflated frontend and backend systems [Bell et al., 2014; Hübner et al., 2015]. Various concepts for store delivery, home delivery, store pick-up and return handling need to be developed as well [Hübner et al., 2016a].

Current literature does not yet address the topic of how retailers develop from isolated MC logistics to integrated OC systems, although it does identify the need to explore it [Rao et al., 2009; Kozlenkova et al., 2015]. The most recent literature analyzes mainly selected subproblems of MC logistics. Retailers will therefore benefit from an empirically based and comprehensive discussion of development from separated to integrated logistics.

Our fundamental aim is to identify the development options retailers have in transitioning from a multiple but separate channel solution to an integrated logistics system. This research builds mainly on operational structures and archetypes for retailing with multiple channels identified in

preceding studies by Swaminathan and Tayur [2003], Agatz et al. [2008] and Hübner et al. [2015, 2016a]. This paper aims to determine how and why retailers with multiple channels develop their logistics activities into OC systems, i.e., the transition from MC to OC logistics. In a qualitative research approach, we gathered empirical data via an exploratory survey of over 60 international executives from German retail and logistics enterprises.

2. Conceptual background and terminology

A retail business with multiple channels goes through different stages in its level of interconnection and process integration for the different channels. Retailers often expand their business from one primary single channel (SC) to a configuration with multiple channels [Brynjolfsson et al., 2013; Verhoef et al., 2015]. Many different expressions have been developed for retailing on multiple channels. Terms encountered in practice include “multi-channel,” “cross-channel,” “omni-channel,” “everywhere commerce,” or “no-line commerce,” which are often used interchangeably and without a clear differentiation [Beck and Rygl, 2015]. Because we concentrate on operations and logistics, we will not differentiate between the customer interfaces with the retailer for shopping or information gathering, e.g., in-store, web shop, mobile commerce, catalogue or phone, which are commonly used to distinguish channel activities of retailers from a customer point of view [Beck and Rygl, 2015]. Rather, we will only consider how operations and logistics function for the physical store and direct-to-customer channels. Focusing on a logistical perspective, a distinction must be made between three basic channel strategies (see Figure 1):

- (I) In an SC logistics approach, retailers only operate one sales channel and a logistics system dedicated for this individual channel. This category includes (Ia) exclusively B&M players and (Ib) pure online players.
- (II) In a basic MC logistics approach, retailers operate multiple channels, but with segregated units, creating stand-alone systems for operations and logistics [Hübner et al., 2015]. Customers obtain products either in-store or via direct customer deliveries. Processes are not integrated from a customer perspective [Beck and Rygl, 2015] and there is no operational or logistics interface between the two channels [Verhoef et al., 2015]. An example would be an original B&M retailer that opened a web shop with no operational coordination or exchange of goods between the entities.
- (III) With an advanced OC logistics approach, neither the customer nor the retailer distinguishes between channels anymore [Brynjolfsson et al., 2013; Bell et al., 2014; Verhoef et al., 2015]. There is only one common logistics interface to the customer and distance orders can also be

processed through the stores as well as orders placed in-store for home delivery (see also Beck and Rygl [2015]; Hübner et al. [2016a]). Information exchange, joint operations, logistics and inventories across channels enable conflation of the fulfillment processes.

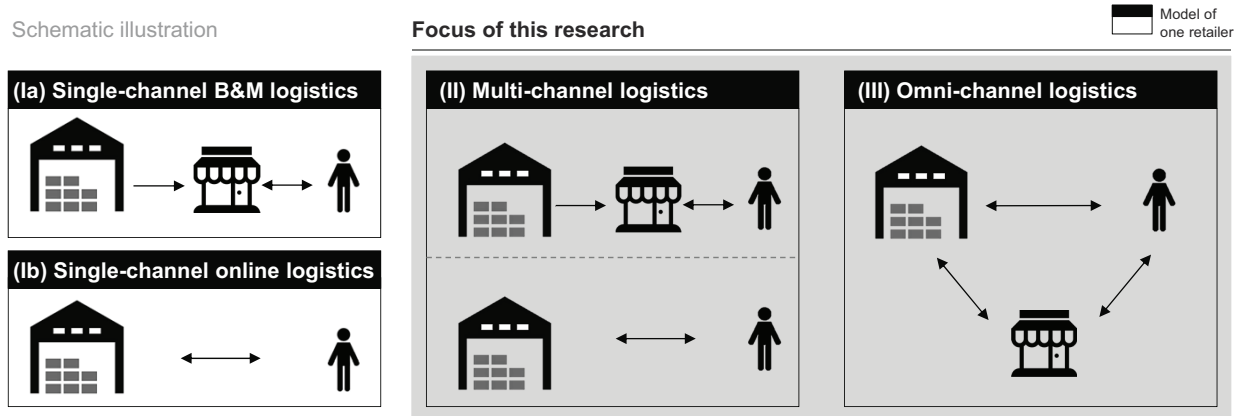


Figure 1: Overview of differences between single-, multi- and omni-channel logistics

This paper focuses on the development options in operations and logistics from (II) a basic MC strategy with no cross-channel interaction, to (III) an advanced OC strategy with operational and logistics interfaces and synergies between the channels.

3. Related literature in retailing on multiple channels and deduction of the research question

Research on retailing with multiple channels is driven by the rapid development of online sales and inherently changing customer behavior. This is the reason why today's research in OC retailing in most cases focusses on channel-specific requirements, mainly online retailing or customer behavior [Hübner et al., 2013; Verhoef et al., 2015; Kozlenkova et al., 2015]. In the new research area of retail logistics on multiple channels, existing literature is still rare. It can be structured into three areas. The first set of papers discusses subproblems in logistics, the second set analyzes configuration planning of entire logistics systems, and the final area summarizes contributions with development options. Altogether this forms the foundation for developing the research question. The literature review is based on a qualitative content analysis [Kotzab et al., 2006].

Research on channel-specifics and logistics subproblems. Several papers deepen subproblems in logistics that are either related to warehousing or distribution services. Mahar et al. [2009] show, that the design of a warehouse network and choice of inventory locations is the foundation for fulfillment options. Hübner et al. [2015] identify that retailers with multiple channels operate

warehouses either separated by or integrated across channels. Integration results in advantages for inventory pooling [Chiang and Monahan, 2005; Schneider and Klabjan, 2013; Bhatnagar and Syam, 2014], may allow to afford a broader assortment [Zhang et al., 2010], but requires aligned picking processes for store and direct-to-customer shipments [Lang and Bressolles, 2013] and solutions for capacity management [Xie et al., 2014]. Concepts for the “last mile” have considerable implications on costs and to meet customer expectations and service quality [Boyer et al., 2002; Rabinovich et al., 2007; Rao et al., 2009; Xing et al., 2010]. Alptekinoglu and Tang [2005] study whether online orders should be fulfilled from physical stores or from a distribution center. Chatterjee [2010] identify the growing customer expectations in retailing on multiple channels as the driver for expanding delivery modes. Gallino and Moreno [2014] and Bell et al. [2014] identify the effect of “buy-online, pick-up-in-store” in terms of additional store sales and customer channel-shift. Some retailers not only allow shoppers to pick up their online purchases in stores, but also let them return online purchases in a store [Zhang et al., 2010].

However, all contributions focus on a restricted part of warehousing or distribution and assume predetermined logistics designs without focusing on development steps. We therefore want to bring together the online and offline logistics models, and contribute by analyzing the characteristics of retailers who integrate their channel logistics.

Research on configuration of entire logistics systems. Swaminathan and Tayur [2003] and Agatz et al. [2008] review decision models in e-business and multiple channel environments. Swaminathan and Tayur [2003] describe major issues in traditional supply chain management and present an overview of analytical research models for e-commerce supply chains. They either apply a supply chain perspective or treat the topic of multiple channels in the sense of two separate areas. Agatz et al. [2008] present various logistics planning areas in an MC environment. They structure these into sales and delivery planning and supply chain management, covering a broad set of individual logistics issues. For each planning area they formulate chances and challenges, discuss multiple channels, and therefore contribute with some initial insight into integration of fulfillment. However, most of the planning models presented do not consider the interplay between distance and B&M retailing. The authors conclude that there is a lack of literature dealing with logistics interactions between e-commerce and traditional retailing.

Hübner et al. [2015] identify different warehouse and network types as well as picking technologies. They identify archetypes, describe the advantages and disadvantages of various design options and present the challenges of operating integrated networks. In a similar approach, Hübner et al. [2016a] address forward distribution and backward return processes in multiple channel retailing.

They systemize concepts of store delivery, home delivery and store pick-up, as well as concepts for return handling. Hübner et al. [2016b] identify logistics and operations archetypes for food retailing.

To sum up, research on configuration of logistics systems describes areas required for an OC fulfillment, but does not investigate the transition and development steps.

Research on development of logistics systems. Ashworth et al. [2006] were the first to present a framework for retailers' development from an SC B&M approach to a sustainable OC business. Their five-step model encompasses the stages: "web presence," "information competence," "value integration," "enhanced integration," and "leverage to maximize profits." It is developed in a comparative case study approach for the fashion industry. Logistics design is not the main focus of the model, but plays an important role in the last two phases. According to the authors, it is important to redesign logistics structures and optimize cross-channel processes in these stages in order to build up a sustainable and integrated business.

Development of the research question. Ashworth et al. [2006] were the only authors to depict development toward integrated OC models. This first development framework is the starting point for our research. Yet here, a discussion of the transition toward integrated logistics systems is missing.

In light of the discussion above, Agatz et al. [2008], Bell et al. [2014] and Gallino and Moreno [2014], among others, see the need to explore the integration and development of online and offline channels. Rao et al. [2009] see the "very interesting question for future research" in how OC retailers can piggyback on their existing infrastructure and integrate the logistics for online and store fulfillment. Kozlenkova et al. [2015] show the lack of knowledge about operational implications of innovative distribution channels. This requires systematization and analysis of multiple channel distribution. Because this is a recent phenomenon, they conclude that it is not surprising that there is limited literature to study it. A comprehensive and empirically based analysis of logistics designs for the development from primary separated to advanced integrated logistics is necessary.

We want to contribute to the theory of logistics in OC retailing by outlining the development from separate MC to integrated OC logistics. The goal of this paper is to develop propositions for OC integration based on empirical findings and to develop a framework, which provides guidance in different logistics areas. This results in the following research question:

How and why do retailers transit from MC to OC logistics?

We elaborate in detail on our research process and the methodology applied, the construction of the survey, the data collection and data analysis in the following section.

4. Methodology

Research approach. Our structured literature review gave us a very limited number of publications for the recent phenomenon of OC retailing and the required logistics systems behind. Hence, the research question targets to develop propositions “how and why” retailers develop their logistics from separate MC to integrated OC systems. The research question focuses on an open and unexplored area. Therefore, we explore and analyze this phenomenon empirically (following Babbie [1990]; Forza [2002]). Among others, Forza [2002] recommends to collect data through an exploratory survey with experts in this field for such situations. Forza [2002] explains that in order to discover new facets of a phenomenon under study an exploratory survey is appropriate. Subsequently, it can help to uncover or provide preliminary evidence of association among concepts. An open research question is a justifiable rationale for conducting an exploratory study with the goal to develop pertinent propositions based on empirical work, thus using an inductive approach. In line with Edmondson and McManus [2007] “the combination of qualitative data to help elaborate a phenomenon and quantitative data to provide preliminary tests of relationships can promote both insight and rigor.” Exploratory surveys are a method used in supply chain and operations management contributions as well (e.g., Themistocleous et al. [2001]).

Research on MC and OC retailing lacks empirical support. Hence, we aimed at a large sample size to obtain more general insights as compared to single case studies or resource-intensive qualitative interviews. Surveys allow such a broad analysis with an extensive range of retailers and experts, which, in turn, supports not only a description of the current status, but also the development of transferable theory. The completion of a survey is also less time intensive for the participants compared to face-to-face interviews [Babbie, 1990]. This increases the likelihood of participation. Furthermore, we wanted to obtain mainly structural data (e.g., how is inventory stored across channels, which store pick-up solutions are applied, where can orders be returned) to assess specific developmental stages and their contextual factors (e.g., duration of activity in multiple channels, industry). The survey allowed us to collect company figures and key indicators efficiently, thus giving us the opportunity to provide at least mild statistics.

We implemented a web-based survey, which offers the opportunity to create an interview-like event and react to participants’ answers [Grant et al., 2005]. It enables control over the flow of stimuli, i.e., order of questions, to provide support if necessary, and enables a demand-driven

dialogue with the respondent through the use of conditional questioning, which is a “substitute for interviewer control in face-to-face interviews” [Tuten et al., 2002]. We used conditional questioning if participants answered in a certain way and provided additional questions if we wanted to learn more on a specific answer. Apart from the principle that questions have to be as short, as precise and as simple as possible, we provided the opportunity to retrieve explanations for terms, which can be misunderstood. Thereby web-based surveys lead to a context-driven interview situation [Grant et al., 2005].

Construction of the survey. The survey considers various aspects of retailing on multiple channels, from warehouse operations to order fulfillment and possible returns. This enables us to learn how and why different configurations are used by retailers in the transition from MC to OC logistics.

The survey comprised two parts. To close the research gap for the recent changes from MC to OC logistics, structural data was gathered. Hence, the first part collected structural data on warehousing, inventory management, picking systems, delivery and return options as well as general organization and IT systems. We used practitioners-oriented articles as a starting point (e.g., PwC [2013]; BCG [2014]; EY [2015]) and the preceding single-problem studies that identified certain structures and typologies in operations and logistics for retailing with multiple channels. The main sources were Swaminathan and Tayur [2003], Ashworth et al. [2006], Agatz et al. [2008] and Hübner et al. [2015, 2016a, b]. This data was collected from retailers operating at least one direct-to-customer and a parallel B&M channel.

The second part of the survey asked participants about the integration and expansion of different logistics areas to supplement the structural data. The transition is primarily discussed in practical studies, from which we derived qualitative statements about development directions in order to combine practical insights with a theoretical methodology. Multiple secondary sources, such as published interviews, reports and data provided by market research institutions and service firms, were used as well. This part was also sent to logistics experts in a separate questionnaire.

The survey layout followed the recommendations of Babbie [1990], Creswell [2002] and Forza [2002]. Tests for interdependence between questions were performed to ensure that no patterns could occur by design. Before the questionnaire was released, a pre-test was conducted with one retailer and one logistics expert to test click streams and the general functionality and appropriateness of the questions.

Data collection and sample. During the sampling process, we first identified potential participating companies, before identifying interviewees from these companies. The targeted retailers had to fulfill three criteria. First, the scope of the investigation included retailers with multiple channels

only. Retailers are defined as belonging to this group if they have a distance sales channel as well as B&M outlets. Second, the retailers had to be active in both channels for at least one year. Third, the challenges of integrating on- and offline distribution concepts are particularly relevant for large retailers with established distribution networks and options for gaining economies of scale in this area. Therefore, retailers were required to have revenues of at least EUR 150 million per annum and at least ten outlets. The company sample was thus derived from the latest industry rankings of official statistical data, based on annual sales.

We invited all German retailers with multiple channels who fulfilled our criteria to take our exploratory survey. In the first round, 94 retailers were contacted by mail. Only board members, general managers, directors and division managers who were able to guarantee a comprehensive view of logistics structures and processes were invited to answer the questionnaire. In addition, another 109 logisticians from SC retailers, third-party logistics service providers and consultancies were contacted to complete the second part of the survey as logistics experts.

Two weeks after the first mailing, 16 retailers and 20 experts had responded. Another 30 retailers and 16 experts responded after receiving a reminder by mail during the following five weeks. In total, we achieved our goal to adequately depict the MC/OC retail market through a response rate to our direct mailing of around 40 percent (46 retailers and 36 experts). We believe that we managed to get a high response rate because we held on to potential participants and contacted them via traditional mail, e-mail, and phone to convince them to participate as well as promised them an anonymized report of the final results.

Surveys from participants who answered the questions in a certain pattern or answered a repeat-question differently twice were excluded from further analysis. To reduce response bias, non-complete questionnaires and finally unreturned questionnaires were excluded as well. In addition, a test for late-response bias and non-response bias was performed [Flint and Mentzer, 1997]. The test for late-response bias showed no result. Answers from respondents were not different in the first and final third of the questionnaires submitted. For non-response bias, we tested the size of the company measured by revenue of a subset of non-respondents against all respondents to enhance the external validity of the data [Armstrong and Overton, 1977; Flint and Mentzer, 1997]. No significant differences in average company revenues were found, leaving us with a total of 61 un-biased questionnaires: 31 international OC retailers and 30 additional logistics experts without their own OC business (see Table 1).

More than half (52 percent) of participating retailers with at least two channels had a total annual turnover of more than EUR 1 billion. 16 percent reported a yearly turnover of between EUR 500 million and 1 billion, whereas about one-fourth could be considered a small or medium-

<i>Sector MC retailers</i>	<i>No.</i>	<i>Sector logistics experts</i>	<i>No.</i>
Fashion	10	Consultancy	6
Grocery	5	Logistics service provider	6
Customer electronics	3	Bricks-and-mortar retailer	7
Furniture	2	Non-store retailer	6
Do-it-yourself	1	Other (e.g., union)	5
Special retailer	6	Subtotal	30
No focus	4		
Subtotal	31		

Table 1: Participants overview

sized enterprise with a revenue of less than EUR 500 million per year. Most of the participants were fashion retailers (32 percent), special retailers (19 percent), grocery retailers (16 percent) or electronics retailers (11 percent). Retailers with more than five years of experience on multiple-channels made up 48 percent of our sample, 19 percent reported experience of three to five years and another 29 percent of less than three years of experience on multiple channels. Originally, 84 percent were exclusively B&M retailers, the remaining 16 percent originally mail-order retailers.

Some of the largest consulting firms and four of the ten largest logistics service providers in Europe participated in the survey as retail experts. SC retailers, i.e., seven retailers that operate exclusively offline and six retailers that operate exclusively online, were surveyed within the expert sample to break up the uniformity of opinions and provide ideas from all perspectives, i.e., not limited to multiple channels.

Data analysis. Data analysis for both questionnaires was conducted in two phases. First, distinct searches for structures in the answers were performed to verify or reject initial presumptions. Evaluations were carried out on the basis of frequency of assent statistics from the prompted questions. Second, a search for previously unknown structures in the answers was conducted with help of statistical computing. In-depth evaluations were performed, such as cross-table analysis and correlations between responses. Spurious correlations, i.e., correlations in which no causal link can be assumed, were not taken into account in the analysis and interpretation. A χ^2 test showed that the answers were stochastically independent. The statistical analysis provided additional empirical support for our conceptualized propositions. Although a proper test based on previously derived hypotheses from the literature could not be conducted, implicit tests showed a strong indication that our propositions hold true. Table 2 summarizes these results.

In the following section, which formulates propositions and presents the results of the survey, we use the term “retailer” exclusively in reference to MC and OC retailers, and explicitly state so in cases where we mean an SC retailer.

<i>Characteristics</i>		<i>Pearson correlation</i>	<i>t-value</i>	<i>p-value</i>
Primary Channel	Picking cost for online orders	0.505	3.16	***
Revenue	Order processing time	0.536	3.42	***
Revenue	Cut-off time for next-day delivery	0.305	1.72	*
Outlet density	Delivery velocity	0.404	2.38	**
Outlet density	Importance of click-and-collect	0.513	3.22	***
Outlet density	Availability of click-and-collect and click-and-reserve	0.533	3.39	***
Order processing time	Return processing time	0.470	2.87	***
Inventory integration	Online information on store inventory	0.566	3.70	***
Warehouse integration	ERP separation	-0.330	-1.88	*

Note: ***, **, * Significant codes at 0.01, 0.05 and 0.1

Table 2: Descriptive statistics

5. Empirical findings

This section derives propositions for the development of operations and logistics competencies from our empirical findings. The propositions focus the transition from MC to OC logistics. We divide the development areas into inventory, picking and assortment (1-3), delivery and return (4-5), and organization and IT systems (6-7) as shown in Figure 2. The first subsection elaborates channel integration in inventory and picking in warehouses as well as the assortment range. The second subsection analyzes the expansion in delivery and return options. The third and final subsection investigates organizational and IT systems that act as relevant enablers for fulfillment.

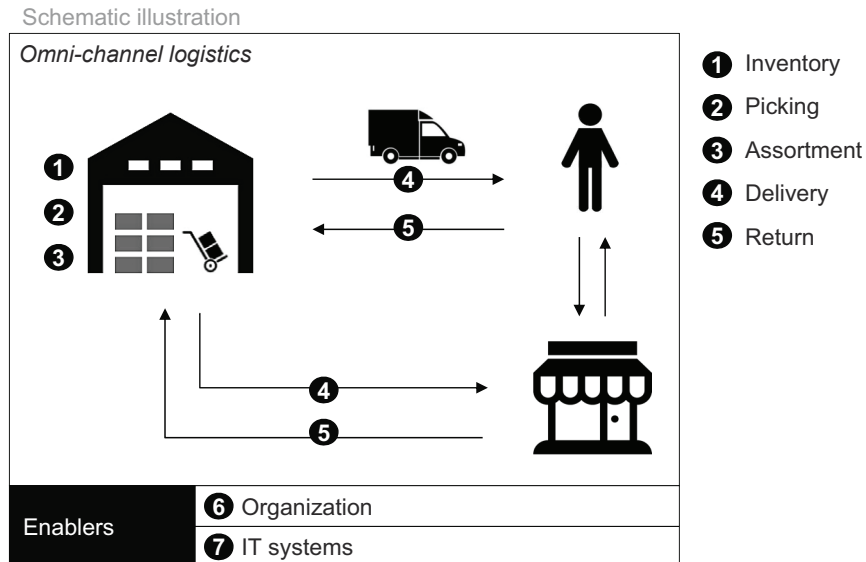


Figure 2: Areas of OC logistics

5.1. Inventory, picking and assortment

In retailing on multiple channels, it is possible to differentiate between three different warehouse types based on the level of integration of the inventory and picking processes. Type SI-SP involves separated inventories (SI) with separated picking (SP) for direct-to-customer and store orders. Type II-SP has cross-channel-integrated inventories (II) but separate picking zones, whereas type II-IP also has integrated picking (IP) zones for the different channels (see Figure 3). We first elaborate on the inventory system (SI and II) structures, before summarizing the findings on picking systems (SP and IP).

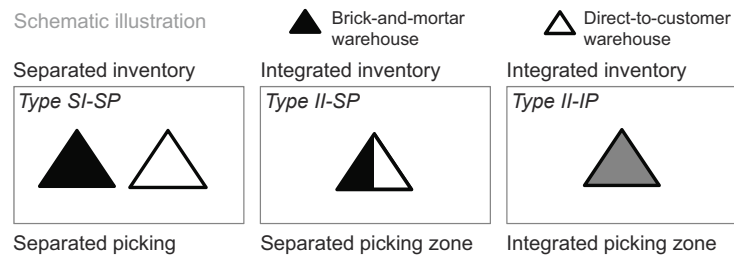


Figure 3: Overview of warehouse types in retailing

Inventory system. More than half of the retailers surveyed operate or plan to operate integrated inventories (type II) for direct-to-customer and store logistics. Therefore, they manage their inventories jointly across all channels. The participants validated that this enables flexible and demand-driven inventory allocation, making it possible to achieve compensation effects and keep less inventory overall. The group of retailers who recently built up direct-to-customer sales - all of them had recently opened an online channel after having been active for years in a B&M business - show significantly lower percentages of integrated inventories than experienced retailers in direct-to-customer fulfillment. In total, 78 percent of those retailers that have been active for more than five years in both direct-to-customer sales and store business have completely integrated inventory, whereas none of the “recent” direct-to-customer retailers with less than three years’ experience has fully integrated inventory. Only 22 percent of the “recent” retailers with multiple channels have partially integrated warehouses for select product categories.

Less than half of the retailers surveyed apply type SI. The majority recently entered the business with multiple channels. Only 30 percent of type SI retailers have more than five years’ experience in combined direct-to-customer and store fulfillment, whereas 50 percent have been in the MC business for less than three years. Those with more than five years’ experience and type SI are an exception, because they operate separate legal entities for their online and offline channels, and therefore do not mix their operational entities through common warehouses. This leads to the

conclusion that complete inventory integration requires a certain degree of MC process experience. These findings result in the first proposition:

P1a. Retailers with multiple channels evolve from separated inventory systems to channel-integrated inventory enabling flexible and demand-driven inventory allocation.

Picking processes. The picking processes in type SI are negligible from a cross-channel perspective since they can only be separate. Analyzing picking processes, therefore, is only relevant for type II. Almost six out of ten type II-retailers pick across channels in a common zone. These retailers belong to type II-IP and the picking zone is not separated by channels. They all have been active in direct-to-customer business for more than three years and 80 percent for more than five years. Furthermore, four out of five retailers and logistics experts confirm that a common picking zone for direct-to-customer orders and store orders leads to higher overall warehouse efficiency. Retailers who handle orders in parallel, in a single picking zone, also use the same picking personnel for all channels. Of the retailers with a common picking zone, nearly three-fourths always pick direct customer and store orders at the same time, whereas the remaining quarter of retailers apply dedicated picking time slots for each channel. For the latter group this means that there is no simultaneous picking of customer and store orders. The next proposition targets the relationship between integrated inventory and picking in one zone:

P1b. Retailers with channel-integrated inventory aim to integrate their picking procedures in one common picking zone across channels.

The fundamental challenge of integrated picking across channels is to establish efficient processes to achieve low costs for direct-to-customer-picking. Order sizes of stores are significantly larger than those of customers, which ultimately results in a higher picking productivity and therefore lower picking costs for store orders. In our sample, the average items per store order were 34 times higher than for a direct-to-customer order. The costs for store picking can therefore be assumed as a lower bound for picking costs in each company. To factor in product and industry specifics (e.g., fashion retailing with large order sizes vs consumer electronics with small order sizes), we use the differentials between picking costs for B&M vs picking costs for direct-to-customer deliveries to assess the picking performance and development stage of a retailer.

Original distance retailers have clear advantages in the various aspects of warehouse operation, especially in the complex direct-to-customer picking, also supported by significant statistical characteristics (see Table 2). Whether a retailer's primary business was in B&M or in mail-order or

online has a significant impact on overall picking costs for direct-to-customer orders. Original distance retailers have lower picking costs for direct customer orders than original B&M retailers. The original distance retailers already have capability and experience in picking for direct-to-customer shipments. Two-thirds of retailers with over three years of experience in fulfillment for multiple channels quote direct-to-customer picking costs that are similar to the B&M picking costs, whereas all retailers with limited experience in fulfillment for multiple channels say their direct-to-customer picking costs are significantly higher than store picking costs. The discussion above results in the following proposition about direct-to-customer picking efficiency which is the driver for cost-efficient cross-channel picking:

P1c. Advanced processes in direct-to-customer logistics are prerequisites for achieving cost-efficient cross-channel picking systems.

Assortment. Part of inventory management is to decide which items to keep in stock, which means defining the number of stock keeping units (SKUs) and the appropriate inventory level for each unit. The former involves setting the assortment depth and breadth, i.e., deciding which SKUs should be supplied from a warehouse. B&M shelf space is limited, which in turn limits the range of SKUs offered at a physical store. At an online store, a retailer can offer virtually limitless SKUs due to lower storage space costs. However, if a retailer adds a new SKU to the web shop, he has costs for creating photos and product data. The range of products is thus only limited by the space in the warehouse and the marginal costs for adding a new SKU. This and the fact that online channels may achieve stronger inventory pooling effects enable them to have a broader set of SKUs and ultimately also broader assortments than B&M stores. Consequently, an online channel also serves as a virtual store shelf extension.

A total of 60 percent of surveyed retailers already offer a more extensive range of SKUs online than in their stores. Over 80 percent see a more extensive online assortment as a goal and as a valuable asset to an OC strategy. Of those that currently offer a smaller range of SKUs in their web shop than in stores, 64 percent want to change this current situation. The majority of retailers with a smaller online assortment have been operating a web shop for less than three years. Nearly 90 percent of retailers with a larger online than offline assortment have been operating their web shop for more than three years, 76 percent for more than five years. Retailers increase the set of SKUs and assortment diversity in their online channel compared to their stores over time and use the online assortment as supplement to store offers. Therefore, the next proposition is formulated as follows:

P1d. Retailers with multiple channels start their operations with a smaller online rather than offline assortment. They gradually expand their online assortment over time until it is bigger than the offline assortment, thus creating a virtual shelf extension.

5.2. Delivery and return

For the retailer, the different configuration possibilities of delivery and return modes are of particular importance, as they are direct customer interaction points. Additionally for direct customer orders delivery velocity is a major issue that needs to be addressed.

Delivery velocity. The majority of participants (84 percent) see shorter delivery times as an opportunity to differentiate themselves from competitors. However, the cost of shortening delivery time (e.g., through later order cut-off time or more tours) cannot entirely be transferred to customers. Nearly nine out of ten respondents share this opinion. Furthermore, neither retailers nor experts assume that customers expect same-day delivery of a non-food online order in the case of direct-to-customer deliveries; almost 94 percent of all interviewees share this opinion. According to all participants, customers are less willing to pay for this service. Thus, most respondents expect that customers are satisfied with next-day delivery. Two-thirds of the retailers surveyed have an average delivery velocity of between one and two working days. Company size in terms of yearly revenues and outlet density indicate higher delivery velocity (see Table 2) but based on the retailers' answers a causal link cannot be provided.

Delivery mode. At an MC retailer, customers either shop in-store or get their products delivered to their home for an online or mail-order purchase. Around one quarter of participating retailers separate their channels like this. In OC retailing delivery modes exist that connect stores and direct-to-customer shipments. An analysis of delivery channels shows that 70 percent of retailers surveyed already offer pick-up services, where customers pick up goods purchased online at a store. In total, 81 percent consider it a necessity to offer this service free of charge. Pick-up services can be differentiated into click-and-collect (C&C) and click-and-reserve (C&R). C&C offers pick-up of online bought products in-store, whereby the product is sent from a warehouse to the store. C&R is a further development of C&C, which additionally leverages store inventory for online orders. C&R connects the inventories in warehouses to inventories in stores. This increases overall availability as more inventory sources are used. However, only one-fourth of retailers surveyed offer C&R to their customers. This implies that the store today serves largely as a "pick-up station" and that processes for online orders are performed in parallel, i.e., not yet integrated into processes for store deliveries. Almost all retailers (94 percent) with more than five years of experience in

direct-to-customer shipments provide the C&C option, and 58 percent either offer or intend to offer C&R. The situation is different for retailers with less than five years' experience. None of them already offer C&R and only 7 percent of them plan to create C&R options. The importance and availability of pick-up services for retailers increase with the outlet density (see Table 2), because they can leverage their wide spread physical point-of-sales also for the distance channel. Our next proposition therefore concerns the relationship between outlet density and introduction of pick-up services for OC fulfillment:

P2. The higher the outlet density, the more beneficial it becomes for retailers to introduce pick-up services.

Return mode. Return mode describes the options available to customers for returning goods (in-store or postal shipments) and how retailers process the returns (shipped to a return center or left at a store). Evidence exists that efficient order processing, i.e., short order processing time, correlates to efficient return processes, resulting in shorter return processing times as well (see Table 2). At 23 percent of participating retailers returns are strictly separated between channels, which means that an online order has to be returned via postal shipment and a store purchase has to be returned in-store. However, results from the questionnaire show that it should be possible for customers to return goods that were ordered online or via mail-order at the store and vice versa. Hence, the option to return orders across channels is mandatory for OC retailers. This is confirmed by virtually all (91 percent) of the survey participants. Nevertheless, of the retailers who see this becoming standard, only 77 percent already offer this service. This may indicate what retailers will most certainly offer in the future. However, this option is independent of retailer experience and the duration of activity in multiple channels. Rather, it depends on product and industry characteristics, as well as outlet density and the size of a company. The majority of retailers that do not yet offer in-store returns are fashion retailers, a fact that necessitates a brief description of other factors, which influence return options. For the ultimate processing of returns two-thirds of retailers report that they add in-store returns to the store inventory, or plan to do so in future, whereas the remaining third of retailers forward returned goods to a return center. Forwarding generates additional transportation and handling costs. This is primarily the case in fashion retailing, where only 30 percent of companies add the goods to store inventory. The remaining 70 percent forward the products, resulting in longer processing times until they are available again for re-sale. The fashion retailers that forward returns to a warehouse because they either cannot or do not want to keep them at the store, have all been active in retailing with multiple channels for more than three years. The development in return modes depends on the factors mentioned previously, such

as product characteristics, rather than the duration of activity in a channel. For example, fashion products may require additional cleaning, washing and preparation until they can be put out for re-sale. Furthermore, some SKUs (e.g., special dress sizes) are preferably stored centrally in a warehouse. For DIY or consumer electronics retailers, handling returns is much simpler and items can be resold faster. The findings above do not allow formulating a definite proposition despite the fact that return processing does not seem to be dependent on experience in multiple channels. However, the way in which retailers process returns, either in-store or via a return center, depends on various characteristics, such as product, sector, outlet density and company size.

5.3. Organization and IT systems

In OC retailing, the organizational units for the different channels have to be aligned to a common strategy. Integrated IT systems help to overcome the complexity when dealing with channel-integrated warehousing and processes.

Organization. All of the survey participants confirm that in OC retailing, the “if” is no longer paramount, but the “how” is. Some 40 percent of retailers and experts say that if a new channel is added, organizational units can be separated to define processes and setup resources. In the long run, however, a total of 81 percent of retailers and 90 percent of experts agree that both channels can be operated more efficiently if logistics is managed and handled by the same organizational unit. Seven out of ten respondents agree that cannibalization among channels in a well-established OC business does not play a major role since only the total company revenue is relevant. Of the retailers surveyed, 39 percent operate logistics divisions that are separated by channel. One may assume that these retailers would disagree with the statement that it leads to a higher long-term efficiency for both channels if their logistics are managed and handled by the same organizational unit. However, 84 percent of them agree with the statement indicating that they are dissatisfied with the separation of organizational units by channel, because they assume that higher efficiency would result from integrated channels and therefore pursue this goal.

IT systems. Retailers and logistics experts share the opinion that nowadays customers can reasonably expect to receive inventory information for a web shop (90 percent) and store (70 percent). Almost 80 percent of retailers provide availability information on online inventory to their customers, while only 52 percent do so or intend to do so for store inventory. Of the 45 percent of retailers that update availability information in real time, 85 percent have interfaces between the enterprise resource planning (ERP) systems of the respective channels, or operate a joint system.

A significant correlation exists between the capability of showing store inventory availability in the web shop, and the integration level of online and offline inventory in one warehouse (see Table 2). Furthermore, all retailers who operate separate, channel specific warehouses operate channel-specific ERP systems, whereas 70 percent of those who have integrated warehouses with joint inventories also have a joint ERP system for online and offline channels (see Table 2). Retailers need channel-integrated information for their joint warehouses and inventory, and customers want this cross-channel information for a seamless OC experience. This is only possible with a channel-integrated ERP system that provides this information.

6. Discussion and conclusion

Development of framework and contribution to literature. In this section we discuss our empirical findings and propositions in the light of literature, and sum up our results in a framework depicting the transition from MC to OC logistics. The propositions identify transition areas for retailers who operate with few or no interfaces between direct-to-customer shipments and store logistics, and who are becoming retailers with expanded service options across channels and integrated backend functions. Like Ashworth et al. [2006], we identify advantages of integrating operations systems (i.e., picking processes, inventory holding) and organizational and IT systems. The empirical findings and resulting propositions allow a construction of a framework that helps to structure the steps involved in transitioning from a basic MC approach to a fully integrated and expanded OC approach. Figure 4 summarizes and illustrates the findings.

