Service supply chain resilience: a social-ecological perspective on last-mile delivery operations

Article

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Service Supply Chain Resilience: A Social-Ecological Perspective on Last-Mile Delivery Operations

Abstract

Purpose – Considering the last-mile delivery service supply chain as a social-ecological system rather than just a firm-based service system, we exploit the COVID-19 pandemic disruption to investigate how the supply chain develops resilience from a viewpoint that integrates a social-ecological perspective with the traditional engineering one.

Design/methodology/approach – We adopt a multi-case study approach using qualitative data collected via semi-structured interviews with executive-level managers from nine leading UK last-mile delivery companies. Data analysis is guided by a research framework which is developed by combining the social-ecological perspective with the structure–conduct–performance paradigm. This framework aids the investigation of the impacts of external challenges on companies' resilience strategies and practices, as well as performance, in response to disruptions.

Findings – We identify three distinct pathways to resilience development: stabilization, focusing on bouncing back to the original normal; adaptation, involving evolutionary changes to a new normal; transformation, involving revolutionary changes in pursuit of a new normal-plus. Three strategic orientations are identified as operating across these pathways: people orientation, digital orientation, and learning orientation.

Originality/value – In contrast to the manufacturing supply chain focus of most current research, we concentrate on the service supply chain, investigating its resilience with a social-ecological perspective alongside the traditional engineering one.

Keywords Last-mile delivery, Service supply chain resilience, Social-ecological perspective

Paper type Research paper

1. Introduction

Last-mile delivery (LMD), the service that delivers parcels to customers' doorstep (Aljohani and Thompson, 2020), has confronted huge challenges during the COVID-19 pandemic, but has been offered significant opportunities too. With more people working from home and shopping online, home delivery volume increased significantly (Kapser *et al*., 2021). According to the World Economic Forum report, it led to a 25% rise in 2020 (WEF, 2021). In the UK, couriers have also reported strong volume growth since the start of the pandemic; for example, Yodel reported an overall increase in volume of 22% in H1 2022 (Yodel, 2022). However, this does not automatically translate into revenue growth because it also brings huge pressures to bear on LMD services (Pimenta *et al.*, 2022). The capacity (Micheli *et al*., 2021) and quality (Movarrei *et al*., 2021) of LMD services directly influence not only service supply chain performance, but also customer experience and the well-being of wider society (Modgil *et al*., 2021). Quarshie *et al*. (2021) warned that such a delivery boom will become unmanageable without a sustainable approach.

Developing and enhancing supply chain resilience (SCRES) is believed to help companies better reduce the severity and duration of disruption (Scholten *et al*., 2020; Nikookar and Yanadori, 2022). SCRES can be defined as "the capacity of a system (supply chain) to return to its original state or move to a new, more desirable state after being disturbed" (Christopher and Peck, 2004, p.2). However, the resilience of LMD has not been sufficiently addressed, despite its increasing importance as discussed above, and most current research is focused on goods-based manufacturing supply chains rather than services-based supply chains. This paper aims to address this by answering the following research question:

RQ: How do last-mile delivery companies develop service supply chain resilience in responding to disruptions?

Many different definitions and perspectives of resilience exist, across a variety of domains. In this research, we adopt a social-ecological perspective to investigate resilience in the LMD service supply chain. The traditional, widely adopted engineering perspective treats the supply chain as an engineering system that has an optimal equilibrium to achieve, and to which it can return after a disruption. It thereby spotlights the predictability, robustness and stability of the supply chain (Holling and Gunderson, 2002). However, the supply chain is a considerably more complex system than this suggests, which demands an alternative perspective to observe its resilience more fully (Tukamuhabwa *et al*., 2015; Kahiluoto *et al*., 2020). Hence, Wieland (2021) introduced the social-ecological perspective to SCRES. This perspective implies more than just one equilibrium for a supply chain system (Folke, 2006; Walker 2020), and emphasizes the ability to adapt and transform the system in an unpredictable disruptive environment (Wieland, 2021). The application of the social-ecological perspective to this field is still in an early stage of development (Adobor, 2020) but represents an ongoing frontier of discovery (Flynn *et al*., 2020; Folke *et al.*, 2021).

Following the social-ecological perspective, this paper conducts a multiple-case study within the LMD sector with the aim of understanding how such companies respond to disruptive events and develop SCRES accordingly. The research results contribute to knowledge development about SCRES by addressing the LMD sector in particular, and considering the service supply chain context more generally. The research also contributes to a more comprehensive understanding of SCRES by bringing the social-ecological perspective to bear alongside that of engineering. The results give rise to important and specific implications for policymakers and industry associations, as well as having practical implications for managers across the supply chain.

2. Literature review

To address the research question, we broadly reviewed current literature concerning SCRES and identified two emerging themes. A review of LMD research was also undertaken to clarify the specific context of our research. These reviews as described below enabled us to develop a research framework to guide the research, which is set out at the end of this section.

2.1 SCRES: From engineering to social-ecological perspective

This research adopted the concept first described by Christopher and Peck (2004), more detailed accounts of these perspectives, their definitions and comparisons between them can be found in various review papers (Agrawal and Jain, 2022; Al Naimi *et al*., 2022; Shishodia *et al*., 2022).

One of the important future research directions identified in these reviews is the growing need to address the dynamic nature of SCRES (Ali *et al.*, 2017). Today's supply chains strive to deliver products in a manner at right time, right place, and right quantity, within markets that are unpredictable (Sá *et al*., 2019), which means that they must respond to a dynamic, unstable, and disruptive environment (Tukamuhabwa *et al*., 2015). Hence, supply chain behaviours have become more dynamic in their ranges over space, time, and in the interrelations between supply chain actors and their external context (Spiegler *et al*., 2012; Wieland, 2021). However, from an engineering perspective, the supply chain is described as being more like a linear system, or a nonlinear system but with a stable equilibrium (Ludwig *et al*., 1997). Resilience is then more focused on the stability of the system and returning it to its original state of equilibrium following a temporary disturbance (Holling, 1996). For example, building redundancy and flexibility into the supply chain could help the company quickly recover from disruption (Sheffi and Rice 2005); or using cross-functional teams to increase their robustness to potential supply chain disruptions (de Vries *et al*., 2021). Clearly, the traditional engineering perspective

and approach to understanding and building SCRES with a static view is an oversimplification and no longer sufficiently comprehensive (Wieland and Durach, 2021).

Hence, a shift in perspective from traditional engineering thinking to a dynamic view is required; a view focused more on the dynamics and complexities at the system level that copes with extreme vulnerabilities, uncertainties and unforeseen disruptions (Shishodia *et al*., 2022), which represents the second key theme trending in SCRES research. SCRES itself is a system-level pattern that emerged from dynamic and non-linear interactions among firms within the supply chain and different supply chain functions (Ali *et al*., 2017). With an emphasis on non-linear dynamics of resilience (Folke, 2006) and "the reality of more than one equilibrium" (Holling, 1996, p.33), the social-ecological perspective, which emerged from ecology in the 1960s/70s and expanded thereafter, was introduced into this field by Wieland (2021) and has attracted growing attentions of SCRES researchers. This perspective highlights the persistence, change and unpredictability of the supply chain, and involved more than just bouncing back; hence it could be regarded as a forward-looking approach (Folke *et al*., 2021). Instead of resistance to disturbance emphasized in the engineering perspective, it seeks the absorption of disturbance for *adaptation* and *transformation* to an even better state and emphasizes the interplay between the supply chain and its outside world (Wieland, 2021). This helps address the dynamic and complex nature of the non-linear supply chain and its uncertain and surprising behaviours, and serves to mitigate the disadvantage of system oversimplification associated with an engineering perspective (Davis-Sramek and Richey, 2021).

We summarize these two perspectives in Figure 1 and aim to understand how LMD companies develop their SCRES.

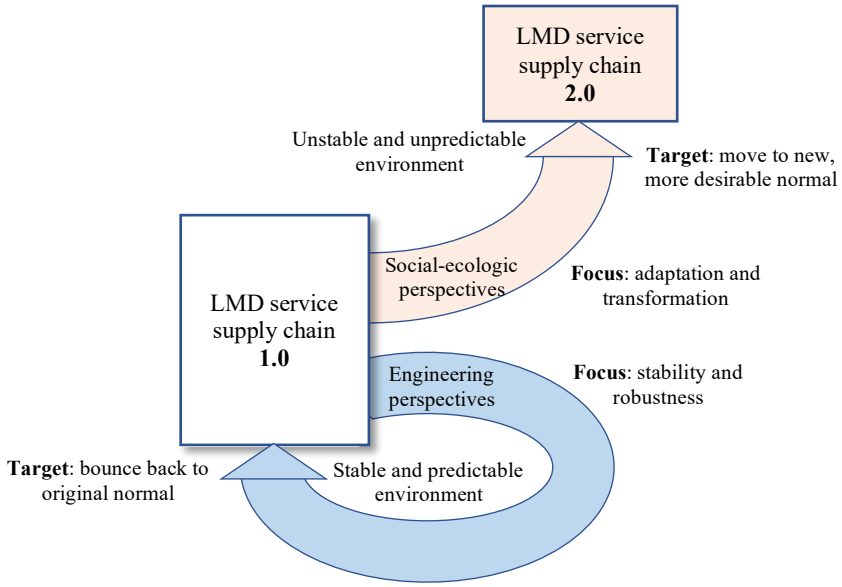

Figure 1. Engineering and social-ecological perspective on SCRES

2.2 Service supply chain: From firm-based service system to social-ecological system

The introduction of the social-ecological perspective reflects not only the shift in research focus on the dynamic nature of SCRES, but also the perspective shift on supply chains as complex systems.

Within the current literature, the LMD service supply chain is predominantly considered as a firm-based service system. Taking the engineering perspectives and approaches, this can be simulated and optimized to maximize/minimize various objectives (Snoeck and Winkenbach, 2022). However, service supply chains tend to be much more complicated than traditional supply chains, its complexity can lead to negative effects on operational performance (Akın Ateş *et al*., 2022). They are complex systems with elements that continuously interact with one another and the wider environment adaptively, not least in terms of elements like social actors intertwining with ecological ones. Hence they can be defined as a social-ecological system (Wieland, 2021), and also be regarded as a type of complex adaptive system (CAS) that can adapt to changing conditions, learning and self-organizing in response to internal and external pressures from various disruptions (Azadegan and Dooley, 2020). This reinforces the argument

that a CAS-based theoretical framework treating resilience as a systemic feature is a more promising approach to examining and understanding SCRES (Tukamuhabwa *et al*., 2015).

