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Examining the anatomy of last-mile distribution in e-commerce omnichannel retailing: A supply network configuration approach

Abstract

Purpose – This paper investigates the interplay among the configuration dimensions (network structure, network flow, relationship governance, and service architecture) of Last-Mile Supply Networks (LMSN) and the underlying mechanisms influencing omnichannel performance.

Design/methodology/approach – Based on mixed-method design incorporating a multiple embedded case study, mapping, survey and archival records, this research involved undertaking in-depth within- and cross-case analyses to examine seven LMSNs, employing a configuration approach.

Findings – The existing literature in the operations management (OM) field was shown to provide limited understanding of LMSNs within the emerging omnichannel context. Case results suggest that particular configurations have intrinsic capabilities, and that these directly influence omnichannel performance. The study further proposes a taxonomy of LMSNs comprising six forms, with two hybrids, supporting the notion of equifinality in configuration theory. Propositions are developed to further explore interdependencies between configurational attributes, refining the relationships between LMSN types and factors influencing LMSN performance.

Practical implications – The findings provide retailers a set of design parameters for the (re)configuration of LMSNs and facilitate performance evaluation using the concept of fit between configurational attributes. The developed model sheds light on the consequential effects when certain configurational attributes are altered, providing design indications. Given the global trend in urbanization, improved LMSN performance would have positive societal impacts in terms of service and resource efficiency.

Originality/value – This is one of the first studies in the OM field to critically analyze LMSNs and their behaviors in omnichannel. Additionally, the paper offers several important avenues for future research.

Keywords Last-mile, Omnichannel retailing, Network configuration, Case study

Paper Type Research paper

1. Introduction

Omnichannel retailing is a relatively recent phenomenon that has been transforming the retail landscape. For retailers, providing consumers with a seamless and consistent shopping experience across both physical bricks-and-mortar and digital e-commerce channels has been most demanding (Piotrowicz and Cuthbertson, 2014). It requires complex trade-offs between delivery responsiveness, product variety, and convenience, and is dependent on enterprise-wide information visibility (Laseter *et al*., 2015). The design of the "last-mile", often the most expensive segment of a logistics supply chain (Harrington *et al.*, 2016; Lim *et al*. 2018) is the focus of this paper. In this new digital context, direct replication of previously successful last-mile models has brought limited success (McClean and Evans, 2016), suggesting the need for new design frameworks.

Several studies on the design of last-mile distribution structures exist, drawing on a previous pre-digital era. For example, Chopra (2003) provided a prescription for the selection of six forms of distribution structures based on certain performance outcomes. Boyer and Hult (2005) developed a typology comprising four types of extended last-mile models. Lim *et al*. (2018) conducted a literature review on last-mile logistics models, developing a prescriptive design framework. Yet there is little explanation why a straightforward adoption of distribution structures corresponding with product-consumer attributes, suggested by these prescriptions, does not work well in practice.

Given this, both academic scholars and practitioners have called for more studies in this field (e.g. Piotrowicz and Cuthbertson, 2014; Hübner *et al.*, 2016a). Our study responds to these calls by examining how last-mile supply networks (LMSNs) are configured to support e-commerce development within an omnichannel context. Because last-mile distribution interacts as part of the broader omnichannel system, we argue that the traditional structural focus on distribution is insufficient to capture this complex reality. The conceptual study by

Lim *et al*. (2016) offers a reconceptualization of prior thinking by employing configuration concepts to the study of LMSNs. They develop a content-based framework examining the configuration of LMSN on four dimensions: network structure, network flow, relationship governance, and service architecture. We extend this work by carrying out a process-based (Van de Ven, 1992) empirical study investigating interdependencies among the configurational attributes. In doing so, we present a middle-range theory (Merton, 1968; Doty and Glick, 1994) of LMSNs in an emergent omnichannel context. LMSN, in this study, is defined as the last stretch of a business-to-consumer parcel delivery, spanning the order penetration point to the final consignee's preferred destination point, for the reception of goods.

The benefits of extending configuration and equifinality concepts examining complex phenomena are well established in the management (Miller, 1986; Eisenhardt *et al*., 2016) and operations management (OM) disciplines (Boyer *et al*., 2000). Yet, they have scarcely featured in the study of LMSNs in omnichannel retailing. The majority of extant configuration-based studies focus on identifying archetypes through typological or taxonomical development using methods such as clustering procedures (Flynn *et al*., 2010), and set-theoretic approaches (Fiss, 2007). Consequently, current thinking considers configuration as a black box and does not attempt to uncover critical internal links. This is unfortunate since configuration theory suggests strong interdependencies (Miller, 1986): changing one configurational attribute can have an impact on another, but we lack the knowledge to anticipate the consequential effects.

Therefore, to address some of these unresolved theoretical issues in the literature, we propose the following research questions:

RQ1: How are LMSNs configured to support e-commerce development within an omnichannel context?

RQ2: What are the key interdependencies within an LMSN configuration?

By mapping and assessing the complete LMSN of seven in-depth cases, our study addresses the identified knowledge gap, demonstrating how the interdependencies within an LMSN function and how the underlying mechanisms influence performance. We argue that insights gained from uncovering these interrelationships are valuable inputs to the design and sustainability of viable LMSNs. The analysis draws on the literature of omnichannel supply chains (Piotrowicz and Cuthbertson, 2014; Hübner *et al.*, 2016a, 2016b) and configuration theory (Miller, 1986), building on supply network configuration design (Srai and Gregory, 2008) and LMSN distribution configuration concepts (Boyer and Hult, 2005; Lim *et al*., 2016).

The following sections set out the theoretical context for the exploration of an LMSN configuration-based analysis, including methodological arguments leading to a multiple embedded case study approach and research outcomes. Results from the case investigations identify LMSN types, and suggest that there are intrinsic capabilities for particular configurations that directly influence omnichannel performance. Further, we develop a set of propositions to further explore interdependencies between configuration dimensions, refining the relationships between LMSN types and the factors influencing LMSN performance. Finally, we discuss theoretical contributions to LMSN configuration design, conclusions we can draw about archetypal network structures, supply sourcing, resource orchestration, and information requirements for effective LMSN execution.

2. Theoretical background

In this section, we present the related literature to which this research contributes. We then provide an overview on configuration theory constituting our theoretical basis, and subsequently define the four dimensions of LMSN configuration and their key variables.

These variables form the tools of analysis to examine interdependencies between configurational attributes.

2.1. Omnichannel supply chains

Our paper contributes to two main streams of literature in omnichannel supply chains: studies investigating the downstream distribution to enable omnichannel retailing, and those developing models of last-mile distribution. The first thread of literature extends knowledge regarding how retail logistics enables the transition to omnichannel modes of operation (Hübner *et al*., 2016b), namely – realignment of the physical distribution process (Ishfaq *et al*., 2016); conditions under which retailers prefer to dropship rather than hold inventory (Netessine and Rudi, 2006); and the development of a planning framework for last-mile fulfillment and distribution (Hübner *et al*., 2016a). Hitherto, no study has conducted an in-depth empirical examination to understand the interdependencies within an LMSN to better enable omnichannel retailing. In this regard, we argue that, from a supply chain perspective, omnichannel success hinges critically on the retailer's ability to align the key dimensions characterizing an LMSN.

The second thread of literature on last-mile distribution models focuses on discriminating distribution models typically from a structural perspective: Chopra (2003) and Hübner *et al*. (2016a) consider centralization based on inventory location to differentiate types; in addition to inventory location, Boyer and Hult (2005) add a structural vertical integration dimension to deliberate extended last-mile models, while Lim *et al*. (2018) classify structural types based on the degree of delivery effort among vendors and end-consumers. Alas, the structural focus, although it contributes to our understanding of the key distribution models, fails to capture the broader omnichannel system in which last-mile distribution interacts. Our aim is therefore to broaden the insights from selected case studies to explain the configuration of LMSNs by considering the dimensions of network structure, network flow, relationship

governance, and service architecture (Lim *et al.*, 2016) to provide a richer picture of how LMSNs operate within an omnichannel context.

2.2 Configuration theory

Miller and Mintzberg (1984, p. 12) define configuration as "commonly occurring clusters of attributes or relationships that are internally cohesive […]". Since configurations are composed of tight constellations of mutually supportive elements, they are considered useful, as certain elements can lead to the reliable prediction of the remaining elements (Miller, 1986). As the theory of configuration suggests the described attributes are interdependent, we argue that LMSN configurations displaying coherent patterns will result in better performance. Additionally, the theory promotes the concept of equifinality: i.e. there are multiple, equally effective ways in which an organization can achieve environmental or internal fit (Katz and Kahn, 1978). These alternatives typically represent patterns of context and structure (Van de Ven and Drazin, 1985), useful in our analysis for investigating forms of LMSN generating comparable performance outcomes.

While configuration is a meta-theory that can be applied across various fields of study, its dimensions need to be grounded in the specifics of the research context, in our case omnichannel retailing. This paper adopts Srai and Gregory's (2008) supply network configuration approach to the omnichannel context (Lim *et al.*, 2016), defining LMSN distribution configuration (hereafter LMSN configuration), as: "*[…] those arrangements or permutations of the last-mile supply network dimensions – network structure, network flow, relationship governance, and service architecture – that enable retailers to trade-off delivery responsiveness and product variety"*.

2.3 Dimensions of LMSN configuration

In this section, we clarify the key variables of interest within each of the four dimensions of LMSN configuration: network structure, network flow, relationship governance, and service

architecture (see Table I for variables and their definitions). We emphasize that the focus of this study is not to elaborate the role of these variables but rather to use them as analytical tools to help us examine the interdependencies among the four dimensions of LMSN configuration. We develop our understanding of each of these four dimensions by exploring the relevant literature sources, as set out in Column 2 of Table I.