The first two areas concern the integration of inventories and picking across all channels. The literature on inventory management analyzes the benefits of pooling inventories across channels (e.g., Chiang and Monahan [2005]; Agatz et al. [2008]; Mahar et al. [2009]; Schneider and Klabjan [2013]; Bhatnagar and Syam [2014]), whereas the warehousing literature discusses the challenges of operational systems (e.g., De Koster [2002]; Lang and Bressolles [2013]; Hübner et al. [2015]). Our empirical findings specify the developmental stages and reveal that retailers use separate inventories and picking processes in the basic MC solution. This means that they have at least one warehouse location for direct-to-customer shipments and at least one warehouse location for the B&M channel; each of which holds channel-specific inventories. In an advanced OC warehousing solution, retailers develop toward integrated inventory which enables flexible and demand-driven inventory allocation as well as cross-channel picking processes in one common zone. Our results show a strong indication that the positive effects of integrated warehouses and inventories outweigh the cost of complexity for picking across channels. In most cases, it is evident that retailers pursue the integration of

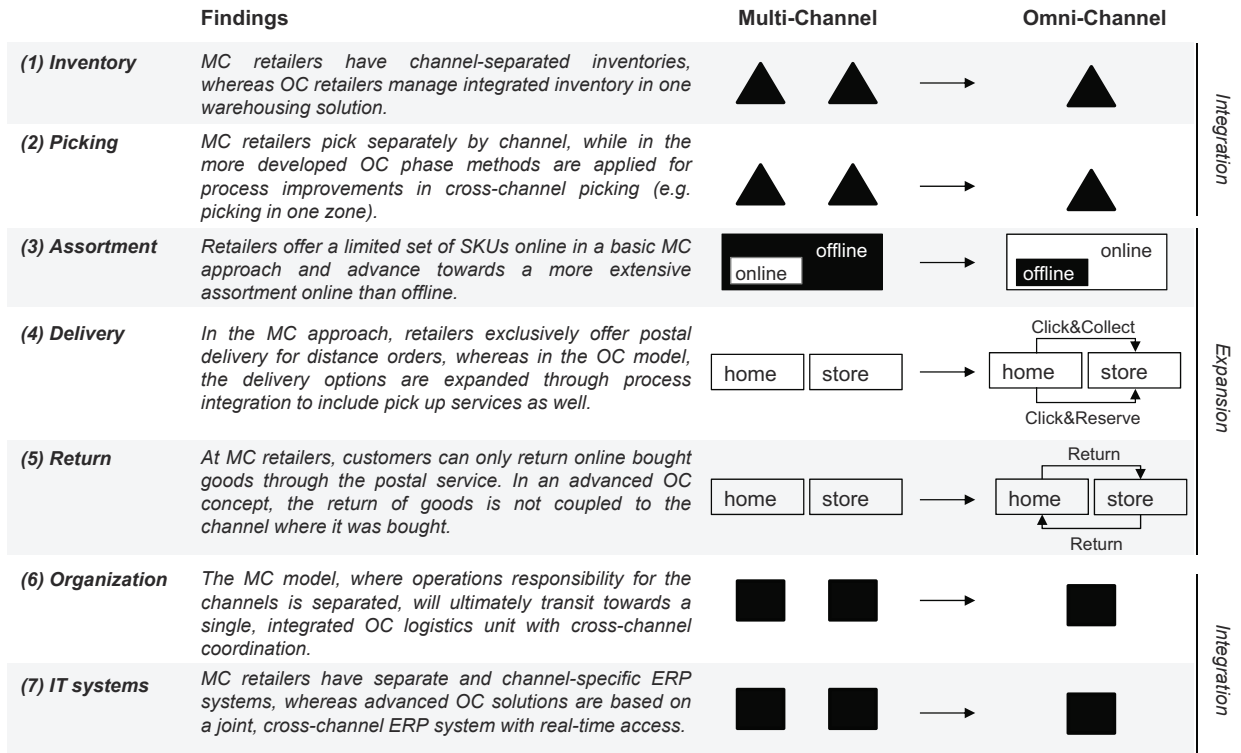


Figure 4: Framework of the transition from multi- to omni-channel logistics

direct-to-customer and store fulfillment from a joint warehouse as they gain experience in the direct-to-customer business.

The third area is related to assortment variety. Available literature mainly considers a single assortment, namely, either the same assortment in all channels or the assortment of an SC retailer (see review of Hübner and Kuhn [2012]). However, online channels may achieve strong pooling effects and thereby can afford a broader assortment than physical stores [Agatz et al., 2008; Zhang et al., 2010]. Products with high carrying costs can be withdrawn from the B&M stores and made available exclusively at the online store where the inventory carrying costs are comparatively low [Bhatnagar and Syam, 2014]. We enhance these findings as we show that retailers expand their assortment variety with growing experience in the online channel. In the basic MC model, the retailers offer a limited set of SKUs online, because they have to overcome complexity with a common internet appearance (e.g., pictures, product data). After a learning period, a more extensive online assortment compared to offline is stocked in the advanced OC solution, where the online shop functions as a virtual shelf extension.

The next two areas are concerned with retailers' forward and backward distribution. In terms of delivery modes for distance orders from customers, pertinent literature analyzes the effects of delivery concepts on customer service (e.g., Boyer et al. [2002]; Rabinovich et al. [2007]; Rao et al.

[2009]; Xing et al. [2010]; Hübner et al. [2016a]), increasing customer expectations (e.g., Chatterjee [2010]) and the impact of expansion of cross-channel delivery concepts on sales (e.g., Gallino and Moreno [2014]). With our empirical findings we enhance the results from literature by explicitly delineating the pattern of the transition from MC to OC logistics. At the start of their operations, MC retailers exclusively offer postal delivery of goods, whereas in the OC model, the delivery options are extended to include C&C (i.e., in-store pick-up of goods delivered from warehouse inventory) and C&R (i.e., online orders are allocated from store inventory) through process integration. Due to growing customer expectations of buying and obtaining goods wherever and whenever they want, retailers must be capable of delivering goods to homes and stores at any time, while customers must be entitled to return products through all channels. OC retailers therefore strive to expand their delivery modes and return options. Current literature on the latter demonstrates the customers' benefits when retailers offer return options across channels. Returning products in-store that were purchased online not only enhances customer convenience and hence satisfaction, but also provides the retailer with an opportunity to cross-sell and up-sell during a customer's store visit [Zhang et al., 2010]. In the basic MC model, the customer can only return the goods through the postal service, whereas in an advanced OC concept, the return of goods from a distance channel can be handled instore; the returned items are then either forwarded to the warehouse or added to store inventory. We thereby confirm the findings of Hübner et al. [2016a] about return flows in advanced OC systems. We further broaden the theoretical understanding of OC return processes from a retailer perspective by showing the development of return options. Therefore, similar to the development in delivery options, at the basic MC model the customer can only return the goods via the postal service. In an advanced OC concept, the return of goods is not coupled to the channel where it was bought.

The final two areas summarize the enablers for efficient and effective logistics integration. Organization addresses the issue whether organizational responsibility for logistics should be separated or integrated. Current literature shows that retailers need to fulfill customer preferences regardless of any internal, organizational channel structures (see McAdam and McCormack [2001]; Smart [2008]). For example, Fawcett et al. [2008], Chen et al. [2009] and Gallino and Moreno [2014] highlight the importance of rethinking incentive alignments for retailers with multiple channels. Ashworth et al. [2006] point out that in an organizational learning cycle consolidating both channels into one unit is perceived as essential for future business success. Similarly, our empirical findings reveal that integrated organizational structures are an enabler for channel integration regarding logistics. Even those retailers with channel-separated organizational units are willing to merge their departments, because they expect higher logistics efficiency. They transit from the ba-

sic MC model, where operations responsibility for the channels is separated, toward cross-channel coordination, which will ultimately result in a single, integrated OC logistics unit. The situation is similar for IT systems. In the initial stage, the ERP may be separate and channel-specific, whereas advanced OC solutions are based on a joint, cross-channel ERP system with real time access. This is in line with current literature. Boyer and Hult [2005], Oh et al. [2012] and Gallino and Moreno [2014] identify that converging channels increases the pressure to leverage IT for operations and service functions, whereas for example Holsapple and Sena [2005] already identify the benefits of IT standardization and integration in terms of better transparency and decision making processes. Therefore, as our results reveal, a joint ERP system will facilitate cross-channel inventory management, article tracking and customer communication. We enhance the findings from literature by demonstrating, that they are prerequisite for cross-channel inventory information and thus a true OC logistics solution resulting in a seamless OC experience for retailer and customer.

In summary, the development from MC logistics with separate channels for direct-to- customer and store deliveries, to OC logistics, requires integration and expansion efforts. Inventories and picking, organizational units and IT systems need to be integrated across channels, while the range of SKUs available online, as well as delivery and return modes, must be expanded to include the various options. The purpose of integration is to create synergies across all channels, especially in inventory availability. Expansion enhances the service options for customers so that they can choose the most convenient one.

Application of framework and discussion of managerial implications. The different development phases in the areas discussed above lead us to compare the current stages of development of the participants, identify differences among retailers, and determine the reasons behind these differences. The framework above can therefore also help retailers to identify their developmental needs compared to all other retailers with multiple channels. Each retailer with multiple channels could be assigned to a development phase based on the structural data obtained from the survey responses.

A point system is applied to compute the average: if a retailer currently applies a basic MC approach in a certain area, he is assigned one point. If a retailer applies a more advanced solution, he is assigned three points. Only in the areas of delivery and return modes we differentiated between postal delivery and return (first phase), C&C and instore return (second phase), and C&R and adding returns to store inventory (third phase). In this case we assigned from one to three points.

The average of all participants with multiple channels indicates a need for integration in terms of inventories, and a need for expansion in delivery modes (see Figure 5). The absolute amount

of time a retailer has already spent operating its warehouse with its own stores and direct-to-customer shipments has a significant impact on the overall development level. Retailers that have already been operating direct-to-customer logistics for more than five years are further along in their development toward OC fulfillment integration. In contrast, if a retailer has operated its direct-to-customer business for less than three years, he is usually in the initial phase of multiple channels. This is plausible as integration, expansion and operational experience develop over time into multiple channels operations. The situation is similar for the range of SKUs in warehouses. The longer a retailer operates an online channel, the larger the online assortment. This is also due to the difficulty of the operational task of making all items available online and enabling fulfillment in order to handle additional items for direct-to-customer shipments.

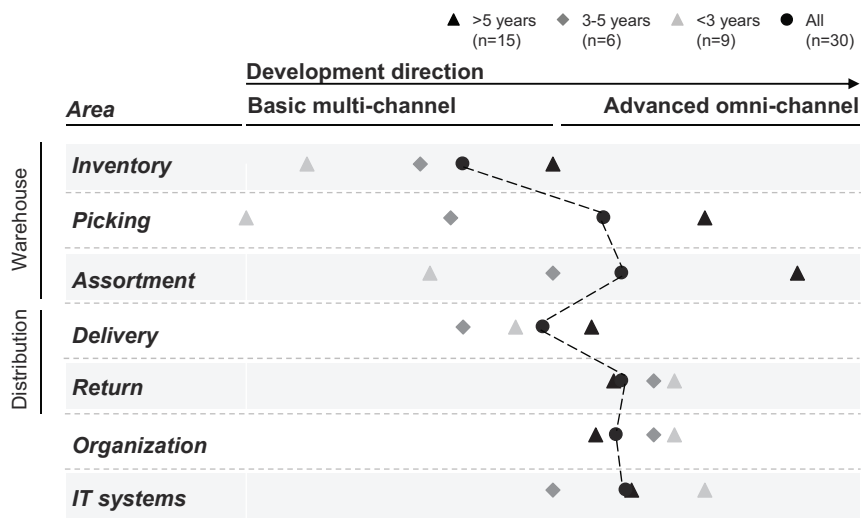


Figure 5: Average development phase of participants by duration of multi-channel activity

However, the situation is different for distribution management. There is only a slightly higher average shift toward expanded delivery solutions among the experienced companies, whereas on average there is only a minimal difference for return handling. Establishing a connection between direct-to-customer shipments and store pick-up is not as complex if retailers are already capable of direct-to-store shipments. A store can then serve as a pick-up station. Returns are a standard process at stores and especially for direct customer orders. Therefore, all retailers must already have capabilities in this area and are just ready to enter in an advanced OC phase when they add a new channel. The main driver behind the decision to also add returns into store inventory is the product characteristics. Moreover, customer-oriented processes are usually the ones of prime concern to retailers when they enter the multiple channel business and, therefore, the first issue to be tackled. Finally, retailers who recently entered the MC business tend to integrate organizational

units and ERP systems for logistics activities more. This may be because several competitors approve the entry into online shopping and, therefore, the perceived risk is lower. Consequently, new companies already start out with a single, integrated system.

In summary, the findings provide insight into designing logistics structures for practitioners and the propositions emanating from the empirical findings can be seen as implications for retail managers. Especially logisticians from MC companies can use our propositions as concrete advice on how to advance their mainly separated MC business toward an integrated OC business. However, real managerial implications can only be fully demonstrated when our propositions are tested in a quantitative research design. Development in the warehouse from MC to OC structures is particularly dependent on experience with multiple channels. This leads to the conclusion that learning effects play a key role in developing an integrated warehouse. But at the conflation of delivery and return structures, development toward OC structures is not directly dependent on experience in retailing on multiple channels.

Limitations and future research. As all research has its limitations, these findings are no exception. First, the research was carried out in Germany and a similar study of retailers from mixed countries could be part of future research. We expect the results to be transferable to other countries since the participants are internationally active retailers. Out of the top 25 German retailers, 21 have multiple channels, 13 offer C&C, and five offer additional C&R. For example, in the UK out of the top 25 retailers, 24 have multiple channels, 21 offer C&C, and three offer additional C&R. Therefore retail companies from Germany and the UK seem to be comparable regarding the presence in multiple channel retailing and the services offered. However, we acknowledge that in certain product categories like food retailing, the UK is far more developed in terms of online sales than German retailers. Second, the sample consists exclusively of large enterprises, resulting in an obvious selection bias. Future research should try to repeat our results in a test with a truly random sample. Third, the analysis was mainly based on how long a retailer has been operating a multiple-channel business, because we saw major differences in this area in our data. Other factors play a role as well, and should be considered in future studies. Finally, although we find strong indications that our empirical findings hold true, we did not perform a proper statistical test as confirmation because we focused on identifying structures and testing simplified statements within a new research area. Our propositions require testing by further quantitative methods. However, one obstacle will be to find the appropriate criteria for confirmation, since reliable information is limited and difficult to evaluate based on small industrial samples. Because we have already surveyed more than one third of the top 100 retailers with multiple channels, it will be difficult to

obtain a larger company sample of German retailers.

Moreover, another test for quantification of performance criteria and cross-channel controlling could be carried out. Above all, we see progress in the interaction of IT systems and in the mode and speed of delivery opportunities. Therefore, we recommend that future researchers look at the opportunities that a developed connection between ERP and CRM systems could offer to an OC retailer. Future systems should help to prioritize customer orders based on individual customer utility rather than on a first-come, first-served method. This additionally requires full cost transparency for all processes and an estimation of opportunity costs for missed sales between channels. Another area for future research could be to select a single commodity group (e.g., grocery) for a more in-depth analysis of channel integration. Cross-channel integration is generally considered to be good. But complete channel harmonization and development toward an integrated solution may not be feasible or fruitful for specific sectors [Verhoef et al., 2015]. Future research could also identify analogies of disruptive technologies, like the implementation of ERP systems in manufacturing, [Themistocleous et al., 2001] and the impact of a strong online channel on retailing.

References

- Agatz, N.A., Fleischmann, M. and van Nunen, J.A. (2008), "E-fulfilment and multi-channel distribution - a review", *European Journal of Operational Research*, Vol. 187 No. 2, pp. 339-356.
- Alptekinoglu, A. and Tang, C.S. (2005), "A model for analyzing omni-channel distribution systems", *European Journal of Operational Research*, Vol. 163 No. 3, pp. 802-824.
- Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402.
- Ashworth, C.J., Schmidt, R.A.D., Pioch, E.A. and Hallsworth, A. (2006), "An approach to sustainable 'fashion' e-retail: a five-stage evolutionary strategy for 'clicks-and-mortar' and 'pure-play' enterprises", *Journal of Retailing and Consumer Services*, Vol. 13 No. 4, pp. 289-299.
- Babbie, E. (1990), *Survey Research Methods*, Cengage Learning, Stamford, CT.
- BCG (2014), "Omni-channel retail it's still about detail", *bcg.perspectives*, London.
- Beck, N. and Rygl, D. (2015), "Categorization of multiple channel retailing in multi-, cross-, and omni-channel retailing for retailers and retailing", *Journal of Retailing and Consumer Services*, Vol. 27, pp. 170-178.
- Bell, D.R., Gallino, S. and Moreno, A. (2014), "How to win in an omni-channel world", *MIT Sloan Management Review*, Vol. 56 No. 1, pp. 45-55.
- Bhatnagar, A. and Syam, S.S. (2014), "Allocating a hybrid retailer's assortment across retail stores: bricks-and-mortar vs online", *Journal of Business Research*, Vol. 67 No. 6, pp. 1293-1302.
- Boyer, K.K., Hallowell, R. and Roth, A.V. (2002), "E-services: operating strategy – a case study and a method for analyzing operational benefits", *Journal of Operations Management*, Vol. 20 No. 2, pp. 175-188.
- Boyer, K.K. and Hult, G.T.M. (2005), "Extending the supply chain: integrating operations and marketing in the online grocery industry", *Journal of Operations Management*, Vol. 23 No. 6, pp. 642-661.
- Brynjolfsson, E., Hu, Y.J. and Rahman, M.S. (2013), "Competing in the age of omnichannel retailing", *MIT Sloan Management Review*, Vol. 54 No. 4, pp. 23-29.
- Chatterjee, P. (2010), "Causes and consequences of 'order online pick up in-store' shopping behavior", *The International Review of Retail, Distribution and Consumer Research*, Vol. 20 No. 4, pp. 431-448.
- Chen, H., Daugherty, P.J. and Landry, T.D. (2009), "Supply chain process integration: a theoretical framework", *Journal of Business Logistics*, Vol. 30 No. 2, pp. 27-46.
- Chiang, W.Y.K. and Monahan, G.E. (2005), "Managing inventories in a two-echelon dual-channel supply chain", *European Journal of Operational Research*, Vol. 162 No. 2, pp. 325-341.
- Creswell, J. (2002), *Research Design – Qualitative, Quantitative and Mixed-Methods Approaches*, Sage, Thousand Oaks, CA.
- De Koster, R. (2002), "Distribution structures for food home shopping", *International Journal of Physical Distribution & Logistics Management*, Vol. 32 No. 5, pp. 362-380.
- Edmondson, A.C. and McManus, S.E. (2007), "Methodological fit in management field research", *Academy of Management Review*, Vol. 32 No. 4, pp. 1246-1264.

- EY (2015), "Re-engineering the supply chain for the omni-channel of tomorrow: global consumer goods and retail omni-channel supply chain survey", The Consumer Goods Forum, London, pp. 1-39.
- Fawcett, S.E., Magnan, G.M. and McCarter, M.W. (2008), "Benefits, barriers, and bridges to effective supply chain management", *Supply Chain Management: An International Journal*, Vol. 13 No. 1, pp. 35-48.
- Flint, D.J. and Mentzer, J.T. (1997), "Validity in logistics research", *Journal of Business Logistics*, Vol. 18 No. 1, pp. 199-216.
- Forza, C. (2002), "Survey research in operations management: a process-based perspective", *International Journal of Operations & Production Management*, Vol. 22 No. 2, pp. 152-194.
- Gallino, S. and Moreno, A. (2014), "Integration of online and offline channels in retail: the impact of sharing reliable inventory availability information", *Management Science*, Vol. 60 No. 6, pp. 1434-1451.
- Grant, D., Teller, C. and Teller, W. (2005), "Web-based surveys in logistics research: an empirical application", in Kotzab, H., Seuring, S., MÄijller, M. and Reiners, G. (Eds), *Research Methodologies in Supply Chain Management*, Physica-Verlag, Heidelberg, pp. 139-154.
- Holsapple, C.W. and Sena, M.P. (2005), "ERP plans and decision-support benefits", *Decision Support Systems*, Vol. 38 No. 4, pp. 575-590.
- Hübner, A., Kuhn, H. and Sternbeck, M.G. (2013), "Retail demand and supply chain planning – an operations planning framework", *International Journal of Retail and Distribution Management*, Vol. 41 No. 7, pp. 512-530.
- Hübner, A.H. and Kuhn, H. (2012), "Retail category management: a state-of-the-art review of quantitative research and software applications in assortment and shelf space management", *Omega*, Vol. 40 No. 2, pp. 199-209.
- Hübner, A.H., Holzapfel, A. and Kuhn, H. (2016a), "Distribution systems in omni-channel retailing", *Business Research*. doi: 10.1007/s40685-016-0034-7.
- Hübner, A.H., Holzapfel, A. and Kuhn, H. (2015), "Operations management in multi-channel retailing: an exploratory study", *Operations Management Research*, Vol. 8 No. 3, pp. 84-100.
- Hübner, A.H., Kuhn, H. and Wollenburg, J. (2016b), "Last mile fulfillment and distribution in omni-channel grocery retailing: a strategic planning framework", *International Journal of Retail and Distribution Management*, Vol. 44 No. 3, pp. 228-247.
- Kotzab, H., Seuring, S., MÄijller, M. and Reiner, G. (2006), *Research Methodologies in Supply Chain Management*, Springer Science & Business Media, Heidelberg.
- Kozlenkova, I.V., Hult, T.G., Lund, D.J., Mena, J.A. and Kecec, P. (2015), "The role of marketing channels in supply chain management", *Journal of Retailing*, Vol. 91 No. 4, pp. 586-609.
- Lang, G. and Bressolles, G. (2013), "Economic performance and customer expectation in e-fulfillment systems: a multi-channel retailer perspective", *Supply Chain Forum: An International Journal*, Vol. 14 No. 1, pp. 16-26.
- McAdam, R. and McCormack, D. (2001), "Integrating business processes for global alignment and supply chain management", *Business Process Management Journal*, Vol. 7 No. 2, pp. 113-130.
- Mahar, S., Bretthauer, K.M. and Venkataramanan, M.A. (2009), "The value of virtual pooling in dual sales channel supply chains", *European Journal of Operational Research*, Vol. 192 No. 2, pp. 561-575.
- Oh, L.-B., Teo, H.-H. and Sambamurthy, V. (2012), "The effects of retail channel integration through the use of information technologies on firm performance", *Journal of Operations Management*, Vol. 30 No. 5, pp. 368-381.
- Planet Retail (2014), "Retail sales worldwide from 2008 to 2018, by channel (in billion US dollars)", available at: www.statista.com/statistics/311300/global-retail-sales-by-channel/ (accessed November 29, 2014).
- PwC (2013), *Demystifying the Online Shopper – 10 Myths of Multichannel Retailing*, US Studio, New York, NY.
- Rabinovich, E., Knemeyer, A.M. and Mayer, C.M. (2007), "Why do internet commerce firms incorporate logistics service providers in their distribution channels? The role of transaction costs and network strength", *Journal of Operations Management*, Vol. 25 No. 3, pp. 661-681.
- Rao, S., Goldsby, T.J. and Iyengar, D. (2009), "The marketing and logistics efficacy of online sales channels", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 2, pp. 106-130.
- Schneider, F. and Klabjan, D. (2013), "Inventory control in omni-channel retail", *European Journal of Operational Research*, Vol. 227 No. 1, pp. 101-111.
- Smart, A. (2008), "E-Business and supply chain integration", *Journal of Enterprise Information Management*, Vol. 21 No. 3, pp. 227-246.
- Swaminathan, J.M. and Tayur, S.R. (2003), "Models for supply chains in e-business", *Management Science*, Vol. 49 No. 10, pp. 1387-1406.
- Themistocleous, M., Irani, Z. and O'Keefe, R.M. (2001), "ERP and application integration: exploratory survey", *Business Process Management Journal*, Vol. 7 No. 3, pp. 195-204.
- Tuten, T.L., Urban, D.J. and Bosnjak, M. (2002), "Internet surveys and data quality: a review", in Batinic, B., Reips, U. and Bosnjak, M. (Eds), *Online Social Science*, Hogrefe and Huber, Seattle, WA, pp. 7-27.
- Verhoef, P.C., Kannan, P.K. and Inman, J.J. (2015), "From multi-channel retailing to omni-channel retailing: introduction to the special issue on multi-channel retailing", *Journal of Retailing*, Vol. 91 No. 2, pp. 174-181.
- Xie, W., Jiang, Z., Zhao, Y. and Hong, J. (2014), "Capacity planning and allocation with multi-channel distribution", *International Journal of Production Economics*, Vol. 147 No. 1, pp. 108-116.
- Xing, Y., Grant, D.B., McKinnon, A.C. and Fernie, J. (2010), "Physical distribution service quality in online retailing", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 No. 5, pp. 415-432.
- Zhang, J., Farris, P.W., Irvin, J.W., Kushwaha, T., Steenburgh, T.J. and Weitz, B.A. (2010), "Crafting integrated multichannel retailing strategies", *Journal of Interactive Marketing*, Vol. 24 No. 2, pp. 168-180.

Configuring Retail Fulfillment Processes for Omni-Channel Customer Steering

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Abstract

Omni-channel retailers systematically connect their online and store sales, communication and distribution channels to create a seamless shopping experience. This is not only to expand into new channels, but also because customers shopping using more than one channel spend more money and are more loyal than single-channel customers. Influencing customers channel choices, which we term “steering customers across channels”, has so far mainly been viewed from the marketing point of view. In this paper, we focus instead on the fulfillment and logistics process as certain fulfillment configurations can help to steer customers through multiple channels (e.g., order in one channel, fulfillment in the other channel).

The objectives of our research include identifying and analyzing the benefits of fulfillment-enabled customer steering opportunities used by omni-channel retailers and the reasons why certain structures enable retailers to leverage these opportunities. In this exploratory study, data is collected through face-to-face interviews with fashion retailers and focus customer groups and combined with additional market data from retailers websites. We focus on fashion retailing as it has some distinctive structures (e.g., a significant share of online and offline sales), and is one of the most enhanced omni-channel segments. Our key results are that steering along the fulfillment process requires integrated solutions in the company structure, IT infrastructure and warehouse operations. Retailers can display cross-channel inventory availability, differentiate delivery and return options to steer customers into a preferred channel. This results not only in a differentiation and cross-selling potential across channels for retailers but also in additional services for customers.

With this paper we contribute to an understanding of how logistics and fulfillment options can be leveraged for customer management in omni-channel retailing, thus, enabling retailers to steer customer in a certain channel direction. It changes the general perception that cross-channel customer steering is accomplished in the marketing department alone. Fulfillment and logistics practices can contribute to customer cross-channel steering in the same way that other disciplines do.

Keywords: Omni-channel retailing, Retail supply chain management, Fulfillment, Customer steering, Fashion industry, Exploratory study

1. Introduction

Online and store retailing is increasingly overlapping from a customer and organizational perspective (see, e.g., Cao [2014], Piotrowicz and Cuthbertson [2014], Hübner et al. [2016b]). Nowadays, 55% of shopping is done using online and bricks-and-mortar channels [AT Kearney, 2014]. To enable cross-channel shopping, cross-channel customer interfaces are required. This phenomenon is called omni-channel (OC) retailing, where neither the customer nor the retailer distinguishes between channels anymore [Beck and Rygl, 2015; Hübner et al., 2016c]. In OC retailing, online orders can be processed through the stores and orders placed in-store can be delivered at home. The channels are conflated by, e.g., information exchange, joint systems and inventories across channels. Shopping across channels is double-edged and requires new concepts. On the one hand, OC customers who shop in-store and additionally online are more loyal and produce higher revenues than single-channel customers (e.g., Danaher et al. [2003], Kumar and Venkatesan [2005], PwC [2013]). On the other hand, increasing online sales originate partially from customer migration from stores [Gallino and Moreno, 2014]. Cross-selling is much more effective in-store [Nielsen, 2013], online sales especially in the fashion industry have a higher return rate [Bower and Maxham, 2012], and different operations costs across channels may result in retailers preferring one channel over the other. Thus, as channels overlap more and more, questions arise as to whether customers can be guided or “steered” into a specific channel direction which may have economic benefits for the retailer and potentially also service advantages for the customer.

In our context, steering means “influencing customers’ channel choices” [Thomas and Sullivan, 2005] during the shopping and fulfillment process, i.e., directing customers towards a specific channel. Approaches of the retailer include but are not limited to advertising one channel in the other channel, enabling substitutions across channels when items are out-of-stock in one channel, and offering store pick-up of online orders. For many retailers, the means of customer steering are not always transparent, straightforward or affordable. Furthermore, customer control is sometimes viewed critically (see, e.g., Neslin and Shankar [2009]), which is why customer steering options should be thoroughly analyzed, evaluated and carefully considered.

Customer steering efforts are presumably not among the first concerns of OC retailers who have recently integrated their channels. This is therefore more suited as a development step for retailers who have well-integrated channel structures that are already sophisticated (see e.g. Hübner et al. [2016c]). Furthermore, distinctive industry structures (such as significant sales in both channels, homogeneous products, and frequent shopping) are helpful for analyzing steering options. We have therefore chosen fashion retailing for our analysis.

Myers et al. [2004] and Herhausen et al. [2012] are the only scholars who have considered options for steering customers through channels. However they mainly concentrate their analyses on the marketing-related part of the shopping decision process. Therefore, in the present paper we concentrate on steering opportunities arising in a fulfillment context by systematically analyzing the shopping and fulfillment process in OC retailing. Our study pursues two aims: identifying cross-channel steering opportunities for retailers by means of fulfillment options and disclosing the reasons why certain structures enable retailers to leverage these opportunities. Since this is a new area of OC retailing research, we conducted an exploratory study [Stebbins, 2001; Creswell, 2003].

The remainder of the paper is organized as follows. Section 2 sets out the conceptual background, reviews literature related to customer steering, and develops the research question. Afterwards the methodology is described in Section 3. Section 4 presents the essential structures enabling customer steering as well as the actual steering options through the channels along the fulfillment process. Section 5 discusses the findings in the light of literature. Finally, we draw conclusions, present limitations of our study, and discuss future areas of research in Section 6.

2. Conceptual background and research question

In this section findings from literature are used to define the conceptual background of cross-channel customer steering and its prerequisites (see 2.1). From there, the research question is derived to target how OC retailers configure fulfillment processes to steer customers across channels (see 2.2).

2.1. Conceptual background and related literature

During the past decade retailers have put a lot of effort into building up online channels and integrating online processes into their existing bricks-and-mortar networks [Hübner et al., 2016c] or expanded from online channels into store channels [Bell et al., 2015]. Nowadays as advanced OC retailers all business units are integrated between channels, so customers can trigger full channel interaction and/or the retailer controls full channel integration [Beck and Rygl, 2015]. Integrated OC structures include a joint corporate culture (e.g., Lewis et al. [2014], Cao [2014]) as well as mutual awareness of retailers' offerings and customer requirements (e.g., Herhausen et al. [2012]). Above all, customer education of OC offers leads to greater loyalty and less mistrust or fear [Eisingerich and Bell, 2008; Fernández-Sabiote and Román, 2012] as well as increased retailer sales [Neslin et al., 2006]. Furthermore integrated and joint IT systems are a prerequisite for OC activities (e.g., Oh et al. [2012], Cao [2014]) and now the pressure for OC retailers is increasing to leverage IT for operations and service functions [Piotrowicz and Cuthbertson, 2014]. Accordingly, integrated

warehouse operations structures are prerequisites for cross-channel inventory information and distribution. Retailers with joint inventory enable flexible and demand-driven inventory allocation and prioritization of orders [Hübner et al., 2015, 2016c].

The primary goal of retailers when establishing cross-channel shopping options was mainly to react to new online competition by trying to rapidly capture as much as possible of the growing online segment. This goal has changed. Now OC retailers are asking themselves how they can leverage these advantages of established and well-integrated channels to use these connections in shopping and fulfillment processes for an increase in both customer satisfaction as well as return on investment. Capitalizing on these connections requires sophisticated cross-channel customer steering methods. Customer steering can take place along the entire shopping process and already start before the final buying decision is made. These steering opportunities typically involve marketing efforts such as advertising a specific channel that has already been the focus of scholarly research (e.g., Myers et al. [2004] and Herhausen et al. [2012]). However, despite marketing efforts, the need to integrate logistics and fulfillment-related aspects in channel management has been pointed out early in (multiple-channel) retail research [Alvarado and Kotzab, 2001].

In this paper we therefore focus on fulfillment-related aspects of customer steering at the interaction between retailers and customers, i.e., inventory availability information (online or at a store), pick-up and delivery as well as return options across channels. In general, the fulfillment process is initiated by a buying decision [Gupta et al., 2004; Puccinelli et al., 2009]. Then the *inventory availability information* of a product is checked, which in OC retailing should be possible for all products across online and store channels, including when an online purchase is made in the store (e.g., using an online terminal) [Oh and Teo, 2010].

Searching and buying in different channels is attributed a positive synergy, with the most common form being a search in the online shop followed by purchase in the store [Neslin et al., 2006; Verhoef et al., 2007] but also vice versa. The following area is *delivery or pick-up*. After the online purchase transaction is made, the product is delivered to the customer's home or made available for pick-up at the store (see e.g., Agatz et al. [2008]; Hübner et al. [2016a]). When customers buy at an outlet, customers may choose between taking the product immediately, having it delivered, or picking it up later at the store.

The linkage of the channels for delivery offers some advantages. New services such as in-store pick-up of online orders especially reinforce the strengths of the store, i.e., being near to the customer. The physical store can act as a hub in city centers, linking the different channels and thus becoming a new source of value creation. Acting as a pick-up and distribution hub, the store reduces delivery times as well [Cao, 2014]. Offering pick-up also results in higher store traffic

and ultimately higher store sales. Online reservations reduce the in-store non-availability risk for customers that they face when deciding to visit a physical store [Gallino and Moreno, 2014]. Similar benefits with conflated channels can be generated for product *returns*. In an area where a physical store of an OC retailer exists, the online return quota is lower, again underlining the critical role of stores for an OC retailer [Bell et al., 2015]. Returning online orders in-store may also lead to increased store sales [Neslin and Shankar, 2009; Kollmann et al., 2012]. In addition, it is possible to directly add the article to the store inventory at the in-store return point, thus shortening the cycle time during which the product is out of stock [Hübner et al., 2016a].

Retail practice is now looking for approaches to systematically capitalize on the advantages of cross-channel linkages.

2.2. Derivation of research question and scope

In summary, ramping up the full spectrum of OC fulfillment options usually requires major investments to build up cross-channel warehouses and distribution systems, secure real-time data exchange between stores and online shops, etc., but may have a significant impact on channel choice, such as by providing the option to buy online and pick-up in-store. This can in turn increase sales as customers who shop across multiple channels have a larger basket size [Kumar and Venkatesan, 2005] and are more loyal to a retailer than single-channel customers [Danaher et al., 2003; Shankar et al., 2003; Wallace et al., 2004; AT Kearney, 2014]. In addition to increasing sales, these efforts can reduce processing costs (e.g., reduce returns via mail by increasing return handling in-store, etc.) and improve customer satisfaction by providing more services. Thus, cross-channel customer steering can potentially have advantages for both retailers and customers.

