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Supply chain resilience in a developing country context: a case study on the interconnectedness of threats, strategies and outcomes

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Abstract

Purpose – In few prior empirical studies on supply chain resilience (SCRES), the focus has been on the developed world. Yet, organisations in developing countries constitute a significant part of global supply chains and have also experienced the disastrous effects of supply chain failures. The purpose of this paper is therefore to empirically investigate SCRES in a developing country context and to show that this also provides theoretical insights into the nature of what is meant by resilience.

Design/methodology/approach – Using a case study approach, a supply network of 20 manufacturing firms in Uganda is analysed based on a total of 45 interviews.

Findings – The perceived threats to SCRES in this context are mainly small-scale, chronic disruptive events rather than discrete, large-scale catastrophic events typically emphasised in the literature. The data reveal how threats of disruption, resilience strategies and outcomes are inter-related in complex, coupled and non-linear ways. These interrelationships are explained by the political, cultural and territorial embeddedness of the supply network in a developing country. Further, this embeddedness contributes to the phenomenon of supply chain risk migration, whereby an attempt to mitigate one threat produces another threat and/or shifts the threat to another point in the supply network.

Practical implications – Managers should be aware, for example, of potential risk migration from one threat to another when crafting strategies to build SCRES. Equally, the potential for risk migration across the supply network means managers should look at the supply chain holistically because actors along the chain are so interconnected.

Originality/value – The paper goes beyond the extant literature by highlighting how SCRES is not only about responding to specific, isolated threats but about the continuous management of risk migration. It demonstrates that resilience requires both an understanding of the interconnectedness of threats, strategies and outcomes and an understanding of the embeddedness of the supply network. Finally, this study's focus on the context of a developing country reveals that resilience should be equally concerned both with smaller in scale, chronic disruptions and with occasional, large-scale catastrophic events.

Keywords Developing Countries, Resilience, Supply Chain disruptions

Paper type Case study

1. Introduction

Recent research has emphasised the importance of supply chain resilience (SCRES) for surviving the adverse effects of disruptive events (Carvalho *et al.* 2012; Brandon-Jones *et al.* 2014). SCRES is based on the premise that not all risks are avoidable (Jüttner and Maklan, 2011; Hohenstein *et al.* 2015), but by building resilience, firms can manage the threat of disruption to their supply chains and continue delivering goods and services to customers (Ambulkar *et al.* 2015; Scholten and Schilder, 2015). Although we are yet to reach full consensus on a definition of SCRES (Scholten *et al.*, 2014; Kim *et al.* 2015), most scholars agree that it is concerned with a supply chain's

readiness, effective response to and recovery from a disruption – returning to the previous level or, preferably, an even better level of operational performance (Hohenstein *et al.* 2015; Tukamuhabwa *et al.* 2015).

SCRES is an important topic in the operations and supply chain management literature that is in need of more research (Ambulkar *et al.* 2015; Hohenstein *et al.* 2015; Kim *et al.* 2015; Scholten and Schilder, 2015). To date, few empirical studies on SCRES have been reported in the literature; and those that have been published were mainly conducted in Western Europe and North America (Zsidisin and Wagner, 2010; Gölgeci and Ponomarov, 2013; Scholten and Schilder, 2015), leaving developing countries severely underrepresented. Yet developing countries, which constitute a significant part of global supply chains and the world's population, have similarly experienced the devastating effects of supply chain failures (Chika *et al.* 2011). Further, there are grounds for believing