2.3.1 Network structure

A supply network is "essentially an organizational form in a larger context or a system of firms" (Choi and Hong, 2002, p. 470). We draw on the literature on organization design complexity (e.g. Price and Mueller, 1986; Daft, 1989), supply network (e.g. Choi and Hong, 2002; Srai and Gregory, 2008) and logistics (e.g. Stock *et al*., 1998) to examine network structure in terms of centralization, vertical integration, horizontal integration, and geographic dispersion.

2.3.2 Network flow

Flows in supply networks are characterized by their degree of coordination and integration (Christopher, 1992; Cooke, 1997; Lee and Ng, 1997; Stock e*t al*., 1998). According to Cooke (1997), the management of flows comprises the successful coordination and integration of all those activities and information associated with moving goods from the raw materials stage through to the end user. Similarly, the management of flows in LMSNs requires the successful coordination and integration of all activities and information associated with moving products, from their order processing stage through to their delivery and return. Therefore, we draw mainly on the supply chain flows literature to examine network flow in terms of flow integration and flow coordination.

2.3.3 Relationship governance

Scholars have argued that the effective governance of relationships is critical to the development of competitive advantages among firms (e.g. O'Keeffe, 1998; Stock *et al*.,

1998; Lejeune and Yakova, 2005). This is particularly important for retailers. Given the limited resources and capabilities that these firms possess, together with consumer demand for an increasing range of products, the competitive success of these firms will be based on their ability to leverage their partners' resources and skills to improve the availability of their inventory and distribution capabilities (Dutta and Segev, 1999). We draw mainly from interdependence theory (Thibaut and Kelley, 1959; Kelley, 1979) and the governance (Coase, 1937; Williamson, 1981; Rabinovich *et al*,. 2007) literature to examine relationship governance in terms of interdependence, governance mechanism, and strength of network governance structure.

2.3.4. Service architecture

Voss and Hsuan (2009, p. 546) define service architecture as "the way the functionalities of the service system are decomposed into individual functional elements/modules to provide the overall services delivered by the system". Each service element/module represents a system component or process (Voss and Hsuan, 2009). Warehousing, for example, is a module in logistics services (Pekkarinen and Ulkuniemi, 2008). Although essential in the more service-centric LMSN, the concepts of service architecture and modularity are relatively new in the literature, and there has been little application of them in the design of services (Voss and Hsuan, 2009; Brax *et al.*, 2017). Therefore, we have relied mainly on the works of Voss and Hsuan (2009) and Pekkarinen and Ulkuniemi (2008), who have applied the concept in operations management (OM) to examine service architecture in terms of service uniqueness and modularity.

<< INSERT TABLE I ABOUT HERE >>

Consolidating the above, we extend Lim *et al.*'s (2016) content-based study by undertaking a process-based (Van de Ven, 1992) empirical examination on the interplay among configurational attributes and the underlying mechanisms influencing performance.

We measure omnichannel performance in terms of effectiveness via a proxy of "consumer experience", adapting previous survey research by Thirumalai and Sinha (2005) measuring consumer satisfaction. Additionally, we introduce new items that capture the omnichannel context to measure consumer convenience (see Table IV). While we do not use traditional OM-based measures, such as cost, quality, flexibility, delivery measures and dependability (e.g. Boyer and Lewis, 2002), as performance indicators in this research, elements of these dimensions are reflected in the set of items we use to measure omnichannel performance. We emphasize the use of consumer experience as a proxy for the effectiveness of omnichannel performance since the overall perception of delivery appears to determine the success of an omnichannel system. As one senior manager highlighted:

> "*It doesn't matter how sophisticated your technologies nor how attractive your delivery propositions are if your consumers do not perceive [them] as such. Ironically, most of our existing KPIs do not seem to capture this […] Perception management is critical in omnichannel*."

According to Pennings and Goodman (1977), efficiency refers to an input-output ratio or comparison, whereas effectiveness refers to an absolute level of either input acquisition or outcome attainment. Further, the core differentiator in terms of cost and delivery efficiency in last-mile logistics is the percentage of first time delivery success, which would be captured in consumer satisfaction and convenience (Song et al., 2009). Moreover, all the cases sit within a common competitive and regulatory landscape (e.g. input cost factors prevalent in the U.K. urban environment), with equivalent access to technology and infrastructure. This would suggest that performance differentiators, relevant to this study, are more likely to be driven by the operating model underpinning a last-mile configuration, and service delivery success rather than operational efficiency of the delivery (or returns) process.

3. Methodology

Given the limited study of LMSNs from a network configuration perspective, we used a multiple in-depth case study approach to unpack LMSN configurations by examining the interdependencies among the configurational attributes (Eisenhardt, 1989; Yin, 2014).

The case method allowed us to study the phenomenon in its natural setting, so meaningful and relevant theory was generated from the understanding gained by observing actual practices (Benbasat *et al*., 1987; Meredith, 1998). We used the theory elaboration approach (Ketokivi and Choi 2014) to: (1) examine LMSN based on the four configuration dimensions proposed previously by Lim *et al.* (2016); and (2) allow for the inductive development of new omnichannel-relevant theoretical constructs (Eisenhardt, 1989; Yin, 2014). According to Ketokivi and Choi (2014, p. 236): "*There are many ways in which theories can be elaborated: one can introduce new concepts, conduct an in-depth investigation of the relationships among concepts, or examine boundary conditions.*" We used a mixed-method design incorporating multiple data sources, including interviews, mapping, site visits, surveys and archival records, examining the interplay among the configurational attributes and their association with performance, an aspect largely neglected in the literature.

3.1 Case sampling

We adopted a theoretical sampling strategy (Eisenhardt, 1989), including polar cases spanning different retail formats, product types, variety, and delivery responsiveness, to increase overall confidence levels in our findings and conclusions (Miles *et al*., 2014).

The developed preliminary theory was first applied on a single-case study before replication logic was employed through multiple-case studies, that is, a series of cases treated like a series of experiments (Eisenhardt and Graebner, 2007). Each case tested the theoretical insights gained from the examination of previous cases, and was used to refine the model. This logic facilitated the emergence of testable theory free from researcher bias (Eisenhardt,

1989) and supported close correspondence between data and theory (Glasser and Strauss, 1967), augmenting external validity.

Seven in-depth case studies from five leading U.K. firms (*Retailer A to E*) in the retail sector were examined. They were selected based on the matrix in Figure 1 and included both "pureplay" (online only) and "hybrid" (bricks-and-mortar retailers with an online presence) models, facilitating literal and theoretical replication logic, and maximizing learning (Eisenhardt 1989). We emphasize that the *x* and *y* axes in Figure 1, product variety and delivery responsiveness, respectively, capture two of the most important operational decisions distinguishing LMSN types in omnichannel retailing (Hübner *et al*., 2016a, 2016b). Delivery responsiveness determines inventory locations impacting network structure (centralized vs. decentralized), while product variety influences the vertical and horizontal complexity of an LMSN. The primary focus of case study observation was the distribution (fulfillment and delivery) processes for business-to-consumer (Campbell and Savelsbergh, 2005).

<< INSERT FIGURE 1 ABOUT HERE >>

Given Type 4 as an emerging configuration, only limited mature cases are available. Focusing on one case, ECHO, the leading incumbent innovation in the U.K., allowed us to achieve more in-depth data collection and analysis. The seven cases are summarized in Table II. Pseudonyms (ALPHA to GOLF) are used to anonymize case identities.

<< INSERT TABLE II ABOUT HERE >>

As this study targets LMSNs within a given context, it is crucial to control the context, ideally selecting a geography where LMSNs are at a more advanced stage of development. The U.K. market leads the global e-commerce market in terms of online spending per head (Thomas, 2013) and is an ideal environment for our study. We focused on one sector to minimize extraneous effects. We chose retailing, given that the emphasis of this study is on

omnichannel and once again the U.K. is the most developed in terms of revenue percentage taken online.

3.2 Unit of analysis and data collection

The purpose of this study was to understand how LMSNs are configured to support the development of e-commerce for an enhanced consumer experience within an omnichannel context. As such, the retailer is our unit of analysis, with its LMSN as the embedded sub-unit of analysis.

Data collection involved three stages. The first mapped and evaluated the LMSN of each case, building on supply network configuration design (Srai and Gregory, 2008) and LMSN configuration concepts (Lim *et al*., 2016). We decomposed each retailer's omnichannel operation into subnetworks – each an LMSN – based on speed of delivery responsiveness and variety of product range, consolidating the associated enabling systems and processes. Combining both qualitative and quantitative data, the first author and a senior researcher assigned ratings to each LMSN, facilitating subsequent analyses (see Table III note *A* & *B* for scale details). Initial and revised interrater reliabilities were computed using an intraclass correlation formula [ICC(3,k)] (Shrout and Fleiss, 1979) and all variables achieved at least 0.84 reliability in the revised round.

The second stage comprised 53 interviews with managers in various positions within the retailers, their representative suppliers, and third-party logistics providers (3PLs) conducted between January 2015 to August 2016 (see *Appendix A*). A focus group was held with experts in the retail industry, providing input for the interview protocol (the condensed interview protocol is available in *Appendix B*). Interviews were semi-structured and tied to the configuration constructs.

The final protocol was tested in a pilot case with Tea Too Ltd, a tea retailer, prior to full-scale implementation. Each interview lasted between 45 minutes and two hours, and all

interviews were tape-recorded and transcribed verbatim. Verbatim transcription facilitates the development of an audit trial of data analysis and brings researchers closer to the data (Halcomb and Davidson, 2006). To compensate for potential human errors in the transcription process, we combined the procedure with memo and field note writing to capture our interpretations and generation of meanings (Wengraf, 2001). We visited and toured the facilities where possible to observe operations first-hand and interview all relevant informants.