The objectives of our research include identifying the fulfillment-related cross-channel customer steering opportunities used by OC retailers as well as the reasons behind these, i.e., assessing the how and why of the steering methods. The objectives formulated lead to the following research question:

How do OC retailers configure front- and back-end fulfillment processes to steer customers across channels, and why are those configurations effective?

Figure 1 frames the scope of our investigation. This exploratory study contributes to the small body of literature concerning customer steering in OC retailing by providing an overview of options as well as advantages of cross-channel customer steering during the fulfillment process. The aspects of customer steering in inventory availability information, pick-up and delivery as well as return

options across channels are analyzed based on the structures required to enable fulfillment-related customer steering. These areas build the foundation for the empirical part of our research and are revisited in Section 4, where our findings are carved out. We analyze the integrated OC operations structures needed for cross-channel steering and identify mutual benefits for both the retailer and the customer.



Figure 1: Overview of fulfillment related areas in OC retailing

The focus of this study is on fashion retailing, i.e., retailers that exclusively sell apparel and accessories or have a significant fashion share if they also sell other categories. Fashion retailers are selected for this study on steering mechanisms because the fashion segment is among the top categories in sales on multiple channels and has some distinctive characteristics that are helpful when investigating steering and fulfillment options. Traditional bricks-and-mortar fashion retailers were among the first to go online and they have the most developed configurations in terms of channel integration [Blázquez, 2014; Hübner et al., 2016c]. Furthermore, there is no absolute dominating channel (e.g., because customers enjoy buying in both channels as a leisure activity) whereas in electronics, for instance, a stronger shift towards the online channel is apparent. Among the non-food categories, fashion retailing faces certain shopping patterns that are unique (e.g., frequent shopping rather than one-time purchase, high return rates). Although fashion retailing has comparatively homogeneous fulfillment requirements for each item, different fulfillment and business models exist. For example, while Uniqlo focuses on technological differentiation, using long product development cycles and offering basics that appeal to a large consumer base, Zara, in contrast, has built a supply chain that allows it to follow fashion trends and deliver goods in near real-time [Forbes, 2012]. Finally, fashion retailers set trends in OC shopping and are key innovators in supply chain and technology developments. For example, with the aid of efficient data management, “fast-fashion” retailers operate agile and rapid international supply chains with production facilities in Asia and short sales periods in western markets [Bhardwaj and Fairhurst, 2010; BCG, 2013]. Another example is Radio Frequency Identification (RFID) that can help to better track and merge that data [Cao, 2014], especially when the consolidation of online and store

data is crucial for efficient OC logistics (see, e.g., Gerry Weber [2016]). Former bricks-and-mortar fashion retailers try to delineate themselves from retail nemesis Amazon by integrating technology into the store – for example via augmented reality in store [KPMG, 2012; GfK, 2016]. Essentially stores are repurposed towards channel convergence. For instance Burberry has equipped all of their store personnel with iPads that help to make a customers’ store experience closer to an online experience [McKinsey, 2014]. This triggers possibilities for cross-channel steering.

3. Methodology

As the OC retail literature does not provide enough insight into the practice of customer steering across multiple retail channels during the fulfillment process, an investigation into this new area of OC retailing requires a theory about how the process unfolds [Flynn et al., 1990; DeHoratius, 2011] and thus undertaking an exploratory study. Exploratory studies are appropriate to investigate the hows and whys of a little-known research area [Stebbins, 2001; Creswell, 2003]. Qualitative research is particularly appropriate to uncover currently unknown structures and processes taking a holistic approach.

3.1. Data collection

Analyzing customer steering options during the fulfillment process requires at least two perspectives, i.e., a retailer and a customer point of view. Therefore, we employ multiple sources of data for our analysis in order to provide these two perspectives. In addition we expect that using multiple sources of data provides further insights into retailers’ steering concepts, and allows for cross-checking and triangulation [Creswell, 2003]. We collected data for our study by holding semi-structured interviews with OC retailers and discussions with consumer focus groups. Quantitative market data and reports as well as discussions with other experts in the field served as a source for triangulation for the steering concepts derived from interview data.

Semi-structured interviews. We started our field research with face-to-face interviews with executives at the OC retail companies from the areas of supply chain management and sales (e.g., e-commerce-, cross-channel sales). These experts have a fundamental knowledge of design, implementation, and control of steering options from their position within the companies (see, e.g., in Flynn et al. [1990], Creswell [2003], Trautrim et al. [2012]). The aim of these exploratory discussions was to gather information and systematize structures of customer steering options actually applied in OC fulfillment without formulating restrictive hypotheses in advance. Knowledge was gained in a recursive dialog between researchers and reflective practitioners [Corley and Gioia,

Company	Sector	Number of interviews	Number of participants	Role of participants	Focus area of participants	Number of stores	Sales in Euro per year	Online since
1	Fashion	2	2	Managing Director, Section Head	Logistics, Cross-Channel	>300	>1 bn	1997
2	Fashion	1	1	Managing Director	Sales	<100	500mn-1bn	2009
3	Department store	1	1	Section Head	Logistics	<100	>1bn	2001
4	Fashion	1	1	Section Head	Logistics	<100	300-500mn	2002
5	Fashion	1	1	Section Head	Logistics	>300	500mn-1bn	2003
6	Fashion	1	1	Section Head	E-Commerce	100-300	300-500mn	2003
7	Fashion	1	1	Section Head	E-Commerce	<100	300-500mn	2011
8	Department store	1	1	Section Head	Logistics	>300	>1bn	2010
9	Fashion	1	2	Managing Director, Section Head	Logistics, E-Commerce	<100	>1 bn	2013
10	Fashion	1	1	Section Head	Sales	<100	300-500mn	1990

Table 1: Overview of participating companies

2011]. An overview of the interview questions used can be found in Appendix II. In total, 11 managers from 10 internationally active OC retailers with a focus on fashion retailing based in Germany participated in our study. We used theoretical sampling for our interviews, which took place over a period of five months, until saturation in the data was preliminarily reached [Glaser and Strauss, 1967]. Note, also further literature indicates that six to twelve interviews are sufficient to describe and explore structures for a homogeneous group of participants (i.e., managers from fashion retailers). After six interviews, any information provided by further interviewees decreases rapidly and may not contribute any more to supporting the theory [Guest, 2006]. The criteria for selection included a minimum sales volume of EUR 300 million p.a., ensuring the operation of a sufficiently large network of store outlets. The retailers chosen needed to have own outlets and be responsible for logistics and warehouse operations processes. Furthermore, the retailers had to pursue true OC retailing activities, i.e., a minimum of three years in online and store retailing, presuming that cross-channel customer steering was not a priority at the start of their multiple channel strategy. In addition, we wanted to focus on the fashion industry because it has special characteristics in terms of customer requirements (e.g., return policies) and fashion was among the first categories also sold online by former pure bricks-and-mortar retailers, so OC retailing activities have been present for some time. The target group of the study were the top OC fashion retailers from Germany. A total of eight OC fashion retailers and additionally two department stores with their own online channel and a primary focus on fashion retailing participated in our study. They represent 37% of the total sales volume of the top 30 OC fashion retailers in Germany. We interviewed managing directors and section heads in order to get the broadest possible view and the most in-depth insights. We chose the most informed and experienced experts in OC retailing who have been directly involved in the development and execution of such cross-channel systems. An overview of participating companies and interviewees is provided in Table 1.

When interviewees reported insightful incidents or experiences, we allowed for a narrative flow and did not strictly adhere to the schedule. Interviews took on average 75 minutes, and no interview took less than 60 minutes. They were always completed by at least two interviewers (four interviewers in total) to increase the level of objective analysis. Field notes were written during and immediately after interview completion, where a recording was not possible, and subsequently transcribed for further analysis.

Focus group discussions. Since customers are the object of steering efforts, it is highly relevant to analyze customers' feedback on steering efforts applied by OC retailers. This is particularly true because customers are sensitive to being directly influenced in their shopping behavior (see, e.g., Neslin and Shankar [2009]). Furthermore, customers may imply additional steering options retailers have not yet thought of.

We took the customer perspective into account in our study by holding discussions with two independent customer groups. We chose focus group discussions because they are an appropriate method of exploring information from customers on general perceptions and future expectations related to retailer's steering options [Flynn et al., 1990; Bryman and Bell, 2011; Saunders et al., 2012]. A summary of the questions used in our discussions with customers is available in Appendix III.

The selection criteria for focus group members included, being (a) the main shopper in the household, (b) an online and store customer, i.e., buying at least five times per year in each channel and (c) a customer at retailers with multiple channels, i.e., having bought at least one time at a retailer operating more than one sales channel. The two discussions lasted 70 and 100 minutes. Observation of gestures, register, display of emotions, and atmosphere during each topic of discussion were noted and the discussions were recorded and transcribed afterwards for further analysis.

The data gathered were particularly used to underpin and challenge statements from retailer interviews in the subsequent analysis. We brought together a total of 15 customers in two groups, i.e., seven and eight customers, respectively, to discuss shopping behavior across multiple channels that is related to fulfillment, without confronting them with steering methods disclosed in retailer interviews. Most of the participants were between 20 and 30 years old, whereas gender was almost equally distributed. Participants came from different geographical regions of Germany (i.e., from big cities to small villages). As OC shopping is still more important to younger customers [McKinsey, 2014] this sample gives a good first impression of cross-channel customer steering effectiveness. An overview of the focus group participants is displayed in Table 2.

	Focus group 1	Focus group 2
Participants	8	7
Age		
<20	2	1
20-30	6	4
>30	0	2
Gender		
Male	3	3
Female	5	4

Table 2: Overview of participants in customer focus groups

Primary market data. We also collected market data relating to OC logistics for triangulation. We collected primary data from the top 30 highest-grossing OC fashion retailers in Germany. Websites were scanned for customer service offers such as availability information of products as well as delivery and return offerings and cost. Other documents included strategy statements, newsletters, performance reports, and articles in professional journals (see, e.g., PwC [2013], AT Kearney [2014]). We used the documents as a secondary data source, providing insight into the context and to substantiate our constructs. Although this data was not used extensively, it helped us to appreciate the context in which systems are enacted.

3.2. Data analysis

Our inductive analysis is neither driven by deductive logic nor follows a strict grounded theory approach [Randall and Mello, 2012; Manuj and Pohlen, 2012], because “data is inextricably fused with theory” [Alvesson and Kärreman, 2007]. Internal validity was achieved through triangulation with different data sources and confirmation checks with interview partners. In a preliminary report presented at several academic conferences and at an interim presentation at one OC retailer, we showed informants our evolving analysis to get additional feedback. The organization supporting this study also organized two panels with retail experts, some of whom had also participated in the interviews, to discuss intermediate findings at different stages of analysis. This feedback was also incorporated into our findings.

During the analysis, the transcripts were reflected on and compared to create meaningful categories [Trautrimis et al., 2012]. Transcripts of interviews and focus groups were subsequently coded and categorized [Miles et al., 2013] using the transcript analysis software MAXQDA 11. The data were coded and categorized until preliminary theoretical saturation was reached [Glaser and Strauss, 1967; Corbin and Strauss, 1990], i.e., repeatability was high, and certain patterns emerged and the gain in experience from the interviews contributing to customer steering became marginal. This was our criterion for terminating the sampling and not adding more participants to the study (see also sample size in Section 3.1). In order to provide external validity of our findings,

two researchers coded the data independently of each other. This was followed by a continuous comparison of codes by all authors to come to an objective hermeneutics (i.e., an intersubjective development of interpretive patterns). At regular meetings, all authors discussed the codes, categories, themes and findings to set aside subjective impressions from only one author and come to an objective meaning of interviewee perceptions. Disagreements between the researchers were discussed until a consensus was achieved. This additional step helped to ensure the repeatability of our findings regarding cross-channel customer steering [Bryman and Bell, 2011]. If a description or view did not fit to an already assigned code, then a new code was assigned to this item. Each code was linked to a phrase from the interview transcript or recording. This enabled complete traceability from an individual code to the original source. We organized the data into first-order categories and second-order themes to facilitate their later assembly into a more structured form [Gioia et al., 2013]. We coded first-order “in vivo” data, searching for relevant words, phrases and descriptions. In total 779 distinct passages were assigned to codes and code sets. They were grouped into 13 first-order categories which are still close to what participants said during the interviews. Six second-order themes were derived from theoretically informed interpretations of the data. The data structure and thus evidence for our themes and categories is displayed in detail through quotes from interviews, focus groups, and further observations in Table 4 in Appendix I.

The next section (4) summarizes our empirical findings. The structure of this section follows the themes and categories that emerged from our data analysis. Afterwards, Section 5 reflects our empirical findings in relation to existing theory.

4. Empirical findings

This section analyzes how and why fulfillment processes can be configured to steer customers towards a specific channel using the example of fashion retailing. It first presents the back-end prerequisites for cross-channel customer steering and secondly the front-end opportunities for customer steering during the fulfillment process that can be applied by retailers. This section builds on the fulfillment areas during the shopping process defined in Section 2. Essential back-end structures that enable customer steering in OC fashion retailing are analyzed in Section 4.1. Such structures entail establishing a joint corporate organization across channel entities, creating awareness about needs and offers across channels, integrating IT systems as well as establishing adequate warehouse operations. Finally, the options to steer customers across channels by means of inventory availability information and differentiation in delivery and return options are portrayed and analyzed in Section 4.2, 4.3 and 4.4. Figure 2 summarizes the structure of this section and displays the depen-

dencies between back-end prerequisites and front-end steering options related to logistics enabled fulfillment.

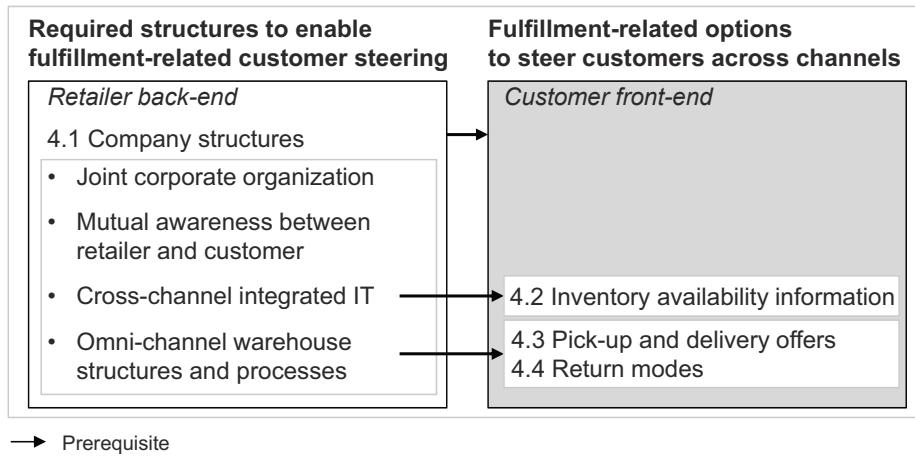


Figure 2: Overview of customer steering prerequisites and execution options

4.1. Essential company structures to enable fulfillment-related customer steering

Creating joint corporate organization. A joint corporate organization across all sales channels which is shaped top down builds the foundation for seamless OC activities and is a prerequisites for cross-channel steering.

The organization has to be shaped top down and won't work at the lower level if it is not already running at the top management level [Company 3, Section Head, Logistics].

Managers therefore have to ensure that store personnel understand that an online store also operates as an information channel and for preparation of sales to erase the myth of cannibalization, and to show that increasing sales in the online channel also leads to an increase in OC customers and thus store sales as well. The information should be shared at meetings and events with store personnel at every store to underline the impact it has for the whole company. Through the integration of sales channels, the inter-divisional mind-set, and coordination of an organization becomes more important. Store employees should receive incentives to guide customers into the online channel by getting a share of sales on orders that are initiated by the store, or when online orders are sent to the store and picked up in-store by the customer (i.e., click&collect).

OC only takes off when employees are incentivized based on revenues of click&collect, in-store ordering and shipping to stores [Company 8, Section Head, Logistics].

Creating mutual awareness of omni-channel options between customer and retailer. Retailers need to be aware of customers' requirements in order to provide opportunities for customer steering.

If retailers know what customers want, than it becomes possible to influence decision processes. Along the same lines, customers need to be aware of retailers' offerings.

Before we can steer customers, we have to get to know store customers by analyzing data collected about them [Company 6, Section Head, E-Commerce].

To be honest, I have never done that [check store availability of products online] so far and did not even know that something like that existed [Focus Group (FG) 1, participant (P) 3].

Customers should be guided to learn to use the other channel to overcome ignorance or mistrust of cross-channel offerings. Human interactions in-store that are not available online may help in those cases. For example, availability checks for store and online inventory in both channels or the possibility of deliveries from store to home for delicate or bulky items.

We use iPads in stores to show our online shop offerings. [...] They are handled by the staff and orders are conducted in the presence of customers [Company 10, Section Head, Sales].

On our Youtube channel we explain our multi-channel offers to customers and give them tips on how to buy online and pick-up products in store [Company 1, Section Head, Cross-Channel].

Creating cross-channel IT systems. A cross-channel integrated IT system is an indispensable prerequisite for data transparency and enables transactions across channels. Hence, integrated IT builds the foundation for cross-channel fulfillment. Moving from a closed IT system with few and limited interfaces between sales channels to a cross-channel IT infrastructure is necessary since separated IT systems will result in silo channels lacking a cross-channel overview of stocks, customer buying behavior, and processes in general. From a logistics perspective, separate IT systems result in a lack of inventory transparency and complicate inventory allocation. This also causes a lack of transparency for customers and possibly lower product availability if the lower flexibility in inventory allocation causes stock-outs in one channel despite surpluses in the other. Cross-channel delivery options like click&reserve, i.e., reservation of store inventory online for later pick-up, or direct refunding of online ordered goods in-store cannot be offered if IT systems are not appropriately networked.

Click&reserve is not possible at the moment because we lack real time data and the IT infrastructure for that [Company 1, Section Head, Cross-Channel].

If CRM-, ERP- and cash systems are not networked across channels it is not possible to provide an OC system that facilitates customer steering. A lack of cross-channel information sharing can even have a negative impact on retailers' performance.

When customers return products bought online in-store, they get their money back although we

are unable to see whether or not the product was paid for. We have to make adjustments here by connecting our CRM to the cash system [Company 1, Section Head, Cross-Channel].

If IT systems are merged to form cross-channel IT systems, mutual inventory management, suitable cross-channel inventory allocation as well as cross-channel distribution and return concepts become possible.

Creating warehouse operations structures and processes. The warehouse structures and operations have to be further developed to enable cross-channel steering. Warehouses of OC retailers can be either separated by channel and location or integrated where inventory for the online channel and the store channel are consolidated (see Figure 3). With integrated warehouse locations, retailers avoid a potential surplus of an item in one channel while it is out-of-stock in the other. A common inventory across channels reduces shortage and disposal costs as well as overall inventory levels, storage space and transshipment costs. Integrated warehouses require adjusted infrastructure, resources and know-how for cross-channel picking of orders to handle store (i.e., full palettes or cartons) and single customer orders (i.e., single items) efficiently.

Schematic illustration



Figure 3: Warehouse structures in OC retailing and implications for customer order steering

To support customer steering in terms of processing velocity, OC retailers with separated warehouses (see left part of Figure 3) can only prioritize orders if IT requirements are given for a firm-wide inventory and order transparency exist such that order lead time can also be differentiated across the different warehouse locations. However, the focus of the following discussion will be on warehouse operations in joint warehouses for the online and store channel. OC retailers with integrated warehouses (see right part of Figure 3) need to manage joint inventories and joint picking processes across channels. Furthermore, integrated warehouses require defining processing priorities, as the different channels share inventories and picking capacities and orders may arrive at the same time. The implementation of such rules enables OC retailers to differentiate among customers or channels with regard to product availability and delivery velocity. Additionally, adjustments in

the warehouse processes are necessary to enable shorter order lead times. This is because the actual transportation is usually outsourced to a logistics service provider (LSP). Hence, retailers can only reduce order lead times by themselves by preparing an order and commissioning the LSP faster.

OC retailers usually prioritize their online over store channel through reservations and earlier processing in the warehouse because, products ordered online are already sold to the customer while store orders are only for replenishment.

[...] online is prioritized before bricks-and-mortar during the picking process, because the online item is already sold and we can refer to alternatives in store [Company 2, Managing Director, Sales].

Store orders are not that urgent as these generally concern only supplementary orders and replenishment of stock [Company 10, Section Head, Sales].

Further prioritization are made by customer type (e.g., loyalty card owners before others) or by delivery mode (e.g., express before standard delivery).

We identify three different options to adjust warehouse operations allowing for order prioritization in integrated warehouses. Retailers can (1) rearrange the picking list, (2) use reserved time slots for picking, or they (3) pick more frequently in smaller batches, allowing a more flexible scheduling.

(1) Prioritized picking list. In the warehouse, orders are sequenced for picking. Thereby items and thus orders can be re-prioritized, whenever a picker has completed his current job. If the picking procedure is done separated for the different channels, then the picking list can be prepared by using segmentation rules for customer types. At channel-integrated picking, channel segmentation rules can be applied on top of customer segmentation rules.

(2) Prioritized time slots. OC retailers can reserve time slots for certain orders just before the cut-off time for pick-up of online orders at the warehouse by LSPs. Figure 4 displays a scheduling and picking example. At (a) certain time slots during the day are always reserved for priority order picking. At (b) the time immediately before the cut-off for online orders is typically reserved for online order picking or prioritized online orders.

This enables prioritized orders to be handled in a reserved time slot for immediate shipping afterwards. It guarantees that comparably late orders are shipped on the same day and, depending on the retailers warehouse locations, delivered on the next. Thus, a high delivery velocity can be guaranteed for example for online orders, which is in line with customer preferences and can help if customers should be steered into the online shop.

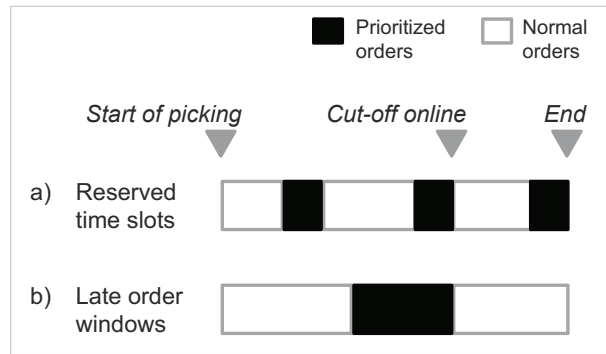


Figure 4: Picking with prioritized time slots

Our delivery usually takes 24 hours, and we guarantee delivery within two days to any address in Germany [Company 9, Section Head, E-Commerce].

The late order windows can, however, also be dedicated to a certain delivery option, which is favored, e.g., store pick-up for steering customers into the store. Besides delivery velocity advantages, the reservation of dedicated time slots also creates stability for the daily picking and capacity plans. As sales volumes peak in both channels at the weekends, an accumulation of processing jobs occurs at the beginning of the week. Through prioritization of orders, capacity can be balanced, e.g., if online or pick-up orders are picked immediately due to the higher velocity requirements and regular store orders can be postponed.

(3) Smaller batch size. Customer orders are batched to allow for fast processing of prioritized orders. Retailers can schedule smaller batches in short intervals instead of bigger batches in large intervals. Because of the smaller batch sizes the picking system is much more flexible and is thus able to schedule a prioritized order before a regular order, even if the prioritized order is received after the regular order, right before the closure of the batch.

Picking more frequently in smaller batches allows for order prioritization without sacrificing too many standardization effects, resulting from the picking of units in batches - instead of picking every prioritized order separately. [...] Therefore, a high-priority order does not have to completely bypass the automated process [Company 10, Section Head, Sales].

This can also lead to postponement of regular orders into a later batch, which is perhaps not processed until the next day. However, the prioritization results in additional costs for picking because of smaller batch sizes and thus longer average picking distances due to the higher heterogeneity of items.

Summary of essential structures that enable customer steering. Summarizing, OC retailers need to promote not only a joint corporate organization but also create mutual awareness between customers

(requirements) and retailers (offers). With cross-channel IT systems, fulfillment processes across channels are supported. They enable cross-channel inventory information. Moreover, adequate warehouse operations with priority and allocations rules are a prerequisite for steering customers through the channels using a faster delivery process. All of the following steering options in the front-end fulfillment process require those essential back-end OC structures.

4.2. Using inventory availability information to steer customers across channels

To ensure accurate inventory allocation and communication of inventory information, cross-channel IT systems are an absolute imperative for this method of steering. By leveraging inventory information customers can be influenced in their channel choice and steered through the different sales channels. This can be achieved by cross-channel inventory availability checks which display stock information to the customer (see 4.2.1) and additional product or substitution recommendations (at non-availability, see 4.2.2).

4.2.1. Displaying inventory availability across channels

Figure 5 structures the different types of steering options through (cross-channel) availability information from a store and online shop perspective. In the online shop, availability is either displayed only for online items or for both, online and store items. Similarly, availability can be checked in-store for store inventory or for online inventory.

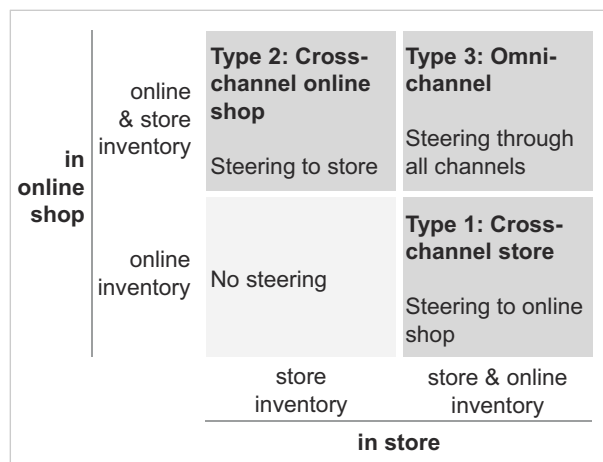


Figure 5: Inventory availability check options for the online and store channel

While no inventory information across channels does not allow for customer steering through inventory information, three steering types can be identified if cross-channel inventory information is available in at least one channel. The different types are characterized in the following paragraphs.

Type 1: Cross-channel store. Type 1 displays cross-channel inventory information in the store for the online shop. This offers the opportunity to guide customers into the online shop.

Customers can be steered to the online shop [...] by displaying online availability in-store [Company 7, Section Head, E-Commerce].

This is especially relevant for retailers who want to popularize their online channel to boost online sales. Customers can be made familiar with the online offerings and customers' future visits of the online shop become more likely. For the retailer the availability check for the online shop assortment acts as a virtual extension of shelf space of the store. Customers can then benefit from a broader and deeper assortment, while they get simultaneously personal guidance and advice from store personnel. In-store access to the online shop can also bring the customer benefit of a more convenient delivery mode, as purchased items not need to be carried home.

I like that if I go to a store and want to buy more than a few items I can order them in the store [from online stock] and they are send to my home afterwards. This way I don't have to carry them home [FG1, P7].

Four options of implementation can be distinguished. First, retailers can set up terminals that the staff uses to enter the online shop in the store. The staff can thereby guide the store customers into the online channel. However, the customers do not have direct access to online availability information. Second, these terminals can be set up for the customers to inform themselves about the online offers. Drawbacks include high initial investments for terminal setup and that customers may need to enter personal data in public. Moreover, terminals often do not result in completing a sale and are often only used by employees and not by customers. Third, with wireless Internet in stores, customers can use their own device to shop online in-store. It offers cheap and low installation effort but also enables a direct price comparison and increases the risk of migration. This can be avoided if other websites beside the own online shop are prohibited. Finally, tablets can be acquired for stores which are used by employees who guide customers through the shopping process. Investment costs are moderate, it leads more often to a completion of sale because of a guided shopping process and it forces customers and employees into sales conversations.

The staff utilizes terminals to extend the store's range of products and to indicate additional offers [...] in the online channel [Company 2, Managing Director, Sales].

We steer customers from the store to the online shop through our availability check in-store for the online channel using iPads [Company 3, Section Head, Logistics].

Type 2: Cross-channel online shop. In type 2 cross-channel inventory information is displayed in the online shop for the online shop and the store, which offers the opportunity to influence customers in their channel choice and guide them into the store. Customers appreciate this inventory information on store items and are drawn to the store.

With our online availability check for stores we try to bring customers into the store [Company 8, Section Head, Logistics].

I like to search at home precisely where to buy what, so that I don't need to run into three different stores [FG1, P6].

The retailer has the opportunity to popularize his store outlet and cross-sell products through a direct sales talk. More than 50% of the top 30 OC fashion retailer websites in Germany that were researched display store availability of a product online. Four options of implementation can be distinguished. First, retailers can show only available items and hide unavailable products on the website. The advantage of this option include no migration due to unavailability and no need to recommend a substitute. But it is also not a true availability check as everything online is per definition available. Second, unavailable products are marked as not available. It only provides information that customers really need, i.e., is this product available or not. As it does not indicate any information about the number of products left at the store, this option might lead to dissatisfied customers if they go into the store only to find that the product is now sold out. The threshold for availability therefore should be set high enough to make such situations unlikely to happen. Third, traffic lights (i.e., green, yellow or red marking of items) can be implemented which show a direction of availability but not the precise number of items remaining. Thus, retailers can use scarcity (items in yellow) as a method for steering customers towards a specific product or channel. On the other hand, indicating scarcity for the physical store can result in customers not going to the store as the perceived risk of unavailability in store is too high. Fourth, retailers can display the exact number of items left in stock. This option especially makes sense if customers typically buy more than one item of a product, as in fashion retailing for socks or underwear. The pure numbers, however, do not correspond with the probability of an item being sold out when a customer is in the store. Nevertheless it is the most transparent availability information. Fashion retailers have difficulties providing such availability information as they have items dispersed in the sales area and fitting room. The usage of RFID technology may help to better track store inventory.

It is hard to track real front-end availability as items could be left in the fitting room and therefore the customer cannot find them it and is dissatisfied [Company 8, Section Head, Logistics].

Type 3: Omni-channel. In type 3 OC retailers introduce information for online and store inventory in the online shop as well as in the store. Customers are provided with a transparent assortment and can choose the channel to buy from. They are guided through the channels in order to stimulate the usage of multiple channels during the buying process.

This [online check for store inventory] provides the opportunity to make a store's assortment range transparent to customers [Company 10, Section Head, Sales].

We provide cross-channel availability checks online and in the store. [...] Online customers should know about direct availability in-store if they purchase online [Company 9, Section Head, E-Commerce].

Options of implementation include all of type 1 and 2 with the same benefits and obstacles discussed above.

4.2.2. Recommending product substitution when product is unavailable

All retailers strive for high availability rates on both channels. Customer satisfaction is the primary goal and outweighs minimizing inventory cost because margin losses in fashion due to stock-outs are usually greater than the additional logistics cost.

Customer satisfaction is our No. 1 concern. We accept high inventory for an even higher on-time in-full quota [Company 6, Section Head, E-Commerce].

The target on-time in-full quota of participating retailers was more than 95% on average. In order to achieve this, retailers apply different flows of goods to increase availability and build agile logistics, e.g., drop shipments from supplier, transshipments between stores to exchange inventories or direct shipment from outlets to customers.

However, if something is unavailable, three different options for substitution exist: a different product in the same channel, the same product in a different channel or a different product in a different channel. The first option is the classical form of substitution. In the online-shop *recommendation engines recommend substitution products* [Company 1, Section Head, Cross-Channel]. The same is done in the physical store by sales personnel. As a result, customers buy a substitution product instead of leaving the online shop or store empty handed.

If I need something immediately, I go to a store and either buy the product or a substitute [FG1, P2].

The two further options, however, steer customers across channels. They require cross-channel stock information where front- and back-end solutions are interlinked. In-store, the staff uses terminals and tablets to recommend substitution products to the customer. The same options can be used as

in the cross-channel store type of the availability check discussion (type 1). On top, store personnel offers to send a product not in stock in the store from warehouse inventory directly to the customer's home. In the online shop inventory information can be displayed for online and store products to see directly where the product is available. When a product is unavailable in the online shop, the nearest store is displayed where the product can be picked up. This transparency increases the flexibility for the customer. If the same product is not available in either of the channels, product substitution can be also leveraged within and across channels. This again enables retailers to bring customers to the other channel.

4.3. Using different pick-up and delivery offers to steer customers across channels

In order to enable customer steering by design choices in delivery, logistics processes have to be interconnected across channels. OC retailers offer their customers home delivery and store pick-up of goods ordered online. While home delivery is associated with the online channel, store pick-up increases customer frequency at the outlets. These delivery modes can be offered at a specific cost and velocity. The combinations chosen for the different delivery modes can thereby help to make a certain mode more attractive for customers and steer them into a specific channel. Regarding delivery velocity we can distinguish between same-day, next-day or delivery on a later day. Today fashion retailers try to guarantee next-day delivery for orders that are placed by a certain cut-off time. The steering potential for retailers offering guaranteed next-day instead of a later-day delivery is therefore limited. However, as long as next-day delivery is not guaranteed by every retailer and as long customers perceive a next-day service as a quick mode of delivery, steering potentials arise. Same-day delivery service is of course even faster, but currently not a required service in fashion retailing [Essen and Leeuw, 2013]. In terms of cost, various conditions can be thought of and customers can have different cost thresholds for their preference of a certain delivery mode. As our goal is to depict the basic steering designs and directions we stay on an aggregated level and distinguish between delivery free of charge or at cost. Figure 6 summarizes the different velocity- and cost-configurations for the two major delivery modes that guide the customer towards a certain channel, depending on the composition of attributes. The distinct options for customer steering through a combination of those fields are described in the following. Note that the offer of store pick-up itself can already be seen as a steering option as it promotes the store channel, but the specific velocity- and cost-conditions can reinforce or undermine the effect.

4.3.1. Differentiating the costs by delivery mode

Orders can be delivered free of charge or at a cost to a customers home or to a store for pick-up.

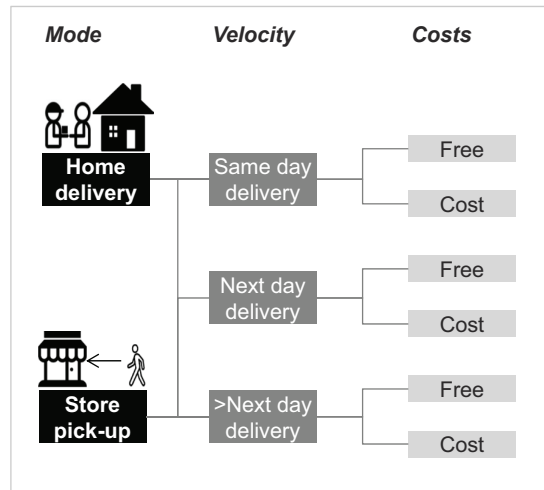


Figure 6: Delivery mode, velocity and costs

Supporting store pick-up. It is possible to boost in-store pick-up by offering it for free and home delivery at a cost to the customer. Although store pick-up incurs the same cost as home delivery for most retailers because both order types are sent via regular mail, home delivery comes at a cost at 80% of the OC fashion retailers interviewed, while store pick-up is free for customers. Retailers want customers in their store because of the opportunity for sales talk and cross-selling by store personnel.

Standard shipping costs of EUR 4.20 steer customers towards cost-free click&collect, which increases cross-selling potential in stores [Company 5, Section Head, Logistics].

According to our own market research, the average cost for delivery of a standard package to a customer's home is EUR 3 on average, while a fee for pick-up in-store is not charged at any of the 30 OC fashion retailer websites in our sample. Still, customers are not always drawn by that. It depends on the distance to and from the store, and whether the avoidance of the trip is worth the fee.