Considering the differentiation in nature from the manufacturing supply chain, social actors, including individual customers, play a critical role in building resilience in the service supply chain. Following service-dominant logic (SDL, Lusch and Vargo, 2014), customers are involved in the service process and treated as value co-creators, influencing the delivery performance (Song *et al*., 2016). As already described, the rapid growth of e-commerce, especially in response to COVID-19 lockdown measures, LMD services and their resilience has been massively influenced by changing customer consumption and buying behaviour. Meanwhile, the COVID-19 scenario, as well as raising the profile of service quality to LMD, has highlighted SCRES concerns about health and safety-related issues around people (both delivery workers and isolated/quarantined customers) (Modgil *et al*., 2021). When considering the supply of essential goods, resilience factors need to consider people, customers and ecosystems (Pimenta *et al*., 2022).

Clearly, given fast-changing situations like the COVID-19 pandemic, the social-ecological perspective helps better understand how firms and supply chains develop resilience in response to such disruptions.

2.3 Last-mile delivery

The challenges brought by the disruptive scenario such as the pandemic are very multi-faceted; by no means location-specific but rather affecting the entire supply chain and almost every industry (van Hoek and Loseby, 2021). Many researchers have focused on the upstream of the supply chain (Dabhilkar *et al*., 2016; Durach *et al*., 2020) rather than its downstream. It has been shown, for example, that uncertainties and risks play a critical role in creating

vulnerabilities for logistics service operations (Gultekin *et al*., 2022), and that resilience is essential to the logistics industry in confronting adverse events (Singh *et al*., 2021).

Equally, LMD services faced major challenges during the various phases of COVID-19 lockdowns (Modgil *et al*., 2021), and this situation has been exacerbated by the COVID-19 pandemic. It has significantly accelerated the rapid growth of e-commerce and the number of home deliveries which has increased significantly (Schaefer and Figliozzi, 2021), not only for traditional online shopping items but also for essential goods such as PPE and food (Singh *et al*., 2021). That has brought critical challenges and problems for LMD (Pimenta *et al*., 2022), including unsatisfactory delivery service quality (Movarrei *et al*., 2021), inefficient home deliveries (Che *et al*., 2022), increasing troubles in urban areas (Boysen *et al.*, 2021), and health and safety-related issues (for example, human-human infection) around people within the LMD service supply chain (Modgil *et al*., 2021). Various technologies have been introduced to try and address such challenges, such as autonomous delivery vehicles (Kapser *et al*., 2021) and automated parcel lockers (Schaefer and Figliozzi, 2021). However, empirical insights about the development of resilience in LMD services remain scarce.

Thus, the COVID-19 pandemic emergency has changed the role of LMD services, and also increased its importance and associated challenges, and this research takes LMD as the context in which to investigate the development of SCRES.

2.4 Research framework

Based on the literature review, a research framework (see Figure 2) was designed to guide the research, particularly the data collection and analysis processes.

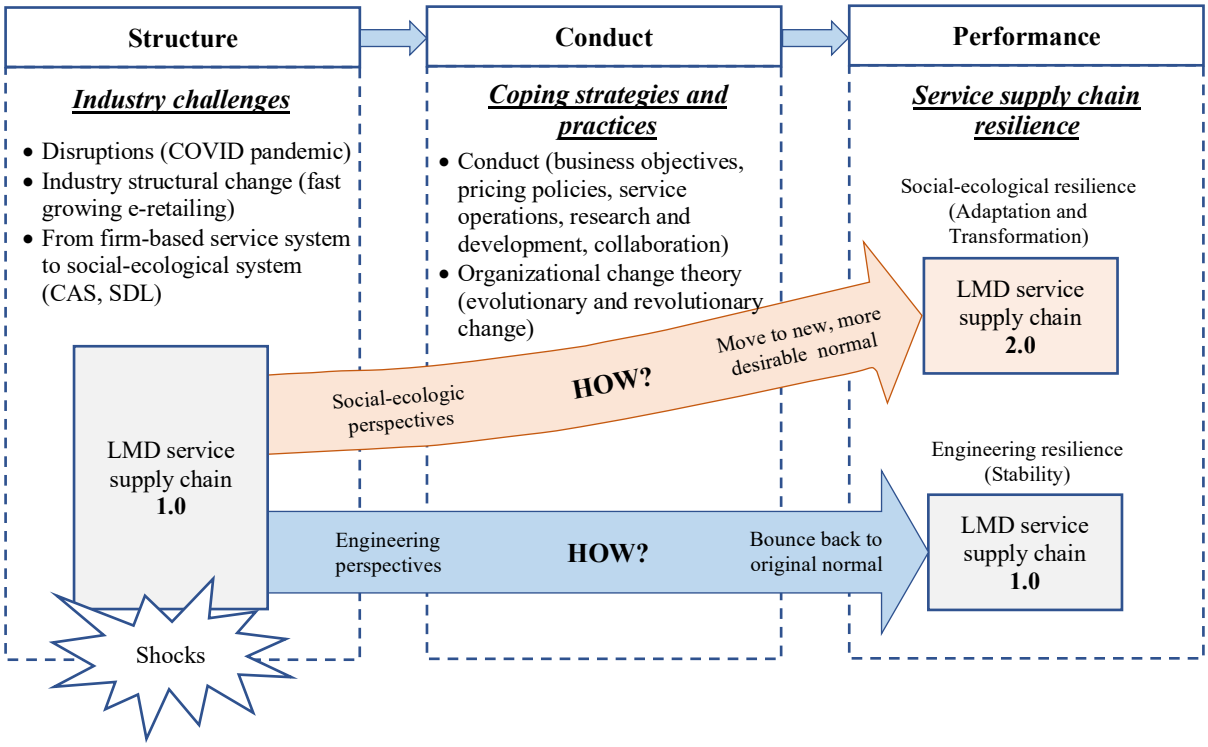

Figure 2. Research framework

To design the research framework, we combine the social-ecological perspective proposed by Wieland (2021) with the structure–conduct–performance (SCP) paradigm developed by Bain (1951). The aim is to investigate the effects of the external environment (the "structure"), such as the ongoing shocks and challenges in the LMD sector, on a firm's behaviour (the "conduct") in developing SCRES including the strategies and practices that a company implement in response to disruptions and on their resilience performance. Regarding the application of the SCP paradigm, we study the classic "conduct" elements when it comes to analysing data, which include business objectives, pricing policies, product/service design, research and development, collusion and merger (Lipczynski *et al*., 2017). However, to better reflect the internal and external behaviours of LMD companies, we extend the notion of service design into service operations to cover service processes, service people (colleagues, drivers, couriers) and customers, representing social actors; we also combine collusion and merger as collaboration.

As illustrated in Figure 2, we build on the theories of CAS and SDL and treat the LMD service supply chain as a social-ecological system. We set out to investigate the approaches taken to develop service SCRES, including social-ecological and engineering resilience, that leads the supply chain to either bounce back to its original normal or move to a new normal. The reason why we include engineering resilience is to reflect the dynamic nature of the SCRES. Rapidly stabilizing the service operations sometimes is always the first choice in the event of a disruption, and is also an essential skill of supply chain managers (Wieland, 2021).

Interpreting after the adaptive cycle (Holing and Gunderson, 2002), social-ecological resilience highlights the ability to adapt and transform toward desired future state (Wieland 2021). Hence it acknowledges that the supply chain needs to change over time (Wieland and Durach, 2021), and it is "all about changing in order not to be changed" (Walker, 2020, p.11). Those changes could be gradual and rapid (Folke, 2006). Following the social-ecological perspective to address the question of "*how*", organizational change theory (Jones and George, 2020) suggests that adaptation normally involves gradual and slow changes to adapt to the changing environment (Walker, 2020), which could be defined as evolutionary change. By contrast, transformation implies more radical changes (Davoudi *et al*., 2013), which could be regarded as revolutionary changes. This research seeks to apply this categorization to the strategies and practices implemented in LMD companies to understand how to develop social-ecological resilience in responding to supply chain disruptions.

3. Methodology

3.1 Research Design

There is a growing demand for empirical studies that bring practical and in-depth insights to SCRES (van Hoek, 2020). The purpose of this research is to contribute to the associated knowledge bank through a focus on the LMD sector. Given the explanatory nature of our

defined research question concerning *how*, case study is suitable means by which to understand the operational links (Yin, 2018). Those links represent the interrelationships between "structure", "conduct", and "performance", providing the theoretical foundation for our research framework; case study is sufficient to establish explanation outcomes in the form of cause-effect linkages (Welch *et al*., 2011). Thus, an explanatory comparative case study is deemed most appropriate for addressing our research question (Pahl-Wostl *et al*., 2022).

A multiple-case study can be expected to generate more compelling and robust findings than a single-case study (Herriott and Firestone, 1983). An overview of proactive measures taken to address concerns of reliability and validity of case study research is summarised in Table 1.

Table 1. Validity and reliability concerns addressed in this case study research

Reliability/Validity criterion*	**Research phase**			
	Research design	**Case selection**	**Data collection**	**Data analysis**
Reliability Demonstrating that the operations can be repeated, with the same results.	Developed case study protocol and interview guidelines.	Selection based on the National Courier Awards (NCA) records, and company annual reports.	Common interview questions for all interviewers. Secured case study database with interview recordings and transcripts.	Involved all researchers in data coding. Data coding cross-compared, verified and confirmed by all authors.
Internal Validity Establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.	Founded on the SCP paradigm, theories of CAS and SDL.	Selection criteria recorded in case study protocol.	Second chance to verify the transcripts with the interviewees via email. Control for data bias.	Triangulation of semi-structured interviews and secondary data. Group discussion to attain inter-rater agreement.
Construct Validity Establishing correct operational measures for the concepts being studied.	Question design followed the SCP paradigm and revised from previous research in the field of SCRES.	N/A	Multiple sources of information for triangulation. Multiple interviewers for each interview.	Interviewees received and read the case study protocol and questions before the interview conducted.
External Validity Establishing a domain in which the study's findings can be generalized.	Case company within the NCA records and met multiple selection criteria.	Clear description of case company's context and situation.	Comparison of available secondary data.	N/A

(* Based on Yin, 2018; Reuter *et al*., 2010)

3.2 Case selection

We chose to focus our study on the LMD sector because of its critical importance to the well-being of wider society, especially when confronting adverse supply chain disruptions and ongoing industry structural change. We targeted the Top 15 express delivery companies based on the ranking data on the Logistics Report 2021, which is an annual report reviewing the performance of the UK Logistics Transport and Storage sector. Nine of them agreed to participate in this research, they made up 20% of the overall Gross Value Add (GVA) to the sector in 2020 (Logistics UK Policy, 2021).