Our informants were highly knowledgeable and able to view the focal phenomenon from diverse perspectives. We asked them to explain the motivation and rationale of their current adopted LMSN(s). The interview protocol was modified accordingly when interviewing informants from different roles within and outside the focal firm's LMSN. We added more interviews as new themes emerged, and continued to do so until saturation (Glasser and Strauss, 1967).

In the third stage, we collected survey responses and archival data, such as company documents and press releases to corroborate, the primary data. The consumer experience survey was implemented in April 2016 (see Table IV). Actual retailer and service names were used. We engaged Clickworker (a crowdsourcing solution provider) to administer the survey for 500 random consumers based in the U.K. Although all responded, only 299 met our criteria of having shopped online at least once across all seven cases within six months prior to attempting the survey. After filtering incomplete responses, 77 fully completed usable responses remained, giving us a response rate of 15.4%.

3.3 Data analysis

The verbatim transcription process yielded 1,370 pages. The interview data were fully coded twice: first manually, and then using MAXQDA software two months later. They facilitated the interpretation of interdependencies among the configurational attributes (Saldaña, 2016).

The inter-coder agreement was 93.7% (Miles *et al*., 2014). We used a combination of audio-textual analysis, ocular scan, word repetition, similarity-based (categorizing) and contiguity-based (connecting) analytic strategies (Maxwell and Chmiel, 2014) to analyze the data, collected from multiple sources. The key constructs of resource orchestration, supply base depth and information visibility were derived inductively through the data.

To derive theoretical implications that can be generalized within the LMSN context, we mainly focused on identified common patterns between the configuration types. We carefully compared the results of the LMSNs along the four configuration dimensions. We then identified theoretical relationships among the dimensions and incorporated the inductively developed constructs. This was not a linear analytical process. We continuously iterated between the categories, themes and literature until we had a "clear grasp of the emerging theoretical relationship" (Corley and Gioia, 2004, p. 184).

Table V consists of representative quotes that exemplify key interdependencies and their assigned strengths. We were guided by Miles *et al*. (2014) and OM scholars who conducted within- and cross-case analysis for inductive/abductive studies (Senot *et al*., 2016; Bhakoo and Choi, 2013).

We applied tests of construct validity, internal validity, external validity and reliability, validating the research findings and helping to develop convergent lines of inquiry (Yin, 2014). We used multiple sources of evidence, including interviews, site visits, documentary evidence and surveys, for data triangulation, ensuring construct validity. Using within- and cross-case analysis to develop the propositions ensured internal validity. External validity was achieved by using replication logic to conduct and analyze each of the cases. Lastly, we used an interview protocol ensuring procedures were consistent across all cases, increasing reliability. Additionally, informants reviewed draft case reports and through follow-up emails provided additional data to improve the reliability of our interpretations.

4. Results

4.1 Within-case analyses: A taxonomy of LMSN types

The within-case analyses of the seven LMSNs, addressing RQ1, entailed the categorization of configuration models. Each of these LMSN types were further evaluated against the primary configuration dimensions. Results are set out in Table III in terms of consumers' performance evaluation (Table IV). This multiple data analysis approach increases the robustness of our examination and interpretation.

<< INSERT TABLE III ABOUT HERE >>

<< INSERT TABLE IV ABOUT HERE >>

A taxonomy of LMSNs emerges from the analysis, building on and expanding Figure 1 with two hybrid forms. The inclusion of hybrid forms reflected the idiosyncrasies of BRAVO and DELTA, which aimed to balance delivery responsiveness (albeit depending on product characteristics) and consumer demanded delivery speed (see Figure 2). Consequently, we examined the key characteristics of the LMSNs' at the type level, guided by the data structure in Table III.

<< INSERT FIGURE 2 ABOUT HERE >>

Type 1 LMSN (ALPHA[a] and GOLF[b]) is based on slow delivery responsiveness (delivery speed: 7.96[a] and 7.81[b]) and low product variety (product selection: 7.44[a] and 7.51[b]), with efficiency at its core. ALPHA provides convenience by offering one-hour delivery windows (convenience: 7.38) while GOLF offers consumers a late cut-off for next day collection from its 2,500 stores (convenience: 7.19). Both ALPHA and GOLF have a highly centralized network structure using a hub-and-spoke distribution model, benefiting from inventory aggregation. While ALPHA has high vertical and low horizontal integration, GOLF has moderate vertical and horizontal integration. ALPHA's advanced technological capability enables the attainment of high flow integration. As the ALPHA Flow Manager stated: "*I've*

visibility over every single stage of the pick, pack and delivery process, it's all integrated, everything just works backwards from a customer's order."

The limited reliance on supply chain partners reduces flow coordination effort. In fact, the heightened level of information visibility incentivizes suppliers to perform and limit opportunistic behaviors. The Senior Operations Manager at ALPHA stated:

> "*We explained to the suppliers how our information systems work in tandem with physical operations. If they don't turn up on time at the fulfilment center and miss the slot, there's not another bus, it's gone. So there's a healthy tension for them to turn up on time otherwise they don't sell their goods.*"

Conversely, because of its distributed store footprint with heterogeneous sizes and system capabilities, GOLF's flow integration and coordination remain moderate. GOLF relies substantially on 3PLs to service its last-mile. According to the Head of Logistics, "*Our products are highly differentiated and many are exclusive, therefore we're not compelled to compete in the last-mile.*" Unlike ALPHA, which mainly leverages hierarchy governance and to a limited extent relational contract to extend geographical reach, GOLF employs a mix of hierarchy, relational contract and market governance structures, driven by access to desired capabilities. ALPHA maintains high service uniqueness through integrated service elements for competitive advantage but trades off service modularity, limiting outsourcing. GOLF maintains high service uniqueness through store differentiation with high service modularity, enabling ease of outsourcing. The Omnichannel Value Proposition Manager at GOLF explained:

> "*Our stores are our biggest asset; they are the public face of GOLF […] the control of customer experience in-store is absolutely critical. Being in health and beauty means there're things you simply can't perform without human interaction […], the personalization and advice which you can't replicate with a computer*."

Type 3 LMSN (FOXTROT) is based on fast delivery responsiveness (delivery speed: 8.22) and low product variety (product selection: 7.69), with flexibility at its core. FOXTROT provides convenience through its fast-track, same-day delivery proposition and offers collection from its 800 stores (convenience: 7.55). Regardless of store format, consumers have access to identical product assortment. FOXTROT uses a decentralized network structure with local inventory points enabling fast delivery speed. The Central Operations Director told us: "*I know most click-and-collect operators will use couriers to deliver into store. The bulk of our collect-in-store orders is sourced from the stores which is why we're very effective and fast.*" FOXTROT has a unique hub-and-spoke store replenishment model with larger hub stores fulfilling orders for the smaller spoke stores, and delivers via a milk-run model. High flow integration is enabled by a distributed order management system with moderate flow coordination due to legacy systems, limiting interface compatibility. Given its reliance on selected partners, interdependence is high. A mix of hierarchy, relational contract and market structures governs exchanges. The Central Operations Director emphasized:

> "*We've to build up long-term trust with our key 3PL because when shit hits the fence, you need to know you can rely on each other. And normally around peaks, companies who have the best relationships with the 3PL will get better service.*"

Type 5 LMSN (BRAVO) is based on hybrid (slow and fast) delivery responsiveness (delivery speed: 8.17) and low product variety (product selection: 7.69), combining Type 1 and Type 2 strategies to offer varying delivery speeds. BRAVO provides convenience by offering one-hour delivery windows and collection from its 317 dotcom-capable stores (convenience: 7.44). BRAVO fulfills 90% of online grocery orders from stores for speed and 10% from its seven dark stores, aggregating demand for efficiency. Dealing primarily in highly perishable commodities, it employs a high vertical and low horizontal integration

structure with a high geographic dispersion. A milk-run delivery model is used to service the last-mile. Theoretically, the limited reliance on supply chain partners relaxes flow coordination effort and interdependence. However, BRAVO's decentralized structure reduces this effect as a means of countering structural complexity and the associated forecasting challenges. BRAVO's top suppliers committed staff to work alongside BRAVO's employees at *Retailer B*'s head office, to support demand planning and replenishment efforts. As the e-Commerce Manager of a key FMCG supplier stated:

> "*By having our people in their office, we have access to all their systems to allow us to do collaborative forecasting, monitor sales and uncertainty and mitigate against those risks in a very responsive manner*."

Type 2 LMSN (CHARLIE) is based on slow delivery responsiveness (delivery speed: 7.23) and high product variety (product selection: 8.64), with risk-hedging at its core. CHARLIE provides convenience through collection from its 1,750 stores (convenience: 7.63), and has a centralized structure, using a mix of hub-and-spoke and dropshipping distribution models. CHARLIE has a low vertical and high horizontal integration structure inducing high geographic dispersion to provide consumers with varying delivery capabilities, through multiple product sources and carriers. Given CHARLIE's heterogeneous supply base, enabling high product variety but often with low volume contracted to any one supplier, flow integration and coordination are moderate at best. As the Head of Dropshipping Operations indicated: "*[The] integration platform [was a] basic sort of CSV file which didn't work amazingly well for larger vendors and it wasn't scalable*". CHARLIE maintains a strong networked governance structure leveraging ecosystem capabilities. Due to its use of standardized services, service modularity is high, with a trade-off on service uniqueness. The Head of Dropshipping Operations stated: "*Our systems and processes are very modular, each having separate shelf packages but the way they are architected together is not very good.*"

Type 4 LMSN (ECHO) has speed at its core, and is based on fast delivery responsiveness (delivery speed: 8.60) with high product variety (product selection: 8.09). ECHO provides convenience through on-demand delivery within an hour or within a two-hour window (convenience: 7.87). ECHO is characterized by a decentralized structure, using a point-to-point distribution model, coupled with low vertical and high horizontal integration. High product variety is achieved by leveraging local inventories from partner vendors. Due to the short lead-time, geographic dispersion is restricted to specific areas of operation. Flow integration is low but countered by high flow coordination via a common application-based platform accessible by partners in the LMSN. ECHO's strong IT capability enables high information visibility, reducing opportunistic behaviors, despite market governance. ECHO's Transportation Analyst told us: "*We've full track and trace information via the handheld device our delivery associates carry. This facilitates full visibility, performance tracking and timely response to contingencies from fulfilment to order delivery*." As ECHO relies on vendors' inventory and independent contractors for last-mile delivery, it maintains a strong networked governance structure.