If the store is within 15 minutes from me, I would save the five euros and quickly go to the store [FG1, P7].

A widespread store network is therefore essential to enable this method of steering, such that a large proportion of customers can benefit from a free pick-up offering and the additional advantages of in-store pick-up. These include trying on apparel, obtaining support from store employees, or even the option of directly exchanging the item if it does not fit or appeal to the customer.

Supporting home delivery. The opposite steering direction is also possible by popularizing the online shop by offering free home delivery. According to our research of OC fashion retailers websites,

free home delivery without a minimum shopping basket value is offered by 23% of retailers, and an additional 27% offer free home delivery in combination with a minimum order value. For customers free home delivery is a very convenient delivery option, which offers them the opportunity to shop from home without running the risk of unnecessary delivery-cost expenditure in case of a product return. It also saves the trip to the store.

If home delivery is free of charge I don't have to go the store [to save delivery cost] [FG2, P3].

Retailers benefit from additional online sales, but have to ensure efficient processes at the warehouse to be able to compensate for the margin loss because of the missing revenues of the shipping fees, if they want to profit from their free delivery offer. On top of this, retailers have to consider the basic customer requirements of home delivery, which include tracking of parcels.

Tracking of an online order is an imperative to me. The easiest way is to get an e-mail after order completion where I can directly click on the tracking number and be redirected to the tracking page [FG1, P7].

4.3.2. Differentiating the velocity by delivery mode

Delivery can be made on the same day, on the next day, or on a later day to a customer's home or to a store for pick-up. Thus, even if retailers do not raise costs for home delivery and store pick-up, customers can still be steered towards a certain channel by adjusting the delivery velocity. Regarding the issue of steering by delivery velocity, the only thing that can be arranged by the retailer themselves is a faster provision of an order, as the actual delivery is typically outsourced to an LSP. Therefore an additional imperative for differentiation in delivery is to apply prioritization rules in order processing.

Supporting store pick-up. One instrument for increasing delivery velocity is reducing the lead time for order provision. If an online order can be assembled completely from store inventory, the lead time for pick-up can be reduced to only a few minutes. Hence, customers who need the items they ordered quickly can be guided to the store.

I would choose the store delivery option if I could pick it up directly after my order because home delivery is sometimes too slow [FG1, P5].

However, it is especially difficult for fashion retailers to provide click&reserve from store shelves because articles may not be on at the allocated place on shelf due to customers taking them to fitting rooms, leaving employees (and customers) in front of empty shelves despite the IT system saying that there is one more item available in store. This is one of the reasons why fewer than

10% of the top 30 OC fashion retailers in Germany offer direct pick-up after order completion from store inventory. If the order cannot be assembled from store inventory, than prioritization in the warehouse is necessary to enable customer steering into the store. Online orders for pick-up are then prioritized in the warehouse, enabling faster processing and thus leading to a guaranteed pick-up possibility the next day at the local store. Customers then profit from a guaranteed availability at the store and can also use the additional advantages of physical stores like personal advice, direct try on and possible exchange.

Supporting home delivery. High velocity for home delivery can steer customers into the online channel. Over 30% of the top 30 German OC fashion retailers offer faster than standard delivery, and thus a diversified way of getting the product to a customer's home. This does not mean that the order is received by the customer on the same day in all cases, the fastest option is of course same-day home delivery. OC retailers can exploit their decentralized structures by fulfilling orders directly from local store inventory, thus enabling faster home delivery.

Utilizing store stocks for same-day deliveries of online purchases exploits the advantages of decentralized structures [Company 9, Managing Director, Logistics].

However, same-day delivery to a customers home is currently uncommon in Europe. According to our own market research, only one of the top 30 OC fashion retailers in Germany offer same-day home delivery. Even in the US and Australia no more than 10% of all retailers offer it as a delivery option [Essen and Leeuw, 2013]. The question of who bears the cost remains open. If customers pay for this service they get prioritized in order processing to enable faster delivery. Some retailers claim that as prioritization results in additional planning requirements, process complexities and costs only paid privileges are beneficial (e.g., express before standard delivery). Nevertheless a guarantee for next-day home delivery can be an option to steer customers into the online channel, as it is a quick and convenient way of getting a product. For a lot of customers this delivery velocity is sufficient.

If I need my product faster than on the next day, I go to a local store [FG2, P6].

If cost and velocity differentiations are used simultaneously, the steering effects described intensify if one mode of delivery is both cheaper and faster. If one mode of delivery is faster and another one cheaper then the effects of steering into a certain direction can cancel each other out.

4.4. Differentiating the return modes to steer customers across channels

Return prevention is a relevant topic for fashion and fashion-related retailers, with online purchases. If the return quota is very low (i.e., below 5%), meaningful descriptions and pictures of items, benchmark items, and measurement charts can be sufficient to prevent returns.

We even accept articles for return that have not been bought at our department store [Company 3, Section Head, Logistics].

However, if the return quota is up to 20%, which is not uncommon in fashion retailing (see, e.g., Bower and Maxham [2012]) retailers begin to build up process-related obstacles for returning items and start to provide incentives for no returns. For example, they have customers print out their own return label autonomously, have them register a return or reward customers via their loyalty program for “no-returns”. Especially when the return quota for individual customers is higher than 20%, retailers *do not allow too many different sizes of the same article to be bought at once* [Company 9, Managing Director, Logistics]. To prevent customers from wearing a garment once and then returning it, *stickers are attached to the garment that have to be undamaged to permit return of the garment* [Company 4, Managing Director, Logistics]. All retailers strive to organize return handling efficiently.

Therefore reducing the return quota and ensuring fast and efficient return processes are the main objectives of the OC retailers in this domain. These two objectives can also be supported by steering the customer to a return mode which favors one or both of the objectives. We distinguish between two major return modes: in-store and via LSP, whereby the latter is attributed to a common online channel return. Thus, retailers can either support or discourage in-store returns.

4.4.1. Supporting in-store returns

Almost 70% of the top 30 German OC fashion retailers offer free in-store returns on their websites. Retailers actively support in-store returns to steer customers into the store. The return in-store is usually free for customers, even though only a small percentage of retailers can incorporate the returned items into store inventory. Most retailers have to send returned items back to the warehouse and cover the cost. By charging a fee for returning items by mail, customers are steered into the store. Moreover, retailers use printed notes with a map in the parcel that display the nearest store for possible return and exchange or encourage customers to call the service hotline to return in-store.

Our customer service encourages customers on the phone and online to return products ordered online in-store to be able to directly offer a substitute in another size or color [Company 6, Section Head, Cross-Channel].

One reason for promoting in-store returns is return prevention. As the rate of real exchanges (e.g., a red t-shirt for a blue t-shirt) instead of pure “money-back returns” is higher in-store, due to the possibility for a sales conversation, retailers like to have customers come into the store to return an item.

An in-store return is preferred over a mail return because we can immediately recommend an alternative product [Company 10, Section Head, Sales].

In addition retailers have easy access to important information about the reasons for the return when products are returned in-store. This information can help to advance return prevention in the future. Another reason for favoring in-store returns is the cross-selling potential that increases with an in-store return.

Of course we want customers to return their products in-store because that provides direct cross-selling potential [Company 7, Section Head, E-Commerce].

For some retailers operational efficiency is also a reason for in-store returns. Some fashion retailers, for example, only offer returned products in-store, as online customers are more demanding and do not accept any sign of previous product usage. In-store returns allow retailers to save transportation costs and to guarantee a quick reintegration into store inventory. Rapid reintegration is also a reason for other retailers to promote in-store returns, although the handling effort is typically more expensive in-store than in the warehouse.

Directly reworking returned items in stores and integrating the products into our store inventory is the fastest option to get the returns back into our marketable inventory. As we have established lean in-store return processes, it is the most efficient option for us [Company 9, Managing Director, Logistics].

However, if products have to be reworked (e.g., cleaning, ironing), the retailers have to have enough space and capacities for such operations in-store to be able to use the benefits. Customers profit from a free return option. In-store returns may be also more convenient if customers do not have to repack the items, but can hand them directly to the store personnel. Additionally the possibility of a direct exchange instead of a reorder not only saves process cost and generates revenue for the retailer, but is also convenient for the customer.

If the store is as close to me as the next post office, I would return it in-store to save time packing it up as a parcel [FG1, P2].

I like to return products in-store because I can get a direct replacement and don't have to wait a couple of days [FG1, P3].

4.4.2. Discouraging in-store returns

Retailers discourage in-store returns of online purchases to steer customers to a return via LSP. LSP return is then usually offered for free and the possibility of in-store returns is not actively advertised. The additional effort at the outlets, refunding issues, and IT requirements are reasons why retailers hesitate to promote in-store return processes. Some retailers with high online sales volume see losses in process efficiency when products are returned in-store.

The option to return in-store may both be advertised but is often appreciated and used by the customer. However, it makes a negative impression on other customers in-store and on the store layout if returned items are laying around [Company 2, Managing Director, Sales].

In-store return processes for items bought online are more complicated than for postal return [Company 7, Section Head, E-Commerce].

Efficient return processes for retailers are established at warehouses or external return centers. The faster the return arrives at the warehouse, the faster the products can become part of the online inventory again. Nevertheless, in most cases in-store returns are possible and retailers consider this a basic service requirement, but the customer is not informed about this option. From a customer perspective free returns via LSP saves money and make the customer independent from store opening hours. As LSPs offer a wide range of return pick-up locations this is also a convenient way to return orders, although the items have to be packed up into a parcel.

4.5. Summary of fulfillment design options to steer customers across channels

Summarizing the empirical findings above, leveraging logistics and fulfillment options for customer and order steering include influencing the channel choice, the mode of delivery and returns. The results are summarized in Table 3.

To leverage steering opportunities OC organization and business processes including logistics and IT systems as well as mutual awareness of customers preferences and retailers offers are necessary. Cross-channel IT systems allow retailers to steer customers into the store by providing an online availability check of store inventory. The same is possible in the other direction when online inventory is checkable in-store. By recommending substitution products when a product is unavailable customers can also be guided to other channel. When a fee is charged for home delivery but in-store pick-up is free, customers can be steered into the store and vice versa. Rapid order provision for in-store pick-up brings customers to the store as well, while fast home deliveries (same-day, next-day) can steer customers to the online channel. Retailers can promote in-store returns to steer customers to the store, or discourage them if LSP returns are preferred. In-store exchanges instead of money-back returns online are initiated and cross-selling potentials exploited

Table 3: Summary of empirical findings

Fulfillment area	Mode of steering	Direction of steering	Rationale for retailer	Benefit for customer
Inventory information	Availability check / substitution possibility online for store	Into store	Popularize store; cross-selling opportunities for sales personnel	Transparency of channels; try on and ask questions
Inventory information	Availability check / substitution possibility in store for online	Into online shop	Popularize online shop; cross-selling by recommendation engines; extension of shelf-space	Transparency of channels; no carrying home; see more products online
Delivery	Cost for home delivery; free pick-up in store	Into store	Popularize store; cross-selling opportunities for sales personnel	Free delivery option; product try out and ask questions; direct exchange possibility
Delivery	Free home delivery	Into online shop	Popularize online shop; cross-selling by recommendation engines	Free delivery option; saves trip to the store
Delivery	Same-day pick-up in-store; >Next day home delivery	Into store	Popularize store; cross-selling opportunities for sales personnel	Fast delivery option; product try out and questions; direct exchange possibility
Delivery	≤Next-day home delivery	Into online shop	Popularize online shop; cross-selling by recommendation engines	Fast delivery option; saves trip to the store
Return	Cost for LSP return; free return in-store; in-store return promotion	Into store	Exchange instead of money-back return; cross-selling and recommendation; potentially logistics efficiency and integration speed	Free return option; convenient return (e.g., no repacking); direct exchange of product
Return	Free LSP return; no in-store returns	Into online shop	Possibly increased return handling efficiency and reintegration speed	Free return option; not dependent on store opening hours

in-store or online. Furthermore, participating fashion retailers confirm that cross-channel customer steering stimulates SC to OC customer development, which leads to higher loyalty and more sales.

OC customers are the most valuable and most loyal [...] Pure online customers are [...] less loyal. Pure bricks-and-mortar customers are loyal, but with lower average revenue [Company 3, Section Head, Logistics].

The customers with both the highest total sales volume and the highest average sales per purchase are of course customers who shop across multiple channels. They are by far more valuable to our company than single channel customers [Company 1, Managing Director, Logistics].

In conclusion, customers can be steered into the channel which favors logistics efficiency, or into the channel which the retailer wants to popularize. The customer is offered transparency between channels, help with product search and provided with faster, more convenient or free modes of delivery and return. Thus, cross-channel steering options will not only result in benefits for the retailer, but also for the customer.

5. Discussion

Theory (e.g., Danaher et al. [2003], Kumar and Venkatesan [2005]) and practice (see Section 4) have identified that multiple-channel shopping is beneficial for both retailer (i.e., higher sales) and customer (i.e., broader service choice). To obtain the potential in a first step, retailers are integrating their channels at the front end (e.g., Cao [2014]) and back end (e.g., Hübner et al. [2016c]). In a second step, retailers are beginning to use their integrated channel structures for cross-channel customer steering to generate higher sales and improve operational costs and customer service. According to the criteria of Corley and Gioia [2011], empirical research is especially

appropriate as the new ideas in management that have been put into practice have come from practice rather than from academia, which is also true for our question regarding customer steering. Despite being a relevant and innovative topic in practitioner-oriented publications (see, e.g., PwC [2013], BCG [2014], EY [2015]), little research has yet looked into cross-channel customer steering opportunities. Customer steering to the online channel has so far only been analyzed in marketing literature (e.g., Herhausen et al. [2012]). The new contribution of this study is first of all the cross-channel customer steering itself (despite customer steering in a single channel), and secondly that fulfillment and logistics-related options can contribute to this effort as well. Despite the fact that customers ultimately cannot be controlled in their channel choice and enjoy flexibility, we identify opportunities for guiding them subtly towards the direction of a specific channel.

We discover that retailers influence customers in their channel choice through by inventory information in a specific way and differentiating delivery velocity, mode and cost as well as return options. This requires developed OC structures to enable fulfillment-related customer steering. The steering methods that we analyze are effective because they mostly establish a win-win situation for the retailer and customer. They are directly applicable by OC retail managers and other organizational practitioners (see summary in Table 3 above).

The main findings of the current study are discussed as follows. First (1) we discuss the structures required to enable fulfillment-related customer steering options. Afterwards (2) the fulfillment-related options for steering customers across channels are discussed in more detail.

(1) Structures required to enable fulfillment-related customer steering. First, a joint corporate organization is necessary and retailers should work to shift corporate culture towards a mutual understanding of channels [Cao, 2014; Lewis et al., 2014]. We enhanced this understanding and identified ways to overcome channel conflicts. Building a joint corporate culture requires incentives and communication. Incentives are needed for staff to cooperate within the given structures, such as giving store sales staff a share of sales on online orders initiated by the store or picked up in-store, as well as communication, such as explaining that an online store also serves as an information channel and for preparation of sales for the stores. Second, knowledge sharing and customer education is a further prerequisite for customer steering [Steinfeld et al., 2002; Cao, 2014]. We identify that in some cases customers are not aware of retailers' offerings and mistrust the companies' abilities to master technologies. Our findings emphasize that concrete methods (e.g., tablets in-store for online assortment or an online traffic light availability check for store inventory) are required to familiarize the customer with retailers' cross-channel offerings. Furthermore, OC retailers build up cross-channel IT systems to make the channels more transparent for the customer (e.g., Oh et al.

[2012], Cao [2014], Mahnke et al. [2015]). Our findings confirm these observations. In addition, we can extrapolate from our findings that a lack of cross-channel information sharing can have a negative impact on retailers' OC sales, customer service offers as well as cross-channel delivery and return processes. Finally, integrating warehouses and picking systems described in literature (e.g., Cao [2014], Hübner et al. [2015], Hübner et al. [2016c]) is a first step for OC retailers. It is necessary to leverage those systems for a second step, which is cross-channel customer steering during the fulfillment process. We extend the technical realization of warehouse operations and especially order picking by conceptualizing concrete methods of enabling prioritization and thus customer steering. In our empirical findings, we focus on channel-integrated warehouse structures and highlight the importance of prioritization for fast delivery. We elaborate on the logistics configurations necessary in the warehouse to actually implement prioritization. To prioritize a specific channel or customer order, retailers can reserve dedicated time slots in job sequencing for prioritized orders, such as handling picking complexity in channel-integrated warehouses. We further show that these integrated time slots are also a prerequisite for cross-channel customer steering by means of delivery configurations. Moreover, we discover that smaller batch sizes in picking allow flexible scheduling of prioritized items and orders but can result in higher picking distances.

(2) *Fulfillment-related options to steer customers across channels.* Cross-channel inventory availability information is appreciated by customers and can encourage a buying decision [Neslin et al., 2006; Verhoef et al., 2007; Oh and Teo, 2010]. Transparency can be increased by either providing an online check for store inventory that provides opportunities for steering customers into the store, or – if products are not available in-store – to the online channel for a substitution purchase. We systematize the configuration options by structuring them in two dimensions and provide concrete design options for enabling cross-channel availability checks and customer steering. In-store terminals, free wireless Internet and tablets can be used to make product availability in the online store visible (see also Cao [2014]). Guided inventory information provided by store employees with the help of tablets is identified as an especially suitable lever for realizing inventory information transparency in-store. We emphasize that new technology such as RFID can also help to track availability in-store. The advantages and disadvantages of the different design choices are analyzed from a retailer and customer perspective. We found that these steering methods are effective because they create value for both retailer and customer. When customers come into the store after checking availability online to try out and ask questions about the product, store personnel can cross-sell additional products during the sales conversation, thereby creating mutual benefits.

New delivery modes such as direct in-store pick-up of items previously bought online reinforces

the strengths of the physical store resulting in higher store traffic and a fast way of obtaining a product [Gupta et al., 2004; Cao, 2014; Gallino and Moreno, 2014]. In our empirical findings we confirm the importance of store pick-up and delivery velocity in OC retailing and conceptualize how cost and velocity configurations for the OC delivery modes home delivery and store pick-up can be used to steer customers through channels. Delivery offerings influence customer decision making and make it possible to steer customers to a specific channel. We conceptualize and analyze the different delivery offerings with regard to their steering direction along the dimensions of delivery mode, velocity and cost. Cost-free pick-up paired with home delivery at a cost steers customers to the store. This can lead to mutual benefits as customers get a cost-free delivery option while retailers have the opportunity for sales conversations and thus potential for sales conversions. The contrary steering direction of offering cost-free home delivery may also provide benefits for customers and retailers, especially for those that strive to popularize their online shop. Guaranteed next-day receipt of products ordered, either at home or via store pick-up can promote the respective delivery mode and help to steer customers to the online shop or physical store. In summary, the steering methods in terms of delivery options are particularly effective because a win-win situation for retailer and customer is created.

Like Neslin and Shankar [2009] as well as Kollmann et al. [2012] we emphasize that steering customers into the store for a return enables more exchanges of items instead of pure money-back returns, which is desirable from a customer perspective as they perceive a broader service choice and from a retailer perspective because of lower net sales losses. However, our analysis enhances their findings as when in-store return processes are not smoothly integrated, additional operational efforts thwart this effect. As a result, return handling effort and reintegration speed are reasons why not all retailers support in-store returns but instead discourage them, e.g., by not actively advertising this return option. In line with the findings of Hübner et al. [2016a], the preferred return mode depends on the retailer's structural conditions, and the steering direction can change accordingly. Effective customer steering by altering return options can therefore incur mutual benefits for retailer and customer.

To sum up, our retail practice perspective on theory building leads to a unifying dimension that can account theoretically for both scientific and pragmatic value [Corley and Gioia, 2011]. It offers not only original insights into cross-channel customer steering but also insights that are valuable for advancing ideas with a practical dimension, where retail practice informs theory and vice versa. Our findings are applicable to OC retailers who want to make the best out of their multiple channels in terms of both sales and customer service. Fulfillment and logistics can contribute to that. The

research is revealing in that our findings are unconventional and surprising (i.e., fulfillment methods being used as cross-channel steering options) [Mintzberg, 2005]. More precisely, it changes the general perception that customer steering is the responsibility of the marketing department alone. It shows that overall fulfillment and logistics practices can contribute to customer cross-channel steering. Furthermore the research is useful for retailers as it improves the current managerial practice of organizational practitioners (e.g., bringing customers to the store by offering cost-free pick-up but home delivery at a cost).

6. Conclusion and future areas of research

With interconnected sales, communication and logistics channels, OC retailers are beginning to use these connections to their advantage to influence customer decisions. Our research focuses on how OC retailers enable cross-channel customer steering during the fulfillment process and the reasons behind various options. According to our research review, there are few insights on the topic of cross-channel customer steering, which led us to adopt a qualitative, interpretative approach by interviewing expert fashion retailers and customer focus groups. We first discussed the back-end prerequisites for interconnected channels to enable steering, especially IT systems and warehouse and logistics structures. Then, we analyzed how customers of OC retailers are steered through and into specific channels alongside the fulfillment process steps of product availability information, delivery and return. Furthermore, we provided concrete motives for customer steering into a specific channel and through the channels. Afterwards the results were discussed in the light of literature from related fields of study.

We contribute to the theory of customer steering through multiple channels. Our paper differs from the small body of empirical literature on customer steering (i.e., Myers et al. [2004], Herhausen et al. [2012]) by primarily taking a logistics and fulfillment perspective and focusing on cross-channel guidance and steering. We focus our analysis on the fashion industry because customer steering is a further development step for retailers who have well-integrated channel structures that are already sophisticated, leading to frequent shopping events and significant sales in both channels. We show that by choosing among different fulfillment options, OC retailers can guide customers into a specific channel, which leads to more customers buying across channels. This has advantages for retailers (e.g., higher sales) and customers (e.g., better services). Hence, as a complement to other studies (e.g., Myers et al. [2004], Herhausen et al. [2012]) steering approaches not only offer differentiation and cross-selling potentials for retailers but also additional value for customers. Moreover, we contribute to an understanding of how logistics and fulfillment options

can be leveraged for customer management in OC retailing.

Furthermore, this paper offers guidance for operations managers who want to direct customers through their channels. The suggestions can be easily adjusted towards a retailer's channel preferences. For example, availability checks online for store inventory can attract online customers into the store. Promoting the online channel by offering fast delivery options can be managed by prioritizing online orders using reserved time slots, late order windows and small batch picking. If retailers like to increase store attractiveness, free pick-up and return solutions guide online customers to their store, allowing cross-selling and exchange instead of money-back return, which is especially relevant for fashion retailers.

The limitations of our study provide opportunities for future research. First, the empirical research was carried out in Western Europe and although we expect it to be transferable to other regions since the participants are internationally active retailers, future research might extend this study in other markets, e.g., with different levels of OC development, market concentration or transportation distances. Second, the sample consists exclusively of large retailers. Due to the high density of store outlets throughout the country, e.g., the use of stores as convenient pick-up locations, makes sense to those OC retailers. Future research could try to test whether steering into the store is also beneficial for smaller OC retailers with fewer outlets. Third, we focused on fashion retailing because of the advanced OC structures and distinctive industry characteristics that support the analysis of distinctive steering options. A further generalization of our results to other settings (e.g., higher shift towards online sales as in consumer electronics), different product characteristics (e.g., small and bulky items in the DIY segment) or different logistics requirements (e.g., frozen food in the grocery segment) can enhance our findings. Fourth, future research should extend our exploratory findings and look again in detail at the customer perspective of cross-channel steering because the customer perspective was only one supporting element of this research, but not the heart of our study. Finally, a quantification of the implementation of steering methods remains outstanding. The cost of establishing and using steering methods as well as costs of lost customers and the actual benefit for the retailers should be calculated and evaluated as part of future research.

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7. Appendix

Appendix I: Themes, categories and representative data

Second-order themes and first-order categories {779}	Representative data
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1. Cross-channel organizational structures {81}

A. Establish a channel-independent corporate culture {37}

A1. *The organization has to be shaped top-down and won't work at the lower level if it is not already running at the top management level* [Company 3, Section Head, Logistics].

A2. *The online channel should be seen as a colleague and friend [...] not as an enemy* [Company 4, Section Head, Logistics].

B. Incentivize employees to incorporate cross-channel services {44}

B1. *OC only takes off when employees are incentivized based on revenues from click&collect, in-store ordering and shipping to stores* [Company 8, Section Head, Logistics].

B2. *Stores often provide repair service, [...], if I send the product to the retailer by mail, I have to box it, wait a week for it to get repaired and then receive it. It is simpler to bring it to the store* [FG1, P3].

2. Mutual awareness of customers' requirements and retailers cross-channel offerings {85}

C. Build up cross-channel knowledge among customers {39}

C1. *Before we can steer customers, we have to get to know store customers by analyzing data collected about them* [Company 6, Section Head, E-Commerce].

C2. *We consolidate frequency of returns and revenue of a customer into a KPI and withdraw the privilege of purchasing on account for the lowest 10% of customers* [Company 6, Section Head, E-Commerce].

D. Build up customer trust in OC services through education and interaction {46}

D1. *To be honest, I have never done that [checked store availability of product online] and did not even know that something like that existed* [FG1, P3].

D2. *On our youtube channel we explain our multi-channel offers to customers and give them tips on how to buy online and pick-up products in store* [Company 1, Section Head, Cross-Channel].

3. Cross-channel back-end IT and logistics systems {74}

E. Merge the IT infrastructure and systems across channels {29}

E1. *Click&reserve is not possible at the moment, because we lack have real-time data and the IT infrastructure for that* [Company 1, Section Head, Cross-Channel].

E2. *When customers return products purchased online in-store, they get their money back although we are unable to see whether or not the product was paid for. We have to make adjustments here by connecting our CRM to the cash system* [Company 1, Section Head, Cross-Channel].

F. Integrate logistics and fulfillment systems across channels {45}

F1. *We consider utilizing store stocks for same day deliveries of online purchases to exploit the advantages of decentralized structures* [Company 9, Managing Director, Logistics].

F2. *Order picking takes place in a joint warehouse* [Company 10, Section Head, Sales].

Continued on next page

Table 4 – Continued from previous page

4. Prioritization of warehouse processes across channels {178}	
G. Segment customers into priority groups {68}	<p>G1. <i>Loyalty card customers are prioritized [. . .] and thus potentially override other customers in order-picking sequences.</i> [Company 1, Section Head, Cross-Channel].</p> <p>G2. <i>[...] the more I buy, the more discount I receive in proportion to somebody who owns a less valuable [e.g. silver instead of gold] loyalty card than me.</i> [FG2, P2].</p>
H. Give preference to online channel {52}	<p>H1. <i>[...] online is prioritized over bricks-and-mortar during the picking process, because the online item is already sold and in store we can refer to alternatives in-store</i> [Company 2, Managing Director, Sales].</p> <p>H2. <i>Store orders are not that urgent as these generally concern only supplementary orders and replenishment of stock</i> [Company 10, Section Head, Sales].</p>
I. Configure warehouse systems for fast delivery velocity {58}	<p>I1. <i>Priority orders can be handled in a reserved time slot for immediate shipping afterwards</i> [Company 1, Managing Director, Logistics].</p> <p>I2. <i>Our delivery usually takes 24 hours, and we guarantee delivery within two days to any address in Germany</i> [Company 9, Section Head, E-Commerce].</p>
5. Inventory information sharing across channels {129}	
J. Enable cross-channel availability check {90}	<p>J1. <i>We try to bring customers in the store by providing an online availability check for stores</i> [Company 8, Section Head, Logistics].</p> <p>J2. <i>I like to search at home precisely where to buy what, so that I don't need to run into three different stores</i> [FG1, P6].</p>
K. Recommend additional or substitution products across channels {39}	<p>K1. <i>The staff utilizes terminals to extend the store's range of products and to indicate additional offers [...] in the online channel</i> [Company 2, Managing Director, Sales].</p> <p>K2. <i>If I need something immediately, I go to a store and either buy the product or a substitute</i> [FG1, P2].</p>
6. Differentiation in cross-channel distribution {232}	
L. Differentiate delivery options across channels according to velocity and/or cost {124}	<p>L1. <i>Standard shipping costs of EUR 4.20 steer customers towards cost-free click&collect, which increases cross-selling potential in stores</i> [Company 5, Section Head, Logistics].</p> <p>L2. <i>I would choose the store delivery option if I could pick it up directly after my order because home delivery is sometimes too slow</i> [FG1, P5].</p>
M. Enable exchange instead of mere return {108}	<p>M1. <i>In our online shop, for example, we do not allow too many different sizes of the same article to be bought at once. [...] In the future we also want to reward customers for no-returns</i> [Company 9, Managing Director, Logistics].</p> <p>M2. <i>An in-store return is preferred over of a mail return because we can immediately recommend an alternative product</i> [Company 10, Section Head, Sales].</p>
FG=Focus group, P=Participant, { }=Number of codes	

Table 4: Themes, categories and representative data

Appendix II: Interview protocol (abbreviated)

Steering options in fulfillment

- How can retailers steer customer orders (i.e. in the warehouse) in OC retailing and at the intersection of the channels?
- Why should this method be implemented? What are its advantages and disadvantages?

Steering options in customer behavior

- How can retailers steer customer behavior during the product-related process (i.e. availability check, purchase, delivery, and return) and at the intersection of the channels?
- Why should this method be implemented? What are its advantages and disadvantages?
- How can you measure customer value?
- What are criteria for measuring customer value?

Other

- How do you create a channel independent corporate culture for online- and bricks-and-mortar retailing?

Appendix III: Summary of questions in focus groups

Availability

- What do you think about being able to check store inventory online and does it influence your purchasing behavior?
- What do you think about using tablets, terminals, and wireless internet in stores to see the company's online offers and does this influence your purchasing behavior?

Purchase

- Do payment methods influence your purchasing behavior or channel choice?
- Do customer loyalty programs influence your purchasing behavior or channel choice?
- What added value do you expect from customer loyalty programs?

Delivery

- What type of delivery and receiving do you prefer for online orders and why?
- What would cause a change in your preferences?
- How relevant are shipping costs in your considerations?
- Under which circumstances would you be willing to pay more for better service?

Return

- What factors play a role to you when you return products?
- What measures should a retailer take to lower the frequency with which you return products?
- What influences your behavior in terms of returning products in the store?