Based on a literature review and preliminary interviews with industry experts, we developed the criteria to ensure the case company is representative enough to gain comprehensive insights (Perry, 1998), hence the selection seeks to maximize the richness of available information while minimizing the number of selected cases. The selection criteria cover the company's history in the sector, its positive performance during the COVID-19 pandemic, and the representation of same-day and/or next-day delivery services in the B2B and/or B2C markets. The characteristics of the case companies and informants are presented in Table 2. To help mask company identities, we have used ranges to present the information relating to company age and size, as suggested by Golicic and Sebastiao (2011).

Table 2. Case company and interview overview

	Case company overview			Interview overview		
Case #	**Business/Services**	**Company age**	**Company size**	**Interviewee**		**Length**
				position	**working experience**	
Case #1	B2B and B2C; Next-day delivery; Saturday/Sunday delivery.	50-55	>15K	Head of Transport	14 years	37 mins
Case #2	B2B; Same-day delivery; Next-day delivery.	15-50	<1K	Chief Operating Officer	33 years	38 mins
Case #3	B2B; Parcel delivery, e-commerce fulfilment.	10-15	1-5K	Chief Executive Officer	34 years	46 mins
Case #4	B2B; Order fulfilment (including parcel delivery).	<5	<1K	Chief Operating Officer	22 years	33 mins
Case #5	B2B; Next-day delivery; Saturday/Sunday delivery.	45-50	>15K	Chief Operating Officer	16 years	30 mins
Case #6	B2B and B2C; Same-day delivery; Next-day delivery; Saturday delivery.	>100	1-5K	Executive Chairman	16 years	48 mins
Case #7	B2B; Next-day delivery.	15-20	5-10K	Chief Executive Officer	12 years	44 mins
Case #8	B2B and B2C; Same-day delivery; Next-day delivery.	20-25	<1K	Commercial Director	22 years	42 mins
Case #9	B2B and B2C; Same-day delivery; Next-day delivery.	10-15	10-15K	Chief Operations Officer	37 years	45 mins

3.3 Data collection

We conducted semi-structured interviews to collect primary data. The brief of the interview is presented in Table 2, including the length and the position and working experience of the interviewees. Interview guidelines were produced to ensure consistency in their conduct (Yin, 2018). The interviews were conducted via Zoom in the January and early February of 2022. Each interview was attended by at least three researchers from the team, with one researcher present in all nine interviews to further guarantee consistency. The interviews were recorded and stored securely, invoking data protection policies as appropriate. Transcripts were derived from the recordings and cross-checked and corrected by the research team.

To obtain in-depth insights, we targeted high-level managers (COOs and CEOs) within each organization. The interviewees had impressive industry experience, ranging from 12 to 37

years, and could discuss different aspects of resilience development more holistically. Moreover, to enhance the data richness of each case, we collected secondary data from various sources (including news and annual reports on company websites, industry reports, and professional association reports since March 2020 the first lockdown was introduced in the UK). Following triangulation logic (Yin, 2018), proactively cross-verifying the collected primary and secondary data helps enhance data reliability and eliminate data collection bias.

3.4 Data analysis

Coding and theme-building approaches were adopted in the process of analysing data. Multiple researchers from the team were involved in this process, with all the coding outcomes cross-checked by other team members to ensure that understandings and interpretations of the evidence were consistently and correctly represented. Themes were built upon the codes, reflecting the connections and relationships among them. Comparisons across the nine cases were conducted to analyse and identify the commonalities and differences in support of the theme building (Dey, 1993). Moreover, to address the research question as effectively as possible, the coding and theme-building results were subjected to continuous refinement by the research team (Yin, 2018), helping to ensure that no important evidence from any case was omitted and that data analysis was consistent and accurate.

4. Findings and discussion

Following in-depth data analysis, the results were summarized into a framework of service SCRES, as depicted in Figure 3. The findings demonstrate that LMD companies can develop resilience via three pathways; the details of *how* they achieve this are presented in Figure 4. It reflects the three elements of SCP paradigm: “structure” emphasizing the environment in which

the companies are operating, “conduct” being how the companies behave, and “performance” describing principally the economic outcomes.

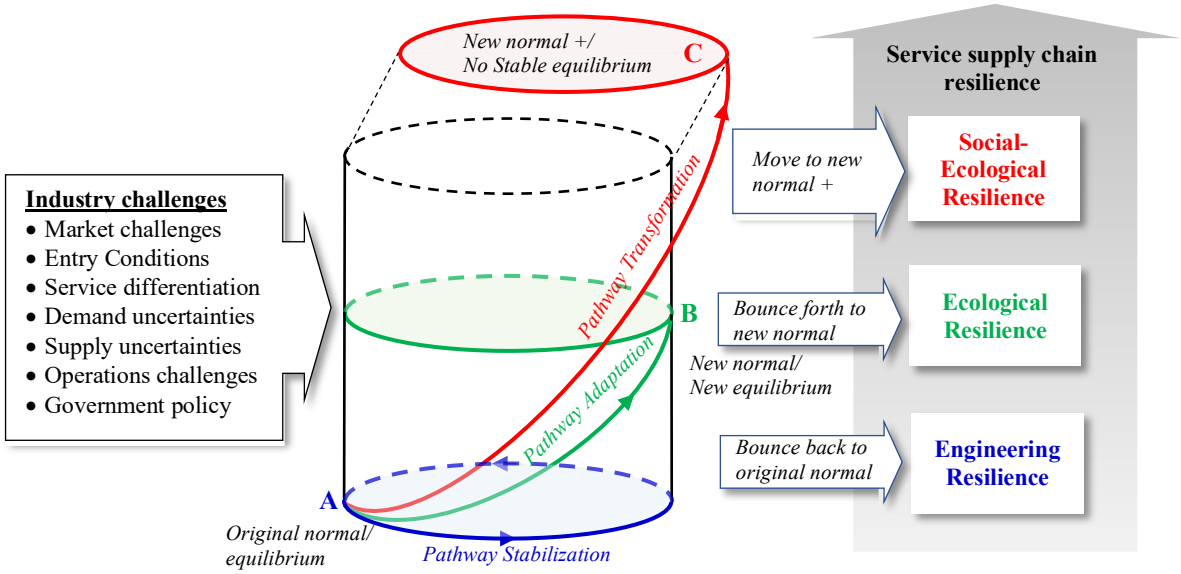

Figure 3. Service SCRES with social-ecological and engineering perspectives

A cross-case comparative study was performed, and the results are presented in Table 3. All companies are clustered into one of three pathways, with the double-line boxed areas identifying the implemented “conduct” items associated with the relevant pathway. However, this highlights that companies are also implementing “conduct” items beyond those boxed areas and within the field of other pathways. This reflects the dynamics of resilience development in terms of the interactions among the three pathways, and also the nature of simultaneous development from a social-ecological perspective (Wieland, 2021). The results imply that companies may pluralize their choices of resilience development in response to disruptive events. Hence, their “conduct” items may exhibit characteristics of multiple pathways at different levels and scales over time.