Finally, Type 6 LMSN (DELTA) is based on hybrid delivery responsiveness (delivery speed: 8.00) and high product variety (product selection: 8.68), combining Type 3 and Type 4 strategies, to offer agility and varying delivery speeds. DELTA provides convenience by offering members free next-day delivery and collection from its 16,000 collection points (convenience: 7.93). DELTA is characterized by high centralization using a mix of hub-and-spoke and dropshipping distribution models, coupled with moderate vertical and high horizontal integration. DELTA is steadily increasing its degree of vertical integration due to saturation of delivery capacity in the U.K. market. According to the Supply Chain Director: "*Our volume is growing so fast that it incapacitated the carrier network in 2012. So we cannot rely on them any more and need to develop our own capabilities*." Like ECHO,

DELTA's technological capability promotes efficient flows and reduces the negative effects of market governance, while maintaining a heterogeneous supply base.

In the next section, we examine the interplay among the configurational attributes.

4.2 Cross-case analyses and formulation of propositions

4.2.1 Internal interdependencies: Network structure as nexus

Based on the coded relationships in Table V, we cross-examine the dominant interdependencies with the extant literature to answer RQ2 and develop the model in Figure 3. Leveraging the richness of our data from multiple sources, we uncover key interdependencies within the LMSN through interview data, and inductively develop new constructs that influence these linkages drawing on mapping and interview data. The analysis examines the intensity of links through archival records, and relates them to omnichannel performance via consumer experience survey data. The uniqueness of our approach and data helps increase the completeness of our analysis, enables triangulation and minimizes bias. In this section, we discuss the interdependencies among the configurational attributes with new knowledge translated into propositions.

<< INSERT TABLE V ABOUT HERE >>

<< INSERT FIGURE 3 ABOUT HERE >>

From Figure 3, we observe network structure as the nexus influencing all other dimensions. The extant literature has focused on understanding how structure influences flow. From the seminal works of Chopra (2003) and Stock *et al*. (1998), we infer that a vertically integrated structure is likely to result in higher flow integration while a horizontally integrated structure will result in higher flow coordination to be effective. How network structure influences the other dimensions – relationship governance and service architecture – is less understood.

From our case data, LMSNs with high vertical integration within the last-mile distribution (ALPHA, BRAVO and FOXTROT) have lower interdependence with their supply chain partners as the majority of distribution activities are carried out in-house. DELTA's high information visibility further reduces supplier contact, as activities are centrally coordinated via the supplier portal. Interestingly, and counter-intuitively, as BRAVO and FOXTROT decentralize their distribution activities by equipping more stores with online fulfillment capabilities or opening new stores, interdependence with partners increases. Further probing revealed that, as the degree of inventory aggregation decreases, demand forecast errors increase, promoting collaboration. According to FOXTROT's Central Operations Director:

"With 30,000 SKUs across 800 locations, sales per store line at the tail is very low. It's really hard to know if that's a trend given a sale of one unit, if average sale is one in four weeks. So we spend a lot of time collaborating with our partners to optimize this."

Therefore, we posit:

***Proposition 1 (P1)**: A vertically integrated LMSN structure is likely to result in lower interdependence between the focal firm and its supply chain partners. This effect is reduced by decreasing the degree of centralization.*

LMSNs with high horizontal integration across their last-mile distribution (CHARLIE, DELTA and ECHO) have higher interdependence among their supply chain partners, and stronger networked governance structures, allowing the retailers to leverage previously untapped capabilities from the ecosystem. While intuitively, higher horizontal integration promotes higher interdependence on distribution delivery systems, our findings suggest an effect reduction as retailers increase the depth of their supply base (creating redundancies in supply source) in conjunction with breadth extension (obtaining new product types). According to DELTA's Supply Chain Director:

"We have multiple suppliers for the same product/service so that we get the best price and don't depend on any one supplier. Consequently, we don't really build relationships with

our suppliers."

GOLF provides a convergent illustration by sourcing directly from product owners with limited redundancies, and focuses on increasing the breadth of its supply base but not the depth. According to the Supply Manager: *"We recognized this is a problem as we don't have alternate suppliers. While this allows us to build strong relationships with our suppliers, our risk exposure to stock-out is high."*

Based on this analysis, we posit:

***Proposition 2 (P2)**: A horizontally integrated LMSN structure is likely to exhibit elements of (a) higher interdependence and (b) stronger networked governance structures. The effect with interdependence is reduced by increasing the supply base depth.*

The other aspect of network structure is the degree of geographic dispersion. Sustaining competitive advantage through differentiation in omnichannel retailing is increasingly challenging as consumers have access to multiple channels to purchase their products. Recently, attention has shifted toward understanding the roles of offline stores and online websites, and their complementary or cannibalization effects (e.g. Gallino and Moreno, 2014). We observed managers citing their offline store presence as a differentiating capability, while pureplay retailers sought to provide faster delivery services and wider product selection. Unique services are introduced through direct consumer-contact channels (e.g. stores). For example, BRAVO, FOXTROT and GOLF use coupons, attracting online consumers to their physical stores. According to GOLF's Omnichannel Value Proposition Manager:

"Stores are absolutely our point of differentiation. We've beauty consultants to provide personalized beauty services […] 75% of our online purchases are collected from stores […] Over 90% of the U.K.'s population is within a 10-minute's drive from a Retailer E store."

Therefore, we posit:

Proposition 3 (P3)*: A geographically dispersed LMSN structure is better able to create greater service differentiation.*

4.2.2 Internal interdependencies: Other factors

Interdependence influences the degree of information sharing (Lejeune and Yakova, 2005). We observe the impact of interdependence in shaping the degree of flow integration and flow coordination via modes, types, and frequency of information sharing as dominant mechanisms. Interdependence associates positively with flow coordination. Dyadic flow integration is enhanced by increasing transaction frequencies and decreasing strengths of networked governance structure. However, information visibility can alter the effects of these observed relationships, as seen in the cases of DELTA, ECHO and ALPHA. According to ECHO's Transport Analyst: *"Because we have full visibility the moment an order comes in, we're able to work with partners to instantaneously respond to any disruptions."* DELTA's Supply Chain Director further highlighted:

> "*We've a long tail of suppliers, so the kind of deep relationship that you'd have in a supermarket with, for example, Unilever or P&G, just isn't there […] Because we work with our suppliers through the supplier portal which they can log in or connect via an API, we're able to effectively monitor and coordinate activities with real-time visibility. We talk on the phone only when necessary.*"

Hence, it is posited that:

Proposition 4 (P4): *A LMSN with low interdependence is likely to result in low flow integration and low flow coordination between the focal firm and its supply chain partners. These effects are reduced by increasing the degree of information visibility.*

Relationships characterized by strong interdependence and governed by relational contracts offer retailers a greater opportunity to develop differentiated services (Voss and Hsuan, 2009). When the product/service becomes essential to sustaining competitive advantage, hierarchy governance is often promoted. For example, the Buying Manager at

GOLF told us:

"We collaborate with brands and build good relationships with them to obtain exclusivity […] When it becomes a core range like 'Soap and Glory,' where we've exclusivity for many years, we acquire them."

Prior thinking on LMSNs specifies service performance levels based on the adopted network structures that align with firm's strategy (Chopra, 2003). FOXTROT contradicted the prevailing wisdom when management took a reverse perspective to determine the types of service outcomes it wanted to achieve and undertook a five-year transformation journey to revamp its network structure and systems, later acquiring a unique nationwide, same-day delivery capability.

Service architecture can also be decomposed into standardized elements that can be easily outsourced and specialized elements that provide differentiation capability (Voss and Hsuan, 2009). We observe that standardized service elements are often high in modularity, enabling ease of outsourcing, as service requirements are well specified. LMSNs high in service modularity (CHARLIE, DELTA and ECHO) have strong networked governance structures and include market structure as a governance mechanism. In contrast, LMSNs high in service uniqueness (ALPHA, FOXTROT and GOLF) have weak networked governance structures and incorporate hierarchy and relational contract as primary governance mechanisms.

Based on this analysis, we posit:

Proposition 5 (P5): *A decomposed LMSN service architecture (into processes and sub-processes) can effectively be categorized as (a) standardized elements that are easily outsourced, promoting market governance, and (b) specialized elements that provide differentiation capability, promoting hierarchy and/or relational contract governance.*

4.3 Equifinality and omnichannel performance

The effect of equifinality in our study is significant. The seven leading cases provide six forms of LMSN to achieve high effectiveness (based on consumer experience rating) in

omnichannel performance. Type 1 provides further equifinality illustrations among variants of the same type. As an illustration, the data in Table III (see ALPHA[c] and FOXTROT[d]) demonstrate that flow integration can be achieved through lean competitiveness and cost leadership techniques, delivering relatively high levels of order visibility (order tracking: 7.74[c] and 7.77[d]) and on-time delivery (8.19[c] and 8.25[d]) performance (see Table IV).