References

- Agatz, N., Fleischmann, M., van Nunen, Jo A.E.E., 2008. E-fulfillment and multi-channel distribution – a review. *European Journal of Operational Research* 187 (2), 339–356.
- Alvarado, U. Y., Kotzab, H., 2001. Supply chain management: The integration of logistics in marketing. *Industrial Marketing Management* 30 (2), 183–198.
- Alvesson, M., Kärreman, D., 2007. Constructing mystery: Empirical matters in theory development. *Academy of Management Review* 32 (4), 1265–1281.
- AT Kearney, 2014. On solid ground: Bricks-and-mortar is the foundation of omnichannel retailing. *Consumer Products and Retail: Ideas and Insights*, 1–12.
- BCG, 2013. Rethinking the fashion supply chain: https://www.bcgperspectives.com/content/articles/retail_supply_chain_management_fast_flexible_lean_rethinking_fashion_supply_chain/.
- BCG, 2014. In omnichannel retail, it's still about detail.
URL https://www.bcgperspectives.com/content/articles/supply_chain_management_sourcing_procurement_omnichannel_retail_still_about_detail/
- Beck, N., Rygl, D., 2015. Categorization of multiple channel retailing in multi-, cross-, and omni-channel retailing for retailers and retailing. *Journal of Retailing and Consumer Services* 27, 170–178.
- Bell, D. R., Gallino, S., Moreno, A., 2015. Offline showrooms and customer migration in omni-channel retail. Available at SSRN 2370535.
- Bhardwaj, V., Fairhurst, A., 2010. Fast fashion: response to changes in the fashion industry. *The International Review of Retail, Distribution and Consumer Research* 20 (1), 165–173.
- Blázquez, M., 2014. Fashion shopping in multichannel retail: The role of technology in enhancing the customer experience. *International Journal of Electronic Commerce* 18 (4), 97–116.
- Bower, A. B., Maxham, J. G., 2012. Return shipping policies of online retailers: normative assumptions and the long-term consequences of fee and free returns. *Journal of Marketing* 76 (5), 110–124.
- Bryman, A., Bell, E., 2011. *Business research methods*, 3rd Edition. Oxford university press, New York.
- Cao, L., 2014. Business model transformation in moving to a cross-channel retail strategy: A case study. *International Journal of Electronic Commerce* 18 (4), 69–96.
- Corbin, J. M., Strauss, A., 1990. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative sociology* 13 (1), 3–21.
- Corley, K. G., Gioia, D. A., 2011. Building theory about theory building: What constitutes a theoretical contribution? *Academy of Management Review* 36 (1), 12–32.
- Creswell, J. W., 2003. *Research design: Qualitative, quantitative, and mixed method approaches*, 2nd Edition. Sage Publications, Thousand Oaks and Calif.
- Danaher, P. J., Wilson, I. W., Davis, R. A., 2003. A comparison of online and offline consumer brand loyalty. *Marketing Science* 22 (4), 461–476.
- DeHoratius, N., 2011. Field research in operations and supply chain management. *Journal of Operations Management* 29 (5), 371–375.
- Eisingerich, A. B., Bell, S. J., 2008. Perceived service quality and customer trust: Does enhancing customers' service knowledge matter? *Journal of Service Research* 10 (3), 256–268.
- Essen, N. v., Leeuw, S. d., 2013. Global webshop logistics: <http://www.globalwebshoplogistics.com> of 10/05/2015.
- EY, 2015. Re-engineering the supply chain for the omni-channel of tomorrow: <http://www.ey.com/publication/vwluassets/ey-re-engineering-the-supply-chain-for-the-omni-channel-of-tomorrow/file/ey-re-engineering-the-supply-chain-for-the-omni-channel-of-tomorrow.pdf>.
- Fernández-Sabiote, E., Román, S., 2012. Adding clicks to bricks: A study of the consequences on customer loyalty in a service context. *Electronic Commerce Research and Applications* 11 (1), 36–48.
- Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A., Flynn, E. J., 1990. Empirical research methods in operations management. *Journal of Operations Management* 9 (2), 250–284.
- Forbes, 2012. The future of fashion retailing: <http://www.forbes.com/sites/gregpetro/2012/11/05/the-future-of-fashion-retailing-the-hm-approach-part-3-of-3/#288f3f776dbf>.
- Gallino, S., Moreno, A., 2014. Integration of online and offline channels in retail: The impact of sharing reliable inventory availability information. *Management Science* 60 (6), 1434–1451.
- Gerry Weber, 2016. Rfid at gerry weber: <http://www.gerryweber.com/ag-website/en/ag-website/company/company-profile/rfid>.
- GfK, 2016. Future fashion retail in germany: https://www.gfk.com/fileadmin/user_upload/dyna_content/global_documents/news/2016/fashion-talk_01-2016_en.pdf.
- Gioia, D. A., Corley, K. G., Hamilton, A. L., 2013. Seeking qualitative rigor in inductive research notes on the gioia methodology. *Organizational Research Methods* 16 (1), 15–31.
- Glaser, B. G., Strauss, A. L., 1967. *The discovery of grounded theory: Strategies for qualitative research*. Observations (Chicago, Ill.). Aldine de Gruyter.
- Guest, G., 2006. How many interviews are enough?: An experiment with data saturation and variability. *Field Methods* 18 (1), 59–82.
- Gupta, A., Su, B.-C., Walter, Z., 2004. An empirical study of consumer switching from traditional to electronic channels: A purchase-decision process perspective. *International Journal of Electronic Commerce* 8 (3), 131–161.
- Herhausen, D., Schögel, M., Schulten, M., 2012. Steering customers to the online channel: The influence of personal

- relationships, learning investments, and attitude toward the firm. *Journal of Retailing and Consumer Services* 19 (3), 368–379.
- Hübner, A., Holzapfel, A., Kuhn, H., 2015. Operations management in multi-channel retailing: An exploratory study. *Operations Management Research* 8 (3), 84–100.
- Hübner, A., Holzapfel, A., Kuhn, H., 2016a. Distribution systems in omni-channel retailing. *Business Research* 9 (2), 255–296.
- Hübner, A., Kuhn, H., Wollenburg, J., 2016b. Last mile fulfilment and distribution in omni-channel grocery retailing: A strategic planning framework. *International Journal of Retail & Distribution Management* 44 (3), 228–247.
- Hübner, A., Wollenburg, J., Holzapfel, A., 2016c. Retail logistics in the transition from multi-channel to omni-channel. *International Journal of Physical Distribution & Logistics Management* 46 (6/7), 562–583.
- Kollmann, T., Kuckertz, A., Kayser, I., 2012. Cannibalization or synergy? consumers' channel selection in online-offline multichannel systems. *Journal of Retailing and Consumer Services* 19 (2), 186–194.
- KPMG, 2012. Trends in retail 2020: <https://www.kpmg.de/docs/20120418-trends-im-handel-2020.pdf>.
- Kumar, V., Venkatesan, R., 2005. Who are the multichannel shoppers and how do they perform? *Journal of Interactive Marketing* 19 (2), 44–62.
- Lewis, J., Whysall, P., Foster, C., 2014. Drivers and technology-related obstacles in moving to multichannel retailing. *International Journal of Electronic Commerce* 18 (4), 43–68.
- Mahnke, R., Benlian, A., Hess, T., 2015. A grounded theory of online shopping flow. *International Journal of Electronic Commerce* 19 (3), 54–89.
- Manuj, I., Pohlen, T. L., 2012. A reviewer's guide to the grounded theory methodology in logistics and supply chain management research. *International Journal of Physical Distribution & Logistics Management* 42 (8/9), 784–803.
- McKinsey, 2014. Succeeding in tomorrow's global fashion market: <http://www.mckinseyonmarketingandsales.com/succeeding-in-tomorrows-global-fashion-market>.
- Miles, M. B., Huberman, A. M., Saldaña, J., 2013. *Qualitative data analysis: A methods sourcebook*. SAGE Publications, Incorporated.
- Mintzberg, H., 2005. Developing theory about the development of theory. *Great minds in management: The process of theory development*, 355–372.
- Myers, J. B., Pickersgill, A. D., Metre, E. S. V., 2004. Steering customers to the right channels. *McKinsey Quarterly* 4, 36–47.
- Neslin, S. A., Grewal, D., Leghorn, R., Shankar, V., Teerling, M. L., Thomas, J. S., Verhoef, P. C., 2006. Challenges and opportunities in multichannel management. *Journal of Service Research* 9 (2), 95–113.
- Neslin, S. A., Shankar, V., 2009. Key issues in multichannel customer management: current knowledge and future directions. *Journal of Interactive Marketing* 23 (1), 70–81.
- Nielsen, 2013. Global trends in online shopping: A nielsen global consumer report: <http://at.nielsen.com/site/documents/q12010gos-onlineshoppingtrendsune2010.pdf>.
- Oh, L.-B., Teo, H.-H., 2010. Consumer value co-creation in a hybrid commerce service-delivery system. *International Journal of Electronic Commerce* 14 (3), 35–62.
- Oh, L.-B., Teo, H.-H., Sambamurthy, V., 2012. The effects of retail channel integration through the use of information technologies on firm performance. *Journal of Operations Management* 30 (5), 368–381.
- Piotrowicz, W., Cuthbertson, R., 2014. Introduction to the special issue information technology in retail: Toward omnichannel retailing. *International Journal of Electronic Commerce* 18 (4), 5–16.
- Puccinelli, N. M., Goodstein, R. C., Grewal, D., Price, R., Raghuram, P., Stewart, D., 2009. Customer experience management in retailing: Understanding the buying process. *Enhancing the Retail Customer Experience* 85 (1), 15–30.
- PwC, 2013. *Demystifying the online shopper: 10 myths of multichannel retailing*. New York.
- Randall, W. S., Mello, J. E., 2012. Grounded theory: An inductive method for supply chain research. *International Journal of Physical Distribution and Logistics Management* 42 (8/9), 863–880.
- Saunders, M. N. K., Saunders, M., Lewis, P., Thornhill, A., 2012. *Research methods for business students*, 6th Edition. Pearson, Harlow.
- Shankar, V., Smith, A. K., Rangaswamy, A., 2003. Customer satisfaction and loyalty in online and offline environments. *International Journal of Research in Marketing* 20 (2), 153–175.
- Stebbins, R. A., 2001. *Exploratory research in the social sciences*. Qualitative research methods series 48. Sage Publications, Thousand Oaks and Calif.
- Steinfeld, C., Bouwman, H., Adelaar, T., 2002. The dynamics of click-and-mortar electronic commerce: Opportunities and management strategies. *International Journal of Electronic Commerce* 7 (1), 93–119.
- Thomas, J. S., Sullivan, U. Y., 2005. Managing marketing communications with multichannel customers. *Journal of Marketing* 69 (4), 239–251.
- Trautrim, A., Grant, D. B., Cunliffe, A. L., Wong, C., 2012. Using the “documentary method” to analyse qualitative data in logistics research. *International Journal of Physical Distribution and Logistics Management* 42 (8/9), 828–842.
- Verhoef, P. C., Neslin, S. A., Vroomen, B., 2007. Multichannel customer management: Understanding the research shopper phenomenon. *International Journal of Research in Marketing* 24 (2), 129–148.
- Wallace, D. W., Giese, J. L., Johnson, J. L., 2004. Customer retailer loyalty in the context of multiple channel strategies. *Journal of Retailing* 80 (4), 249–263.

Last Mile Fulfilment and Distribution in Omni-Channel Grocery Retailing

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A Strategic Planning Framework

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Abstract

Purpose - For traditional grocery retailers, the growing importance of online sales means creating new logistics models for omni-channel (OC) management. Due to these transformational changes, retail research and practice are lacking a comprehensive view on integrated fulfilment and distribution concepts for home and store deliveries as they have evolved recently. The purpose of this paper is to develop a planning framework for last mile order fulfilment in OC grocery retailing and to discuss the advantages and disadvantages of different design concepts.

Design/methodology/approach - The findings were developed and evaluated by means of exploratory interviews with grocery retail and logistics experts. Additionally, key literature on last mile order fulfilment and retail supply chain management was reviewed to supplement the integrated OC grocery operations planning framework.

Findings - OC logistics planning can be structured into back-end fulfilment (e.g., warehouse and instore picking) and last mile distribution concepts (e.g., attended and unattended home delivery). The design choices depend on country specifics (e.g., population density), retailer specifics (e.g., capability for cross-channel process integration) and customer behaviour (e.g., possibility of unattended home delivery). The application areas and their contextual factors are discussed for each design parameter.

Practical implications - The last mile fulfilment options identified can be applied to pinpoint the necessary steps for further optimizing OC integration. Grocers can gain insights into current fulfilment concepts used in different contexts. This architecture also forms the foundation for further research on decision support systems.

Originality/value - The coherent planning framework summarizes the general design options for last mile order fulfilment arising from new requirements for OC fulfilment.

Keywords: Distribution strategies, Grocery logistics, Last mile operations, Omni-channel retailing, Order fulfillment

1. Introduction

As e-commerce and bricks-and-mortar are merged into omni-channel (OC) retailing, customers gain more opportunities to buy what, where, when and how they want. Empirical studies show the value of OC shopping for customers (e.g., Esper et al. [2003], Gallino and Moreno [2014], Herhausen et al. [2015]). Traditional bricks-and-mortar retailers have to learn how to use the new distribution channels to become attractive “bricks-and-clicks” retailers. Cross-channel optimization offers a number of opportunities for improving supply chain (SC) performance [Agrawal and Smith, 2015]. This is especially relevant in the context of grocery. Even with bricks-and-mortar concepts dominating the grocery market, online grocery is facing an upheaval in the twenty-first century. Online grocery already has a relevant market share (e.g., 4.4 per cent in the UK) and is growing rapidly [IGD, 2014]. By 2018, grocery retailing will surpass consumer electronics in online sales to become the second largest category in Europe after apparel [Forrester, 2014]. The biggest challenge in designing a successful business model with OC grocery retailing is the high cost and complexity of fulfilment for groceries bought online [Aspray et al., 2013]. Six out of ten challenges relating to online shopping have their roots in last mile fulfilment [Fernie and McKinnon, 2009]. In addition, a customer at a grocery store who picks, packs and delivers the goods himself saves the company 13 per cent in total cost of sales [Hays et al., 2005]. Nevertheless, there is a limited willingness to pay for delivery services. Teller et al. [2006] show that the perceived inconvenience connected with shopping for groceries had no impact on respondents’ willingness to pay for home delivery services or their future intentions to use such services. Innovative operational and logistical solutions have to be developed to make home delivery and click and collect (C&C) not only possible, but profitable. OC grocers therefore need to create efficient structures in order fulfilment and delivery. Effective SC planning is a basic requirement for coordinating warehouse and delivery in the retailing context [Kotzab and Schnedlitz, 1999]. OC grocery retailers across Europe apply various fulfilment and delivery techniques. For example, attended home delivery is still the predominant model in the UK and the Netherlands, whereas unattended home delivery is well-established in Switzerland, mainly driven by Migros LeShop. Grocery pick-up is the main distribution channel in France, where grocers operate some 3,000 drive-through stations. These concepts differ considerably and include individual planning, picking and delivery tasks. Due to these different configurations and recent transformational changes, retail research and practice do not have a comprehensive view on fulfilment and distribution concepts for OC grocery retailing, which have evolved more recently. Current literature on fulfilment and distribution planning of grocery retailing focuses more on single channels (e.g., Hübner et al. [2013]) by either investigating bricks-and-mortar requirements

or those of online channels (e.g., Agatz et al. [2008]). Retail practice and research would benefit from a holistic framework for coordinating grocery logistics across channels. Therefore, the aim of this paper is to identify and analyze the general options in a planning framework for OC grocery retailers by orchestrating last mile order fulfilment and logistics. This planning framework should define the objectives, constraints and alternatives by breaking them down into different planning modules [Miller, 2001]. This makes it possible to coordinate and consider interdependencies. In the context of this paper, a planning framework contains the relevant issues a retailer is confronted with when integrating logistics and operations across channels for back-end fulfilment and last mile distribution of a grocery product. The applications and settings applied by OC retailers in Europe are summarized in a general overview of strategic planning areas. Decision criteria, drivers and context-specific characteristics (e.g., preference for store pick-up, high population density) are used to describe when and why OC retailers have chosen distinct specifications. To accomplish the aim, we took three steps. First, a review of key literature on logistical frameworks in bricks-and-mortar and online retailing was conducted to investigate their applicability to OC grocery. Second, we used qualitative methods to gather empirical data from OC grocers and experts. Through personal interviews with leading European grocery retailers and with experts in related positions, we gained insights into last mile order fulfilment issues. Third, we used the empirical findings to develop a framework on last mile order fulfilment. Our contribution to theory is the development of a comprehensive framework for last mile fulfilment in particular that identifies and integrates relevant planning aspects. Grocers gain insights into fulfilment concepts used in different contexts and find out which logistical configuration is best suited to their specific business model. This enables both practitioners and researchers to classify planning areas, understand the interdependencies and help to overcome the complexity of various planning aspects in OC logistics. The remainder of the paper is organized as follows. In Section 2, we review existing planning literature, structural frameworks and literature reviews. We then describe the approach for developing our framework in Section 3, after which we formulate a structural framework in Section 4. This section analyses each design parameter, discusses the advantages and disadvantages of each option and uses case examples for illustrations. The final Section 5 draws conclusions and develops fields for further research.

2. Related literature and research questions

The related literature for grocery SC planning can be divided into two streams, whereas the first focuses on logistics frameworks in e-commerce and the second on bricks-and-mortar retailing.

2.1. Frameworks in e-commerce

Smáros et al. [2000] question whether improving purchasing opportunities and optimizing physical distribution are the two things that matter most in the e-grocery business. The authors present a framework for examining other factors such as customer demand and identifying the quality of customer service for e-grocery. As a result, they call for flexible services that not only offer the same products as an online store. They argue that despite automation and technological solutions for problems, success also depends on customer acceptance. Kotzab and Madlberger [2001] introduce a web-scan framework to analyze the nature of web offerings and the logistical elements of e-tailing. Swaminathan and Tayur [2003] describe issues of visibility, supplier relationships, distribution and pricing, customization and real-time decision technologies that have grown in importance with the prevalence of e-business in traditional SCM. They present an overview of analytical research models for dedicated e-commerce SCs. Because traditional models focus solely on solutions for single parameters, the authors see a growing need for models that can provide insights into the relative impact of altering the different parameters in the SC. They conclude that integrating online and offline operations will become more significant. Agatz et al. [2008] review e-fulfilment literature and quantitative planning models. They give a comprehensive overview of managerial planning tasks and corresponding quantitative models. Here, they highlight service components that are inherent to e-fulfilment. An online channel not only provides a physical product but also several related services, most notably delivery. This results in novel planning issues and corresponding trade-off decisions. They identify future research and modelling efforts including a closer integration of demand and supply management in e-fulfilment and closer interaction between e-fulfilment and other distribution channels. Xing et al. [2010] discuss a conceptual framework for order fulfilment to achieve electronic physical distribution service quality from a consumers' perspective in non-food retailing.

2.2. Frameworks in bricks-and-mortar retailing

Fisher and Raman [2010] develop a back-end logistics framework for bricks-and-mortar retailers to manage inventory for faster turns and fewer discounted offers. They note that “retailers have three tactics at their disposal for matching supply with demand: accurate forecasting, supply flexibility and inventory stockpiling”. Agrawal and Smith [2015] discuss the SC planning process and material flow of two retailers. They identify cross-channel optimization as an opportunity for improving SC performance. Hübner et al. [2013] describe various planning aspects in grocery retail logistics, without differentiating between bricks-and-mortar and online business. The authors develop a holistic demand and SC planning framework for grocery retailing. The planning framework

integrates specifics of bricks-and-mortar retailing as well as hierarchical and sequential aspects of decision making and classifies planning problems.

2.3. Research gap in frameworks for OC retailing

Only Hübner et al. [2015, 2016a] identify the planning areas in OC warehouse operations and logistics management for non-food retailers comprehensively. The authors explain that challenges for food fulfilment are fundamentally different and are not reflected in their planning approach. Swaminathan and Tayur [2003], Gallino and Moreno [2014] and Hübner et al. [2015] come to the conclusion that it is becoming increasingly important to integrate channels. All point out that there is a lack of literature dealing with the logistics interaction between e-commerce and traditional retailing. None of these papers take a comprehensive view of the interaction and possible integration of e-commerce and bricks-and-mortar grocery retailing. While they analyze independent channel specifics for grocery logistics on the last mile, they still lack a perspective on options for integrating online and bricks-and-mortar retailing. None of the frameworks mentioned consider online and offline channels as a holistic entity from a logistics perspective. They treat them as separate channels without depicting the different options of joint online and offline fulfilment. A holistic perspective on OC structures and design options in OC grocery last mile concepts has not yet been developed or empirically evaluated. A specific analysis of back-end fulfilment and front-end logistics and the coherent development of a structured framework are still missing. A proper planning framework should define the objectives, constraints and alternatives. It should be a compromise between practicability, integrating interdependencies and breaking down the overall planning process into modules [Miller, 2001].

2.4. Research questions

We therefore formulate the following three research questions (RQ):

RQ1. What are the parameters of a strategic planning framework for last mile order fulfilment and delivery in OC grocery retailing and how are they interrelated?

RQ2. How do grocery retailers fulfil and deliver online orders to their customers?

RQ3. Why do OC grocery retailers choose different last mile fulfilment and delivery options?

The next section describes the methodology applied.

3. Methodology

The research questions focus mainly on the how and why of grocery fulfilment and delivery. Therefore, a qualitative, interpretive approach has been taken to develop a framework that depicts the various design parameters and describes the major fulfilment and delivery strategies and concepts pursued by retailers in the online grocery landscape [Fawcett et al., 2011; Yin, 2014]. Qualitative research concentrates on formulating questions and exploring the answers and not on testing hypotheses against empirical research [Mason, 2002]. Therefore, the research approach is inspired by grounded theory and is by nature inductive, whereby data is collected from an empirical study and theory developed as a result of data analysis [Strauss and Corbin, 1990]. Interviewing experts is a common and adequate method for data collection because their knowledge of overall processes provides insights into companies and their strategic intentions [Creswell, 2002]. In addition, exploratory interviews are suitable for collecting information not only to derive new fields of research but also to build a theory and concepts [Brinberg and McGrath, 1985; Stebbins, 2001; Creswell, 2002]. Moreover, qualitative research is particularly appropriate for studying retail logistics and SCs to generate new theoretical perspectives [DeHoratius and Rabinovich, 2011; Trautrim et al., 2012].

3.1. Data collection

In this paper, a meta-analytical approach is taken based on (i) desk research and (ii) conducting semi-structured interviews with retailers and experts from the grocery industry. The collection of secondary data in (i) is done by means of a literature review in the field of order fulfilment and delivery strategies in online grocery retailing as well as distribution in the OC environment. Our research is also informed by the planning areas and development stages for non-food retailing described by Hübner et al. [2015, 2016b]. The concepts of non-food items are further elaborated for OC grocery retailing. Furthermore, currently available statistics in the respective fields were assessed from international sources. In addition, the websites of grocery retailers as well as other online offerings such as annual reports, press releases and further studies were researched for details concerning logistical activities. For the original part of research (ii), eight semi-structured interviews were conducted with grocery retailers and experts from Europe. We applied theoretical sampling, whereby we increased our sample gradually, starting with four interviews with OC grocery retailers. Following an intermediate analysis, we decided to invite further experts to our study, as we assumed that the data had not yet reached saturation level [Glaser and Strauss, 1967]. After analyzing the eight interviews, data saturation was reached for the time being and no further added value could be found in the data. This is presumably because we invested upfront in identifying qualified experts

who are currently or have been engaged in building up OC grocery operations. We believe that we interviewed true experts in the field who offered valuable contributions to this study. A total of four major OC grocery retailers as well as four leading experts in grocery retailing and retail SCM contributed to our work. All grocery retailers interviewed are leading European retailers in terms of annual sales. Three of them are among the top ten European retailers across all industries measured by turnover, and one is a major traditional grocery retailer with innovative new fulfilment and delivery concepts. The retailers are active in the bricks-and-mortar as well as the online business. They operate internationally, providing country-independent, generic insights into grocery fulfilment models. The companies' representatives were required to have a senior management position in logistics: most interviewees are currently in charge of OC logistics and fulfilment as board members, general managers and directors, providing a holistic view of the logistics structures and processes for the OC grocery business. All experts hold senior management positions in retail consultancies and two of them have multiple years of practical experience at grocers in Europe. All four have been in charge of developing OC retailing initiatives across Europe in multiple countries, either as employees at a retailer or as consultants to a retailer. They advise retailers worldwide on channel integration to reduce logistics complexity. This gave our study a global perspective and enhanced our results on a theoretical level. Furthermore, literature indicates that 6-12 interviews are sufficient to describe and explore structures for a homogeneous group of participants. After six interviews, any information provided by further interviewees decreases rapidly and may not contribute any more to supporting the theory [Romney et al., 1986; Morse, 1994; Guest et al., 2006]. Due to geographical distances between interviewer and interviewee five interviews were conducted face-to-face, and three interviews over the telephone. The interviews lasted 60 minutes on average. The order of questions was not prescribed and questions could be asked at any time, allowing the conversation to flow naturally [Lindlof and Taylor, 2011]. The interviews were always conducted by at least two interviewers to guarantee a more objective interpretation. Field notes were written during the questioning and shared and discussed immediately after the interviews.

3.2. Data analysis

The interviews were analyzed using content analysis techniques with a gradually increasing sample size inspired by grounded theory [Glaser and Strauss, 1967; Bryman and Bell, 2011]. We cycled among data, emerging theory and relevant literature to develop a deeper knowledge of OC grocery fulfilment. During the analysis, the transcripts were rephrased, reflected and compared to ultimately create a framework structure [Trautrimis et al., 2012]. We used an appropriate software application designed to aid text analysis throughout the entire process. Furthermore, we used

two major methods to ensure the trustworthiness of our data analysis. First, as stated before, the dedication of multiple distinct interviewers allowed for a reduction in subjective perceptions towards the interviewees. The interviewers compared notes to each other, thus enhancing the understanding until a sufficient degree of similarity was reached. Disagreements were discussed until consensus was achieved. This additional step helped to ensure repeatability of our findings and the emergent theoretical framework. Second, to ensure that a joint solution was reached, the framework was handed back to participants for further discussion. Apart from suggestions for minor adaptations which were subsequently implemented, the framework was met with general approval as showing current and future structures in OC grocery fulfilment and delivery. There was general consent that the information gathered enhances retail and SCM as it provides an overview of last mile activities and interrelations between SC subsystems [Kuhn and Sternbeck, 2013]. Examples and practical implications from the interview analyses were also used to underline the commonly applied fulfilment and delivery concepts.

4. Strategic planning framework for last mile order fulfilment and delivery

The strategic planning framework consists of two major blocks: back-end fulfilment and last mile distribution. The first deals with all warehouse operations concepts, whereas the latter concentrates on delivery design options. The final outcome is summarized in Figure 1.

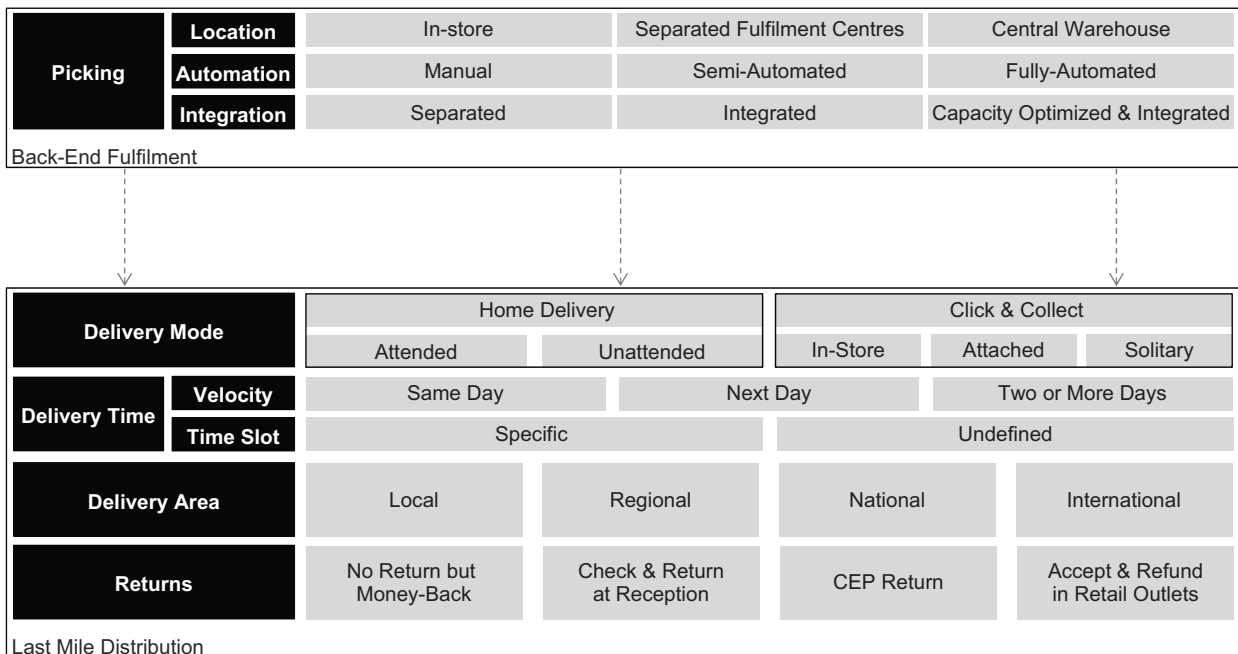


Figure 1: Characteristics and design parameters for back-end fulfilment and last mile distribution in omni-channel grocery retailing

The characteristics on the vertical axis (picking, delivery mode, delivery time, delivery area, returns) constitute distinct planning areas for retailers setting up a strategic fulfilment and logistics structure for OC grocery. All attributes within one planning area on the horizontal axis constitute design parameters and are independent of each other, but retailers may choose more than one design parameter, e.g., home delivery and C&C. The characteristics and design parameters are derived from the interviews. Based on an iterative process with retailers, the rows and columns in the framework were developed in two categories – back-end fulfilment and last mile distribution. The different characteristics and design parameters are described in the following and supplemented with a discussion of their application in different contextual factors. Moreover, the discussion is enriched with practical and literature examples.

4.1. Back-end fulfilment

An average shopping basket in e-grocery contains between 60 and 100 items, up to 60 times more than a non-food online order [Ferne and McKinnon, 2009]. This complicates the picking and packing procedure. First, we differentiate the design parameters for picking location, degree of picking automation and degree of picking integration.

4.1.1. Picking location

OC grocery retailers pick their online orders either in-store, at separate fulfilment centres or at central warehouses. In-store picking is usually the primary option for a bricks-and-mortar retailer who wants to enter the OC business. The picking of online orders is done by merchandizers who collect the groceries directly from the retail shelves. Many retailers use it as an entry model, because it allows them to offer a full product range within the existing structures, enabling them to expand fast without investing in new logistical facilities while future demand is still uncertain. Also it is less costly to modify existing stores or structures than to build new warehouses. However, the picking operation is expensive when done in conventional stores because space restrictions limit the e-fulfilment volume. In addition, professional order pickers and regular customers can get in each other's way [Bruno and Gonzalez-Feliu, 2012]. The store layout is designed for displaying products, not for picking efficiency. In essence, customers perceive the convenience associated with a shopping experience as being higher in a store with a clear layout and a sophisticated arrangement of products [Teller et al., 2012]. But this is not necessarily in the interest of picking efficiency. The existing structures of conventional stores therefore have to be significantly altered to achieve the efficiency in picking that e-grocery requires. Furthermore there is an out-of-stock risk due to the time gap between order placement and picking, as other customers can meanwhile buy the item.

This uncertainty pushes up demand planning costs and requires a higher (online) safety stock. Furthermore, retailers have to decide at which store to fulfil a customer's order. The retailer has to consider the trade-off between picking efficiency in each store and delivery distances, delivery times, and delivery costs to decide at which outlet the online order should be picked and delivered [Hays et al., 2005]. Picking at decentralized and separate fulfilment centres avoids interaction between pickers and shoppers in-store. All interviewees described three advantages of this type. First, in contrast to store-based fulfilment, order picking can be done more efficiently here as the fulfilment centres are especially designed for picking online orders and are easier to scale-up for larger volumes. This also makes it possible to use efficient warehouse configurations like differentiation into channel-specific slow and fast movers. Second, because customer fulfilment centres only stock inventory for the online channel, it is simpler to provide information on product availability to web shoppers. Third, unlike central and integrated warehouse systems, in decentralized fulfilment centres, the transportation costs from storage to customer are generally lower as the distance to a customer's home is shorter. In addition, delivery time accuracy can be improved, again enhancing customer satisfaction. On the downside, additional costs are incurred as an additional location needs to be supplied by contractors. Tesco, for example, started its online operations by using the existing store network and picked orders in-store. After they grew in scale they shifted from picking orders made via the website in a nearby superstore to so-called "dot com only stores", sometimes called "dark stores", which are regional fulfilment centres that only serve orders made online. In doing so, they copied the Migros model which has always sold online orders through specialized fulfilment centres. Tesco now operates six of these centres in the UK, supplying 50 per cent of the total online grocery market in Britain through this network. Picking at integrated centralized warehouses for direct customer distribution and store delivery requires more comprehensive processes. This strategy is usually applied by firms that have already been operating their online grocery channel for some time. With the integration of a warehouse, more complex picking systems are needed at the location to master store-order and customer-order picking. However, there are also advantages, such as short-term allocation decisions and synergies via joint deliveries from the supplier. Experts report that this is operationally effective and, depending on the total online volume, more cost efficient than other models, i.e. a single pick is cheaper in a warehouse than in a store. In a centralized warehouse, a consolidated inventory leads to a higher turnover, lower inventory costs and requires less links in the SC. Inbound transportation costs are lower, since deliveries are made to a single location in larger volumes. But the cost advantages from centralization do not come into effect due to higher delivery costs with a longer distance to the customer. Nevertheless, the biggest online grocer Ocado operates two centralized warehouses in Great Britain. However, to be

able to deliver to 70 per cent of the British population, Ocado has to use an additional hub and spoke network.

4.1.2. Picking automation

Different degrees of picking automation can be distinguished as well. In-store picking involves a manual picking procedure, as automation cannot be introduced in a shop. Whether a retailer chooses to pick his orders in warehouses in a manual, semi or fully automated way has an impact on the investment and operating costs. Whereas all levels of automation can be found at decentralized online fulfilment centres, most integrated warehouses use at least supporting picking technologies. Interviewees confirmed the increasing picking speed with the level of automation, leading to savings in operating costs and lower costs per pick. But rather than simply investing in automation, grocers also need to pay attention to the layout and design principles of the fulfilment centre. Special attention must be paid to planning the order assembly process. Compared to in-store picking efficiency without automation of about 80-120 items per hour, in a specifically designed warehouse, picking efficiency can be as high as 150-300 items per hour and more.

4.1.3. Picking integration

The question of the degree of picking integration is also important for OC grocery retailers. They can integrate online orders into the picking processes of their regular stores to further utilize existing assets. However, this requires making design adjustments to prepare locations for efficient online order picking. Online order picking can be done separate, integrated and in a next step capacity-optimized and integrated. With a capacity-optimized and integrated solution, capacities can be balanced, risks pooled, as well as stock-outs and lead-times reduced. Also, shared resources can lead to reduced overhead costs and inbound transportation costs. The difficulty of such integration plans is to handle inventory and storage systems simultaneously for both channels.

4.1.4. Summary of design concepts for picking

The choice of picking location, automation and integration is driven by shopping behaviour arising from distinct preferences within countries and geographical conditions within a region. Cultural driven shopping preferences influence the affinity to shop online and ultimately the market share and maturity of home shopping concepts. Teller et al. [2006] and Navis et al. [2012] point out that socio-cognitive factors can play a role in the emergence of new business models in this context. Hence, different delivery preferences result in different picking locations (see also next section on last mile distribution). Geographical and population density also impact the choice of picking location, automation and integration. Regions with a higher population density and higher market potential

reach break even for separate fulfilment centres or centralized warehouses and automation earlier than less dense regions. Retailers across Europe generally start their online business in large cities due to higher economies of scale and customers that are more willing to pay. The hybridization of operational concepts, i.e. with both in-store and centralized picking, will continue in the light of demographic changes, a greater choice and online grocery customers' increased expectations [De Kervenoael et al., 2016]. For example, Tesco UK generally operates regional fulfilment centres for picking online orders but also a central warehouse with greater automation and scalability near London, to enable it to fulfil the most populous region in the country and organize delivery to regional online fulfilment centres from there. Table 1 summarizes findings on design concepts, advantages and challenges for the different picking concepts.

4.2. Last mile distribution

The second building block is concerned with distribution on the last mile. The last mile is of particular importance for retailers as the cost of last mile delivery accounts for up to 50 per cent of total SC cost [Kuhn and Sternbeck, 2013; Vanelslander et al., 2013; Hübner et al. 2014]. The characteristics are denoted delivery mode, delivery time, delivery area and returns and consist of various design parameters which are further specified in the following.

4.2.1. Delivery mode

A decision about the delivery mode depends to a large extent on the geographic situation. The relative efficiency of different models varies depending on the population density as well as local competition. Apart from logistical aspects, delivery is the only situation where an online customer comes into personal contact with the retailer. Therefore, the delivery mode plays an important role in terms of customer relationship management and channel selection. Nilsson et al. [2015] show that accessibility by car and availability in terms of opening hours of a store determine the choice of store and channel. The predominant delivery concepts of home delivery and C&C will be analyzed in the following. However, because retailers assess further last mile solutions, we use the concept of crowd shipping as an example.

Home delivery. At a bricks-and-mortar grocer, goods are delivered to the store and customers perform the picking and final delivery to their home themselves. Regional grocers or grocers with a low density outlet network can expand their market coverage with home delivery. An OC retailer who offers home delivery not only needs to cope with picking online orders, but also has additional expenses to cover the last mile. Time savings in online shopping are perceived by customers above all as time not spent traveling to and from the store, rather than a decrease in

Picking of online orders			
	In-store	Separate fulfilment centre	Central warehouse
Location	Orders picked directly from the store shelves	Orders picked from dedicated dot-com-only fulfilment centres	Orders picked from an integrated central warehouse
Automation	Manual picking only	Largely manual picking; economies of scale do not allow for large automated picking systems	Manual, semi and fully automated picking depending on economies of scale for investments in picking systems
Integration across channels	Not possible	Not possible	Integrated picking across channels or separate picking from same inventory
Advantages from retailers' perspective	Offering full offline product range within existing structures; enables rapid expansion without investing in new logistics facilities; less costly to install processes for online order picking; usually shortest transport distance to customers; store participation in online sales	No interaction between pickers and shoppers in-store; designed for online picking, therefore easier to scale-up for larger volumes; easier to keep track of inventory transparency; lower transportation distance to customer, also allowing for higher time accuracy	No interaction between pickers and shoppers in-store; flexible capacity management across channels and lower investment costs when part of bricks-and-mortar structure; lower picking costs with higher order volume; postponement of inventory allocation; synergies via joint delivery from supplier
Challenges from retailers' perspective	Additional logistics and replenishment for online volume to store; store space restrictions limit e-fulfilment; store layout is designed for displaying products; hard to keep track of inventory transparency; picking with customer interaction and conflicting inventory allocation rights in case of shortages	High fixed cost for setting up fulfilment centre; no integrated inventory and capacity management across channels; additional inbound transport and handling costs either from supplier or central warehouse	Longer average distances to customer; adjustment of picking system required for integration

Table 1: Design concepts for back-end fulfilment for omni-channel grocery

actual shopping time. As a result, home delivery is a concept that provides additional customer satisfaction [Morganosky and Cude, 2000]. The direct concept offers consumers two models: an attended and unattended model of reception. Attended home delivery means that the customer has to be at the point of reception within a selected time frame to accept a delivery. This concept is used for home delivery of grocery goods across Europe regardless of market proliferation, e.g., in the UK, Netherlands or Germany. In most countries, attended home delivery accounts for the largest share of last mile delivery. Whereas in the UK, Tesco mainly fulfils its online orders with attended home delivery, it is currently more or less the only delivery channel used by Rewe in

Germany. However, home attendance creates complexity for all participants: On the one hand, the customer is under constraint to wait for his order to be delivered, while on the other, vehicle routing becomes more complex due to customers' time restrictions. Retailers' objectives include maximizing vehicle utilization and minimizing transportation costs, while maintaining a certain level of customer service and satisfaction rates. This requires dynamically assigning delivery time slots as new orders arrive as well as dynamically creating and adjusting delivery routes [Agatz et al., 2011]. If the customer is not available for order reception within the assigned time, the truck returns without fulfilment. This results not only in additional expenses for transportation and handling, but also in storing of the undelivered goods. Moreover, the retailer has to set a new date for delivery and complete an additional tour. Anticipating the likely future delivery cost of an additional order in a given location can lead to a significant increase in profit as well [Yang et al., 2014]. Unattended home delivery enables grocers to deliver online orders regardless of whether the customer is at home or not. The shopping basket is placed in front of the customer's home to be collected upon arrival. The Swiss pioneer LeShop mainly fulfils its orders with cooled delivery boxes, making it possible to drop off twice as many orders per shift than an average online grocer can fulfil with attended delivery but leaving it with initial costs for buying the boxes and the additional effort of collecting them afterwards. The cost of delivery can be reduced by up to 40 per cent compared to attended home delivery with a reception box for unattended home delivery [Kämäräinen et al., 2001]. However, one interviewee stated that this is country-specific: "Whereas in Switzerland an unattended delivery model raises no concern for theft due to a high GDP, in some regions of the UK potential theft of delivery boxes would cause large problems". Because in 50-60 per cent of households no one is at home during a normal workday an average of 12 per cent of home deliveries fail [Fernie and McKinnon, 2009]. The main concern of the unattended model is to ensure safe and secure delivery, so that on the one hand the temperature chain is maintained at all times, and on the other the delivery only reaches the buyer. From a logistical point of view, unattended reception eliminates tight time slots and capacity problems resulting from uneven demand during working hours. As a result, demand peaks are evened out. Delivery trucks can cover shorter distances as the need to visit different geographical regions is reduced to a minimum. Unattended reception shortens the working hours for the distributor. Furthermore, it eliminates the redelivery cost when the customers are not at home at their selected delivery time slot. Retailers that follow the attended reception model will charge additional fees if the customer is not able to receive their delivery in the agreed time slot. Common solutions for unattended reception are delivery boxes, reception boxes and shared reception boxes. From a logistical point of view, the latter can be seen as a hybrid form between unattended delivery and C&C. The customer

has to drive to the shared reception box and collect the purchases. But for the retailer it has the character of an unattended home delivery model with the same planning and coordination expenses. Crowd shipping is a further, innovative concept of home delivery. Walmart has piloted it since 2013. To enable same-day delivery the retailer lets customers cover the last mile for other shoppers. In return, Walmart then offers a discount. However, this approach still faces many legal hurdles as such deliveries may not be as reliable as corporate service providers in terms of theft or fraud. Shopwings in Germany and MyWays in Sweden apply a similar service. Despite the fact that this approach is still in its infancy and its practicability is uncertain, crowdsourcing approaches have remarkable innovative strengths, which is why retailers and logistics service providers should not underestimate this upcoming new delivery mode [Estellés-Arolas and González-Ladrón-de-Guevara, 2012].