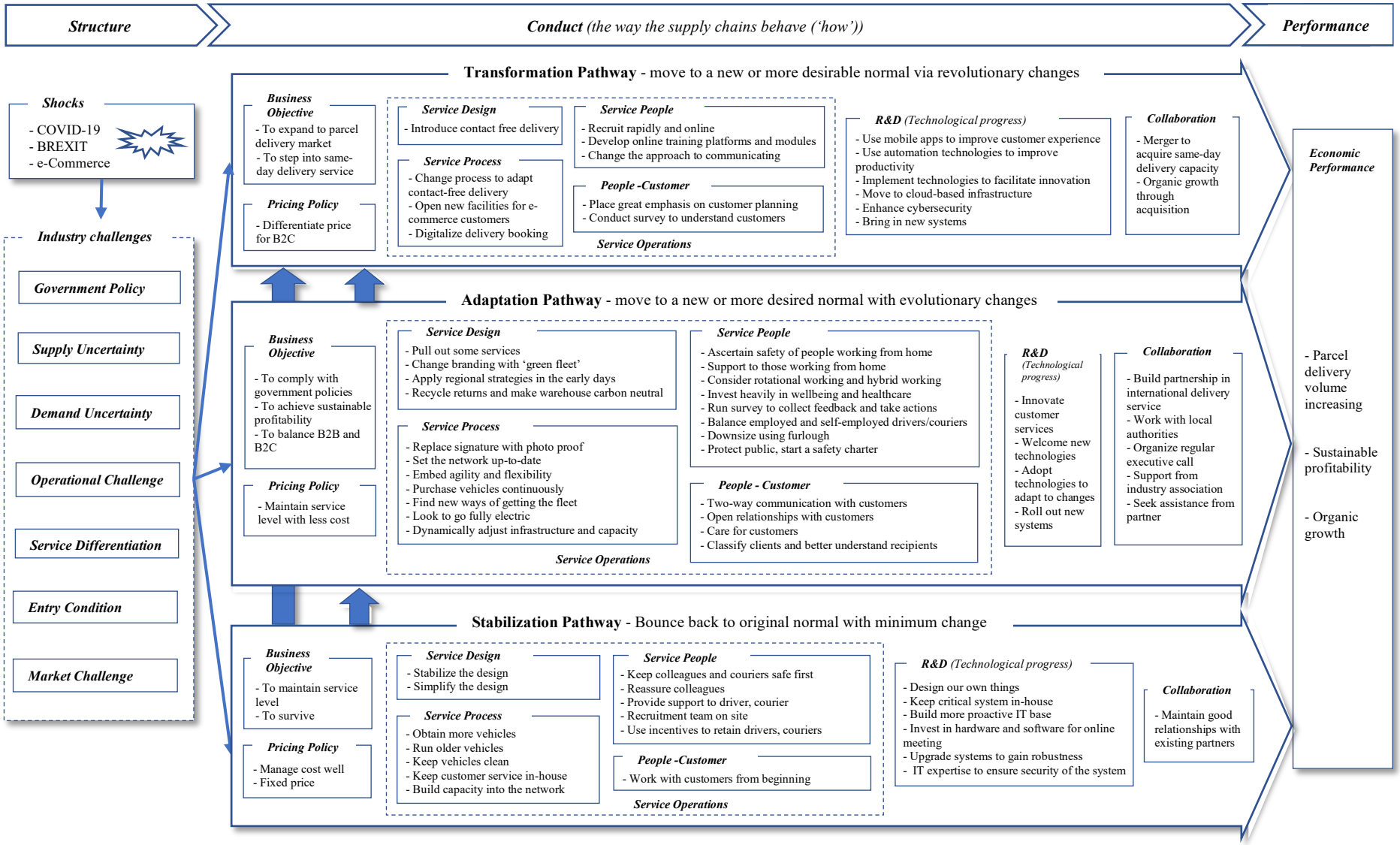

Figure 4. LMD service SCRES

Table 3. Cross-case comparative analysis

SCP		Pathway	Stabilization			Adaptation				Transformation	
		Case#	3	6	7	4	5	8	9	1	2
Structure (Industry challenges)		Government policy									
		Supply uncertainty	*	*	*					*	*
		Demand uncertainty				*	*	*	*	*	*
		Operational challenge								*	*
		Service differentiation									
		Entry condition								*	*
		Market challenge									
Conduct	Stabilization pathway	Business objective	O	O	O						
		Pricing policy									
		Service design									
		Service process									O
		Service people									O
		Customer									
		R&D (technological progress)									
		Collaboration									
	Adaptation pathway	***Business objective***	O	O	O						
		Pricing policy									
		Service design									
		Service process					O		O		O
		Service people									O
		Customer									
		R&D (technological progress)									
		Collaboration									
	Transformation pathway	Business objective									
		Pricing policy									
		Service design					O		O		O
		Service process									
		Service people									
		Customer									
		R&D (technological progress)									
		Collaboration									

(Note: The O represents the starting or ending points; the * represents a relatively higher degree of industry challenge compared with other challenges for the same case; the arrows represent the interactions between different pathways, we will refer to this table when describing each pathway in the following subsections.)

4.1 Structure – industry challenges

First of all, it is important to understand the market environment ("structure") with the industry challenges caused by the shocks, including COVID-19, Brexit, and fast-growing e-commerce. The original research design was focused on COVID-19 impacts, but the results revealed that Brexit and the rapid growth of e-commerce were also responsible for significant interactions, together presenting challenges that influenced the entire LMD sector.

As outlined in Figure 4, besides the challenges of complying with the government's pandemic policies and regulations, LMD companies and their service supply chains also encountered challenges on both the supply side (difficulties in obtaining vehicles, and recruiting drivers and couriers; warehouse shortage) and the demand side (more volume for e-commerce; more demanding customers – easy to be upset by delayed delivery; seasonal sales pattern changes; significant fluctuations for varied business segments; suffered in urban areas). Those uncertainties cause gaps and disruptions to the supply chain (Kovács and Sigala, 2020). In addition, it suffered from operational issues such as colleague safety, different opinions of working-from-home (during lockdown), resistance to returning to work (post-lockdown), financial difficulties, and IT disadvantages (less investment in IT infrastructure and its maintenance; increasing cyber security issues).

The two main services provided by LMD companies are same-day and next-day deliveries, but these represent very fragmented businesses in terms of diversified products and parcels needing to be delivered (service differentiation). Given the high barriers to entry and the intense competition, LMD constitutes a niche sector, and one that it is difficult to enter, especially the same-day delivery business, although it is relatively easy to get into courier work.

The research results show that there is a commonly shared view of COVID-19 impacts on the LMD market as positive overall, outweighing the negatives. Alongside the aforementioned challenges, the shocks bring opportunities into the LMD market at the same time, as articulated by two different managers:

> I think the whole industry is fortunate that actually, the pandemic has been positive for our business as a whole…the challenge was managing the opportunities (Case#8).
> It presents a great opportunity for same-day delivery to expand into new markets (Case#2).

4.2 Developing and enhancing resilience via stabilization

In response to the shocks and challenges of disruptions, the priority is normally placed on recovering and then reinforcing the supply chain (Hajiagha *et al*., 2022). Hence it is understandable that the immediate *business objectives* of a company are to survive and to maintain existing service operations with the normal service level (Case#3,6,7). This also means stabilizing or maintaining profitability level; thus, fixed pricing and better control/management of the cost base (Case#2,7) are the fundamental *pricing policies* and practices used to achieve this. This involved *stabilization* efforts to recover the previous equilibrium, and leads to *engineering resilience*, which is in line with the existing literature in terms of targeting robustness (de Vries *et al*., 2022), resisting disturbance (Zobel *et al*., 2021), and bouncing back to normal (Christopher and Peck, 2004).

Pursuing this pathway, LMD companies stabilize their service operations without making major changes in *service design* (Case#7) and do so as simply as possible (Case#2). Because LMD is a mature sector, but more importantly the three representative cases (#3,6,7) are in very niche markets with well-established service designs, it makes it possible to change less when facing disruptions. However, the sector is facing huge supply uncertainties (highlighted with * in Table 3), especially vehicle and driver shortages concerning the increased number of parcel deliveries to customers. Hence companies made great efforts to secure sufficient resources to ensure that *service processes* could continue as normal. Given increasing difficulties in sourcing the necessary vehicle at short notice, companies had to run older ones (Case#1) or buy electric vehicles instead (Case#1,2,7,8), both of which could also contribute to sustainability and/or green service branding. Another alternative was to rapidly adjust recruitment procedures by working closely with agencies to find enough self-employed vehicle-owning drivers and couriers (Case#6), which helped to quickly address the shortages of both vehicles and drivers. It was also found that keeping the service process (for example,

customer service) in-house helped to better control efficiency (Case#5), while building additional capacity into the service supply chain contributes to a better response to demand fluctuation (Case#6).

Alongside vehicles, *service people* are also crucial to smooth service operations. This includes internal colleagues, especially drivers, obviously, as well as external self-employed drivers and couriers. Given the nature of the COVID-19 pandemic, the first thing is to keep such service people safe, which was evidenced in all of the cases we studied. Besides following the government guidance about personal protection and social distancing, many companies gave extra attention to reassuring staff regarding pandemic fears (Case#9), looking after their mental health (Case#1), focusing on non-work time as well as work time (Case#7), and retaining staff using incentives and rewards (Case#3), which was regarded as more important than recruitment. Nevertheless, the recruitment team were relocated onto the site to ensure real-time information availability and enable quick action to be taken to keep up with changing demand (Case#3).

As an important social actor within the service system, the *customer* also plays a critical role in stabilizing service operations. Working closely with customers from the very beginning (Case#3) and communicating regularly with them (Case#1) have proved to be effective approaches to stabilizing the processes and service supply chain, and maintaining customer satisfaction.

Research and development is an important source of non-price competition between rival companies (Lipczynski *et al*., 2017). Nowadays, the introduction of digital technologies plays a prominent role in service innovation. However, for stabilization purposes, many companies prefer not to apply new technologies to the existing services but just updated them. For example, updating the IT system to increase the robustness of its infrastructure (Case#6) and enhancing IT security (Case#8) to better support the continuous operation of the LMD services. When it

comes to critical IT systems, many companies favoured in-house design (Case#1) and operation (Case#6) to establish full control of them and to maintain their stability.

In terms of *collaboration*, following the same stabilization logic, most companies sought to maintain the good relationships already established with external partners (Case#1,3,5,6,7,8,9), rather than develop new partnerships.

Overall, the stabilization pathway aims to develop and enhance the engineering resilience that supports the supply chain system in bouncing back to the original normal with minimum changes applied. In this respect, we might regard this pathway and the engineering resilience associated with it as foundations for the other two pathways and the social-ecological resilience therein. As the cross-case comparative results presented in Table 3 demonstrate, companies that adopt the other two pathways also put different levels of effort into the stabilization "conduct" items to alleviate their service operations in support of future development. We summarize these points in the following proposition:

Proposition 1: The stabilization pathway serves as a foundation for the other two pathways, and companies in a niche market with low service variety, facing supply uncertainties, tend to develop engineering resilience via the stabilization pathway, to bring service supply chain operations back to their original normal.

4.3 Developing and enhancing resilience via adaptation

Beyond stabilizing the LMD service operations, LMD companies may also need to make changes to service operations to accommodate the changing operational environment resulting from disruption. Based on a social-ecological perspective (Wieland, 2021; Wieland and Durach, 2021), we identified two pathways, adaptation and transformation, described here and in the following subsection, respectively.

Different from the stabilization pathway, *adaptation* represents the ability to absorb (rather than resist) disturbances and adapt to the changing environment, which means *ecological resilience*. The common ground with engineering resilience is that they both seek to reach an equilibrium after a disturbance, but the difference is that they either bounce back to the original one (engineering), or bounce forth to a new one (ecological). This implies that ecological resilience acknowledges the existence of multiple equilibria (Davoudi, 2012).

The research results indicate that the *business objectives* of adaptation are quite different from those of stabilization. In this instance, one objective across all cases is to comply with the fast-evolving government policies and legislation, corresponding to the dynamic circumstances of the pandemic. Another was to raise the service levels to clients and customers (Case#4,5,8,9), as they became more demanding in the context of the pandemic (as described above). A further and more challenging objective was the business turnaround, having suffered financial losses and/or structural decline before the pandemic (Case#3,6,7,9), seeking a return to sustainable profitability. In addition, in response to the UK's fast-growing e-commerce and the increasing parcel volume due to the pandemic, several companies had the objective of a better balance in their operations between B2B and B2C markets (Case#1,3,6,8). Hence, the *pricing policies* adopted here are more adaptive; for example, maintaining service levels with less staff and cost (Case#7), or dynamically reviewing and adjusting service rates (Case#6).

From the cross-case comparative analysis, we can see that Case#3,6,7, originally categorized in the stabilization pathway, appeared here, which indicates that, once these companies have stabilized their service operations, they move forward to make necessary adaptations (shown as the dotted-line arrows in Table 3); for example, balancing B2B and B2C (as discussed below) to reverse the structural decline and restore organic growth. Alternatively, they might simultaneously deploy adaptation "conduct" items to comply with government policies by changing working modes and delivery approaches. Such simultaneous development

applies to all of the case companies. However, given the niche nature of their businesses, these three companies will not make transformative efforts in relation to their business models and service operations.