We questioned the primary mechanisms driving performance resulting from configuration. We found capabilities embedded in the LMSN configuration are the underlying mechanisms driving performance. These are intrinsic capabilities that must be exercised and supported by the requisite resources (i.e. structural and human capital) through resource orchestration and information visibility, to maximize performance. For example, BRAVO has a decentralized network structure to enable fast delivery responsiveness using in-store inventory. However, BRAVO is unable to fully capitalize on this capability due to its ineffective resource orchestration (breadth, depth and life cycle) (Sirmon *et al*., 2010), stakeholder pressures, and the lack of cross-channel visibility. In particular, heterogeneous legacy systems stopped BRAVO leveraging its intrinsic capabilities embedded in the LMSN. According to the Supply Chain Director:

> *"We're at a disadvantage and have been trying to get our legacy IT to adapt to the online retailing world. In-stores systems are not equipped with the right capabilities to service online demands and changing the entire infrastructure is expensive!"*

Therefore, we posit:

Proposition 6 (P6)*: LMSN configuration has intrinsic capabilities that positively influence omnichannel performance when exercised. The effect between configuration and performance is increased (decreased) by (a) more (less) effective resource orchestration and/or (b) higher (lower) global information visibility.*

5. Discussion

This study of LMSNs in omnichannel reveals several insights, elaborating configuration concepts through a set of propositions; first, the benefits between internally/externally-managed dispersed and more localized models, and the interplay between network structure, relationship governance and service architecture (P1–P3). Second, P4 sheds light on how information visibility might impact the dynamics between interdependence and network flows. Third, P5 provides new insights on the relationship between modular networks, governance and service flexibilities. Last, P6 highlights the concept of intrinsic capabilities in conceptualizing LMSN configuration, and considers how resource orchestration and information visibility influence the relationship between configuration and performance.

We now provide a more comprehensive elaboration of the key findings. Our empirically developed taxonomy extends previous frameworks focused either on the structural dimension of LMSN (e.g. Chopra, 2003; Boyer and Hult, 2005) or ideal forms (Lim *et al*., 2016), and considers that hybrids enrich our understanding of the trade-off between delivery responsiveness and product variety. Our study also suggests that the presence of certain variables can lead to reliable prediction of the remaining variables because they are interdependent (see Table III). Configurations that display coherent patterns tend to result in better performance, in our case, consumer experience. The effects of equifinality are present, evidenced by the six forms of LMSN identified, resulting in comparable performance (average of 75% for both consumer satisfaction and convenience). This supports Katz and Kahn's (1978) arguments of multiple, equally effective ways in which an organization can achieve environmental or internal fit.

This study contributes to the continuing debate on the conflicting results between configuration and performance in terms of effectiveness (e.g. Barney and Hoskisson, 1990; Ketchen *et al*., 1997). We posit that the missing link lies in the concept of intrinsic (or

embedded) capabilities in configuration. That is, capabilities mediate the relationship between configuration and performance. Capabilities that are exercised and well implemented are more likely to result in better performance. This association supports Shi and Gregory's (1998) and Srai and Gregory's (2008) studies on international manufacturing networks. We confirm their arguments and extend them to the new omnichannel context.

Within configuration, we observe interdependencies among the configurational attributes and their associations with omnichannel performance (see Figure 3). Network structure is observed to be the nexus influencing the other dimensions. This explains why the traditional structural focus reveals contradictory last-mile performance in practice; it influences the other dimensions and requires a reciprocal "fit" to deliver high performance. Retailers cannot replicate a network structure (often observable) without adjusting other dimensions that might be less observable (e.g. relationships). The classic failure of the online grocer, Webvan provides an apt illustration of a misfit between the adopted network structure and the crafted service proposition (Delaney-Klinger *et al*., 2003). If our model had been applied, Webvan could have been made aware of the need for configurational alignment. Our findings on the relationship between geographic dispersion and service differentiation are supported by Luo's (2016) study: retailers use their physical stores as points of differentiation.

We also identify three omnichannel-relevant factors that influence the performance of an LMSN and explain their roles: (1) resource orchestration, (2) supply base depth, and (3) information visibility. First, while a decentralized structure increases delivery speed, the effects are increased/reduced by the ability of the managers to structure, bundle and leverage firm resources supporting "quick action" (Sirmon *et al*., 2010). Firms need to make resources commensurate with the embedded capabilities in LMSN to realize performance outcomes. This is consistent with the findings of Shockley *et al*. (2015), who argue for the dynamic coordination of capital investments with the complexity of product-service offerings. Second,

while a horizontally integrated structure increases interdependence, supply base depth reduces its effects due to the creation of redundancies in supply source, thereby reducing risk exposure. Last, while the use of market governance and the proliferation of channels and product SKUs increase operational complexity and fragment information flows, our study reveals information visibility can reduce these negative effects. For example, the high complexity of DELTA's supply base (>1 million suppliers) and product portfolio (>200 million SKUs) was countered by DELTA's ability to maintain high information visibility in the LMSN, as evidenced by consumers' high satisfaction scores across several metrics (e.g. ease of ordering: 8.66). Our findings on information visibility are consistent with Hardgrave *et al*. (2013), highlighting the positive effects of information visibility on store inventory performance.

Through these propositions, our study lays the foundation for theory testing. Future research could extend the developed configuration framework to other geographical areas, specialty stores and small to medium-sized retailers. Additionally, there are opportunities to explore the extent of configuration-contingency fit before change becomes necessary; demonstrating a need for simultaneous coordination among the structural, flow, relational and product-service dimension, with the contingencies to stay viable in the dynamic omnichannel environment. Indeed, configuration and contingencies interact to limit the feasible set (Miller, 1981). In this regard, further studies could identify the critical contingency factors (Lawrence and Lorsch, 1967) promoting the use of each LMSN type. Additionally, we call for further cross-disciplinary studies to better reflect real-world complexities, if this domain is to advance with practice development. Notwithstanding, our study observes retailers' tendencies to possess multiple LMSNs (e.g. *Retailer B* and *Retailer C*) to establish omnichannel capability. It would be interesting to examine evolutionary patterns across the taxonomy, and develop a model to measure the maturity of LMSN capability. Finally, revisiting prior

thinking about the trichotomous choice between hierarchy, market and relational contract governance, as well as concurrent sourcing arrangements, presents further research opportunities.

6. Conclusions

This research has important implications for both theory and practice. Using a configuration approach, we develop a middle-range theory for LMSNs, unravelling the interdependencies among the configuration dimensions of LMSN (network structure, network flow, relationship governance, service architecture) and their associations with omnichannel performance. We empirically extend Lim *et al.*'s (2016) conceptual study. Case results suggest LMSN configuration directly influences omnichannel performance via the concept of intrinsic capabilities. Further, our study develops a taxonomy of LMSNs comprising six forms, with two hybrids, supporting the notion of equifinality in configuration theory and confirming its relevance to the omnichannel context.

In particular, our findings suggest network structure as the nexus influencing the other dimensions within LMSN configuration, which, if ignored, could result in configurational misalignment impacting omnichannel performance. This could possibly explain why the prevailing emphasis on network structure without due consideration of the other dimensions characterizing an LMSN has in practice failed to provide workable prescriptions for the selection of last-mile distribution structures. Additionally, we expound: (1) how the physical structural characteristics of an LMSN influences the relational interdependence between the focal retailer and its supply chain partners; (2) the creation of service differentiation through geographically dispersed LMSN structure; and (3) how the LMSN service architecture can be decomposed into standardized and specialized elements influencing the propensity for outsourcing and the appropriate form of governance. Finally, through inductive development, we identify resource orchestration, supply base depth and information visibility as three

omnichannel-relevant factors influencing LMSN performance: the influence of supply base depth on the intensity of interdependence between the focal retailer and its supply chain partners; the influence of effective resource orchestration and global information visibility on LMSN configuration and performance; and the influence of information visibility on the relationship between the degree of interdependence and the degree of flow integration and flow coordination.

We respond to calls from retail scholars to investigate last-mile operations in the emerging omnichannel context (Piotrowicz and Cuthbertson, 2014; Hübner *et al*., 2016a), and from OM/management scholars to further configuration-based studies in uncharted territories (Boyer *et al*., 2000; Eisenhardt *et al*., 2016), characterizing LMSNs in omnichannel.

This study is of direct relevance to managerial practice due to the continuous growth of Internet-based transactions. First, it provides retailers a set of design parameters for the (re)configuration of LMSNs and facilitates performance evaluation using the concept of fit between configurational attributes. Our findings suggest practical guidance for managers to select the appropriate LMSN type for adoption based on delivery responsiveness and product variety. Second, the developed model sheds light on the consequential effects when certain configurational attributes are altered, providing design indications. Finally, industry trends show strong tendencies for retailers to hastily adopt new LMSN(s), in effect imitating competitors' models without fully understanding the complex interrelationships between configuration elements. Our study reveals that retailers should exercise extreme caution when doing so, given the investments required to implement a new LMSN and the substantial lag in adaptation, which can create a mismatch with contextual factors.

This paper has some of the limitations of a case research approach. However, given the nature of elaborating LMSN configuration, we believe this method was most appropriate for uncovering interdependencies among the configurational attributes and for facilitating the

development of middle-range theory. Although our study focused on the U.K. context, we argue the importance of control for context in order to minimize extraneous effects. We believe our study findings can be applied to other geographical areas, by accounting for additional contextual factors. Moreover, since this study has focused primarily on the effectiveness dimension for evaluating omnichannel performance, future research can incorporate the efficiency dimension, more appropriate in cross-geographical studies. Finally, while the propositions are developed from limited cases, we have picked industry-leading cases, sought robustness of empirical findings through theoretical and literal replications, and included a wide range of product types to increase generalizability within the omnichannel context.