Click & Collect. C&C is the other dominant delivery mode in OC grocery retailing. The development of online grocery in France is mainly driven by the installation of drive-through stations, whereas only a limited number of home delivery supply systems have been applied so far. A country like the USA, where drive-through stations already exist even for liquor stores, is predestined to use C&C drive-through for grocery too. Therefore, Walmart is testing them in rural areas and has found that with the right demographics and the right operator, drive-through makes sense for American customers and hence also OC grocery retailers [Walmart, 2014]. Even in countries with a strong home delivery grocery channel like the UK, C&C, which accounts for less than one in five online grocery purchases, is expected to grow significantly over the next five years [IGD, 2013]. With C&C, goods are picked up at the store (in-store and attached) or at a solitary pick-up station at another location. Either way, the goods are ordered via the online channel and then either picked and packed from a central warehouse inventory or in-store inventory and then transported to the pick-up location. The customer can pick-up the order at his convenience. While the obvious advantage of C&C is that the customer bears the full cost of fulfilment on the last mile, reducing logistical costs by up to 70 per cent, the retailer still has to deal with a number of other challenges related to product availability and the picking process. A collection point located in-store is often the ad hoc solution when a retailer wants to enter OC retailing quickly at a low initial cost. In this case, a separate booth is installed inside a store, where customers can pick-up their online orders. This means that the retailer can continue to use its existing assets without major changes. From the customer's point of view, in-store collection points can be less convenient than other fulfilment and delivery solutions as the customer still has to drive to the store and pick-up the order. The only thing he saves is the time spent on picking goods. From the retailer's perspective, in-store

pick-ups offer additional possibilities to cross-sell products. In combination with in-store picking of online orders, it becomes more attractive in terms of investment costs. In the UK, Tesco not only installed in-store pick-up locations at a separate booth but also installed lockers right at the front of the supermarket to save customers the trouble of entering the supermarket and picking up the order further inside the store - trading possible cross-selling opportunities for customer convenience. The pick-up point can also be attached to but not inside the store. The advantages and disadvantages are similar to the in-store solution. A further advantage is that an attached solution mainly offers drive-through opportunities. Furthermore, they cost less to build than a solitary drive-through station. A solitary drive-through station combines a small warehouse, from where the online orders are picked, and a pick-up station. The stations are independent from other stores and are supplied directly and separately from warehouses. This increases logistics costs with the additional shipping location but simplifies demand planning and inventory control compared to an attached solution. Grocers with a low density outlet network can expand their market coverage with solitary drive-through stations. However, setting up a solitary station requires investments. Our interview partners confirmed that the pure costs of setting up solitary drive-through stations in Europe range from 2 to 5 million Euros and more, depending on the facilities and layout. The capacity of a medium-sized solitary drive-through station is around 1,000 orders per week with a maximum of 170 orders per day. Despite higher costs, it reduces cannibalization of in-store sales compared to an in-store or attached solution where cannibalization can be between 10 and 30 per cent of in-store sales [Colla and Lapoule, 2012]. In France, drive-through systems are widely available, with currently more than 3,000 stations. For example, the elimination of last mile expenses allowed Leclerc drive outlets to break even in their first year of operation. In their second year the profit margin was reported to be higher than the average 2 per cent Leclerc makes with its hypermarket business [Colla and Lapoule, 2012]. Table 2 summarizes the discussion above on design concepts for delivery modes.

4.2.2. Delivery time

Delivery time plays an important role in terms of customer convenience, service and satisfaction. The goal is to minimize the time that customers wait to receive a delivery while reducing distribution cost and increasing security. The delivery time (see Figure 1) is divided into two rows, where the first row represents the overall delivery velocity and the second row the time slot. The former is segmented into same day, next day, or two and more days of delivery velocity. The latter distinguishes between a specific time slot and an undefined time slot during the day of delivery. All of them include different logistical approaches and hurdles.

Mode	Home delivery		In-store	Click & Collect	
	Attended	Unattended		Attached	Solitary
Description	Delivery to customers' home in his/her presence	Delivery regardless whether the customer is at home or not	Picking up an order at a desk in a store	Picking up an order at a station attached to a store	Picking up an order at a solitary station
Customer specifics	Preference for delivery over pickup; willingness to pay for service		Reluctance to queue and physical shopping; limited willingness to pay for home delivery		
Country/region specifics	All regions, but better economics in cities with dense customer base	Only cities/regions with safe environment	Only regions with dense store network	Mostly rural areas where retailer does not have stores	
Advantages from retailers' perspective	Possibility of directly interacting with customer	Elimination of tight time slots, capacity problems and redelivery costs; shorter working hours	Possibility of cross-selling at pick-up; low investment	Opportunity for drive-through solution; possibility of cross-selling in attached store; flexible inventory allocation with attached store	Opportunity for drive-through solution; easier entry in new markets with no shops so far; simplified demand planning and inventory control through own inventory
Challenges from retailers' perspective	Complex and costly vehicle routing; need to dynamically assign time slots; additional storage and delivery expenses if customer is not present	No direct customer interaction; temperature requirements and theft at reception point; initial investment for boxes necessary	Difficult to scale up due to limited store space	Larger investment to set up additional facility	High investment to set up solitary pick-up station; no integration or synergies with store

Table 2: Design concepts for delivery modes of omni-channel grocery

Velocity. Same-day delivery presents greater logistical challenges in terms of cost and planning complexity. Customers' willingness to pay for the service even in the grocery business is low, but necessary, as customers often buy groceries for their daily requirements. Next-day delivery is still a complex undertaking but less costly as it allows a greater degree of freedom. Because customer satisfaction and days until delivery after ordering are negatively correlated, a grocer should not expect customer satisfaction to be high when customers receive their groceries more than one day

after the order, especially for fresh produce.

Time slot. If a retailer offers a specific delivery window it is implied that small delivery windows will produce the highest customer satisfaction. Challenges include displaying the latest updated information for available time slots online. High demand for certain time slots, travel time uncertainties for the trucks and narrow time slots complicate on-time delivery [Agatz et al., 2011]. The more precisely the customer can control or select the desired time slot, the higher the cost for retailers. By pricing the time slots differently, retailers can create better, more cost-effective schedules [Campbell and Savelsbergh, 2005]. In terms of capacity management and delivery efficiency, it is useful to balance demand during prime time by charging a demand based delivery-fee. For example, grocers could set higher fees for popular delivery slots or for morning and evening rush-hour times to avoid traffic congestions. The difference between an order delivered during off-peak compared to on-peak hours can be 2.5 times higher in terms of cost per order [Hays et al., 2005]. As an incentive, delivery fees could be lowered if a customer chooses the same time slot for delivery as another customer from the same neighbourhood. Even without a financial incentive, Ocado combines delivery routes by using a “green van” flag in their online system. This allows a customer to see when a delivery truck is already going in his direction and choose this time slot, thus saving the environment and of course reducing Ocado’s driving time and fuel for delivery. Furthermore, the delivery windows themselves could be limited, e.g., 5-10 p.m. only, minimizing the time spent in traffic jams during rush hours in the morning and higher utilization through better balanced deliveries. In contrast, undefined delivery slots require less planning effort but imply lower customer satisfaction. Together with unattended delivery, an unspecific time window achieves significant cost savings, as it enables routes and schedules to be optimized and therefore increases delivery efficiency. An enlarged time slot of one to three hours will lead to significant cost reductions. In general, the more control the customer has over the time for home delivery, the higher the costs [Punakivi et al., 2001].

4.2.3. Delivery area

Characteristic four in Figure 1 is concerned with the delivery area and differentiates between local, regional, national and international operations. It defines where a retailer offers his e-grocery service. The market situation and the retailers’ structure determine his delivery region. Local and regional delivery is especially suitable for small OC grocers with fresh produce.

4.2.4. Returns

The last characteristic in the framework and its subsection of last mile distribution is returns. One of the drawbacks of online shopping is the customers’ inability to see and feel the product

before purchasing it. Especially in online grocery this becomes a common factor as consumers have general reservations about the retailer selecting and touching their food and concerns about the quality. A retailer can offer customers a money-back guarantee, check and return at reception, return by courier, express and parcel (CEP) delivery, or acceptance and refunding in grocery stores. In other OC industries, returning goods by CEP service firms is the prevalent solution. However, the conditions for the online grocery industry are different. In most countries, returning perishable goods via CEP return is restricted by civil code. Therefore, many grocers only offer a money-back guarantee and allow items to be checked and returned at the point of reception. The customer can check the delivery at the moment of acceptance and complain and return it immediately. Because physically exchanging the product is restricted, a later complaint will lead to a money-back offer by the retailer. OC retailers have the advantage of allowing their customers to exchange or refund the products at a local store. However, our interview partners confirmed that less than 1 per cent of all grocery orders are returned, making it a less prevalent problem than, e.g., in fashion retailing.

5. Conclusion and further areas of research

OC grocery retailing is a fast growing business [Forrester, 2014]. While research so far has focused on the customer and service aspects, we consider a logistical perspective for OC grocery. Its success not only depends on whether it is accepted by the customer, but goes hand in hand with an appropriate, scalable and cost-efficient fulfilment and delivery model [de Koster, 2002; Aspray et al., 2013].

5.1. Contribution and final discussion

The aim of this paper is to identify structures and analyze planning areas and design parameters for order fulfilment and logistics on the last mile. Literature so far has investigated autonomous channel specifics for logistics on the last mile, but a comprehensive perspective for integrating online and bricks-and-mortar grocery has not been developed before. We conducted an exploratory study in a new field of research to identify design parameters applied by OC grocers and discuss the pros and cons of each of them. Our research is inspired by grounded theory. The findings are additionally supported by insights from literature on individual design parameters. The theoretical contribution is based on the ability to structure operations and delivery options for OC grocery by creating an integrated strategic planning framework. The framework organizes planning areas around the main process steps of back-end fulfilment and last mile distribution. Within these areas, we identify different design parameters and discuss the pros and cons and the contextual factors for applying each design concept in the grocery sector. The design chosen by OC grocers mainly depends on

country, customer, and retailer specifics. Country specifics include geographical characteristics and population density, the possibility of implementing certain delivery types (e.g., unattended home delivery) and legal requirements (e.g., for grocery returns handling). Furthermore, the design choice is impacted by shopping behaviour, such as a preference for home delivery or store pick-up, as well as the willingness to pay for home delivery or desired time slots. Finally, the grocers' own readiness for investments in new channels and technologies (e.g., automated warehouse), their current market position and network design (e.g., low outlet density) and their ability to integrate processes cost efficiently across channels impacts the choice of certain design parameters in back-end fulfilment and last mile distribution. The trade-offs and practical examples resulting from the empirical study underline the fact that there is not one correct solution for designing a successful fulfilment strategy for OC grocery logistics on the last mile that is valid in every country- customer- and retailer-situation. Hence, the framework serves as a basis for depicting various options in this field and for future research when investigating more specific sub-problems in-depth. This helps to create an overall understanding of a company's back-end and front-end logistics for OC grocery retailing. The framework offers a structural component for planning areas and trade-offs for fulfilling grocery orders. Formulating the strategic planning framework provides retailers and researchers with an overview of fulfilment opportunities and configurations that can be applied to build up a fulfilment and delivery model. Therefore the framework can also depict and map a retailer's value proposition for his operation and distribution concepts. On top, the structure of the framework is transferable to retail in other industries because it does not concentrate on problems exclusively related to grocery items.

5.2. Limitations

Despite the fact that a framework was developed in which the design parameters are independent of each other in most dimensions, we did not manage to fully develop a true morphological box [Zwicky, 1967]. The question of profitability is not answered with this framework. Moreover, this paper did not assess who carries out the last mile. Webvan for example wanted to be a last mile logistics provider and online grocer. It failed when it tried to own the last mile because it had to compete not only with traditional grocery retailers but also with third-party logistics providers. Further quantification of the various characteristics and design parameters is lacking and should be provided in future studies.

5.3. Further areas of research

Building on this qualitative framework, further studies should provide a quantifiable dimension to simultaneously assess costs for the different order fulfilment and delivery processes. The

concepts are not categorically transferable. Even though in our research we touched on the fact that fulfilment and delivery differ by country, a country-by-country comparison of individual design choices will help to further investigate drivers for development and design choices. This also requires understanding historical development steps, i.e. the different histories of grocery markets (e.g., Germany's discount background), and investigating future development stages of advanced OC grocery. Apart from geographical aspects, this disparity could also be due to sociodemographic and socio-cognitive differences between customers in the various countries [Teller et al., 2006; Navis et al., 2012]. Therefore, further research should be conducted to explore whether these factors play a role in the emergence of an old and yet new market such as e-grocery.

References

- Agatz, N.A., Fleischmann, M. and van Nunen, J.A. (2008), "E-fulfilment and multi-channel distribution - a review", *European Journal of Operational Research*, Vol. 187 No. 2, pp. 339-356.
- Agatz, N.A., Campbell, A., Fleischmann, M. and Savelsbergh, M.W.P. (2011), "Time slot management in attended home delivery", *Transportation Science*, Vol. 45 No. 3, pp. 435-449.
- Agrawal, N. and Smith, S.A. (2015), *Retail Supply Chain Management: Quantitative Models and Empirical Studies*, Springer, Boston, MA.
- Aspray, W., Royer, G. and Ocepek, M.G. (2013), "Anatomy of a dot-com failure: the case of online grocer Webvan", in Aspray, W., Royer, G. and Ocepek, M.G. (Eds), *Food in the Internet Age*, Springer, Boston, MA, pp. 25-35.
- Brinberg, D.L. and McGrath, J. (1985), *Validity and the Research Process*, Sage, Thousand Oaks, CA.
- Bruno, D. and Gonzalez-Feliu, J. (2012), "French e-grocery models: a comparison of deliveries performances", *Colloquium on European Retail Research*, Paris, May, pp. 230-245, available at: <https://halshs.archives-ouvertes.fr/halshs-00690092/document>
- Bryman, A. and Bell, E. (2011), *Business Research Methods 3e*, Oxford University Press, Oxford.
- Campbell, A.M. and Savelsbergh, M.W.P. (2005), "Decision support for consumer direct grocery initiatives", *Transportation Science*, Vol. 39 No. 3, pp. 313-327.
- Colla, E. and Lapoule, P. (2012), "E-commerce: exploring the critical success factors", *International Journal of Retail and Distribution Management*, Vol. 40 No. 11, pp. 842-864.
- Creswell, J.W. (2002), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage, Thousand Oaks, CA.
- DeHoratius, N. and Rabinovich, E. (2011), "Field research in operations and supply chain management", *Journal of Operations Management*, Vol. 29 No. 5, pp. 371-375.
- De Kervenoael, R., YanÁšk, S., Bozkaya, B., Palmer, M. and Hallsworth, A. (2016), "Trading-up on unmet expectations? Evaluating consumers' expectations in online premium grocery shopping logistics", *International Journal of Logistics Research and Applications*, Vol. 19 No. 2, pp. 83-104.
- De Koster, R.B.M. (2002), "Distribution structures for food home shopping", *International Journal of Physical Distribution and Logistics Management*, Vol. 32 No. 5, pp. 362-380.
- Esper, T.L., Jensen, T.D., Turnipseed, F.L. and Burton, S. (2003), "The last mile: an examination of effects of online retail delivery strategies on consumers", *Journal of Business Logistics*, Vol. 24 No. 2, pp. 177-203.
- Estellés-Arolas, E. and González-Ladrón-de-Guevara, F. (2012), "Towards an integrated crowdsourcing definition", *Journal of Information Science*, Vol. 38 No. 2, pp. 189-200.
- Fawcett, S.E., Waller, M.A. and Bowersox, D.J. (2011), "Cinderella in the C-suite: conducting influential research to advance the logistics and supply chain disciplines", *Journal of Business Logistics*, Vol. 32 No. 2, pp. 115-121.
- Fernie, J. and McKinnon, A. (2009), "The development of e-tail logistics", in Fernie, J. (Ed.), *Logistics and Retail Management: Emerging Issues and New Challenges in the Retail Supply Chain*, Kogan Page, London, pp. 207-232.
- Fisher, M.L. and Raman, A. (2010), *The New Science of Retailing: How Analytics are Transforming the Supply Chain and Improving Performance*, Harvard Business School Publishing, Boston, MA.
- Forrester (2014), "European online retail forecast: 2013 To 2018", available at: www.forrester.com/European+Online+Retail+Forecast+2013+To+2018/fulltext/-/E-RES115752 (accessed 14 July 2014).
- Gallino, S. and Moreno, A. (2014), "Integration of online and offline channels in retail: the impact of sharing reliable inventory availability information", *Management Science*, Vol. 60 No. 6, pp. 1434-1451.
- Glaser, B.G. and Strauss, A.L. (1967), *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine, Chicago, IL.
- Guest, G., Bunce, A. and Johnson, L. (2006), "How many interviews are enough? An experiment with data saturation and variability", *Field Methods*, Vol. 18 No. 1, pp. 59-82.

- Hays, T., Keskinocak, P. and De López, V.M. (2005), "Strategies and challenges of internet grocery retailing logistics", in Geunes, J. (Ed.), *Applications of Supply Chain Management and E-Commerce Research*, Springer, New York, NY, pp. 217-252.
- Herhausen, D., Binder, J., Schoegel, M. and Herrmann, A. (2015), "Integrating bricks with clicks: retailer-level and channel-level outcomes of online-offline channel integration", *Journal of Retailing*, Vol. 91 No. 2, pp. 309-325.
- Hübner, A., Holzapfel, A. and Kuhn, H. (2014), "Structures and development paths for logistics and distribution systems in multi-channel retailing", in Delfmann, W. and Wimmer, T. (Eds), *Conference Papers of the 7th International Scientific Symposium on Logistics*, BVL International, Cologne, pp. 269-294.
- Hübner, A., Holzapfel, A. and Kuhn, H. (2015), "Operations management in multi-channel retailing: an exploratory study", *Operations Management Research*, Vol. 8 No. 3, pp. 84-100.
- Hübner, A., Kuhn, H. and Sternbeck, M.G. (2013), "Demand and supply chain planning in grocery retail: an operations planning framework", *International Journal of Retail and Distribution Management*, Vol. 41 No. 7, pp. 512-530.
- Hübner, A., Holzapfel, H. and Kuhn, H. (2016a), "Distribution systems in omni-channel retailing", *Business Research* (forthcoming).
- Hübner, A., Wollenburg, J. and Holzapfel, A. (2016b), "Retail logistics in the transition from multichannel to omni-channel", *International Journal of Physical Distribution and Logistics Management*, Vol. 46 Nos 6/7 (forthcoming).
- IGD (2013), "Spotlight on click and collect grocery shoppers", available at: <http://collectec.com/wpcontent/uploads/2014/04/Click-and-Collect-grocery-shoppers-IGD-Guide-2013.pdf> (accessed 28 May 2015).
- IGD (2014), "UK Grocery Retailing in July 2014", available at: www.igd.com/our-expertise/Retail/retail-outlook/3371/UK-Grocery-Retailing/ (accessed 7 August 2014).
- Kämäräinen, V., Saranen, J. and Holmström, J. (2001), "The reception box impact on home delivery efficiency in the e-grocery business", *International Journal of Physical Distribution and Logistics Management*, Vol. 31 No. 6, pp. 414-426.
- Kotzab, H. and Madlberger, M. (2001), "European retailing in e-transition?", *International Journal of Physical Distribution and Logistics Management*, Vol. 31 No. 6, pp. 440-462.
- Kotzab, H. and Schnedlitz, P. (1999), "The integration of retailing to the general concept of supply chain management", *Journal für Betriebswirtschaft*, Vol. 49 No. 4, pp. 140-153.
- Kuhn, H. and Sternbeck, M.G. (2013), "Integrative retail logistics: an exploratory study", *Operations Management Research*, Vol. 6 Nos 1/2, pp. 2-18.
- Lindlof, T.R. and Taylor, B.C. (2011), *Qualitative Communication Research Methods*, 3rd ed., Sage, Thousand Oaks, CA.
- Mason, J. (2002), *Qualitative Researching*, Sage, Thousand Oaks, CA.
- Miller, T. (2001), *Hierarchical Operations and Supply Chain Planning*, Springer, Berlin.
- Morganosky, M.A. and Cude, B.J. (2000), "Consumer response to online grocery shopping", *International Journal of Retail and Distribution Management*, Vol. 28 No. 1, pp. 17-26.
- Morse, J. (1994), "Designing funded qualitative research", in Denzin, N.K. and Lincoln, Y.S. (Eds), *Handbook for Qualitative Research*, Sage, Thousand Oaks, CA, pp. 220-235.
- Navis, C., Fisher, G., Raffaelli, R., Glynn, M.A. and Watkiss, L. (2012), "The market that wasn't: the non-emergence of the online grocery category", *Proceedings of the New Frontiers in Management and Organizational Cognition Conference*, National University of Ireland Maynooth, pp. 1-39.
- Nilsson, E., Gärling, T., Marell, A. and Nordvall, A.-C. (2015), "Importance ratings of grocery store attributes", *International Journal of Retail and Distribution Management*, Vol. 43 No. 1, pp. 63-91.
- Punakivi, M., Yrjölä, H. and Holmström, J. (2001), "Solving the last mile issue: reception box or delivery box?", *International Journal of Physical Distribution and Logistics Management*, Vol. 31 No. 6, pp. 427-439.
- Romney, A.K., Weller, S.C. and Batchelder, W.H. (1986), "Culture as consensus: a theory of culture and informant accuracy", *American Anthropologist*, Vol. 88 No. 2, pp. 313-338.
- Småros, J., Holmström, J. and Kämäräinen, V. (2000), "New service opportunities in the e-grocery business", *The International Journal of Logistics Management*, Vol. 11 No. 1, pp. 61-74.
- Stebbins, R.A. (2001), *Exploratory Research in the Social Sciences*, Sage, Thousand Oaks, CA.
- Strauss, A. and Corbin, J.M. (1990), *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Sage, Thousand Oaks, CA.
- Swaminathan, J.M. and Tayur, S.R. (2003), "Models for supply chains in e-business", *Management Science*, Vol. 49 No. 10, pp. 1387-1406.
- Teller, C., Kotzab, H. and Grant, D.B. (2006), "The consumer direct services revolution in grocery retailing: an exploratory investigation", *Managing Service Quality*, Vol. 16 No. 1, pp. 78-96.
- Teller, C., Kotzab, H. and Grant, D.B. (2012), "The relevance of shopper logistics for consumers of store-based retail formats", *Journal of Retailing and Consumer Services*, Vol. 19 No. 1, pp. 59-66.
- Trautrim, A., Grant, D.B., Cunliffe, A.L. and Wong, C. (2012), "Using the 'documentary method' to analyse qualitative data in logistics research", *International Journal of Physical Distribution and Logistics Management*, Vol. 42 Nos 8/9, pp. 828-842.
- Vanelander, T., Deketele, L. and Van Hove, D. (2013), "Commonly used e-commerce supply chains for fast moving consumer goods: comparison and suggestions for improvement", *International Journal of Logistics Research and Applications*, Vol. 16 No. 3, pp. 243-256.

- Walmart (2014), "Walmart pickup - grocery test opens in Northwest Arkansas", available at: <http://news.walmart.com/videos/b-roll-walmart-pickup-grocery-test-opens-in-northwestarkansas> (accessed 29 May 2015).
- Xing, Y., Grant, D.B., McKinnon, A.C. and Fernie, J. (2010), "Physical distribution service quality in online retailing", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 No. 5, pp. 415-432.
- Yang, X., Strauss, A.K., Currie, C.S. and Eglese, R. (2014), "Choice-based demand management and vehicle routing in e-fulfillment", *Transportation Science*, pp. 1-16, available at: <http://pubsonline.informs.org/doi/pdf/10.1287/trsc.2014.0549>
- Yin, R.K. (2014), *Case Study Research: Design and Methods*, Sage, Thousand Oaks, CA.
- Zwicky, F. (1967), "The morphological approach to discovery, invention, research and construction", in Zwicky, F. and Wilson, A.G. (Eds), *New Methods of Thought and Procedure*, Springer, Berlin, pp. 273-297.

From Bricks-and-Mortar to Bricks-and-Clicks – Logistics Networks in Omni-Channel Grocery Retailing

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Abstract

Purpose - The advent of grocery sales through online channels necessitates that bricks-and-mortar retailers redefine their logistics networks if they want to compete online. Because the general understanding of such bricks-and-clicks logistics systems for grocery is still limited, the purpose of this paper is to analyze the internal logistics networks used to serve customers across channels by means of an exploratory study with retailers from different contexts.

Design/methodology/approach - A total of 12 case companies from six European countries participated in this exploratory study. Face-to-face interviews with managers were the primary source for data collection. The heterogeneity of our sample enabled us to build a typology of logistics networks in grocery retailing on multiple channels and to understand the advantages of different warehousing, picking, internal transportation and last-mile delivery systems.

Findings - Bricks-and-mortar grocery retailers are leveraging their existing logistics structures to fulfill online orders. Logistics networks are mostly determined by the question of where to split case packs into customer units. In non-food logistics channel integration is mostly seen as beneficial, but in grocery retailing this depends heavily on product, market and retailer specifics. The data from our heterogeneous sample reveals six distinct types for cross-channel order fulfillment.

Practical implications - Our qualitative analysis of different design options can serve as decision support for retailers developing logistics networks to serve customers across channels.

Originality/value - The contribution of this paper is to develop a typology for omni-channel grocery logistics networks. It discusses logistics networks with regard to differences between grocery and non-food omni-channel retailing, last-mile delivery systems and market characteristics.

Keywords: Omni-Channel Retailing, Grocery Retailing, Retail Logistics, Logistics Networks, Typology, Exploratory Study

1. Introduction

This paper analyzes logistics network structures for grocery retailing via multiple channels, i.e., where retailers offer their products not only in bricks-and-mortar (B&M) stores, but also online in a “bricks-and-clicks” approach [Wilding, 2013; Beck and Rygl, 2015; Ishfaq et al., 2016]. Focusing on the product flow, the products can be picked up at the store, at pick-up stations or delivered to the customer’s home. Enabling the different delivery and pick-up modes across channels is a recent phenomenon, particularly in grocery retailing. Retailers may operate all types of networks from isolated product flows – where direct-to-customer shipments and store supply are operated independently – to unified systems with comprehensively conflated front- and back-end logistics [Hübner et al., 2016c]. Bricks-and-clicks retailers therefore need to address the question of how to operate logistics networks to serve customers across channels.

Such logistics networks that enable bulk and single unit picking and delivery are more costly than traditional store fulfillment with bulk deliveries to stores, where customers themselves are responsible for order picking at the store. In grocery retailing, differing temperature zones, orders with multiple items, higher waste due to perishable inventories and rapid delivery requirements make logistics for grocery more complex than for non-food. Innovative logistics networks need to fulfill customer expectations particularly in terms of high delivery speed, high product availability and low delivery costs, while retailers need to consider the upside potential of new market segments, but also manage their own costs and complexity arising from different channels and network options. B&M grocers need to find answers to how product flows for the fulfillment of online orders can be organized within their existing network or in a separate distribution channel.

Investigating the different network design options is relevant from a practical and an academic perspective. In Europe grocery retailing is predicted to surpass consumer electronics in online sales to become the second largest category after apparel by 2018 [Forrester, 2014]. In the United States a recent study shows that 41% of customers have already bought groceries online. A total of 21% had purchased groceries within the previous 30 days [Brick Meets Click, 2016]. However the fulfillment options for grocery are very different across markets. For example, German B&M retailers mostly supply their currently small volume of online orders through their existing store outlets, whereas most Dutch and UK retailers fulfill home delivery via specialized online distribution centers [Hübner et al., 2016b]. In France 3,325 drive-through stations for pick-up of online grocery orders are registered – nearly twice the number of hypermarkets in the country [Vyt et al., 2016]. Logistics literature mostly focuses on online grocery fulfillment (e.g., Kotzab and Madlberger [2001]; Teller et al. [2006]; Grant et al. [2014]; Dreyer et al. [2015]) and cross-channel fulfillment for non-

food retailing (e.g., Agatz et al. [2008]; Hübner et al. [2015, 2016a]; Ishfaq et al. [2016]), but only on cross-channel grocery retailers to a very limited degree (e.g., Colla and Lapoule [2012]). Management literature shows that the organizational transformation to omni-channel retailers has a positive effect on firms' sales growth (e.g., Cao and Li [2015]). Most retailers are therefore merging their channels at least to some extent [Hübner et al., 2016c]. However, the question arises as to whether this is always beneficial, especially if this applies for all retail categories, and to what extent [Verhoef et al., 2015].

An exploratory study is appropriate because our understanding of the logistics network for grocery fulfillment across channels is still limited [Seuring, 2008]. A multiple case study approach with grocery retailers from different contexts is therefore used to understand the advantages of different warehousing, picking, internal transportation and last-mile delivery systems. The aim of the paper is to analyze which logistics networks are used to serve customers with grocery across channels.

In the following, we provide the context of our scope of investigation into grocery retail logistics and develop the specific research question in Section 2 before describing the methodology applied in Section 3. The main Section 4 develops a typology of logistics networks and reveals the reasons why retailers use specific structures. Finally the key findings are discussed in the light of literature in Section 5.

2. Conceptual background and research question

Many different expressions have been developed for retailing via multiple channels with “bricks-and-clicks”. Terms encountered in practice include “multi-channel”, “cross-channel” or “omni-channel”, which are often used interchangeably and without clear differentiation [Beck and Rygl, 2015]. In omni-channel (OC) retailing, neither the customer nor the retailer distinguishes between physical store and the Internet channel anymore [Brynjolfsson et al., 2013; Bell et al., 2014; Verhoef et al., 2015]. There is only one common interface to the customer [Wilding, 2013; Beck and Rygl, 2015]. In the context of logistics, OC retailers apply information exchange, joint operations, warehousing and inventories across channels, which leads to a conflation of the fulfillment processes [Hübner et al., 2016c]. However, the fulfillment of retail orders across channels is based on a combination of existing B&M concepts, online fulfillment concepts and new options that arose from the joint fulfillment of both channels. The upcoming subsection therefore first conducts a literature-based channel-specific analysis of *pure B&M* and *pure online* grocery logistics networks in Subsection 2.1. This analysis builds the foundation for formulating the research question of the

present study concerning the logistics networks of OC grocery retailers in Subsection 2.2.

2.1. Bricks-and-mortar and online grocery logistics networks

Briefly, the logistics network of a grocery retailer can be segmented into inbound logistics, warehousing and distribution (e.g., Bournakis and Weightman [2007]; Hübner et al. [2013]; Kuhn and Sternbeck [2013]). The scope of our investigation is on the retailers' internal network. The internal network consists of the subsystems warehousing, internal transportation between distribution centers (DCs) and stores as well as last-mile delivery to customers [Kuhn and Sternbeck, 2013; Hübner et al., 2016b]. In grocery retailing, one additional and crucial part of warehousing is picking processes, which largely determine the configuration of the logistics network. They make up more than 50% of total warehouse operating expenses [De Koster et al., 2007]. In the following we therefore focus on the four areas (i) warehousing, (ii) picking, (iii) internal transportation, and (iv) last-mile delivery. We will first explain the general processes and setting for all four areas, and then describe the specific requirement for each channel separately. Figure 1 gives an overview of product flows from suppliers across different DCs to stores, pick-up stations and customers, and separately for B&M and online fulfillment.

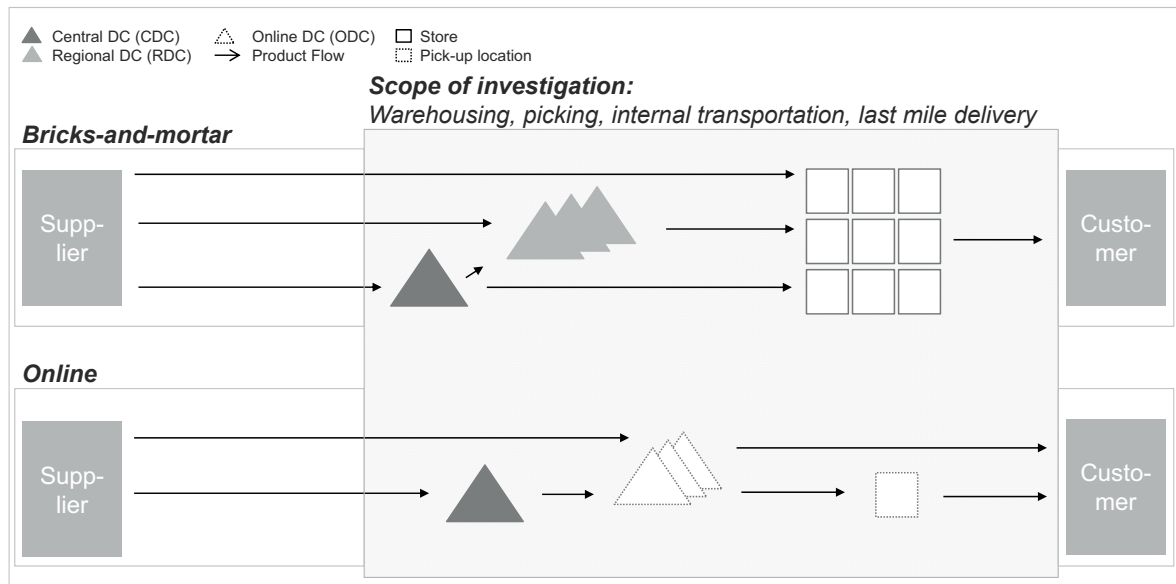


Figure 1: Network structures of pure bricks-and-mortar and pure online grocery retailers

(i) *Warehousing* frames all planning aspects related to long-term network configuration, e.g., sizing the number of DCs, or defining functionalities in terms of central or regional DCs. Retailers use their DCs for inventory holding and picking, but they can additionally serve for cross-docking. Because grocery products have differing temperature requirements, grocery retailers need to operate separate facilities by temperature zone. After the receipt of products from suppliers or other

DCs, items are stored, picked, and distributed in different temperature zones. Retailers receive products in case packs (CPs), i.e., outer packs (secondary packaging), from their suppliers, but sell these products in customer units (CUs), i.e., eaches (primary packaging), to their customers. The suppliers' CP facilitates the handling of multiple CUs in the supply chain and protects the products during picking and transportation [Broekmeulen et al., 2016].