that the most catastrophic effects of supply chain failures (particularly on human life) have been experienced in developing economies. Recent research on SCRES has examined the resilience of supply chains to product counterfeiters (Stevenson and Busby, 2015), and this can be a particularly acute problem in developing countries (Chika *et al.* 2011). Indeed, it was reported that the infiltration of counterfeit drugs into pharmaceutical supply chains led to the death of 2,500 people in 1995 and 192,000 people in 2001 in Nigeria and China, respectively (Chan *et al.* 2010). In addition, developing countries are more vulnerable to particular supply chain risks such as political turmoil, including rebel activities and post-election violence, and to bribery, poor transportation infrastructure, corruption and other unethical business practices (Lakovou *et al.* 2007; Transparency International, 2013). In 2011, Uganda suffered a severe crisis in fuel and raw material supply chains that disrupted the production and delivery of many goods and services. This sparked massive country-wide protests, and was followed by a violent police crackdown and many fatalities (*The Independent,* 2011). It therefore follows that we should be concerned with the resilience of developing world supply chains not only because, in a globally-connected world, their failure has repercussions elsewhere (Pereira *et al.* 2014; Kim *et al.* 2015; Levalle and Nof, 2015), but because the human consequences can be so significant.

The literature has presented many strategies for improving the resilience of supply chains, such as increasing flexibility and creating redundancy. But there is a noticeable lack of research on the relationships between the various strategies. Some scholars consider these strategies to be independent (Sheffi and Rice, 2005; Zsidisin and Wagner, 2010); others argue that they are interrelated (Jüttner and Maklan, 2011; Johnson *et al.* 2013), with their outcomes either complementing or contradicting each other. Thus, it becomes important to study resilience systemically. In other words, investigating the inter-relationships between threats of disruption (and the conditions that lead to threats), strategies and outcomes rather than analysing them individually and separately.

Against this backdrop, we adopt a case study approach, conducting interviews across a supply network of 20 manufacturing firms in Uganda, to address two research questions:

RQ1. What do manufacturing firms in a developing country perceive to be the threats to their supply chains? What strategies they adopt to build resilience? What are the outcomes of implementing these strategies?

RQ2. How are such threats of disruption and strategies interrelated; and what does this mean for supply chain resilience?

The study finds that threats of disruption, strategies and their outcomes are strongly interconnected, with threats commonly being side-effects of strategies, and attempts to build resilience commonly producing unexpected, further adaptations within the supply chain that themselves require intervention. Thus, to build resilience, it becomes important to appreciate the interconnectedness of threats, strategies and outcomes. We also find that it is important to understand the context in which

the supply chain is located to explain such inter-relationships. Therefore, we draw on the embeddedness framework to examine how the political, geographical and cultural context contributes to a phenomenon of supply chain risk migration and influences SCRES.

The remainder of this paper is organised as follows. In Section 2, the relevant literature on SCRES is reviewed before Section 3 outlines the research method used. Section 4 presents a first-level analysis of the data according to threats, SCRES strategies, and outcomes. This is followed by Section 5, which presents a second-level analysis that reveals the interconnections between threats, strategies and outcomes and which adopts an embeddedness perspective to explain how and why such interconnectedness comes about. Conclusions are thereafter provided in Section 6.

2. Literature review

SCRES has emerged from the broader concept of resilience studied in a number of other disciplines, from ecology to organisational studies (Ponomarov and Holcomb, 2009). To date, the literature specifically on SCRES is dominated by modelling and theoretical work on strategies for building resilience. Recent modelling work includes that of Kristianto *et al.* (2014) on supply chain design and redundancy; Levalle and Nof's (2015) on network formation and configuration; Rajesh and Ravi's (2015) on appropriate supplier selection; and Das and Lashkari's (2015) on risk readiness and planning. Recent theoretical contributions include those of Day (2014) on a complex adaptive systems framework that links SCRES to disaster relief and of Pereira *et al.* (2014) on the link between procurement and SCRES. Meanwhile, Kim *et al.* (2015) highlighted how different types of supply chain structural relationships affect SCRES, arguing that resilience should be analysed from a network perspective. Many of these studies highlighted the need for more empirical work on SCRES.