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Appendix A. Overview of interview data

Case	Principal Informant	# Interviews
ALPHA	Key FMCG supplier (E-commerce Manager) (#2), Flow Manager (#2), Operations Manager (#1), Senior Operations Manager (#1), Head of General Merchandise (#1), Supply Chain Engagement Manager (#1), Chief Technology Officer (#1)	9
BRAVO	Key FMCG supplier (E-commerce Manager) (#2), Commercial Director (#2), Head Online Grocery (#1), Supply Chain Director (#2), Supply Chain Analyst (#1)	8
CHARLIE	Head Dropshipping Operation (#2), Senior Operations Manager (#1), Key 3PL (CEO) (#1)	4
DELTA	Key FMCG supplier (E-commerce Manager) (#2), Supply Chain Director (#2), Senior Vendor Manager (#4), Senior Manager (#2), Key 3PL (Executive Chairman) (#1)	11
ECHO	Transportation Analyst (#1), Senior In-stock Manager (#1), Supply Chain Director (#1), Delivery Associate (#2)	5
FOXTROT	Central Operations Director (#3), Buying Manager (#2), Commercial Director (#1),	6
GOLF	Key supplier (E-commerce Manager) (#2), Head of Logistics (#2), IT Analyst (#1), Supply Manager (#1), Head of Omnichannel Value Proposition Manager (#1), Senior Supply Chain Manager (#1), Supply Chain and Innovation Manager (#1), Key 3PL (Vice President Operations) (#1)	10
Total		**53**

Appendix B. Condensed interview protocol

1. General information

- Capture the LMSN configuration using mapping tools
- Obtain company background – history, annual revenue, profit and growth rate, sales channel, product portfolio/SKUs, consumer portfolio, omnichannel value proposition and product-service offerings.

2. Last-mile supply network configuration

- How does [company name] make decisions with regard to product portfolio mix?
- How are the target consumers/market segments for each sales channel managed?
- How many types of distribution structures do you have to fulfill online orders? Why?
- How does [company name] cope with the complexities of omnichannel retail?
- In order to understand your e-commerce operations, could you describe in broad terms the fulfillment and distribution process, returns management, and the enabling IT system and infrastructure?
- Who are your top suppliers/retail partners? What kind of relationships do you have with them?
- Who are your top 3PL partners? What kind of relationships do you have with them?
- Could you broadly describe how [company name] designs its omnichannel value proposition/product-service offering?
- What are the desired performance outcomes (for e-fulfillment and delivery) and how are they measured?

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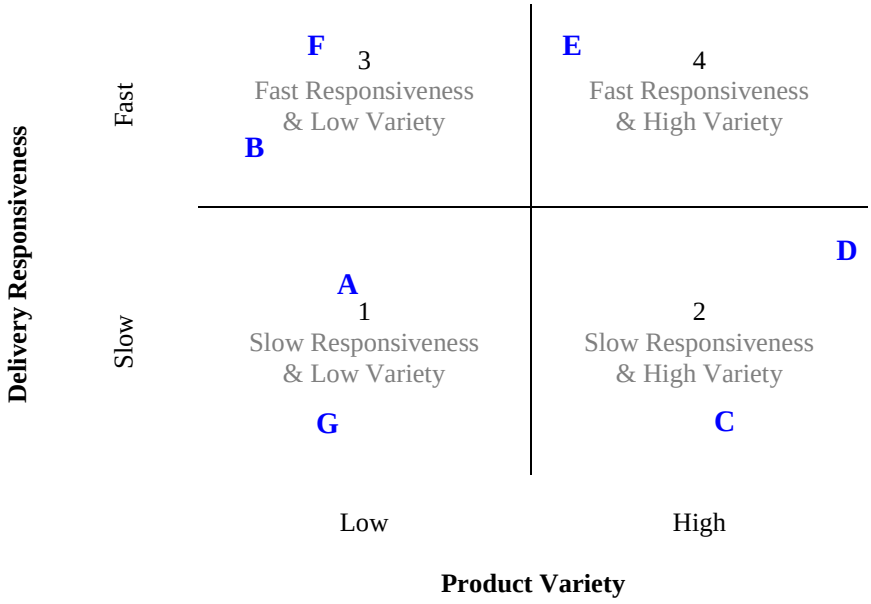
Figures for "Examining the anatomy of last-mile distribution in omnichannel retailing"

Figure 1. Case selection matrix



Legend
A – ALPHA (Pureplay); B – BRAVO (Hybrid); C – CHARLIE (Hybrid); D – DELTA (Pureplay); E – ECHO (Pureplay); F – FOXTROT (Hybrid); G – GOLF (Hybrid).

Figure 2. Taxonomy of LMSN configuration

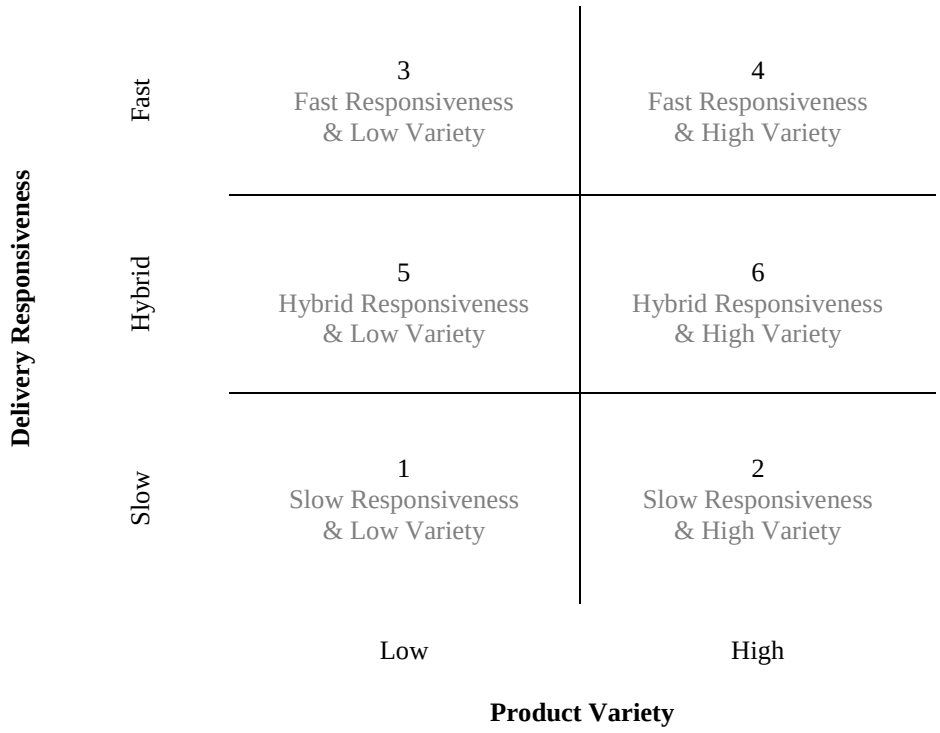
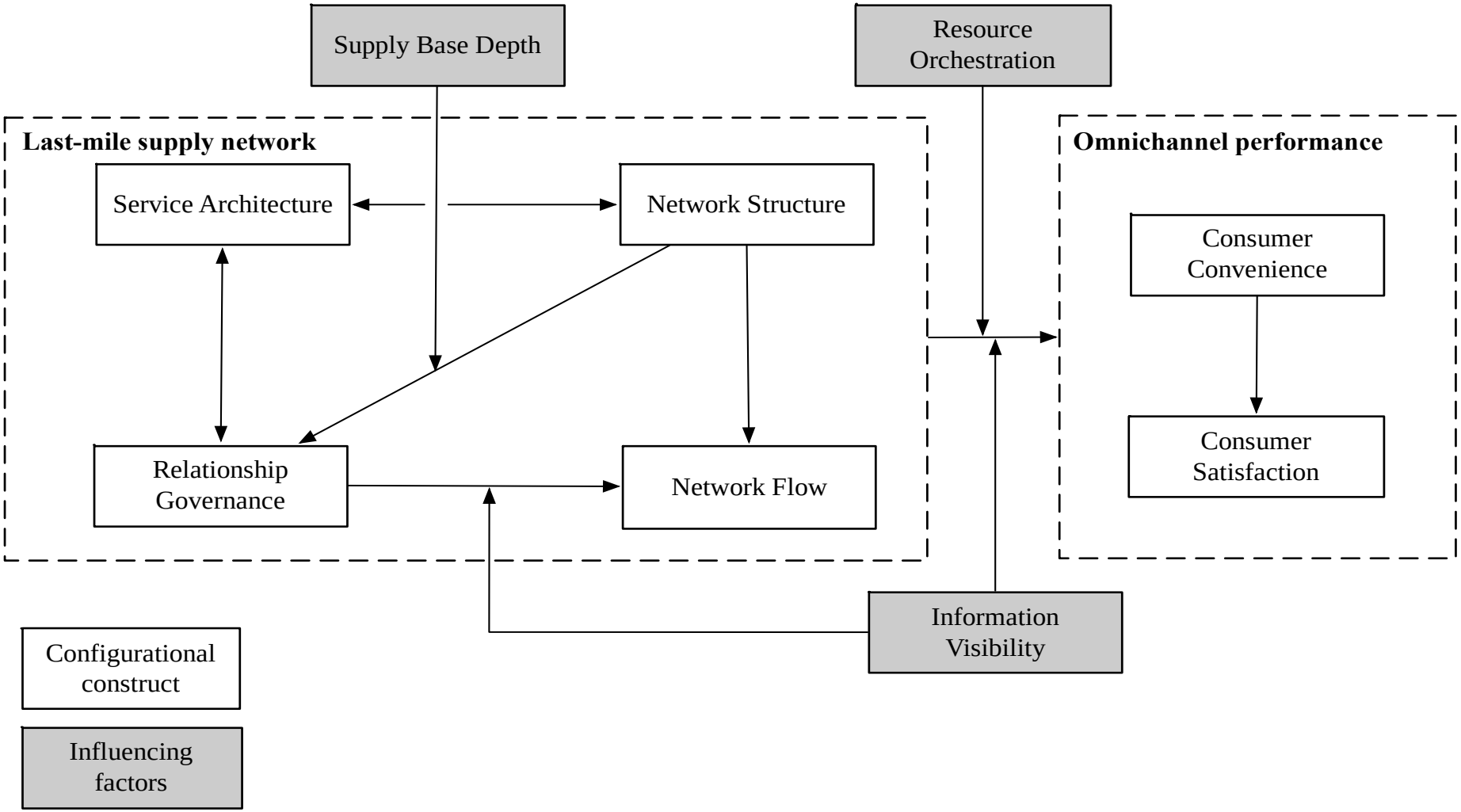