Bricks-and-mortar. A small number of central distribution centers (CDCs) mainly store slow-moving dry food [Hübner et al., 2013]. Multiple regional distribution centers (RDCs) mostly store fast-moving items and items with short transportation lead time requirements (e.g., fresh produce) [De Koster et al., 2007]. Internal consolidation of orders can take place when items from CDCs are cross-docked and bundled in an RDC for further transportation [Kuhn and Sternbeck, 2013]. Items are usually stocked in CPs or in a larger-scale unit (e.g., a pallet).

Online. Pure online grocers operate DCs in different temperature zones. They are termed online distribution centers (ODCs) because they only fulfill online orders [Hübner et al., 2016b]. Sometimes they are also referred to as “dark stores” [Mena and Bourlakis, 2016]. ODCs are built close to customers to shorten the transportation lead time [Hays et al., 2005]. At an ODC CPs are divided into (and stocked in) CUs. We term this point “break-open point”, i.e., where CPs from suppliers are “broken” and divided into CUs for the first time (cf. De Koster et al. [2007]; Broekmeulen et al. [2016]).

(ii) *Picking* is the process where different items for store and customer orders are compiled. Minimizing the travel distance of pickers and consolidation effort of orders is the primary objective [Rouwenhorst et al., 2000; Gu et al., 2007]. Picking is performed in all DC types (i.e., CDC, RDC, ODC) and conducted by temperature zone.

Bricks-and-mortar. In most cases picking is completed in CPs [De Koster et al., 1999; Gu et al., 2007], where a picker takes an entire CP from a storage area and puts it on a transportation unit (e.g., pallet or roll cage). Usually each transportation unit equals one picking job and contains 15 different items on average [Glatzel et al., 2012], i.e., a picker has an average of 15 different items to pick per job. Larger quantities than CPs (e.g., entire pallets) are only picked for bulky items or if stores display items on pallets. Under certain circumstances, e.g., for low-volume high-value products, a B&M retailer removes the secondary packaging at the DC and then uses reusable boxes for transportation. The break-open point is therefore in the store for almost all items. The consolidation of items from various temperature zones takes place either in the DC (if stores are delivered with multi-temperature vehicles [Hübner and Ostermeier, 2016]) or in the store.

Online. In online grocery retailing the unpacking has to be done, i.e., the secondary packaging removed, before customer orders are picked. In a first stage pallets containing items of one product type are often broken up into CPs and then in a second stage CPs are further broken up into CUs. Online picking is also more complex because the orders consist of multiple different items [Agatz et al., 2008]. Each online order contains from 60 to 100 different items [Ferne and McKinnon, 2009]. After picking, the order has to be consolidated (if split up into different picking jobs), packed and sorted by delivery region before the distribution can start. The final consolidation of an order from different temperature zones is performed by vehicle drivers at the customer's doorstep.

(iii) *Internal transportation* deals with deliveries between DCs or from DCs to stores.

Bricks-and-mortar. The minimum transportation unit for store supplies is a pallet or roll cage for most items. After goods have been picked on transportation units, haulage is carried out by temperature-specific trucks (or temperature-specific compartments of a truck) that deliver orders to a store from once per week (i.e., slow movers) to a couple of times per day (i.e., ultra-fresh grocery) [Bourlakis, 1998; De Koster, 2002; Holzapfel et al., 2016]. Repetitive delivery patterns are applied to facilitate the planning of the logistics network in other subsystems [Kuhn and Sternbeck, 2013]. RDCs may serve as transshipment points for CDC shipments. Further transshipment points (e.g., for cross-docking) may be also applied to supply stores.

Online. For online orders the only internal transportation occurs when retailers have CDCs and transport items from different temperature zones to ODCs for further picking and distribution.

(iv) *Last-mile delivery* defines the delivery of online orders to customers and is therefore only relevant for online retailers. After picking, online grocery retailers distribute their products from ODCs with the help of courier, express and parcel (CEP) services or with their own fleet [Rao et al., 2009]. The transportation vehicles need to either contain multiple compartments or be equipped with isolated boxes to transport products from different temperature zones. Basic differences in home delivery concepts are attended home delivery (e.g., Kämäräinen et al. [2001]) and unattended home delivery (e.g., Punakivi and Saranen [2001], Punakivi et al. [2001]), differentiating whether a customer needs to be at home when the grocer delivers the goods to the door or not. Delivery in time windows and balancing demand over the day are critical factors for efficient home delivery (e.g., Punakivi and Tanskanen [2002], Hays et al. [2005], Boyer et al. [2009], Vanelslander et al. [2013]). Some online grocers use pick-up solutions like box systems with different temperature zones in congested areas for shortening the last mile to the customer and for bundling of orders.

2.2. Research question

The analysis of B&M and online grocery logistics networks reveals considerable differences between both channels. The question therefore arises as to how grocery retailers can organize their logistics and operations to supply not only stores but also pick-up points and customers at home at the same time. In grocery retailing all existing OC retailers started from a B&M operational model. To the best of our knowledge up to now, no former pure online grocer has begun to sell grocery products in large store networks. The focus of the present study therefore lies in analyzing former B&M grocery network structures and product flows to serve customers in both channels. This addresses the question of how already existing B&M logistics structures can be used or further developed to fulfill the online channel in grocery retailing.

Whereas logistics structures for non-food OC retailing are analyzed in literature (e.g., Hübner et al. [2016c], Ishfaq et al. [2016]), OC grocery logistics networks have not yet been researched and require separate consideration. The present investigation thus conducts an exploratory study achieving a better understanding of OC grocery retail logistics by answering the following research question:

Which OC logistics networks are used by former pure B&M grocery retailers and why?

The subsystems of warehousing, picking, internal transportation and last-mile delivery are revisited in Section 4 to analyze logistics network structures in OC grocery retailing in a more comprehensive manner. We first detail the research process in the next section.

3. Methodology

The addition of an online channel to an existing B&M grocery logistics network needed to be a rapid transition process because of fast and significant changes in customer shopping behavior. Theory on network design has not kept up pace. Our research into the logistics networks of OC grocery retailers targets this open research area and develops a theory about how existing networks can be used for online fulfillment and the reasons for their (re-)design. Exploratory studies are appropriate to investigate the hows and whys of a little-known research area [Creswell, 2003; Kotzab et al., 2005]. This study therefore follows an exploratory approach [Flynn et al., 1990; DeHoratius, 2011]. Qualitative research is particularly appropriate for the investigation of new structures and processes as it allows the inductive development of new theory within a contextual setting in the investigation of organizational and managerial decisions [Bryman and Bell, 2011]. We applied a

case study approach as this is particularly suitable for exploratory qualitative research [Seuring, 2005; Pagell and Wu, 2009; Yin, 2014].

Sampling. Case studies were conducted with 12 OC grocery retailers from six European countries. The selection of retailers from six different countries provides the opportunity to make firm use of the strengths of a case study approach in exploratory research by combining a sample that shares internal homogeneity (i.e., retail companies sharing common characteristics) and external heterogeneity (i.e., retailers operating from different consumer expectations, population density, infrastructure, etc.) [Wu and Choi, 2005; Seuring, 2008; Trautrimis et al., 2012]. Cases were selected purposefully as recommended for exploratory qualitative studies (e.g., Pagell and LePine [2002]) based on the criteria that the retailer had a minimum sales volume of EUR 500 million p.a. and a minimum of 50 outlets of their own, ensuring an established store logistics network before commencement of online operations. In addition to this, retailers were required to sell all grocery products from multiple temperature zones (i.e., fresh, frozen and ambient) combined in at least one channel and selling grocery products from at least one temperature zone across all channels. As a result we only included full-range grocery retailers that had started initially as B&M grocers and then built up an online channel over time to sell grocery goods across channels. We did not want to mix pure online players with our sample because they started off very differently (e.g., regarding existing logistics network or purchasing agreements) to B&M grocery retailers and do not have another channel to integrate logistics with.

Interviews. We interviewed 16 managing directors and section heads from logistics, IT and e-commerce departments to obtain the broadest possible view and the most in-depth insights. We chose the most informed and experienced experts in OC retailing who have been directly involved in the development and execution of cross-channel systems. An overview of participating companies by country is provided in Table 1.

Country	Germany				France		UK	Netherlands			Austria	Portugal
Case Company	1	2	3	4	5	6	7	8	9	10	11	12
Interviews	1	3	1	1	1	1	1	1	1	1	1	1
Participants	1	3	1	1	1	2	1	1	1	2	1	1
-Logistics		2	1		1	1			1	1	1	
-IT	1	1					1					
-E-commerce				1		1	1	1		1		1
Stores in country	>5,000	>5,000	<500	<500	>5,000	500-1,000	500-1,000	500-1,000	500-1,000	<500	1,000-5,000	<500
Sales in Euro	30-50bn	>50bn	5-10bn	5-10bn	30-50bn	30-50bn	10-30bn	<5bn	10-30bn	<5bn	5-10bn	<5bn
Share in country	10-20%	20-30%	<10%	<10%	20-30%	20-30%	10-20%	10-20%	>30%	<10%	>30%	20-30%
Years online	3-5	3-5	3-5	3-5	>5	>5	>5	3-5	>5	1-3	1-3	>5

Table 1: Overview of participating companies by country

The interviews were conducted face to face at the site of the OC retail companies. The interviewees were self-selected by the retailers as the relevant specialist executives for the logistics

structure of their OC ambitions and can hence be considered the relevant experts for the respective retailer. These experts have fundamental knowledge of logistics networks and warehousing, picking, internal transportation and last-mile delivery systems from their position within the companies. Expert interviews are a suitable instrument for data collection because the knowledge of the experts interviewed stems from their position within the companies (see, e.g., in Flynn et al. [1990], Ellram [1996], Creswell [2003], Trautrim et al. [2012]). The case interviews, with one to three interviews per case company, lasted 80 minutes on average. We used theoretical sampling for our interviews, which took place over a period of six months. We started with five retailers and gradually developed our sample until saturation in the data was reached at 12 case companies [Eisenhardt, 1989; Glaser and Strauss, 1967]. Twelve cases are the upper end of Ellram's (1996) recommendation for the assurance of sufficient generalizability of case study research. Guest [2006] come to the same observation in a similar study on "how many interviews are enough" in qualitative and exploratory research. The interview data was further enriched using market intelligence reports. These additional data sources were used for triangulation to achieve internal validity together with confirmation checks with interview partners [Jick, 1979]. All interviews were recorded and afterwards transcribed for the application of the qualitative data analysis support software MAXQDA 11. A pilot was conducted with one grocery retailer in Germany prior to the interviews. After the interview, minor adaptations were made to the interview guide. The interviews targeted two areas. One was the logistics networks currently used in OC grocery retailing. The other was understanding underlying rationales for the network structures chosen. An abbreviated interview guide used in the main study can be found in the Appendix.

Data analysis. Our inductive analysis is neither driven by deductive logic nor follows a strict grounded theory approach [Randall and Mello, 2012; Manuj and Pohlen, 2012], because "data is inextricably fused with theory" [Alvesson and Kärreman, 2007]. The interview transcripts were analyzed in two layers. First, an objectivist content analysis was conducted focusing on identification of the logistics network structures used by the retailers. The second layer was a subjectivist analysis focusing on the organizational and managerial decision behind the logistics networks. In the first layer we coded the interview transcripts for aspects relating to how the logistics networks are structured and then extracted the underlying reasons for the logistics network structure to understand why the logistics networks are structured the way they are [Trautrim et al., 2012]. After establishing the logistics network structures currently used from the content analysis in the first layer, the second layer of analysis required deconstruction of the data for the extraction of tacit knowledge from the interviews. The transcripts were rephrased, reflected on and compared

to create meaningful categories [Eisenhardt, 1989; Trautrim et al., 2012]. Transcripts of the interviews were subsequently coded and categorized [Miles et al., 2013] using MAXQDA 11. The data were coded and categorized after each interview until preliminary theoretical saturation was reached [Corbin and Strauss, 1990], i.e., repeatability was high, and certain patterns emerged. Two researchers coded the data independently of each other to provide external validity of our findings. Afterwards the researchers compared and discussed the codes and the emerging data structure to ensure the repeatability of our findings [Lincoln and Guba, 1985]. Codes were assigned to reflect interviewee descriptions. A total of 755 individual passages were coded. If a description or view did not fit a code that had already been assigned, a new code was assigned to this item [Maanen, 1979]. Each code was linked to a phrase from the interview transcript or recording. This enabled complete traceability from an individual code to the original source. Three main logistics network configurations resulting in six different types of online channel organization within an existing B&M logistics network are derived from the data. Additional influencing factors are grouped into two categories, namely market and consumer influences. These factors are used in the analysis to address the question of why a certain type is applied at a retailer. The following section presents and analyzes the emerging types of OC grocery logistics networks.

4. Empirical findings

This section presents the empirical findings of the exploratory study conducted. In section 4.1 each OC grocery logistics network type identified is described and analyzed individually before section 4.2 summarizes the typology of OC logistics networks.

4.1. Typology of omni-channel logistics networks in grocery retailing

In OC grocery retailing three main logistics network configurations can be distinguished. In the first network configuration ([1]) online orders are mostly fulfilled via traditional B&M logistics networks. The configuration therefore abstains from establishing a separate ODC for online order fulfillment. The second network configuration ([2]) is characterized by the availability of an independent ODC that fulfills at least a significant share of all online orders. In the third network configuration ([3]) all orders are fulfilled from one channel-integrated DC. The network configurations [1] and [2] can be further divided into two ([1.1], [1.2]) and three ([2.1], [2.2], [2.3]) diverse types, respectively, so that altogether six different types exist.

This subsection describes and analyzes the general setup of these types considering the respective subsystems warehousing, picking, internal transportation and last-mile delivery. This consecutively

answers the research question formulated (i.e., “which OC networks exist?” and “why is a particular OC network operated?”).

Network configuration [1]: Traditional bricks-and-mortar structures for online order fulfillment

Network configuration [1] is based on the traditional structures of a B&M grocer, as stores and pick-up points are supplied through existing networks. A separate ODC does not exist. All online orders are exclusively supplied via stores or pick-up points. CPs are broken into CUs as late as possible in the supply chain, allowing a long continuing common flow of goods. Two different types can be distinguished whereby either all online orders are fulfilled from store (type [1.1]) or separate solo pick-up stations are built up fulfilling part of or all online orders (type [1.2]).

Type [1.1]: Fulfillment of all online orders from store

In type [1.1] all online orders are fulfilled from regular stores. Customers can choose whether they either pick up online orders from a pick-up point that is attached to a store or have their orders delivered to their home. In both cases orders are picked at the store (see Figure 2). The flow of goods goes from the supplier across different temperature and category-specific DCs and transshipment points via stores to the customer. The arrows display the granularity with which items are handled – in CPs or CUs. CPs are divided at the break-open point for the first time (i.e., “broken open”) into CUs, and from there everything is processed on a CU basis. At type [1.1] the break-open point is at the store.

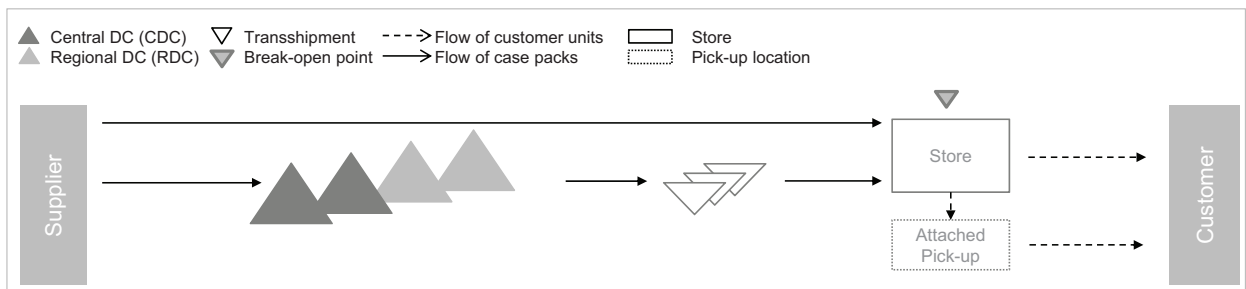


Figure 2: Type [1.1] – Fulfillment of all online orders from store

Description. Suppliers mostly deliver goods to CDCs and RDCs (C/RDCs) on pallets, and via transshipment points to stores in different temperature zones. Slow-moving products are stored in CDCs and fast-moving products are stored in RDCs, which are generally located closer to the stores. Store orders are picked in C/RDCs and online orders in stores. Picking for stores is done in large quantities in DCs and at CP level. Afterwards, the retailer delivers goods from the DCs to the stores in different temperature zones on pallets for store replenishment. Here, the CPs are

divided into CUs and online orders are picked from store shelves by store employees in a defined picking procedure:

With [...] in-store picking, rules have to be defined as to how many pickers are allowed on the shop floor in addition to the customers shopping for groceries [Company 5, France].

After temperature-specific picking, the items are stored temporarily in temperature-specific boxes. Retailers can either only offer pick-up of products from the store or additionally offer home delivery with delivery vehicles from the store. The final consolidation of an order across temperature zones is conducted when customers pick up the order from the associated pick-up station or via home delivery when the driver reaches the customer's doorstep.

Analysis. In this type no additional ODC is necessary, so no investment costs in new warehouse locations and no additional inventory are incurred. Moreover, the identical assortment for online- and store channel leads to joint storage of online and store products in the DCs and therefore no additional space requirements for additional online items. However, no virtual shelf extension with for example slow-moving items is possible in the online shop as products come directly from store shelves. It is also difficult to provide availability information to the online channel. In general, high inventory inaccuracy exists at the store level and there is a higher out-of-stock risk as store customers can take items from shelves before online order picking. The forecasting of joint store and online demand is more complex. Purchase patterns are not the same for online and store channel customers, which can lead to mismatch of store replenishment forecasts and inventory holding.

At 90% service level in store and over 50 different items per online order your order cannot be delivered in full without substitution. [...] Advanced analytics on a customer basis are necessary to know that customer A prefers item Y if item X is not available [Company 9, Netherlands].

In addition, low service levels in store can lead to a lot of product replacements. This is especially relevant in grocery retailing as an order usually contains multiple items per order, so a customer order can rarely be supplied without replacements for missing items.

In non-food you expect two to three different items per basket. We have 50. In the UK, which is still more advanced in terms of online grocery shopping, the average is between 68 and 72 [Company 1, Germany].

However, the acceptance level of substitutions is high for online orders.

Service levels at in-store picking are not a problem for us. French customers accept substitution for dry food in more than 90% of cases [Company 5, France].

The picking in C/RDCs of CPs on pallets allows high operational efficiency in the DCs. However, this is suspended by the additional picking step and low picking efficiency in store as the stores are not designed for order picking. Competition on products between online and store orders (i.e., allocation of products to customer or picker in the event of limited availability) in store is another disadvantage of in-store picking. As a result, retailers claim that this concept is only appropriate if online sales volume is low.

If you reach a figure of 5% for online sales in your store, you should switch to ODC picking to reduce the risk of impacting store customers [Company 12, Portugal].

At the internal (temperature-specific) transportation between DCs and stores, stores can still be supplied using efficient transportation loads. No additional costs are required for internal transportation flows of online orders (e.g., from C/RDCs to an ODC). Furthermore, the high number of shipment locations (i.e., stores instead of ODCs) result in lower transportation costs on the last mile and shorter delivery lead times to the customer. Shipment of last-mile deliveries from a high number of decentralized locations (i.e., stores) results in higher capacity investments for vehicles as there are only very limited pooling effects available across last-mile operations as each store needs to operate its own fleet. An alternative would only be to lower the service levels (e.g., by using time windows that were not so narrow) or to outsource to other logistics service providers that can pool capacities across retailers. However, grocery retailers prefer to keep the last-mile delivery within the company as the handling of grocery items and the final delivery and handover of items is seen as a delicate procedure by customers. OC grocery retailers therefore often invest in their own fleets for last-mile delivery.

Grocery customers expect a traditional B&M grocer, if it is a big brand, to deliver fresh products with its own fleet and not via a logistics service provider [...] [Company 1, Germany].

We have our own fleet of around 3,500 vehicles for home delivery [Company 7, UK].

This logistics network allows fast market coverage for grocers with a dense store network. For example in Germany and Austria more than double the grocery stores per 1 million inhabitants are available compared to France or the UK. Consequently in France and the UK grocery stores are larger and also further outside the city centers than in Germany and Austria [Nielsen, 2015].

We were losing market share, that's why we had to react quickly [Company 8, Netherlands].

No additional pick-up points are necessary throughout the country due to the high density of our outlets [Company 2, Germany]

From a market perspective this type is therefore best suited for regions where a broad customer base can be approached from stores within a short distance and online volume is low. Furthermore, the structure is especially suited for and used by cooperative organizations where every owner knows their local customers best and where there is only limited interest in a central and mutual ODC sharing investment costs.

Type [1.2]: Additional solo pick-up points for online orders

Type [1.1] can be extended by adding solo pick-up points (see Figure 3).

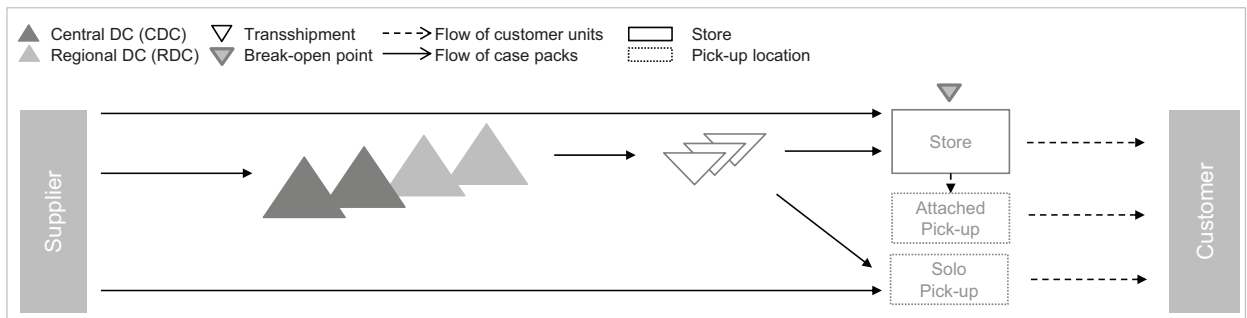


Figure 3: Type [1.2] – Pure pick-up of all online orders

Description. On top of the delivery to C/RDCs and stores, suppliers also deliver selected product categories directly to solo pick-up points that have their own inventory. The solo pick-up points are often organized as drive-through stations and are mainly supplied from C/RDCs with the same internal transportation systems used for store replenishment. At the solo pick-up points CPs are opened and items stored in CUs, where professional pickers take care for the order picking. Online order picking is done directly from store shelves by store employees at attached pick-up stations. Retailers can either only offer pick-up of products from pick-up points or additionally offer home delivery with vehicles from the store.

Analysis. While there is no duplicated inventory holding in ODCs, multiple inventory holding of CUs occurs at every solo pick-up station, leading to increased inventory holding costs. The inventory holding costs include capital costs, costs for the storage area, costs for overstocking (waste), and costs for understocking (out-of-stock). Only selected products are offered online because the DCs attached to solo pick-up stations do not have the facilities to offer all product categories such as ultra-fresh produce like in the store, leading to a more limited assortment. However, this may not be an issue if customers only want to buy a selected assortment online for pick-up.

Up to 20% of total sales in unemotional categories like water, milk or other dry foods are bought via pick-up and drive-through stations. For other segments this is less than 1% [...] for example fresh fish or meat, because customers want to see, touch and feel the products before buying them [Company 5, France].

Picking in DCs to supply stores and solo pick-up points is still possible in CPs, making joint transportation to stores and the pick-up points of the attached DCs concerned easier. However, the two-stage picking for single items for every online order (i.e., first in the RDC and then additionally either in solo pick-up locations or in store) increases picking costs. The disadvantages of in-store picking remain for the pick-up stations attached to stores (see type [1.1]). Home delivery is usually unavailable with this type because solo pick-up points are set up to be close to the customer. However, retailers can also decide to deliver orders picked from store shelves or solo pick-up points to customer's homes.

French customers want to pick up groceries that they have bought online. We have tried home delivery but it does not work [Company 5, France].

This concept is appropriate in markets where the pick-up of products is accepted because retailers save costs on the last mile and customers save shopping time. Whereas in the Netherlands (5.6%) or in Germany (16.8%) the percentage of households where both parents have a full-time job is relatively low, in France (41.4%) and in Portugal (66%) this number is significantly higher [OECD, 2015], leading to difficulties with attended home delivery and therefore to advantages with the pick-up option.

No-one is at home during the day to attend to home delivery. Women work in nearly every household, so they want to pick up online orders when they have the time for it. This is different in other countries such as Germany or the UK [Company 6, France].

In addition, French customers are much more used to driving a longer distance to the next supermarket [Nielsen, 2015]. Even in markets where the home delivery of groceries is already widespread (e.g., the UK), retailers are thinking about steering customers towards pick-up solutions because this has major cost advantages (see also Wollenburg et al. [2016]).

At the moment we have 90% home delivery and 10% pick-up where online grocery orders are concerned. If we could start over, we would definitely promote pick-up more and try to bring customers to our pick-up stations and stores. [...] Our goal is to change these figures to 70% home delivery and 30% pick-up because this will enable us to save transportation and planning costs on the last mile [Company 7, UK].

However, this logistics network is not appropriate when online order volume is low due to the high costs of investing in pick-up locations and the substantial inventory costs because of the risk of waste and inventory obsolescence in decentralized locations.

Network configuration [2]: Dedicated distribution center for online orders

In the second configuration an ODC is introduced to fulfill all or parts of online orders. The ODC may be used solely for home delivery orders (type [2.1]), for all online orders including the supply of pick-ups (type [2.2]), or for specific parts of an online order, whereby some product categories are added from stores (type [2.3]). In any case, CPs are divided into CUs earlier in the supply chain (i.e., in ODCs) compared to network configuration [1].

Type [2.1]: Online distribution center for home delivery orders

One or more ODCs are introduced to fulfill all home delivery orders, while pick-up orders are still fulfilled from stores (see Figure 4).

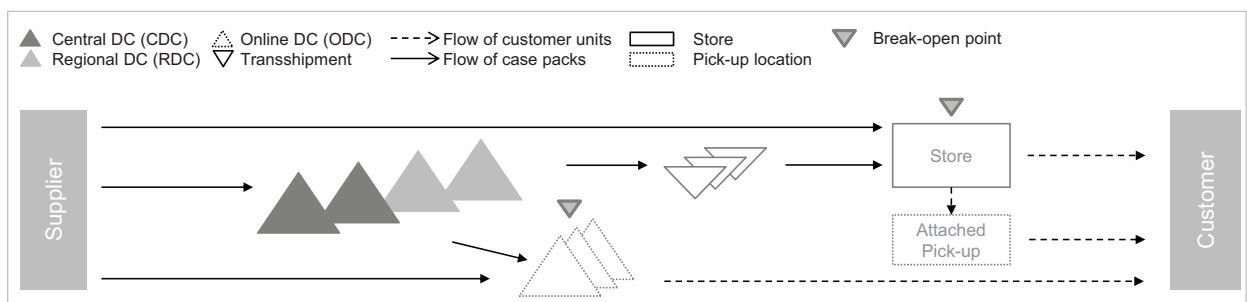


Figure 4: Type [2.1] – Online distribution center for home delivery orders

Description. On top of the supply of C/RDCs and stores already mentioned (see network configuration [1]), suppliers also deliver directly to ODCs, which are usually smaller than C/RDCs. ODCs are additionally replenished from C/RDCs like a B&M store using CPs, which are broken up and then stocked in CUs. Picking of online orders in CUs is completed here for home delivery. Multiple orders are stored in boxes of different temperatures and delivered in small vehicles, where the final order is assembled at the customers' home. Online orders for pick-up are still picked from store shelves and made available afterwards at the attached pick-up station.

Analysis. At ODC inventory holding, customers benefit from longer best-before dates on products ordered online because storage duration in the store is saved, while service levels due to inventory pooling effects in the ODC are usually higher than in store. However, the high initial costs for setting up the ODCs require a certain online order volume to amortize the fixed costs. Another cost factor is duplicated inventory holding to serve online orders in store for pick-up and in ODCs

for home delivery. In addition, virtual shelf extension is not possible for all online orders. The store assortment limits the online assortment because pick-up orders are fulfilled from store shelves. The assortment offered online can only be tailored automatically according to the order fulfillment location in a second step if retailers retrieve the delivery information (i.e., order for home delivery or order for pick-up) from the customer in a first step of the purchasing process. Customers who order for home delivery may see a larger assortment than customers who order for pick-up. Furthermore, because the picking processes for home delivery orders are specialized in ODCs, more efficient picking of CUs can be accomplished here than in a store.

With our ODC we pick 15 to 20 online orders for home delivery at a time. This is not possible in a store [Company 1, Germany].

However, investments in picking technology for CU picking occur (e.g., automation), while in-store picking has disadvantages as pick-up orders are still picked in store. Having two picking locations for online orders at the same time, i.e., store and ODC, will lead to higher internal processing, coordination and transportation costs due to lower economies of scale. On the last mile to customers, the capacity of delivery systems can be better utilized by capturing bundling effects across orders because the ODC serves a larger delivery area than a single store. These bundling effects may make it possible to uphold time windows for home delivery reserved by customers more economically using ODCs. However, delivery may ultimately involve greater transportation distances and longer lead times because stores are closer to customers' homes.

Either you are very fast with your delivery anyway, for example if you deliver direct from your stores, or you offer tight time windows for delivery [...] That is easier from ODCs due to better bundling of orders [Company 11, Austria].

A higher number of ODCs allow shorter transportation distances to customers. Nevertheless, they will usually be greater than delivery from stores. A trade-off exists regarding centralization of the ODC accompanied by pooling effects and decentralization, where the proximity to customers and possible delivery of regional products has to be carefully considered. When online order volume is low, central and larger ODCs are appropriate especially on scattered markets, whereas decentralized and smaller ODCs should be set up in markets where big cities with a lot of potential customers can be approached within short distances.

If online order volume is low, retailers should focus on big cities with high population density for their home delivery. We only supply 30% of the country, but 70% of the population with fresh online products [Company 12, Portugal].

The decision for or against an ODC or the decision that stores are sufficient for online order

fulfillment is dependent on the density of the supermarket structure in a region and on the online order volume [Company 8, NL].

Type [2.2]: Online distribution center for all online orders

In type [2.2] all online orders (i.e., pick-up and home delivery) are fulfilled from ODCs (see Figure 5).

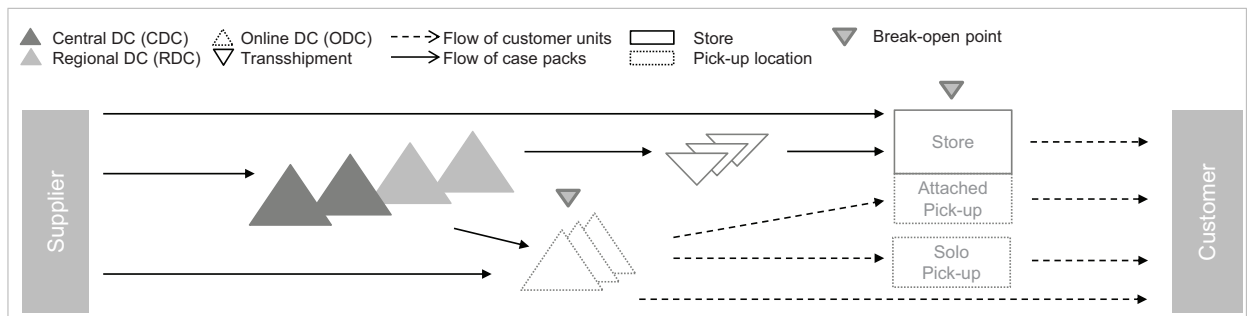


Figure 5: Type [2.2] – Online distribution center for all online orders

Description. This type is similar to type [2.1] in terms of most of the operational practices. The major difference is that the ODC also supplies all pick-up stations with online orders that are picked in CUs and transported in boxes. Multiple online orders are hence transported in boxes from different temperature zones to the various pick-up points (i.e., attached and solo pick-up) and to customers' homes. Stores do not supply any online orders anymore.

In a special case, the ODC can be directly attached to an RDC. If the RDC has all products across temperature zones, the ODC can be fully supplied from the attached RDC on a short distance. Joint transportation with the same vehicle to stores and pick-up stations is possible, whereby vehicles travel (for example) from the RDC (loading pallets with CPs) to the ODC (loading boxes with CUs) to the store (unloading pallets) to the attached pick-up point (unloading boxes) to the solo pick-up point (unloading boxes), thus supplying orders from one temperature zone at a time at multiple locations one after another. Pick-up customers will receive multiple transportation units at the pick-up point for one order, each with items from different temperature zones.

Analysis. Because inventory for all online orders is now stored in the ODC, only one stock for online items is necessary, thereby eliminating inventory holding of online items in multiple locations (i.e., stores). This increases service levels. The online channel can also provide a virtual shelf extension, offering an enlarged assortment online. There is no interaction of store customers and pickers in the store anymore. Retailers benefit from the learning and pooling effects of specialized picking for all online orders in the ODC. Despite the fact that picking in store for attached pick-up points

increases picking costs (see type [2.1]), this decreases internal transportation costs. This is vice versa for the picking of every online order in the ODC, which has a positive effect on picking costs and a negative effect on transportation costs. The question is therefore whether picking efficiency in the ODC compensates for another intermediate transportation and processing step in the logistics network (i.e., RDC to ODC to store/pick-up instead of RDC to store/pick-up).

In special cases where the ODC is physically attached to the RDC, internal transportation costs between RDC and ODC are reduced but presumably the distance to the customer's home is extended because the RDCs location has not been chosen for online order distribution.

Warehouses [i.e., CDCs and RDCs] are not designed to be near the end customer, so the physical integration of both channels in one warehouse is difficult [Company 2, Germany].