Tukamuhabwa *et al.* (2015) recently conducted a systematic literature review on SCRES based on 91 articles and found that the number of empirical papers – case studies or surveys – was limited to just 19 articles. Further, most of this empirical work was conducted in developed countries, particularly in Western Europe and North America (Gölgeci and Ponomarov, 2013; Wieland and Wallenburg, 2013; Scholten and Schilder, 2015). This prior work has also focused on high-profile catastrophic, discrete events, e.g. terrorist attacks (Rice and Caniato, 2003), the global financial crisis (Jüttner and Maklan, 2011), rail crashes (Johnson *et al.* 2013), war (Urciuoli *et al.* 2014) and Hurricane Katrina (Scholten *et al.* 2014). A similar focus on large-scale disasters can also be found in conceptual papers on SCRES (Day, 2014; Saenz and Revilla, 2014). This focus is understandable, but large-scale disasters are rare and common definitions of SCRES do not connect it solely to such disasters. Most supply chains are much more likely to be dealing with chronic, repeated threats of disruption, and it is such threats that are arguably more likely to be undermining their capabilities.

Much of the empirical work on SCRES has focused on investigating factors that could facilitate the building of SCRES, referred to variously as antecedents, enablers, practices, capabilities and competencies. Hohenstein *et al.* (2015) recently

argued that all of these can, in some way, be considered SCRES strategies and include broad ideas such as improving flexibility, creating redundancy, building collaborative supply chain relationships, improving supply chain agility and enhancing visibility. More specific practices highlighted in the literature, such as information sharing (Brandon-Jones et al. 2014) and reconfiguring resources (Ambulkar et al. 2015), can be considered components of collaboration and flexibility, respectively.

In Table I, the various SCRES strategies that have so far been proposed in the literature are summarised according to whether they are employed proactively or reactively, i.e. whether they are used ahead of a potential threat to avoid the disruption or limit its impact or whether they are used after a disruption has occurred to respond or aid recovery. This approach has been adopted by many other authors, including Hohenstein et al. (2015) and Dabhilkar et al. (2016), while others refer to the use of proactive, reactive and concurrent strategies (Hollnagel, 2011; Ali et al. 2017). Concurrent strategies are quick, first responses during or in the immediate aftermath of a disruption and reactive strategies are focused on post-disruption recovery. This is similar to the readiness, response and recovery phases referred to by other authors Ponomarov and Holcomb (2009). The simpler reactive/ proactive classification however is sufficient for the purposes of our paper. Other alternative classifications of strategies that do not focus on when a strategy is deployed could include examining whether they support the robustness and/or agility of the supply chain to a threat (Wieland and Wallenburg, 2013) or examining the actors involved, e.g. whether a strategy is deployed by a single firm or collaboratively, such as with other members of the supply chain (Scholten and Schilder, 2015).

Some particular strategies can be either proactive or reactive depending on when and why they are applied. Collaboration, for example, can help to mitigate before disruptions occur, e.g. by enabling information sharing and the deployment of other strategies, including supplier development. But collaboration can also support post-disruption recovery by enabling supply chain actors to share resources and provide a coordinated response (Nishiguchi and Beaudet, 1998; Scholten et al. 2014). Meanwhile, some strategies may be planned and crafted before a disruption but only applied after the disruption. For example, redundant suppliers may be selected before the risk event but only contracted afterwards.

The relationships between the strategies in Table I are clearly complex and remain ambiguous (Jüttner and Maklan, 2011; Johnson et al. 2013; Hohenstein et al. 2015). For example, while scholars such as Soni et al. (2014) considered information sharing, visibility, and collaboration as separate strategies for building SCRES, others Gunasekaran et al., (2015), Kamalahmadi and Parast (2016) have considered information sharing to be a component of collaboration. It is also argued that forming collaborative supply chain relationships and creating redundancy can improve flexibility (Jüttner and Maklan, 2011; Scholten and Schilder, 2015) and that both flexibility and collaboration can improve agility, allowing companies to react faster and select a suitable option for mitigating the effects of disruptive events (Carvalho et al. 2012; Gunasekaran et al. 2015). In addition, strategies like building social capital and relational competences can be regarded as

facilitators of collaboration (Tukamuhabwa et al. 2015). This clearly points to a need to investigate the relationships among these constructs more systematically.