Objectives such as these require more changes to be applied to the service system than the minimal ones associated with the stabilization pathway. The research results show that adjusting service designs and reconfiguring service processes are helpful to SCRES. In terms of *service design*, it is not only about designing new services (Case#3) or differentiating existing ones for different regions (Case#4,7), but also about suspending or discontinuing some services (Case#4,7,8) to control costs and achieve the financial objectives mentioned above. An interesting finding here is that many companies considered sustainability when redesigning services, for instance, brand to use 'green fleet' (Case#1), and factoring recycling into the services (Case#7).

When it comes to *service processes*, many new changes have been introduced, not only to adapt to the changing operational environment but also to accommodate government policies. First one thing, companies in this pathway are those encountering more challenges from demand uncertainties as mentioned above. Many companies choose to adjust their service capacity of infrastructure (including the warehouse) to meet fluctuated demand (Case#5,6,7), improve customer service (Case#3,7,8,9), and align delivery time-window with other activities (Case#2). Meanwhile, to fill the vehicle shortfall, companies took further long-term oriented actions to ensure sufficient vehicles would be available. For example, continuously purchasing vehicles (Case#1), finding new sources of vehicle supply (Case#1), and looking to go full electric (Case#2). Furthermore, to meet the objective of balancing B2B and B2C, it was also important to build up facility capacity including warehouse and IT infrastructures (Case#3,6) and dynamically adjust the vehicle and driver resources allocation between B2B and B2C (Case#6), as one manager explained:

> We have 80% B2B and 20% B2C before. Overnight B2B volumes just fell through the floor. We had pivoted two or three times to build an infrastructure that allowed us to retain flexibility and agility, but also continued to build profit. It's now settled at around 60% B2B vs. 40% B2C (Case#6).

For another, *service processes* are changed to accommodate government quarantine regulations. For example, the signature proof was switched to photographic evidence (Case#1,4,5), in-personal meetings switched to online ones (Case#2,4), and companies started to consider hybrid working modes for the long term (Case#3), minimized business travel and accommodation (Case#9), and converted people from using desktops to laptop use (Case#1). The most important aspect of these changes in the design and processes is that they aim not only to adapt to the changing business environment and government policy but also to take care of internal *staff* and wider external society, including *customers*. For example:

> We have contact-free delivery, we did it for our drivers, for our protection as well, and for the recipients of parcels (Case#4).

The research results show that communication plays a critical role in taking care of internal staff and external customers, which in return has a positive impact on developing resilience (Wieland and Wallenburg, 2013). In several cases, communication with staff has been improved continuously throughout the pandemic (Case#1,3,4,7,8,9); for example, keeping them informed of the latest updates on new policies and procedures. To take care of *customers*, many companies have changed their ways of communicating with them. For example, not just passively collecting feedback from customers via surveys, but also listening to customers and encouraging active feedback via websites and mobile apps (Case#1,8,9). A more open and interactive relationship has become more common in the sector, with customers not just treated as passive recipients.

Those changes have needed more support from *digital technologies*. The results highlight that companies became more open to the adoption and adaptation of new technologies during

the pandemic (Case#1,3,6,9), more prepared to roll out new management systems (Case#1), and more intend to build up IT capacity (Case#4,6). To adapt to the switch to online meetings, companies invested steadily but heavily in both hardware (online-meeting-enabled laptops and room facilities; Case#1,4,7) and software (popular online meeting platforms like Microsoft Teams and Zoom).

All of these changes are essentially gradual, involving slow ongoing change, which we can regard as *evolutionary changes*. Some, such as working from home and meeting online, have gradually become part of the culture of people, service operations, and the service supply chain system. Other changes, such as rebalancing the mix of B2B and B2C, are still ongoing and are likely to be long-term continuous. We contend that such change also develops and enhances the service SCRES, and enables more sustainable profitability.

One further important finding in this respect is that those changes were not just by the LMD companies themselves, but occurred because of the *collaborations and interactions* with and among their social and ecological partners; for example, suppliers (vehicle manufacturers (Case#1); agencies (Case#1,2,5); IT suppliers (Case#2,4,6,8); customers (Case#1,3,8,9); government (Case #4,9); local authorities (fire) (Case#3); and competitors or peer companies (Case#7,8). This represents a true intertwining and co-evolving with one another (Lade *et al.*, 2020), and is consistent with the mainstream of resilience research that described how interpersonal relationships (Fan *et al.*, 2020), inter-organizational relationships (Fayezi and Ghaderi, 2022) and collaboration (Scala and Lindsay, 2021) have strong associations with resilience.

In all cases, the results highlight that the adaptation pathway has been shown to develop ecological resilience at varying scales and levels via the redesign and/or reconfiguration of service processes and service people, and collaboration with partners (as emphasized by the

bold outlining of these "conduct" items across all cases in Table 3). We summarize the insights in the following proposition:

Proposition 2: The adaptation pathway works most effectively for companies most affected by demand uncertainties. Redesigning and/or reconfiguring service operations is essential in developing the ecological resilience to bounce forth to a new normal with a new equilibrium. Companies on the stabilization pathway may progress to the adaptation pathway once their service operations have been stabilized.

4.4 Developing and enhancing resilience via transformation

Based on the scale of change involved in moving towards a new normal, larger degrees of change goes beyond adaptation and represent a *transformation* pathway in which changes are radical, transforming supply chains to a new *normal-plus* configuration but with no stable equilibrium. This highlights a big difference from the other two pathways that, transformation focuses more on embracing disruption as a "window of opportunity" for transforming into a radically new, and more desirable trajectory (Davoudi *et al*., 2013; Walker 2020; Wieland and Durach, 2021).

In this pathway, *business objectives* are more ambitious, and some LMD companies regarded the disruption as an opportunity that encouraged them to design new services for customers or expand into completely new business areas, such as parcel delivery (Case#2) or same-day delivery marketplace (Case#1). Case#2 is a good example; because of the COVID-19 lockdown, the company was facing the challenges of declining passenger transport services, but successfully designed and launched new same-day parcel delivery services to put itself back on track. Meanwhile, it recognized that its *pricing strategies* required dramatic change to match the new services, and a similar realization applied elsewhere when stepping into the B2C market for the first time (Case#6). A company manager declared:

> 90% of our business at that time was passenger car services, [because of lockdown] 90% of that business went away overnight. Historically we haven't focused on same-day delivery. There were opportunities: PPE equipment, COVID test, a lot need to be delivered. People were at home when they needed the laptops delivered. One of the great successes for us as a business was growing distribution. Because there was an opportunity to do so. As we see today, it is now 25% of our business (Case#2).

We have categorized contact-free delivery in the transformation pathway, because this new, sector-wide service change has made parcel delivery safer and more efficient (as described in Case#5,9); it can be regarded as a *revolutionary change*. Although revolutionary, the actual process of redesign and re-engineering could, traditionally, be very time-consuming. However, within the urgent context of the pandemic, companies made great efforts to redesign delivery processes and implement them extremely quickly (Case Case#2,9), although some processes may still need to undergo slower test, trial and optimization procedures (using photo as delivery proof, Case#5). These new approaches are not just intended for the duration of the pandemic, but rather will now continue as a new normal (Case#9). This result implies that an interaction is required and has happened between adaptation and transformation; specifically, transformation creates demand and direction for adaptation (represented as curved arrows for Case#5,9,2 in Table 3), and continuous adaptation supports and facilitates the achievement of transformation (represented as straight arrows for Case#5,9,2 in Table 3).

In terms of *service people*, this has also undergone a revolutionary change to accommodate changes in service design. For example, recruitment has been moved online (Case#5), and so to training. Approaches to staff communication have also changed, from group to individual focus (Case#5). Similarly, approaches to working with *customers* have also experienced a shift in focus, away from simple, traditional relationship management to a more planned engagement (Case#4).

The results indicate that achieving the business objectives of transformation relies heavily on both the adoption of *digital technologies* and external *collaborations*. Thus, revolutionary

change was supported by implementing technologies including automation technologies (Case#3), mobile apps (Case#5), cloud-based infrastructure (Case#6,8), and cybersecurity technologies (Case#6). Meanwhile, these technologies facilitate more radical innovation, enabling companies to keep pace with a changing environment (Case#5). Besides collaborating with actors more widely within the social-ecological system, merger and acquisition can help in the acquisition of needed capacity and the addition of new services to an existing profile. For example, in early 2022 the company of Case#1 confirmed the acquisition of Case#7 to enable it to quickly open up same-day delivery services, having previously focused mainly on next-day delivery. This was a strategic move in responding to the fast-growing same-day delivery market as well as the e-commerce parcel delivery business.

As represented in Table 3, even though the two companies are categorized as pursuing a transformation pathway, they still include "conduct" elements from the other two pathways. For Case#1, the majority of business is still next-day delivery services, and transforming to new same-day delivery services would require the company to both maintain its existing services and adapt to an altered operational environment. Hence there are fewer "conduct" items in the field of transformation and more in the other two pathway areas. For Case#2, expanding into the parcel delivery market still requires support from existing service processes and service people (as represented by the four curved double-line arrows on the far right of Table 3); for example, existing resources such as vehicles and drivers. In summary of the insights above, we develop the following proposition:

Proposition 3: The transformation pathway is best suited to companies that treat disruptions and industry challenges as windows of opportunity. It needs support from digital technologies and collaboration with the wider social-ecological system, as well as the support of "conduct" items from the stabilization and adaptation pathways.

4.5 Strategic orientations for service SCRES

Across three pathways, a common theme is a way in which a company adapts to its external operating environment, which is defined as strategic orientation (Kumar *et al*., 2012) based on the organization strategy theory of Miles and Snow (1978). After further comparison across the cases, we identify three strategic orientations in the efforts to develop resilience and enhance performance (as Figure 5).