If an ODC is attached to each RDC, i.e., the distance between the two is minimized, then a positive effect results in inventory availability. Moreover, each RDC contains specific regional products that can afterwards be offered online. However, planning complexity for the internal transportation systems involved is greater as it requires the transport of boxes (with CUs) to pick-up points and pallets (with CPs) to stores. Even worse, both may have different lead time requirements. To capture synergies, the transportation vehicles therefore need to be flexible to transport boxes and pallets without major capacity losses. The delivery frequency and time windows need to partially overlap, and the online order volume needs to be high enough to assign orders for a routing to serve stores and solo pick-up points jointly.

If the online order volume increases, ODC and RDC can be physically integrated [i.e., an ODC is docked onto each RDC] leading to high inventory availability and the ability to offer regional products online [Company 11, Austria].

Type [2.3]: Hybrid store and online distribution center for online order fulfillment

In this type orders are fulfilled from both ODCs and stores together depending on the content of the online order (see Figure 6).

Description. Warehousing in C/RDCs and ODCs is the same as in type [2.1], and online orders are picked in ODCs and stores. The majority of products sold online are picked from ODCs, whereas the remainder are added from stores. Ultra-fresh produce in particular (e.g., unpacked fish, meat or fresh bakery goods) is picked in stores because stores are already directly supplied with this commodity group. A broad assortment range, including ultra-fresh products, can therefore be offered online.

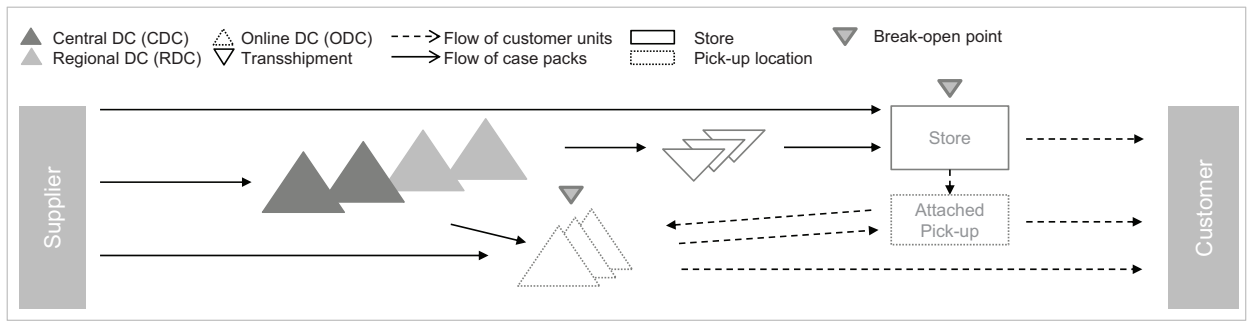


Figure 6: Type [2.3] – Hybrid of store and online distribution center for online order fulfillment

In the ODC 5 - 7,000 fast-movers are picked, representing approximately 85% of products sold online. The remaining 15% come from store, especially counter products like fresh meat and fish. For the final assembly of an order, the products are transported from the ODC to the store [...] or the other way around depending on where the customer lives [...]. Afterwards the order is brought to the customers' home in a multi-compartment vehicle [Company 12, Portugal].

Items ordered online are transported internally either from ODCs to stores or vice versa. The online orders are assembled either in store or in ODCs, depending on the order location, and the products ordered are then transported to the pick-up location or to the customers' home. If an online order consists solely of products stored in ODCs then the order is fulfilled in full from there. Stores therefore mainly act as hubs in city centers where specific items (e.g., ultra-fresh produce) are added to complete an online order from ODC.

With a hybrid model [of ODC and store fulfillment of online orders] specific customer needs, for example 250gr of minced beef, can also be fulfilled [Company 12, Portugal].

Analysis. This hybrid solution can achieve inventory pooling effects between stores and the ODC, leading to high service levels. There is no need for additional inventory holding of ultra-fresh products in ODCs because those products can be added to online orders from store. This significantly reduces the waste for this product category. A broad assortment including ultra-fresh products can be offered online and stored partly in store and partly in the ODC. In addition to the remaining disadvantages of in-store picking (see type [1.1]), more repacking and repicking of CUs is necessary because of the two different picking locations for online orders. Transportation costs are also higher because of the additional transportation between the ODC and stores.

This logistics network can be used especially in markets with a high population and store density, where the stores can serve as hubs for last-mile deliveries. The hybrid approach is also meaningful in markets where customers do not buy prepackaged meat, fish or cheese, and also want ultra-fresh produce online. While some retailers are already using this network structure, it is a

future scenario for others.

In the future, about 80% of items could be stored and picked outside big cities in a highly automated manner. They are then transported to a store or another hub in the cities and the remaining 20% of an order, for example meat, fish or bakery goods, are added directly from store [Company 2, Germany].

Network configuration [3]: Integrated distribution center for all orders

Network configuration (and type) [3] integrates RDC and ODC for fulfillment of all online and store orders (see Figure 7). This may be a future scenario for some retailers, but it is already an existing solution under certain settings and for certain regions (e.g., big cities) and retailers with small store formats (i.e., convenience stores, mom-and-pop stores, nanostores, etc.). The supply of supermarkets and hypermarkets is therefore not considered in this type.

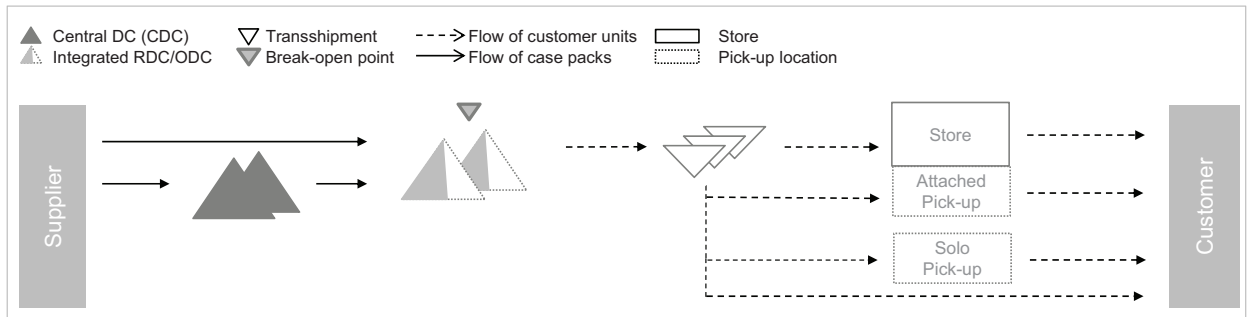


Figure 7: Type [3] – Full integration of regional- and online distribution center for all orders

Description. After reception of products from suppliers and CDCs, all items are stored on a CU basis and not in CPs in an integrated DC that supplies convenience stores, pick-ups and customers directly. Store and customer orders are picked in parallel or sequentially from the same inventory. Convenience stores have a selected assortment range focusing on the presentation of specific grocery products (e.g., ultra-fresh produce).

It is possible to have only select products in smaller stores presented really well, and all products online where presentation is not important [Company 9, NL].

Convenience stores with a select assortment will serve as a pick-up location [...] joint warehousing and transportation for both channels is possible. [Company 4, Germany].

The items can be delivered jointly on one tour with the identical multi-temperature vehicle to the small stores, pick-up locations as well as to customers' homes.

Analysis. Retailers can offer a large assortment online for pick-up (or home delivery) that is stored in integrated DCs with a high service level. The joint inventory allows pooling effects for online

and store items. It is also possible to replenish convenience stores in a demand-actuated manner in CUs, which reduces the waste in stores.

How great would it be to offer 100,000 SKUs on a 100ft shop floor in the city center [Company 7, UK]?

The same stock for customer and store products would lead to a lower risk of waste and demand-actuated supply [Company 10, Netherlands].

However for items such as dry food it is very expensive to unpack and store everything in CUs rather than in CPs for store replenishment. Investments are necessary to rebuild RDCs or build new ODCs and set up the associated picking processes to fulfill small order sizes. On top of this, DC picking in CUs – also for stores – reduces picking efficiency. For internal transportation and on the last mile to the customer, only one kind of multi-compartment vehicle is necessary that can fulfill home delivery, pick-up and convenience store orders. Transportation costs per unit for store delivery are higher due to greater delivery frequency and small volume deliveries. Delivery times for stores and customers also differ. Stores are usually replenished in the morning while customers want their products delivered in the evening. The joint transportation of products is therefore only possible for small stores where store replenishment fits in the smaller vehicles and store and customer delivery times match each other (e.g., early delivery of convenience stores and afterwards a two-hour time slot for delivery to customers near the store). In this case it may be possible to achieve higher store delivery frequency.

Completely integrated DCs have a number of prerequisites if they are to be operated efficiently. First of all, this is beneficial in markets with a dense customer population and expensive rental fees that foster a greater number of small store formats. Secondly, the order sizes and delivery windows for stores and customers should be close. Finally, a high online order volume is required to accommodate the changes in the warehouses. For example in the UK grocers are thinking about applying this logistics network structure in specific regions like London where the city center is congested with a dense population for home delivery. The assortment range is reduced (e.g., by 11% at Tesco, 6% at ASDA, 4% at Sainsbury's) to support smaller store formats [IRI, 2015] and supermarkets and hypermarkets are being remodeled as convenience stores (e.g., Carrefour Express, Sainsbury's Local, Tesco Express). Furthermore, in emerging markets convenience stores or nanostores are already the standard store format. Here CPs are unpacked at a DC level and products are mostly delivered to the stores in small unit sizes (see, e.g., Albán et al. [2015]).

4.2. Summary of findings

To summarize the findings above, OC retailers have different options for grocery logistics with regard to warehousing, picking, internal transportation and last-mile delivery. New warehouses (e.g., ODCs or solo pick-ups with warehouses) have to be set up to fulfill the online channel in all types except for [1.1]. The service level for online orders is higher in dedicated DCs than in types [2.1], [2.2], [2.3] and [3]. Virtual shelf extension is possible in these cases as well. Instore picking such as in types [1.1], [1.2], [2.1] and [2.3] leads on average to shorter travel distances and transportation time for the last-mile home delivery. However, this goes along with higher overall picking costs due to two-stage picking and less efficient instore picking processes, availability issues within the stores, and lower capacity utilization of last-mile vehicles. Warehousing and picking in dedicated ODCs as applied in types [2.1], [2.2] and [2.3] has the opposite consequences, where the higher picking efficiency needs to compensate for aspects such as the higher investments in ODCs and longer distances to customers for home deliveries (see types [2.1], [2.2], [2.3] and [3]). In types [1.1] to [2.3], separate picking processes across the channels are either conducted in CPs for stores or in CUs for the online channel. This is different in type [3], where small stores are supplied in CUs like online customers. This allows a combined picking and transportation procedure and leads to high picking efficiency for CUs.

Overall, the decisive question is where to set the break-open point that separates CPs into CUs. Setting the break-open point upstream in the supply chain at the ODC as in types [2.2], [2.3] and [3] allows economies of scale to be captured in inventory holding and generally makes picking processes for online orders more efficient, but comes at the expense of internal transportation and last-mile delivery costs, and as in type [3] is also at the expense of store supply costs. The effects are the opposite if the break-open point is downstream in the supply chain, at the store (like at types [1.1], [1.2] and [2.1]).

Table 2 summarizes the main (dis-)advantages in the logistics areas of the different types. The types are evaluated as “+” (relatively positive), “o” (neutral) and “-” (rather negative) regarding the main characteristics researched. For example, while initial investment costs in type [1.1] (i.e., fulfillment of all online orders via stores) are rather low, retailers have to make investments in OC warehousing systems in all the other types.

In the following discussion section the overall results are discussed in the light of literature to integrate our findings into existing theory on online and B&M grocery logistics.

		Type					
		1.1	1.2	2.1	2.2	2.3	3
Warehousing	Investment costs in new warehouses (e.g., solo pick-ups, ODCs)	+	-	-	-	-	-
	Inventory holding costs	o	-	-	+	-	-
	Service level for online orders	-	-	o	+	+	+
	Virtual shelf extension	-	-	o	+	+	+
Picking	Picking efficiency per online unit	-	o	o	+	-	+
Internal transportation	Internal transportation costs	+	o	o	-	-	-
Last mile delivery	Utilization of transportation capacity	-	-	o	+	o	+
	Distance to customers	+	+	-	-	-	-

* + relatively positive, o neutral, - rather negative, x not available

Table 2: Overview of advantages and disadvantages of logistics networks

5. Discussion

In this section the main findings are discussed in the light of literature in three areas. (I) First differences in OC grocery and OC non-food logistics are highlighted. (II) Second literature on online fulfillment and last-mile delivery in retailing is linked to our findings. (III) Finally we discuss market characteristics and online order volume as key differentiators for OC grocery logistics networks.

(I) We identified six types of logistics network for OC grocery retailing. However, there are significant differences between OC grocery logistics networks and OC non-food logistics networks. While an online grocery order consists of more than 60 different items on average, an average online shopping basket in non-food retailing (e.g., fashion, electronics) consists of only 1 - 3 items [Fernie and McKinnon, 2009; Hübner et al., 2016c]. Additionally, the larger assortment sizes in grocery stores result in larger warehouses, larger picking distances and ultimately in higher picking costs in grocery than in non-food. Hence, picking and the associated processes, number of stages and locations play a much more decisive role in the entire grocery supply chain. While grocery online orders need to reach the customer as soon as possible (because of the perishability of items and customer expectations), next-day delivery is sufficiently in non-food retailing in most cases [Hübner et al., 2016a]. A higher number of decentralized warehouses are therefore necessary in OC grocery logistics compared to more centralized DCs in non-food retailing. Non-food orders are exclusively delivered from CEP delivery service providers, while former pure B&M grocers build up their own fleet for last-mile home delivery. Moreover, in grocery existing B&M logistics structures are partially used for online fulfillment but the ultimate goal for grocery retailers is not – as for non-food retailers – to have one common warehouse with one stock for B&M and online grocery

items. This can be the case in a specific retail setup with only small stores (see type [3]), but is not the norm. Logistics is only integrated across channels up to the break-open point where CPs are divided into CUs.

However, existing OC literature sees the integration of both channels as the ultimate goal for retailers (e.g., Fisher [2013]; Verhoef et al. [2015]). This is seen to be necessary in terms of market presence and customer interfaces (e.g., Cao [2014], Brynjolfsson et al. [2013]) and for operations and logistics (e.g., Hübner et al. [2016c], Ishfaq et al. [2016]). However, existing literature does not differentiate between grocery and non-food logistics, and neglects grocery specifics such as temperature zones, picking complexity, shorter lead times, etc. What is referred to as OC logistics is in fact mostly OC *non-food* logistics.

It has been shown that the grocery specifics do not allow the copying of non-food structures to grocery networks. Explicitly, the particularities of OC grocery logistics networks and channel integration have not been researched. We therefore contribute to a more differentiated picture of logistics integration in a retailing context with multiple channels.

(II) On the last mile, a higher number of shipment locations (i.e., stores instead of ODCs) enable shorter delivery lead times to the customer. This can also have a positive effect on the transportation costs due to bulk deliveries with larger vehicles to supply these shipment locations (instead of direct deliveries of customers from remote warehouses with smaller vehicles). However, if shipped from many decentral locations, there are fewer options to bundle transportation capacities for the last mile and hence lower economies of scale (e.g., vehicles are not well/fully utilized). The same holds true for inventory efficiency. Decentralized inventories with multi-stage picking processes, low picking volume in each decentral location or less efficient picking in the store drive picking and inventory holding costs. When comparing deliveries from store with delivery from an ODC, the benefits of fulfillment from stores (i.e., mainly smaller distances, no investment costs) therefore need to be offset by higher picking costs per unit, lower bundling effects and lower utilization of delivery vehicles. To overcome the high last-mile delivery costs, some retailers only offer pick-up of online orders. However, this results in high investment costs in solo pick-up stations. The resulting multiple inventory locations (i.e., for each solo pick-up station) lead to higher inventory holding costs as well.

The existing literature gives a short but incomplete overview of how stores and DCs can also be used for online grocery fulfillment (e.g., Kotzab and Madlberger [2001]; Hays et al. [2005]; Teller et al. [2006]). Country specifics like the solo pick-up stations in France [Colla and Lapoule, 2012; Vyt et al., 2016] or barriers for online grocery fulfillment in Germany [Grant et al., 2014] are described without giving a holistic and supply-chain wide view on OC logistics networks. Similarly, Hübner

et al. [2016b] focus predominantly on online grocery fulfillment but do not develop a complete end-to-end picture of OC logistics networks.

The literature often focuses solely on the aspect of how products can be handed over to the customer in the case of online grocery retail, i.e., via attended or unattended delivery (e.g., Kopczak [2001], Kämäräinen et al. [2001], Punakivi et al. [2001], Boyer et al. [2009]). In the case of attended delivery the customer needs to be available at the doorstep to receive a product. When delivery is unattended (i.e., reception box, delivery box, pick-up stations), grocery orders can be distributed according to a fixed route without running the risk of having to approach customers multiple times (e.g., Kämäräinen et al. [2001], Punakivi et al. [2001]). However, the total travel distance and transportation costs are also dependent on where C/RDCs, ODCs and stores are set up, which also influences delivery speed and potential frequency. It is not sufficient to just consider the last-mile costs. Decisions in OC grocery logistics are therefore interdependent and have to be made regarding the requirements of warehousing, picking, internal transportation and last-mile delivery because they affect the entire logistics costs. The advantages and disadvantages of the various subsystems are interdependent and therefore cannot be considered independently. A total cost perspective is essential. We contribute by depicting and analyzing these advantages and disadvantages. We emphasize that OC grocery retailing requires an end-to-end perspective on the logistics network of a retailer and not just on one subsystem of the supply chain (i.e., a supply chain-wide view on OC structures and mechanisms).

(III) With this in mind, we also reveal that logistics networks in OC grocery retailing are not only planned based on logistics parameters such as cost savings, transportation distances or operations synergies [Piotrowicz and Cuthbertson, 2014], but also by considering product, customer and market characteristics such as online order volume (see e.g., Rao et al. [2009]). While the fulfillment of online orders via stores (type [1.1]) is an entry operations model for OC grocery logistics (see, e.g., Hays et al. [2005]), in most cases separation processes start as online order volume grows. ODCs are then used for at least parts of the online order fulfillment after online order volume exceeds a certain percentage (types [2.1], [2.2] and [2.3]).

The complete integration of all warehousing, picking and distribution solutions on a CU basis may be favorable for specific settings (type [3]). Although online order volume in the UK and in France is higher than in Germany, for example, the logistics solutions are different. Whereas in the UK retailers mostly sell online food via home delivery, in France most online orders are fulfilled via pick-up stations. German customers do not really use pick-up stations, instead preferring home delivery. There is a tendency to have more pick-up volume in countries and regions where the employment rate in a household is higher (such as in France), and where customers are more used

to driving longer distances, and to having more home delivery volume where only one member in the household works full time [OECD, 2015]. Regional differences in OC grocery shopping behavior exist even within countries, driving different concepts in populated areas and in the countryside. Each OC grocery retailer will therefore need to apply distinct logistics networks (see types [1] to [3]) for different regions and formats. Current studies related to logistics across channels are based on investigations of individual countries (e.g., Colla and Lapoule [2012], Hübner et al. [2016b]). However country and regional differences are too important to be neglected. The grocery logistics networks in countries differ from each other and there is not one clear and outstanding solution like there is with the integration of channels in OC non-food logistics (e.g., Wilding [2013], Hübner et al. [2016c], Ishfaq et al. [2016]). Different market characteristics, diverse customers in those markets and varying online order volume of OC grocery retailers lead to different network structures as well as fulfillment and logistics solutions. Our heterogeneous sample contributes to an understanding that all logistics network structures in all OC grocery companies have to be adapted accordingly.

6. Conclusion and future areas of research

The dynamic of the OC phenomenon means that it is “necessary to continuously investigate new developments to understand it” [Bernon et al., 2016]. We therefore apply a supply chain-wide view to OC logistics network structures in the field of grocery retailing that has not yet been explored. This paper contributes to the area of OC grocery logistics by providing a typology for logistics execution. Our heterogeneous sample reveals that grocery retailers use different warehousing, picking, internal transportation and last-mile delivery systems depending on product, customer, market and retailer specifics. Whereas in the field of OC non-food retailing, logistics integration is mostly seen as beneficial (e.g., Verhoef et al. [2015], Hübner et al. [2016c]), a definitive answer cannot be given for OC grocery logistics.

The limitations of our research are the basis for future research. Although we began discussing demographic structures, i.e., customer and market differences that differentiate the application area of the different logistics networks, future research could validate our findings by incorporating more data from a market survey (such as customer perceptions from different countries and regions). A detailed cost/benefit analysis is also lacking. Future research could quantify our qualitative and exploratory findings by assigning retailers’ costs and sales data from the different channels to the typology we have developed. In addition, longitudinal research could be conducted by repeating our results in five to ten years to analyze development stages in OC grocery logistics due to order volume changes and shifts from one channel to another. Moreover, when former pure

online grocers develop B&M logistics structures to become capable of providing “omni-channel” service, the question arises as to whether the logistics structures will be similar to those of former pure B&M grocers or different.

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Appendix: Interview protocol (abbreviated)

Logistics Network

1. For our understanding, to get a rough overview on your logistics structures, please sketch a chart of your warehouse operations and distribution (i.e., store replenishment, home delivery and click&collect/drive) for both channels and describe the overall online and offline logistics structure based on the chart. (*Please see additional document as a template for the sketch.*)

Warehousing and Picking

2. How was the inventory holding in the warehouse organized before and after the online channel was added? Why?
3. How was the picking in the warehouse organized before and after the online channel was added? Why?
4. Under what circumstances is an integration of operations (i.e., warehousing, inventory holding, picking) from different channels possible? What are the advantages and disadvantages?
5. Would you decide for or against further integration of warehousing operations if online sales increased to a certain amount of all sales?

Internal transportation and last-mile delivery

6. How was the distribution network organized before and after the online channel was added (i.e., home delivery and click&collect/drive)? Why?
7. Under what circumstances is an integration of distribution (i.e., internal transportation and last mile delivery) from different channels possible? What are the advantages and disadvantages?
8. Would you decide for or against further integration of internal transportation and last mile distribution if online sales increased to a certain amount of all sales?

References

- Agatz, N. A. H., Fleischmann, M., van Nunen, J. J. A. E. E., 2008. E-fulfillment and multi-channel distribution – a review. *European Journal of Operational Research* 187 (2), 339–356.
- Albán, H. M. G., Cardona, O. C. S., Argueta, C. M., Sarmiento, A. T., 2015. A cost-efficient method to optimize package size in emerging markets. *European Journal of Operational Research* 241 (3), 917–926.
- Alvesson, M., Kärreman, D., 2007. Constructing mystery: Empirical matters in theory development. *Academy of Management Review* 32 (4), 1265–1281.
- Beck, N., Rygl, D., 2015. Categorization of multiple channel retailing in multi-, cross-, and omni-channel retailing for retailers and retailing. *Journal of Retailing and Consumer Services* 27, 170–178.

- Bell, D. R., Gallino, S., Moreno, A., 2014. How to win in an omnichannel world. *MIT Sloan Management Review* 56 (1), 45.
- Bernon, M., Bourlakis, M., Soroosh, S., Wilding, R., 2016. Call for paper: Omni-channels special issue. *International Journal of Physical Distribution & Logistics Management*.
- Bourlakis, M., 1998. Transaction costs, internationalisation and logistics: the case of european food retailing. *International Journal of Logistics Research and Applications* 1 (3), 251–264.
- Bourlakis, M. A., Weightman, P. W. H., 2007. *Food Supply Chain Management*. Blackwell Publishing Ltd., Cornwall.
- Boyer, K. K., Prud'homme, A. M., Chung, W., 2009. The last mile challenge: Evaluating the effects of customer density and delivery patterns. *Journal of Business Logistics* 30 (1), 185–201.
- Brick Meets Click, 2016. How consumers are using online grocery. URL: www.brickmeetsclick.com.
- Broekmeulen, R. A., Sternbeck, M. G., van Donselaar, K. H., Kuhn, H., 2016. Decision support for selecting the optimal product unpacking location in a retail supply chain. Tech. rep., Eindhoven University of Technology, School of Industrial Engineering, 1–36.
- Bryman, A., Bell, E., 2011. *Business research methods*, 3rd Edition. Oxford university press, New York.
- Brynjolfsson, E., Hu, Y. J., Rahman, M. S., 2013. Competing in the age of omnichannel retailing. *MIT Sloan Management Review* 54 (4), 23–29.
- Cao, L., 2014. Business model transformation in moving to a cross-channel retail strategy: A case study. *International Journal of Electronic Commerce* 18 (4), 69–96.
- Cao, L., Li, L., 2015. The impact of cross-channel integration on retailers' sales growth. *Journal of Retailing* 91 (2), 198–216.
- Colla, E., Lapoule, P., 2012. E-commerce: exploring the critical success factors. *International Journal of Retail & Distribution Management* 40 (11), 842–864.
- Corbin, J. M., Strauss, A., 1990. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative sociology* 13 (1), 3–21.
- Creswell, J. W., 2003. *Research design: Qualitative, quantitative, and mixed method approaches*, 2nd Edition. Sage Publications, Thousand Oaks and Calif.
- De Koster, M. B. M., Poort, E. S. V. d., Wolters, M., 1999. Efficient orderbatching methods in warehouses. *International Journal of Production Research* 37 (7), 1479–1504.
- De Koster, R., 2002. Distribution structures for food home shopping. *International Journal of Physical Distribution & Logistics Management* 32 (5), 362–380.
- De Koster, R., Le-Duc, T., Roodbergen, K. J., 2007. Design and control of warehouse order picking: A literature review. *European Journal of Operational Research* 182 (2), 481–501.
- DeHoratius, N., 2011. Field research in operations and supply chain management. *Journal of Operations Management* 29 (5).
- Dreyer, H. C., Swahn, N., Kiil, K., Strandhagen, J. O., Romsdal, A., 2015. The responsiveness of food retail supply chains: A norwegian case study. In: *IFIP International Conference on Advances in Production Management Systems*. Springer, pp. 152–160.
- Eisenhardt, K. M., 1989. Building theories from case study research. *The Academy of Management Review* 14 (4), 532–550.
- Ellram, L. M., 1996. The use of the case study method in logistics research. *Journal of Business Logistics* 17 (2), 93–138.
- Fernie, J., McKinnon, A. C., 2009. The development of e-tail logistics. In: Fernie, J., Sparks, L. (Eds.), *Logistics & retail management: Emerging issues and new challenges in the retail supply chain*. Kogan Page Ltd, London and Philadelphia.
- Fisher, M., 2013. Foreword: Special issue on retail operations. *Production and Operations Management* 22 (4), 755–757.
- Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A., Flynn, E. J., 1990. Empirical research methods in operations management. *Journal of Operations Management* 9 (2), 250–284.
- Forrester, 2014. European Online Retail Forecast: 2013 to 2018. URL: <https://www.forrester.com/European+Online+Retail+Market+Worth+2339+Billion+By+2018/-/E-PRE7084> of 05/05/2015.
- Glaser, B. G., Strauss, A. L., 1967. *The discovery of grounded theory: Strategies for qualitative research*. Observations (Chicago, Ill.). Aldine de Gruyter.
- Glatzel, C., Großpietsch, J., Hübner, A. H., 2012. Higher margins through efficient supply chains. *Akzente* (2), 16–21.
- Grant, D. B., Fernie, J., Schulz, B., 2014. Enablers and barriers in german online food retailing. *Supply Chain Forum: An International Journal* 15 (3), 4–11.
- Gu, J., Goetschalckx, M., McGinnis, L. F., 2007. Research on warehouse operation: A comprehensive review. *European Journal of Operational Research* 177 (1), 1–21.
- Guest, G., 2006. How many interviews are enough?: An experiment with data saturation and variability. *Field Methods* 18 (1), 59–82.
- Hays, T., Keskinocak, P., López, V. M. d., 2005. Strategies and challenges of internet grocery retailing logistics. In: Pardalos, P. M., Hearn, D. W., Geunes, J., Akçali, E., Romeijn, H. E., Shen, Z.-J. M. (Eds.), *Applications of Supply Chain Management and E-Commerce Research*. Vol. 92 of Applied Optimization. Springer US, Boston and MA, pp. 217–252.
- Holzapfel, A., Hübner, A., Kuhn, H., Sternbeck, M. G., 2016. Delivery pattern and transportation planning in grocery retailing. *European Journal of Operational Research* 252 (1), 54–68.

- Hübner, A., Holzapfel, A., Kuhn, H., 2015. Operations management in multi-channel retailing: An exploratory study. *Operations Management Research* 8 (3), 84–100.
- Hübner, A., Holzapfel, A., Kuhn, H., 2016a. Distribution systems in omni-channel retailing. *Business Research*, 1–42.
- Hübner, A., Kuhn, H., Sternbeck, M. G., 2013. Demand and supply chain planning in grocery retail: An operations planning framework. *International Journal of Retail & Distribution Management* 41 (7), 512–530.
- Hübner, A., Kuhn, H., Wollenburg, J., 2016b. Last mile fulfilment and distribution in omni-channel grocery retailing: A strategic planning framework. *International Journal of Retail & Distribution Management* 44 (3), 228–247.
- Hübner, A., Ostermeier, M., 2016. A multi-compartment vehicle routing problem with loading and unloading costs. Working Paper.
- Hübner, A., Wollenburg, J., Holzapfel, A., 2016c. Retail logistics in the transition from multi-channel to omni-channel. *International Journal of Physical Distribution & Logistics Management* 46 (6/7), 562–583.
- IRI, 2015. The changing face of retail. URL: <http://www.iriworldwide.com/en-US/insights/Publications/Changing-Face-of-Retail>.
- Ishfaq, R., Defee, C., Gibson, B. J., Raja, U., 2016. Realignment of the physical distribution process in omni-channel fulfillment. *International Journal of Physical Distribution & Logistics Management* 46 (6/7), 543–561.
- Jick, T. D., 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Administrative science quarterly*, 602–611.
- Kämäräinen, V., Saranen, J., Holmström, J., 2001. The reception box impact on home delivery efficiency in the e-grocery business. *International Journal of Physical Distribution and Logistics Management* 31 (6), 414–426.
- Kopczak, L. R., 2001. Designing supply chains for the click-and-mortar economy. *Supply Chain Management Review* 1, 60–66.
- Kotzab, H., Madlberger, M., 2001. European retailing in e-transition? an empirical evaluation of web-based retailing - indications from Austria. *International Journal of Physical Distribution & Logistics Management* 31 (6), 440–462.
- Kotzab, H., Seuring, S., Müller, M., Reiner, G. (Eds.), 2005. *Research methodologies in supply chain management*. Springer, Heidelberg.
- Kuhn, H., Sternbeck, M. G., 2013. Integrative retail logistics: An exploratory study. *Operations Management Research* 6 (1-2), 2–18.
- Lincoln, Y. S., Guba, E. G., 1985. *Naturalistic inquiry*. Sage focus editions. Sage Publications.
- Maanen, J. v., 1979. *Qualitative methodology*. SAGE.
- Manuj, I., Pohlen, T. L., 2012. A reviewer's guide to the grounded theory methodology in logistics and supply chain management research. *International Journal of Physical Distribution & Logistics Management* 42 (8/9), 784–803.
- Mena, C., Bourlakis, M., 2016. Editorial: Retail logistics special issue. *International Journal of Physical Distribution & Logistics Management* 46 (6/7).
- Miles, M. B., Huberman, A. M., Saldaña, J., 2013. *Qualitative data analysis: A methods sourcebook*. SAGE Publications, Incorporated.
- Nielsen, 2015. Number of grocery stores per 1 million inhabitants in Europe. URL: <http://www.nielsen.com/content/dam/niensglobal/eu/docs/pdf/Grocery%20Universe%202015%20BROCHURE.pdf>.
- OECD, 2015. Percentage of households with two full time working parents in Europe. URL: <https://www.oecd.org/els/family/LMF-2-2-Distribution-working-hours-couple-households.pdf>.
- Pagell, M., LePine, J. A., 2002. Multiple case studies of team effectiveness in manufacturing organizations. *Journal of Operations Management* 20 (5), 619–639.
- Pagell, M., Wu, Z., 2009. Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of Supply Chain Management* 45 (2), 37–56.
- Piotrowicz, W., Cuthbertson, R., 2014. Introduction to the special issue information technology in retail: Toward omnichannel retailing. *International Journal of Electronic Commerce* 18 (4), 5–16.
- Punakivi, M., Saranen, J., 2001. Identifying the success factors in e-grocery home delivery. *International Journal of Retail & Distribution Management* 29 (4), 156–163.
- Punakivi, M., Tanskanen, K., 2002. Increasing the cost efficiency of e-fulfilment using shared reception boxes. *International Journal of Retail & Distribution Management* 30 (10), 498–507.
- Punakivi, M., Yrjölä, H., Holmström, J., 2001. Solving the last mile issue: reception box or delivery box? *International Journal of Physical Distribution and Logistics Management* 31 (6), 427–439.
- Randall, W. S., Mello, J. E., 2012. Grounded theory: An inductive method for supply chain research. *International Journal of Physical Distribution and Logistics Management* 42 (8/9), 863–880.
- Rao, S., Goldsby, T. J., Iyengar, D., 2009. The marketing and logistics efficacy of online sales channels. *International Journal of Physical Distribution and Logistics Management* 39 (2), 106–130.
- Rouwenhorst, B., Reuter, B., Stockrahm, V., van Houtum, G. J., Mantel, R. J., Zijm, W. H. M., 2000. Warehouse design and control: Framework and literature review. *European Journal of Operational Research* 122 (3), 515–533.
- Seuring, S. A., 2005. Case study research in supply chains – an outline and three examples. In: Kotzab, H., Seuring, S., Müller, M., Reiner, G. (Eds.), *Research methodologies in supply chain management*. Springer, pp. 235–250.
- Seuring, S. A., 2008. Assessing the rigor of case study research in supply chain management. *Supply Chain Management: An International Journal* 13 (2), 128–137.
- Teller, C., Kotzab, H., Grant, D. B., 2006. The consumer direct services revolution in grocery retailing: an exploratory investigation. *Managing Service Quality: An International Journal* 16 (1), 78–96.
- Trautrimis, A., Grant, D. B., Cunliffe, A. L., Wong, C., 2012. Using the “documentary method” to analyse qualitative data in logistics research. *International Journal of Physical Distribution and Logistics Management* 42 (8/9),

828–842.

- Vanelslander, T., Deketele, L., van Hove, D., 2013. Commonly used e-commerce supply chains for fast moving consumer goods: comparison and suggestions for improvement. *International Journal of Logistics Research and Applications* 16 (3), 243–256.
- Verhoef, P. C., Kannan, P. K., Inman, J. J., 2015. From multi-channel retailing to omni-channel retailing: Introduction to the special issue on multi-channel retailing. *Journal of Retailing* 91 (2), 174–181.
- Vyt, D., Jara, M., Cliquet, G., 2016. Running after square meters vs. customer service: the case of "click and collect" in france. In: Brusset, X., Teller, C., Kotzab, H. (Eds.), *Book of Proceedings: CERR 2016*. University of Toulouse, pp. 228–253.
- Wilding, R., 2013. Multichannel or omni-channel? *Logistics and Transport Focus* 15 (10), 44.
- Wollenburg, J., Holzapfel, A., Hübner, A., Kuhn, H., 2016. Configuring retail fulfillment processes for omni-channel customer steering. Working Paper.
- Wu, Z., Choi, T. Y., 2005. Supplier–supplier relationships in the buyer–supplier triad: building theories from eight case studies. *Journal of Operations management* 24 (1), 27–52.
- Yin, R. K., 2014. *Case study research: Design and methods*, 5th Edition. SAGE, Los Angeles and California.