Figure 3. Internal interdependencies within LMSN configuration



Tables for "Examining the anatomy of last-mile distribution in omnichannel retailing"

Table I
LMSN configuration definition

Dimension	Variables	Description
Network structure	Centralization	Degree of authority or power a firm exercises over other firms in the network. Extends to inventory aggregation context where stocks are pooled at centralized locations.
	Vertical integration	Extent to which a firm owns the various stages of the LMSN.
	Horizontal integration	Degree of multiplicity of each LMSN stage or function.
	Geographic dispersion	Extent to which productive units in the LMSN are dispersed geographically.
Network flow	Flow integration	Refers to internal and external integration: a. Internal integration focuses on activities within a firm, and the degree to which a firm structures its own organizational strategies into collaborative, synchronized processes. b. External integration corresponds the degree to which a firm works with its partners to structure interorganizational strategies into collaborative, synchronized processes.
	Flow coordination	Patterns of decision-making and communication among a set of actors who perform tasks to achieve goals. Concerns with the coordination mechanisms to match flows of order/information with consumer requirements.
Relationship governance	Interdependence	Degree to which firms influence each other and the nature of their relationships.
	Governance mechanism	Determines how a firm governs its exchanges: *hierarchy*, *market*, or *relational contract governance.*
	Strength of networked governance structure	Governance in exchanges is embedded within a networked structure comprising a wider collection of relational links among other members. Measures the extent of these links.
Service architecture	Service uniqueness	Proportion of unique to standard service modules. Unique modules are exclusive to the firm and difficult to copy in the short term.
	Service modularity	Degree of reusable process steps that can be "mixed and matched" to enable flexibility and customization for different consumers/situations in service implementation.

Table II
Summary of cases

Case*	Market position	Product portfolio (SKUs)	Distribution channel	Delivery	Est. # first-tier suppliers	Est. # last-mile 3PLs (%)
ALPHA (*Retailer A*)	U.K.: Leading online grocer	Mainly grocery & FMCG with a small selection of general merchandise (*c.*68,000)	(1) Customer fulfillment centers (CFCs) (through spokes) to postcodes; (2) non-food distribution center (NFDC) through CFCs (and spokes) to postcodes; and (3) NFDC through 3PL to postcodes, covering 73% of the U.K. population	Within a one-hour window (next-day or named-day)	1,000	1 (2%)
BRAVO (*Retailer B*)	Global/ U.K.: Top 3 global	Mainly grocery & FMCG with a small selection of general merchandise (*c.*29,000)	(1) Local stores to postcodes; (2) dark stores to post codes; (3) store fulfillment with consumer pickup; and (4) in-store purchase, covering 98% of the U.K. population	Within a one-hour window (same-day, or named-day) + 317 collection points	10,000	0
CHARLIE (*Retailer B*)		General merchandise including, home electrical, home & furniture, technology & gaming, and clothing (*c.*6 million)	(1) FCs to stores for consumer pickup; (2) FCs to stores by 3PL for consumer pickup; (3) FCs to postcodes by 3PL; and (4) suppliers dropship to postcodes, covering 99% of the U.K. population	Express/standard delivery + 1,750 collection points	200 Dropship suppliers + 70 3rd-party sellers	3 (95%)
DELTA (*Retailer C*)	Global: Top 3 global	General merchandise including, garden & tools, sports & outdoors, automotive & industrial, books, toys, kids & baby, electronics, clothing and digital (*c.*200 million)	(1) FCs (through delivery stations) to postcodes by 3PL; (2) FCs to consumers by DELTA Logistics (DTL); (3) third-party sellers dropship to postcodes; (4) third-party sellers dropship to collection point; (5) FCs to collection points by 3PL; and (6) FCs to collection points by DTL, covering 99% of the U.K. population	Next-day or express/ standard delivery + 16,000 collection points	100,000 + 1 million (3rd-party sellers)	10 (50%)
ECHO (*Retailer C*)		Daily essentials, and local meals/foods (*c.*70,000)	(1) Mini-FCs to postcodes; and (2) local partner stores to postcodes, serving selected areas	Within an hour or a two-hour window	100	50 Independent contractors + 3PL (100%)
FOXTROT (*Retailer D*)	U.K.: Leading high street retailer	General merchandise including, technology, home & garden, baby & nursery, toys, jewelry & watches (*c.*50,000)	(1) Hub stores to postcodes; (2) Hub stores to spoke stores for consumer pickup; (3) One-man DC to postcodes by 3PL; One-man DC to Store for consumer pickup; (4) Two-man DC to postcodes by 3PL; (5) Suppliers dropship to postcodes; and (6) in-store purchase, covering 98% of the U.K. population	Within a 3-hour window (same-day) or standard delivery + 800 collection points	800	1 (10%)
GOLF (*Retailer E*)	Global/ U.K.: Top 2 U.K. health & beauty	Pharmaceutical, health & beauty, electrical, mother & baby, toys and a small selection of FMCG (*c.*52,000)	(1) FC to stores by 3PL for consumer pickup; (2) FC to post codes by 3PL; and (3) in-store purchase	Express/standard delivery + 2,500 collection points	300	3 (50%)

Table III
Evaluation of LMSN configuration types

	Business model	ALPHA	BRAVO	CHARLIE	DELTA	ECHO	FOXTROT	GOLF
	Competitive Strategy	Lean Competitiveness	Cost Leadership	Broad Market Differentiation	Broad Market Differentiation	Niche Differentiation	Cost Leadership	Lean Competitiveness
	Product Variety	Low	Low	High	High	High	Low	Low
	Delivery Responsiveness	Slow	Hybrid	Slow	Hybrid	Fast	Fast	Slow
Configuration dimension	Variable	ALPHA	BRAVO	CHARLIE	DELTA	ECHO	FOXTROT	GOLF
Network structure [A]	Centralization	5	2	4.5	4	1	1.5	5
	Vertical integration	5	5	2.5	3.5	2	4.5	3.5
	Horizontal integration	1	1	4	4.5	4.5	1.5	3.5
	Geographic dispersion	3	5	4.5	5	1	4.5	4.5
Network flow [A]	Flow integration	5	4	3.5	3	2	4.5	3
	Flow coordination	1.5	1	3	4	4.5	3.5	3.5
Relationship governance [A]	Interdependence	2	2.75	3.75	3	3	4	4.5
	Governance mechanism [B]	Hierarchy & Relational Contract	Hierarchy	Hierarchy & Market	Hierarchy & Market	Relational Contract & Market	Hierarchy, Relational Contract & Market	Hierarchy, Relational Contract & Market
	Strength of networked governance structure	1	1	4.5	4	4.5	3	4
Service architecture [A]	Service uniqueness[#]	5	3	2.5	1	3	4	4.5
	Service modularity	1	3	4	4.5	4.5	3.5	3.5
Consumer survey	Satisfaction (100)	75.7	77.3	76.9	83.1	82.1	77.7	74.0
	Convenience (100)	73.8	74.4	76.3	79.3	78.7	75.5	71.9
	Reliability*	0.96	0.90	0.86	0.93	0.89	0.84	0.92

* Reliability is calculated using ICC(3,K) following review for major disagreement (Shrout and Fleiss, 1979).
[#] Based on proportion of unique to standard modules.
[A] Based on a Likert scale 1 to 5: low (1), low-moderate (2), moderate (3), moderate-high (4), and high (5).
[B] Based on a categorical scale indicating the governance mechanism type: hierarchy, market and relational contract.

Table IV

Consumer satisfaction and convenience survey

Consumer satisfaction (N = 77)	ALPHA		BRAVO		CHARLIE		DELTA		ECHO		FOXTROT		GOLF	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Product availability [N]	7.55	1.90	7.86	1.63	7.78	1.84	8.40	1.66	8.17	1.96	7.57	2.05	7.65	1.88
Ease of ordering	7.81	1.66	7.99	1.64	8.01	1.76	8.66	1.54	8.44	1.72	8.21	1.46	7.97	1.99
Product information	7.71	1.66	7.75	1.69	7.73	1.68	8.45	1.71	8.17	1.78	7.84	1.61	7.39	1.93
Product prices	6.49	2.09	7.38	1.72	7.38	1.67	8.38	1.68	7.83	2.00	7.70	1.59	7.12	1.69
Website performance	7.49	1.92	7.79	1.75	7.73	1.77	8.38	1.91	NA	NA	7.73	1.90	7.42	1.76
App performance [N]	6.73	2.29	6.91	2.07	6.61	2.17	7.62	2.24	8.01	1.93	6.79	2.14	6.14	2.21
Product selection	7.44	1.85	7.49	1.62	8.64	1.56	8.68	1.43	8.09	1.97	7.69	1.70	7.51	1.54
Shipping & handling charges, and delivery options	7.03	1.89	7.35	1.88	7.10	1.91	8.09	1.72	8.00	2.10	7.35	2.00	6.60	2.28
Order fulfillment [N]	8.01	1.67	7.95	1.67	7.87	1.63	8.65	1.44	8.39	1.69	8.05	1.75	7.53	1.72
On-time delivery	8.19	1.71	8.17	1.67	8.23	1.51	8.38	1.86	8.62	1.67	8.25	1.55	8.06	1.74
Customer support	7.71	1.72	7.61	1.63	7.60	1.95	8.03	1.88	7.87	1.94	7.38	1.97	7.26	1.98
Product met expectations	8.10	1.67	8.12	1.47	8.12	1.65	8.38	1.41	8.34	1.74	8.17	1.49	8.16	1.35
Order tracking/Status information	7.74	1.89	7.69	1.78	7.66	1.81	8.27	1.78	8.18	1.92	7.77	1.69	7.04	2.14
Delivery speed [N]	7.96	1.80	8.17	1.48	7.23	1.56	8.00	1.78	8.60	1.73	8.22	1.45	7.81	1.81
Total average (10.0)	**7.57**	**1.84**	**7.73**	**1.69**	**7.69**	**1.75**	**8.31**	**1.72**	**8.21**	**1.86**	**7.77**	**1.74**	**7.40**	**1.86**
Consumer convenience (N=77)	ALPHA		BRAVO		CHARLIE		DELTA		ECHO		FOXTROT		GOLF	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Physical convenience in receiving order* [N]	7.70	2.07	7.86	1.88	7.83	2.07	8.35	1.90	8.27	1.90	7.78	1.91	7.56	2.11
Physical convenience in returning product [N]	6.91	2.20	7.04	2.11	7.34	2.06	7.56	2.40	7.45	2.28	7.22	2.00	6.75	2.13
Time convenience in receiving order# [N]	7.73	1.98	7.81	1.93	7.84	1.84	8.26	1.93	8.30	1.85	7.78	1.81	7.42	2.04
Time convenience in returning product [N]	7.17	2.13	7.06	2.22	7.49	2.01	7.55	2.37	7.44	2.31	7.43	1.85	7.03	2.12
Total average (10.0)	**7.38**	**2.10**	**7.44**	**2.04**	**7.63**	**2.00**	**7.93**	**2.15**	**7.87**	**2.09**	**7.55**	**1.89**	**7.19**	**2.10**