Flexibility also facilitates other independent SCRES strategies from Table I, such as supply chain redesign and the creation of a risk management culture (Kamalahmadi and Parast, 2016). It has been further argued that a risk management culture is important in building SCRES through, e.g. helping to institutionalise innovation, which requires an organisation-wide set of shared beliefs and understanding about innovation. Moreover, a culture of innovation and having innovative individuals can facilitate an effective and immediate response to a supply chain disruption (Kamalahmadi and Parast, 2016). Another SCRES strategy – visibility – which involves incorporating true sensors at different parts of the supply chain and monitoring them regularly is sometimes considered a key component of agility (Wieland and Wallenburg, 2013; Kamalahmadi and Parast, 2016). According to Kamalahmadi and Parast (2016), making timely and informed decisions on the status of a disrupted supply chain and the courses of action to be taken is only possible when there is complete visibility, i.e. when decision-makers have complete knowledge of the status of their supply chains. Although complete visibility seems unlikely to achieve in practice, the greater the level of visibility and the more readily information is made available, the more able a firm will be to prepare for or respond to a disruption. For example, Saenz and Revilla (2014) explained that supply chain visibility helped Cisco to improve its agility and resilience to the Japanese earthquake and tsunami of 2011, whereby Cisco was able to map out its supply base beyond tier one suppliers and to field 118 customer enquiries. Visibility is also related to another strategy, i.e. that of using information and communication technology. For example, it is argued that such technology plays a major role in the continuous monitoring of supply chains by increasing visibility (Gunasekaran et al., 2015).

Furthermore, the SCRES strategy of appropriate supplier selection from Table I is related to the SCRES strategy of supply chain re-design. More specifically, appropriate supplier selection helps to appropriately re-design the supply chain by incorporating competent suppliers to mitigate supply-side disruptions (Gunasekaran et al., 2015). Moreover, redundancy, which involves the duplication of capacity to continue operations during a failure, has been linked to flexibility (Jüttner and Maklan 2011; Kristianto et al. 2014). Redundancy avails resources needed to facilitate supply chain flexibility, which facilitates response through the adaptable deployment of resources, avoiding delays and thereby increasing SCRES (Jüttner and Maklan, 2011). Flexibility can also be achieved through another strategy, that of appropriate contracting, e.g. by creating flexible contractual arrangements (Tukamuhabwa et al. 2015).

Although the above strategies appear to potentially complement each other, they can also conflict. For example, building particularly close collaborative relationships can conflict with some aspects of flexibility (Stevenson and Spring, 2007; Scholten and Schilder, 2015) while creating redundancy to facilitate flexibility may result in liquidity risk (Jüttner and Maklan, 2011). Also, collaboration may cause additional threats, e.g. through sharing sensitive