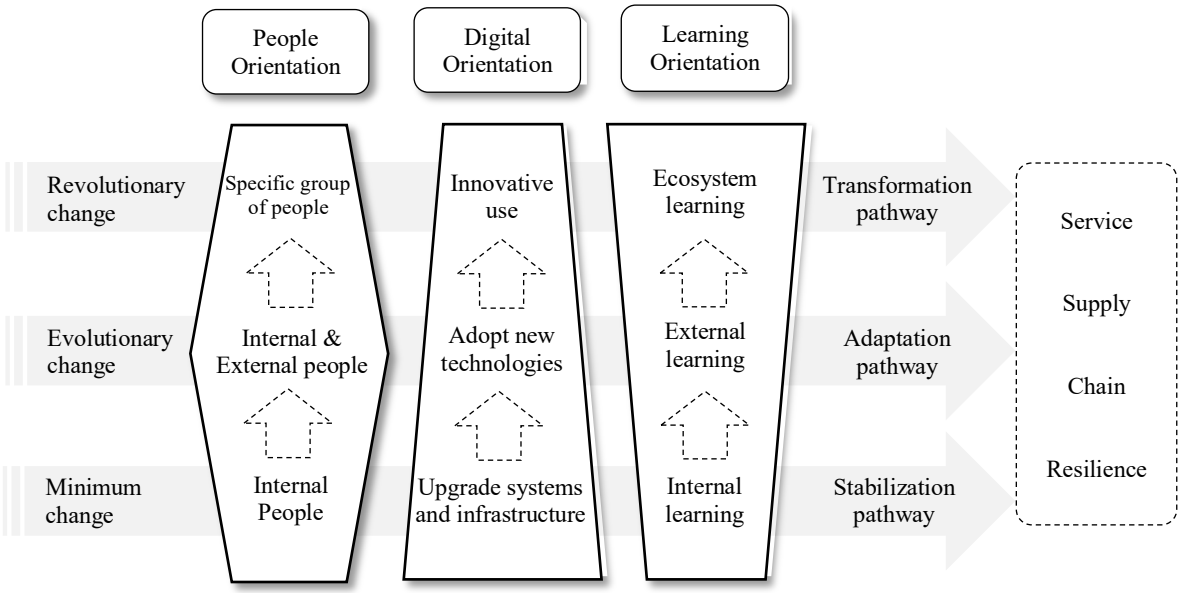

Figure 5. Strategic orientations for service SCRES

People orientation: The results reveal a significant people-focused philosophy within all of the cases and three different pathways to resilience. In contrast to the research focusing just on internal employees (Dennehy *et al*., 2021) at an individual level of analysis, the people orientation looks beyond that to cover a wider range of people, both internally and externally.

Firstly, the results emphasize this people orientation regarding '*people first*'. Thus, during the pandemic, many LMD companies placed a focus on keeping internal staff healthy and safe (Case#2,4,7,8), retaining staff (Case#3), caring about their mental health and wellbeing (Case

#1,5,9), providing relevant training (Case#7), providing a variety of funding to support staff (Case#7), and managing the new modes of working (all nine cases).

The second such emphasis was on '*care for all*', which involved taking care of their internal people but also of people outside of the company, including the local community or even wider society. For example, several companies made efforts not only for their employed drivers but also for those contracted as self-employed drivers/couriers (Case#8,9). Moreover, many companies (Case#2,3,8,9) worked with the government, health agencies, and medical suppliers to deliver essential goods such as PPE, medical equipment and test kits to a wide range of people and communities. As one manager explained:

> We want to do the best for our customers, but also the people who work for us, and all the environmental issues as well. We do support a lot of charities as well. It's not about the profit you make, it's also about how you support your customers and other people within the environment (Case#1).

In particular, the third emphasis is to care for and collaborate with *customers*. In this respect, the results demonstrate good practices ranging from supporting customers via track-and-trace functions (Case#1,8,9) to protecting customers via contact-free delivery (Case#1,4,5,7,9). Beyond that, as a key social actor, customers are not only directly linked to service operations as the recipient but have also become more heavily involved in it. Hence, it has become increasingly important to understand customer demand and expectations via communication and to collaborate more closely with them across all three different resilience pathways, despite most research to date focusing on supply-side resilience (Vanpoucke and Ellis, 2019) rather than customer-side resilience.

As the differing shapes depicted in Figure 5 are intended to illustrate, the range of people involved in each pathway is different. The stabilization pathway mainly involved internal people, but adaptation covers both internal and external people, which aligns with the characteristics of evolutionary change in empowering a wider range of people to achieve it,

and also reflects the great significance of social actors (including people, organizations and wider society) in a social-ecological system (Folke, 2006). However, the transformation pathway of more revolutionary change relies on fewer people (only designated leaders and specific groups of people) to complete it; for example, a merger (Case#1) or stepping into a completely new service business (Case#2). This is consistent with the argument that it is the task of specific social actors (people) to guide the transformation of a system towards a desirable trajectory (Davoudi *et al*., 2013) when considering disruption with chaotic, complex, uncertain, and unpredictable features.

Digital orientation: In the current digital era, technology, and especially digital technologies, plays a critical role in resilience development. The research identifies three levels of digital orientation in play as presented in Figure 5.

Upgrading the current system or infrastructure (Case#5,6,7), which is often outdated, is a foundational practice to ensure a stable and robust IT system in support of service operations, which commonly appeared in the stabilization pathway. Similarly, *adopting new technologies* to adapt to the changing environment is another valuable practice of the adaptation pathway during pandemics. To comply with the work-from-home policy, all of the cases reported a change from physical meetings to online ones. This involved adopting Zoom (Case#1,4,5,7,9) and/or Microsoft Teams (Case#2,3,5,6,7,8), investing in online meeting facilities (Case#7), and investing in laptops to replace desktop use for support staff now working from home (Case#3,4).

In addition to these two levels, several companies also explored the *innovative use* of (digital) technologies to better serve customers, particularly in the transformation pathway. Practices ranged from introducing cloud-based architecture (Case#7,8) to the use of mobile apps (Case#1,9). Taking the latter as an example, introducing a mobile app greatly improved the customer experience through the provision of more visibility and transparency, which also

facilitated a higher level of transformation resilience. It is consistent with the arguments that adopting digital technologies to build end-to-end visibility has demonstrated its effectiveness in enhancing SCRES (Ivanov, 2021). Such apps may have been used by internal staff, external customers, end consumers, or even wider society, which helps to transform the customer experience to new levels. An example was recounted as follows:

> We developed several mobile APPs that our delivery colleagues can use, to message all of them with safety messages. Technology helped, it came along at the right time as contactless delivery. We also developed the APP where receiving customers can input their safe place preferences as a standard instruction to deliver the package. We developed the APP to give pre-notification of delivery time windows during the pandemic (Case #9).

Learning orientation: Finally, the results highlight that learning and sharing are essential elements in supporting resilience development. This aligns with previous research in which learning from experience is proven key to the reconfiguration of supply chain management design in response to acute disruption (Hohenstein, 2022). Both intentional and unintentional learning could help in reducing the impacts of supply chain disruption (Scholten *et al*., 2019). In this research, we characterized three levels of learning in operation: *internal*, *external*, and *ecosystem*.

First, learning from *internal* colleagues contributed to engineering resilience. There are many good practices around internal learning; for example, implementing best practices to improve operational efficiency, incorporating learnt knowledge into continuity/contingency plans, and developing succession plans to pass on and share the knowledge and experience of senior colleagues (Case#3,7), especially those with long working experiences within the sector. Second, sharing/exchanging information with *external* peers about good practices assisted in more rapid adaptation to the changing operations environment. A specific example was a regular executive call among executives from different companies to share information and knowledge during the pandemic (Case #8). Third, with so much uncertainty surrounding such

disruptive events, the capability to learn from the wider *ecosystem* was critical to innovation and transformation. This was evidenced in multiple cases, from a company's development of new services and/or operations based on learning from wider society and community (Case#1,2), or the use of third parties as external consultants, through to attending industry events (Case#7).

Those three levels of learning span the range from organizational learning to supply chain learning, which also reflects an overall learning approach for resilience: creating and sharing knowledge within the firm, transferring and sharing knowledge across the sector and the broader supply chain, and exchanging and sharing knowledge with the wider ecosystem.

In all, we conclude these insights in the following proposition:

Proposition 4: Strategic orientation, including people, digital and learning orientation, has a positive impact on the development and performance of supply chain resilience via all three alternative pathways.

5. Conclusions

This paper conducted in-depth case studies to investigate service SCRES in LMD from both social-ecological and engineering perspectives. The research results make theoretical contributions as well as having practical implications for the field.

5.1 Theoretical contributions

First, this research summarized three distinct resilience pathways within a structural framework consisting of detailed elements. Following the organizational change theory (Jones and George, 2020), we categorized the strategies and practices implemented by LMD companies into two groups: evolutionary and revolutionary changes. This aligns with the two resilience capabilities

of adaptation and transformation highlighted by the application of a social-ecological perspective to SCRES (Wieland, 2021). In addition to identifying the foundational role of engineering resilience, the research results also highlight the interactions between adaptation and transformation pathways, specifically how transformation directs adaptation while continuous adaptation supports and facilitates transformation. On the basis of our data analysis. we adapted the elements of the classical SCP paradigm (Bain, 1951) to generate our detailed elements for this domain. Thus, we substituted *service operations* for *service design* to incorporate service processes, service people, and customers, and combined two further elements into one in the form of collaboration. We believe this better reflects service operational behaviour and better highlights the important role of social actors.

Second, this research identified three strategic orientations operating in support of these resilience pathways at different levels and scales. This reflects a focus on the interactions between the resilience elements of strategic orientation and organizational behaviour, which differs from current literature that rather focuses on analysing the impacts of individual elements on SCRES (Pimenta *et al*., 2022). In particular, the *people orientation* highlights the importance of social actors (including people, organizations, the communities and wider society) within the service system. This aligns with the research on organizational mindfulness with regard to depending upon and caring for internal employees (Dennehy *et al*., 2021), but our results go beyond this to include external people and wider society, aiming to reflect the interactions between social actors and broader ecological actors as per a social-ecological perspective (Davoudi *et al*., 2013; Wieland and Durach, 2021).

Third, this research serves to facilitate the ongoing introduction of the social-ecological perspective into SCRES research. The research framework proposed in this regard is founded on this and other theories including the SCP paradigm, service-dominant logic, complex adaptive systems, and organizational change. It is an attempt to synthesize a framework that

integrates the social-ecological resilience perspective with existing theories and approaches. This contributes to broadening the application of the social-ecological perspective, and helps to inspire its future adoption in other fields of research. Meanwhile, in contrast to the current bulk of the literature, which concentrates on the *manufacturing supply chain* (Christopher and Peck, 2004; Yaroson *et al*., 2021), this research places the focus on the *service supply chain*, specifically that of the LMD sector, and the results add significantly to knowledge regarding the resilience of service supply chain. Complementing the existing knowledge around manufacturing SCRES, helps to build an understanding of SCRES as a whole (Belhadi *et al*., 2021).