Source: Adapted from Thirumalai and Sinha (2005) based on Bizrate online customer survey items and scales.

* Physical convenience in terms of physical effort required.

Time convenience in terms of time commitment required.

N New item.

Table V
Illustration of coded data for configurational attributes

Example description	Strength of association	Coding category
ALPHA: "Centralized hub-and-spoke model allows us to have very efficient distribution, wide coverage while keeping incremental costs low" (Senior OM) BRAVO: "Decentralized structure enables shortening delivery lead-time and costs. […] Complexity is managed by allocating consumers to stores but trade-off global view of inventory […] due to distributed flows […]" (SC Director) CHARLIE: "By default, stocks in CHARLIE warehouses are always considered cheapest. If none had stock, we will search for dropship suppliers based on pricing" (Head Dropshipping Opr) DELTA: "[…] marketplace is too huge to realize integration between partners. We set up a platform for partners to use and they just have to comply" (SC Director) ECHO: "Simple and direct point-to-point flow from local inventory points […]" (Transportation Analyst) FOXTROT: "[…] we have a mixture of fast and slow moving lines, making sure we"ve got the right lines in those big hubs, and the right volume to cope with demand both from spokes and from home delivery" (Central Operations Director) GOLF: "[…] fulfilling online orders using front stock you're going to end up causing availability issues or increasing stock holding cost, because you'll need to hold more stock at the local level than you'd have from a centralized fulfillment point" (SC&I Manager)	+++	Structure and flow
ALPHA: "We only have three CFCs now, so it's easy for suppliers to deliver […] some suppliers pre-segment the products and deliver direct to our separate zones, reducing lead-time between orders and on-shelf replenishment" (SC Engagement Manager) BRAVO: "[…] suppliers only deliver to the National DCs and in some cases Regional DCs, *Retailer B* will then trunk the stocks through its secondary distribution network to the stores and FCs, hence minimum influence on relationships with suppliers" (E-commerce Manager) CHARLIE: "[…] FCs dedicated to handling different products. E.g., one managed by CEVA for furniture and TVs, one by EXPERT for white goods, one clothing […] we work with different specialists handling the products" (Head Dropshipping Opr) DELTA: "FCs are set up to be able to take containers of various sizes and delivery types, open 24/7, and are located in places where there is a good transportation network so that suppliers can deliver easily [..] helps to reduce transaction frictions" (Senior Manager) ECHO: "No involvement from partners for this service model as we handle everything from inbound logistics to last-mile delivery. Suppliers only get the aggregate volume. For deliveries, very transactional, we contract self-employed for last-mile" (Senior In-stock Manager) FOXTROT: "Our key suppliers ship directly into our DCs. But now, for some suppliers we're dealing with direct deliveries into hubs, either on demand or simply direct replenishment to hubs" (Central Operations Director) GOLF: "[…] easy for us to work with GOLF because they only have one national DC. They then use their own distribution network to replenish stores and the Burton FC. Sometimes, they do backhauling for us" (E-commerce Manager)	+++	Structure and relationship governance
ALPHA: "Our key value proposition is freshness. Delivering direct from our CFCs without going through stores reduces handling time" (OM) BRAVO: "[…] in-store fulfillment model […] one-to-one allocation of store to consumer, range is limited by what's available in the allocated store. Consumers in the catchment area of the darkstores will have access to wider range " (SC Analyst) CHARLIE: "Using centralized FCs for fulfillment and dropshipping allow us to offer convenience for in-store collection and wide product range respectively" (Sr. Ops) DELTA: "Combination of centralized fulfillment and dropship from sellers enable us to offer the widest range of products especially long-tail ones […]" (Sr. vendor Manager) ECHO: "Local inventory points allow us to offer one-hour delivery service […]" FOXTROT: "We've the biggest home delivery network in the U.K.. The speed that we're able to fulfill customers' needs and stock availability are second to none" (Central Operations Director) GOLF: "[…] difficult to replicate because we've so many stores, but the bit that makes a challenge for us is that we can't move our cut-off time as quickly as other retailers as we've got a lot more considerations" (Omnichannel VP Manager)	++	Structure and service architecture
ALPHA: "Promotions, product range, merchandising right products and enhanced product content on the website are very important for winning shoppers, if you try and promote as much for the suppliers without their support and investments, you'll go bust!" (Head of	+++	Flow and relationship governance

GM) BRAVO: "We've employees based in *Retailer B* HO to do forecasting and order replenishment enabling instantaneous reaction to demand volatility […] improves flow of information and stocks" (Commercial Director) CHARLIE: "Mostly it comes down to price, 'can you give me a reasonable service at a cheap price?' If you can do that, you'll get the business and what we get is just standard service." (Head of Dropshipping Opr) DELTA: "*Retailer C*'s replenishment systems are designed more for general merchandise, not for CPG, and if we want business improvement in our area, they will require us to invest more in their platform (E-commerce Manager) ECHO: "Because we're so transparent, partners can reach *Retailer C* very quickly and vice versa, allowing consumers to get their products extremely fast " (SC Director) FOXTROT: "Due to our relationship, we have the supplier commitment to manufacture and deliver on-time, and therefore we can accurately work out the time to consumers" (Central Operations Director) GOLF: "We share varied levels of details with the suppliers depending, partly on our relationship with them. Some data we make available as part of the package, if they support us with other opportunities." (Supply Manager)		
Mixed results (full data available upon request)	?	Flow and service architecture
ALPHA: "[…] 10-year partnership with Waitrose resulting in joint buying agreements with several suppliers allow *Retailer A* to obtain competitive pricing translating to more competitive pricing for their consumers" (E-commerce Manager) BRAVO: "[…] sophisticated collaboration involving supplier's staffing at our Head Office enables fast response to demand signals thereby improving availability and impact of contingencies" (Head Online Grocery) CHARLIE: "Everyone is paying for failure, so it's in both parties' interest to get rid of it […]" (Head of Dropshipping Opr) DELTA: "We believe in selection, availability and good value for money. To meet these three, suppliers need to work with us in a very transparent manner, be agile and action our forecasts […] deliver within agreed timelines […] all these have a domino effect, so you can offer and sell more and consumers are happy" (SC Director) ECHO: "Partners know our ambition and because we've a huge shopper base, it attracts suppliers to adapt to our requirements and in some cases, we obtain exclusivity in our product-service offering" (Senior In-stock Manager) FOXTROT: "[…] continues to be a huge opportunity, and we've pushed suppliers to develop dropship propositions to help us increase range" (Buying Manager) GOLF: "So we'd probably be looking with some of the suppliers, looking at future trends and opportunities to be trialed and develop ahead of the rest of the market" (Supply Manager)	++	Relationship governance and service architecture
ALPHA: "We provide the highest convenience through our one-hour delivery proposition for customers by continuously optimizing the flows within our network and with our carrier partner" (Chief Technology Officer) BRAVO: "Our in-store fulfilment structure combined with our own vehicle fleet allow us to offer our customers very competitive delivery pricing with high delivery performance, often times exceeding customer expectations" (Commercial Director) CHARLIE: "It's obviously critical we combine the different aspects of delivery associated with the distribution structure, the network flows, and the development of relationships with our core 3PLs in a way that allow us to offer an attractive delivery service proposition and the highest level of customer service experience" (Supply Chain Analyst) DELTA: "Our fulfilment centers are strategically located around the country […] using our in-house developed systems to connect with our market sellers, we build our competitive advantage around next-day delivery service for our Prime members" (Senior Manager) ECHO: "[…] ECHO's platform strategy enables full visibility across the entire network not only for us, but also for our independent contractors, restaurants, retail stores, etc., to consistently deliver orders on time and in full" (Senior In-stock Manager) FOXTROT: "[…] it's all about how to optimize our network flows and ensuring the adopted network distribution structure are aligned with our value proposition to obtain delivery economics and customer satisfaction" (Commercial Director) GOLF: "They're not mutually exclusive: optimizing our network structure, ensuring we maintain good relationships with our supply chain partners, and offering a competitive delivery proposition are fundamental to consistently deliver high service performance for our customers" (Supply Chain and Innovation Manager)	+++	LMSN configuration and performance