5.2 Managerial implications

The research results have considerable implications for practitioners, including managers and policymakers. First, they provide practitioners with a better understanding of resilience development pathways, summarized in Figure 4, and the detailed "conduct" items that could either be directly adopted or used to inspire the design of appropriate actions in response to similar disruptive situations. The three resilience pathways described could be helpful to practitioners as suggested directions, either for stabilizing service operations, adapting to changing environments, or taking the opportunity to transform services, processes, systems and business models, especially with the support of digital technologies. Second, the results highlight the importance of strategic orientation in support of the three pathways. It provides practitioners with guidance in developing appropriate strategic orientation. By deploying a social-ecological perspective and service-dominant logic, the results highlight the changing roles and behaviours of social actors, particularly people and customers. Practitioners can learn from the successful cases described in this research. Thus, putting people first, caring for all, and enhancing internal and external communications are shown to help companies adapt more

quickly to a changing operational environment. Third, the social-ecological perspective adopted in this research could be used by practitioners to develop a strong social-ecological system for their business, which could help enhance the capability to recover from externally generated forced shocks (Carlisle, 2014).

Moreover, the research results highlight the importance of government and industry associations in disruptive events. It is suggested that practitioners collaborate closely with government and local authorities to get up-to-date information. Meanwhile, government and local authorities should provide sufficient, clear and timely guidance and information to the sector to ensure early protective actions. Furthermore, industry associations can be very helpful in providing specific guidance and training to companies and people in their sector (here, LMD companies and couriers) to help them quickly adapt to a changing environment.

5.3 Limitations and future research direction

Given the limitations of a qualitative explanatory case study, it is worth conducting further *quantitative research* to verify the impacts of the strategic orientations identified herein on the resilience and financial performance, which will help enhance our findings. Having focused here on last-mile delivery, future research should consider other service sectors to develop a more comprehensive understanding of service SCRES. Moreover, developing SCRES is a continuous process, especially when pursuing an adaptation pathway. Hence *longitudinal research* is also required, to capture the whole picture of how resilience is developed and how these pathways and strategic orientations interact. Finally, the study is based mainly on data collected from UK companies; to enrich and broaden these research results, future studies could consider conducting similar research in different cultural contexts.

References

Adobor, H. (2020), "Supply chain resilience: An adaptive cycle approach", *International Journal of Logistics Management,* Vol. 31 No. 3, pp. 443-463.

Agrawal, N. & Jain, R.K., (2022). "Insights from systematic literature review of supply chain resilience and disruption", *Benchmarking-An International Journal*, pp. 1-32, doi:10.1108/BIJ-02-2021-0084.

Al Naimi, M., Faisal, M.N., Sobh, R. & Bin Sabir, L., (2022). "A systematic mapping review exploring 10 years of research on supply chain resilience and reconfiguration", *International Journal of Logistics-Research and Applications*, pp. 1-28, doi:10.1080/13675567.2021.1893288.

Ali, A., Mahfouz, A. and Arisha, A. (2017), "Analysing supply chain resilience: integrating the constructs in a concept mapping framework via a systematic literature review", *Supply Chain Management-An International Journal*, Vol. 22 No. 1, pp. 16-39.

Akın Ateş, M., Suurmond, R., Luzzini, D. and Krause, D. (2022), "Order from chaos: A meta-analysis of supply chain complexity and firm performance", *Journal of Supply Chain Management*, Vol. 58 No. 1, pp. 3-30.

Aljohani, K. and Thompson, R.G. (2020), "An examination of last-mile delivery practices of freight carriers servicing business receivers in inner-city areas", *Sustainability*, Vol. 12 No. 7, pp. 1-21.

Azadegan, A. and Dooley, K. (2021), "A typology of supply network resilience strategies: Complex collaborations in a complex world", *Journal of Supply Chain Management*, Vol. 57 No. 1, pp. 17-26.

Bain, J.S. (1951), "Relation of profit rate to industry concentration: American manufacturing, 1936-40", *The Quarterly Journal of Economics*, Vol. 65 No. 3, pp. 293-324.

Belhadi, A., Kamble, S., Jabbour, C.J.C., Gunasekaran, A., Ndubisi, N.O. and Venkatesh, M. (2021), "Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries", *Technological Forecasting and Social Change,* Vol. 163, pp.1-19.

Boysen, N., Fedtke, S. and Schwerdfeger, S. (2021), "Last-mile delivery concepts: A survey from an operational research perspective", *OR Spectrum,* Vol. 43, pp. 1-58.

Carlisle, L. (2014), "Diversity, flexibility, and the resilience effect: Lessons from a social-ecological case study of diversified farming in the northern Great Plains, USA", *Ecology and Society,* Vol. 19 No. 3, pp. 1-45.

Che, Z.H., Chiang, T.A. and Luo, Y.J. (2022), "Multiobjective optimization for planning the service areas of smart parcel locker facilities in logistics last mile delivery", *Mathematics,* Vol. 10 No. 3, pp. 1-22.

Christopher, M. and Peck, H. (2004), "Building the resilient supply chain", *The International Journal of Logistics Management,* Vol. 15 No. 2, pp. 1-14.

Dabhilkar, M., Birkie, S.E. and Kaulio, M. (2016), "Supply-side resilience as practice bundles: A critical incident study", *International Journal of Operations & Production Management,* Vol. 36 No. 8, pp. 948-970.

Davis-Sramek, B. and Richey, R.G., Jr (2021), "New perspectives on supply chain resilience", *Journal of Business Logistics*, Vol. 42 No. 3, pp. 312-314.

Davoudi, S. (2012), "Resilience: A bridging concept or a dead end?", *Planning Theory & Practice*, Vol. 13 No. 2, pp. 299-333.

Davoudi, S., Brooks, E. and Mehmood, A. (2013), "Evolutionary resilience and strategies for climate adaptation", *Planning Practice & Research*, Vol. 28 No. 3, pp. 307-322.

de Vries, T.A., van der Vegt, G.S., Scholten, K. and van Donk, D.P. (2022), "Heeding supply chain disruption warnings: When and how do cross-functional teams ensure firm robustness?", *Journal of Supply Chain Management*, Vol. 58 No. 1, pp. 31-50.

Dennehy, D., Oredo, J., Spanaki, K., Despoudi, S. and Fitzgibbon, M. (2021), "Supply chain resilience in mindful humanitarian aid organizations: The role of big data analytics", *International Journal of Operations & Production Management,* Vol. 41 No. 9, pp. 1417-1441.

Dey, I. (1993), *Qualitative Data Analysis: A User-friendly Guide for Social Scientists*, Routledge, London.

Durach, C.F., Wiengarten, F. and Choi, T.Y. (2020), "Supplier-supplier coopetition and supply chain disruption: First-tier supplier resilience in the tetradic context", *International Journal of Operations & Production Management,* Vol. 40 Nos. 7/8, pp. 1041-1065.

Fan, Y.Y., Stevenson, M. and Li, F. (2020), "Supplier-initiating risk management behaviour and supply-side resilience: The effects of interpersonal relationships and dependence asymmetry in buyer-supplier relationships", *International Journal of Operations & Production Management,* Vol. 40 Nos. 7/8, pp. 971-995.

Fayezi, S. and Ghaderi, H. (2022), "What are the mechanisms through which inter-organizational relationships contribute to supply chain resilience?", *Asia Pacific Journal of Marketing and Logistics,* Vol. 34 No. 1, pp. 159-174.

Flynn, B., Cantor, D., Pagell, M., Dooley, K.J. and Azadegan, A. (2021), "From the editors: Introduction to managing supply chains beyond Covid-19 - Preparing for the next global mega-disruption", *Journal of Supply Chain Management*, Vol. 57 No. 1, pp. 3-6.

Folke, C. (2006), "Resilience: The emergence of a perspective for social-ecological systems analyses", *Global Environmental Change-Human and Policy Dimensions,* Vol. 16 No. 3, pp. 253-267.

Folke, C., Haider, L.J., Lade, S.J., Norstro, A.V. and Rocha, J. (2021), "Commentary: Resilience and social-ecological systems: A handful of frontiers", *Global Environmental Change-Human and Policy Dimensions,* Vol. 71, pp. 1-3.

Golicic, S.L. and Sebastiao, H.J. (2011), "Supply Chain Strategy in Nascent Markets: The Role of Supply Chain Development in the Commercialization Process", *Journal of Business Logistics,* Vol. 32 No. 3, pp. 254-273.

Gultekin, B., Demir, S., Gunduz, M.A., Cura, F. and Ozer, L. (2022), "The logistics service providers during the COVID-19 pandemic: The prominence and the cause-effect structure of uncertainties and risks", *Computers & Industrial Engineering,* Vol. 165, pp. 1-17.

Hajiagha, S.H.R., Mahdiraji, H.A., Behnam, M., Nekoughadirli, B. and Joshi, R. (2022), "A scenario-based robust time-cost tradeoff model to handle the effect of COVID-19 on supply chains project management", *Operations Management Research*, pp. 1-21, doi:10.1007/s12063-021-00195.

Herriott, R.E. and Firestone, W.A. (1983), "Multisite qualitative research: Optimizing description and generalizability", *Education Researcher*, Vol. 12 No. 2, pp. 14-19.

Hohenstein, N.O. (2022), "Supply chain risk management in the COVID-19 pandemic: strategies and empirical lessons for improving global logistics service providers' performance", *International Journal of Logistics Management*, pp. 1-30, doi:10.1108/IJLM-02-2021-0109.

Holling, C.S. (1996), "Engineering Resilience versus Ecological Resilience", Schulze, P.C. (Ed.), *Engineering within Ecological Constraints*, National Academy Press, Washington, DC, pp. 31-44.

Holling, C.S. and Gunderson, L.H. (2002), "Resilience and adaptive cycles", Gunderson, L.H. and Holling C.S. (Ed.s), *Panarchy: Understanding Transformations in Humans and Nature Systems*, Island Press, Washington, DC, pp.25-62.

Ivanov, D., (2021). "Digital supply chain management and technology to enhance resilience by building and using end-to-end visibility during the COVID-19 pandemic", *IEEE Transactions on Engineering Management*, pp. 1-11, doi:10.1109/TEM.2021.3095193.

Jones, G. and George, J. (2022), *Contemporary Management*, McGraw Hill, New York, NY.

Kahiluoto, H., Mäkinen, H. and Kaseva, J. (2020), "Supplying resilience through assessing diversity of responses to disruption", *International Journal of Operations & Production Management*, Vol. 40 No. 3, pp. 271-292.

Kapser, S., Abdelrahman, M. and Bernecker, T. (2021), "Autonomous delivery vehicles to fight the spread of Covid-19-How do men and women differ in their acceptance?", *Transportation Research Part A-Policy and Practice,* Vol. 148 No. 6, pp. 183-198.

Kovács, G. and Falagara Sigala, I. (2021), "Lessons learned from humanitarian logistics to manage supply chain disruptions", *Journal of Supply Chain Management*, Vol. 57 No. 1, pp. 41-49.

Kumar, K., Boesso, G., Favotto, F. and Menini, A. (2012), "Strategic orientation, innovation patterns and performances of SMEs and large companies", *Journal of Small Business and Enterprise Development*, Vol. 19 No. 1, pp. 132-145.

Lade, S.J., Walker, B.H. and Haider, L.J. (2020), "Resilience as pathway diversity: Linking systems, individual, and temporal perspectives on resilience", *Ecology and Society,* Vol. 25 No. 3, pp. 1-19.

Lipczynski, J., Wilson, J. and Goddard, J. (2017), *Industrial Organization: Competition, Strategy and Policy*, Pearson, Harlow.

Logistics UK Policy (2021), "The Logistics Report 2021", available at: https:// .org.uk/CMSPages/GetFile.aspx?guid=68631c02-c41f-40e8-99b3-fa9b60832742&lang=en-GB, (accessed 1 December 2021).

Ludwig, D., Walker, B., and Holling, C.S. (1997), "Sustainability, stability, and resilience", *Conservation Ecology*, Vol. 1 No. 1, pp. 1-7.

Lusch, R.F. and Vargo, S.L. (2014), *Service-dominant Logic: Premises, Perspectives, Possibilities*, Cambridge University Press, Cambridge.

Micheli, P., Johnson, M. and Godsell, J. (2021), "Editorial: How the Covid-19 pandemic has affected, and will affect, operations and supply chain management research and practice", *International Journal of Operations & Production Management*, Vol. 41 No. 6, pp. 773-780.

Miles, R.E. and Snow, C.C. (1978), *Organizational Strategy, Structure, and Process*, McGraw-Hill, New York, NY.

Modgil, S., Singh, R.K. and Hannibal, C. (2021), "Artificial intelligence for supply chain resilience: learning from Covid-19", *International Journal of Logistics Management*, pp. 1-23, doi:10.1108/IJLM-02-2021-0094.

Movarrei, R., Vessal, S.R. and Aspara, J. (2021), "The effect of type of company doing home delivery during a pandemic on consumers' quality perceptions and behavior", *International Journal of Physical Distribution & Logistics Management*, pp. 1-24, doi:10.1108/IJPDLM-08-2020-0272.

Nikookar, E. and Yanadori, Y. (2022), "Preparing supply chain for the next disruption beyond COVID-19: Managerial antecedents of supply chain resilience", *International Journal of Operations & Production Management,* Vol. 42 No. 1, pp. 59-90.

Perry, C. (1998), "Processes of a case study methodology for postgraduate research in marketing", *European Journal of Marketing*, Vol. 32 No. 9/10, pp. 785-802.

Pahl-Wostl, C., Basurto, X. and Villamayor-Tomas, S. (2022), "*Comparative case study analysis*", Biggs, R., de Vos, A., Preiser, R., Clements, H., Maciejewski, K. and Scluter, M. (Ed.s), *The Routledge Handbook of Research Methods for Social-Ecological Systems*, Routeledge, Abingdon, Oxon.

Pimenta, M.L., Cezarino, L.O., Piato, E.L., Da Silva, C.H.P., Oliveira, B.G. and Liboni, L.B. (2022), "Supply chain resilience in a Covid-19 scenario: Mapping capabilities in a systemic framework", *Sustainable Production and Consumption,* Vol. 29 No. 1, pp. 649-656.

Quarshie, N., Bosett, N., Harding, C., Connelly, K. and Whitehead, R. (2021), "Worth the weight: Making London's deliveries greener and smarter", available at: https://www.centreforlondon.org/reader/freight-deliveries-london/#foreword-impact-on-urban-health, (accessed 1 February 2022).

Reuter, C., Foerstl, K., Hartmann, E. and Blome, C. (2010), "Sustainable global supplier management: The role of dynamic capabilities in achieving competitive advantage ", *Journal of Supply Chain Management,* Vol. 46 No. 2, pp. 45-63.

Sá, M.M.d., Miguel, P.L.d.S., Brito, R.P.d. and Pereira, S.C.F. (2020), "Supply chain resilience: the whole is not the sum of the parts", *International Journal of Operations & Production Management*, Vol. 40 No. 1, pp. 92-115.

Scala, B. and Lindsay, C.F. (2021), "Supply chain resilience during pandemic disruption: Evidence from healthcare", *Supply Chain Management-An International Journal,* Vol. 26 No. 6, pp. 672-688.

Schaefer, J.S. and Figliozzi, M.A. (2021), "Spatial accessibility and equity analysis of Amazon parcel lockers facilities", *Journal of Transport Geography,* Vol. 97, pp. 1-14.

Scholten, K., Scott, P.S. and Fynes, B. (2019), "Building routines for non-routine events: Supply chain resilience learning mechanisms and their antecedents", *Supply Chain Management-An International Journal,* Vol. 24 No .3, pp. 430-442.

Scholten, K., Stevenson, M. and van Donk, D.P. (2020), "Dealing with the unpredictable: Supply chain resilience", *International Journal of Operations & Production Management,* Vol. 40 No. 1, pp. 1-10.

Sheffi, Y. and Rice, J.B. (2005), "A supply chain view of the resilient enterprise", *MIT Sloan Management Review,* Vol. 47 No. 1, pp. 41-48.

Shishodia, A., Sharma, R., Rajesh, R. and Munim, Z.H. (2022), "Supply chain resilience: A review, conceptual framework and future research", *International Journal of Logistics Management*, pp. 1-30, doi:10.1108/IJLM-03-2021-0169.

Singh, S., Kumar, R., Panchal, R. and Tiwari, M.K. (2021), "Impact of COVID-19 on logistics systems and disruptions in food supply chain", *International Journal of Production Research,* Vol. 59 No. 7, pp. 1993-2008.

Snoeck, A. and Winkenbach, M. (2022), "A discrete simulation-based optimization algorithm for the design of highly responsive last-mile distribution networks", *Transportation Science,* Vol. 56 No. 1, pp. 201-222.

Song, H., Cadeaux, J. and Yu, K.K. (2016), "The effects of service supply on perceived value proposition under different levels of customer involvement", *Industrial Marketing Management,* Vol. 54 No. 1, pp. 116-128.

Spiegler, V.L.M., Naim, M.M. and Wikner, J. (2012), "A control engineering approach to the assessment of supply chain resilience", *International Journal of Production Research,* Vol. 50 No. 12, pp. 6162-6187.

Tukamuhabwa, B.R., Stevenson, M., Busby, J. and Zorzini, M. (2015), "Supply chain resilience: definition, review and theoretical foundations for further study", *International Journal of Production Research,* Vol. 53 No. 18, pp. 5592-5623.

van Hoek, R. (2020), "Research opportunities for a more resilient post-COVID-19 supply chain - closing the gap between research findings and industry practice", *International Journal of Operations & Production Management,* Vol. 40 No. 4, pp. 341-355.

van Hoek, R. and Loseby, D. (2021), "Beyond COVID-19 supply chain heroism, no dust settling yet - lessons learned at Rolls Royce about advancing risk management thinking", *International Journal of Operations and Production Management,* Vol. 41 No. 10, pp. 1579-1592.

Vanpoucke, E. and Ellis, S.C. (2019), "Building supply-side resilience - a behavioural view", *International Journal of Operations & Production Management,* Vol. 40 No. 1, pp. 11-33.

Walker, B.H. (2020), "Resilience: What it is and is not", *Ecology and Society*, Vol. 25 No. 2, pp. 1-3.

WEF (2021), "Pandemic, parcels and public vaccination: Envisioning the next normal for the last-mile ecosystem", available at: https://www3.weforum.org/docs/WEF_Pandemic_Parcels_and_Public_Vaccination_report_2021.pdf, (accessed 1 February 2022).

Welch, C., Piekkari, R., Plakoyiannaki, E. and Paavilainen-Mantymaki, E. (2011), "Theorising from case studies: Towards a pluralist future for international business research", *Journal of International Business Studies,* Vol. 42 No. 5, pp. 740-762.

Wieland, A. (2021), "Dancing the supply chain: Toward transformative supply chain management", *Journal of Supply Chain Management,* Vol. 57 No. 1, pp. 58-73.

Wieland, A. and Durach, C.F. (2021), "Two perspectives on supply chain resilience", *Journal of Business Logistics,* Vol. 42 No. 3, pp. 315-322.

Wieland, A. and Wallenburg, C.M. (2013), "The influence of relational competencies on supply chain resilience: A relational view", *International Journal of Physical Distribution & Logistics Management,* Vol. 43 No. 4, pp. 300-320.

Yaroson, E.V., Breen, L., Hou, J.C. and Sowter, J. (2021), "Advancing the understanding of pharmaceutical supply chain resilience using complex adaptive system (CAS) theory", *Supply Chain Management-An International Journal,* Vol. 26 No. 3, pp. 323-340.

Yin, R.K. (2018), *Case Study Research and Applications: Design and Methods*, SAGE Publications, London.

Yodel (2022), "Yodel H1 2022 trading statement", available at: https://www.yodel.co.uk/news/2022/january-2022/trading-statement-2022 (accessed 1 February 2022).

Zobel, C.W., Mackenzie, C.A., Baghersad, M. and Li, Y.H. (2021), "Establishing a frame of reference for measuring disaster resilience", *Decision Support Systems,* Vol. 140 No. 1, pp. 1-12.