Table I Summary of proactive and reactive SCRES strategies

	SCRES strategies	References
Proactive strategies	*Appropriate supplier selection/Procurement*. Using selection criteria that can help to minimise disruptions and their impact, such as political stability in suppliers' territories, quality, capabilities (e.g. technological), financial stability, business continuity, reliability, etc.	Pereira *et al.* (2014), Rajesh and Ravi (2015)
	Building logistics capabilities. Capabilities for managing supply and information flows necessary for minimising vulnerabilities, e.g. risk-hedging capabilities, information technology upgrades, and information sharing	Ponomarov and Holcomb (2009)
	Building security. Measures to protect the supply chain against deliberate disruptions, e.g. theft, terrorism, and the infiltration of counterfeits	Rice and Caniato (2003), Barksh and Kleindorfer (2009), Pettit *et al.* (2010)
	Building social capital and relational competences. Effective communication and information sharing before the risk event increases risk awareness and limits vulnerability, e.g. communication, cooperation, trust, reciprocity, etc.	Johnson *et al.*, (2013), Wieland and Wallenburg (2013)
	Co-opetition. Creating and maintaining collaboration between competitors so as to gain from synergies, e.g. sharing resources for building security and resilience	Barksh and Kleindorfer (2009), Borekci *et al.* (2014)
	Creating appropriate contractual agreements. Long term and short-term contracts that can enable flexibility in supply to minimise shortages	Urciuoli *et al.*, (2014)
	Collaboration with the government/Creating public-private partnerships. Contractual agreement between a public agency and a private sector entity to share skills and assets, risks and rewards to deliver services or facilities to the general public. It increases government interest in private entities' supply chains	Gong *et al.* (2014), Urciuoli *et al.* (2014), Yang and Xu (2015)
	Creating a risk management culture. Ensuring that all organisational members embrace supply chain risk management, and this involves, e.g. top management support and firm integration/team work	Christopher and Peck (2004), Sheffi and Rice (2005), Leat and Revoredo-Giha (2013)
	Increasing innovativeness. The motivation and capability to seek and invent new business ideas, e.g. new products, technologies, processes and strategies that can reduce vulnerability	Gölgeci and Ponomarov (2013)
	Increasing visibility. The ability to see through the entire supply chain (all nodes and links), which helps to identify potential threats	Pettit *et al.*, (2010), Zhang *et al.* (2011), Saenz and Revilla (2014)
	Inventory management. The strategic alignment of inventory management using a system-wide approach to minimise inventory risks	Boone *et al.* (2013)
	Knowledge management. Developing knowledge and understanding of supply chain structures (i.e. physical and informational), and the ability to learn from changes as well as educate other entities	Rice and Caniato (2003), Christopher and Peck (2004), Ponomarov and Holcomb (2009), Jüttner and Maklan (2011), Ponis and Koronis (2012), Scholten *et al.* (2014)
	Portfolio diversification. Indulging in different products to reduce dependence on particular products and suppliers	Urciuoli *et al.* (2014)
	Supplier development. Facilitating suppliers with incentives, e.g. financial, training and technical knowledge to improve efficiency, commitment and reliability	Tang (2006), Leat and Revoredo-Gihahlea (2013)
	Supply chain collaboration. The ability to work effectively with other supply chain entities for mutual benefit, e.g. sharing information and other resources to reduce vulnerability	Rice and Caniato (2003), Christopher and Peck (2004), Bakshi and Kleindorfer (2009), Ponomarov and Holcomb (2009), Pettit *et al.* (2010), Jüttner and Maklan (2011), Zhang *et al.* (2011), Ponis and Koronis (2012), Leat and Revoredo-Giha (2013), Brandon-Jones *et al.* (2014), Scholten *et al.* (2014), Scholten and Schilder (2015)
	Supply chain network structure/design. Constructing the supply chain network for resilience, e.g. balancing redundancy, efficiency, vulnerabilities, etc.	Leat and Revoredo-Giha (2013), Kristianto *et al.* (2014), Geng *et al.* (2014), Scholten *et al.*, (2014), Cardoso *et al.* (2015), Levalle and Nof (2015)
	Sustainability compliance. Compliance to economic, social and environmental requirements to mitigate associated supply chain risks, e.g. reputational risks	Soni and Jain (2011)
	Use of information technology. Information technology enhances connectivity and supports other resilience strategies, e.g. visibility and collaboration, which can help in signalling potential disruptions	Kong and Li (2008), Mensah *et al.* (2015)

Table I

	SCRES strategies	References
Reactive strategies	*Building logistics capabilities*. Capabilities for supply and information flows, e.g. to reduce cycle times, increase delivery competence, knowledge management and customer service to quickly recover from a disruption	Ponomarov and Holcomb (2009)
	Building social capital and relational competences. Effective communication, trust and information sharing can enable rapid access to resources necessary for recovery, e.g. communication, cooperation, trust, reciprocity, etc.	Johnson et al. (2013), Wieland and Wallenburg (2013)
	Contingency planning. Anticipating potential events and specifying the measures to deal with supply chain risks and disruptions before they actually occur, e.g. by forecasting and monitoring early warning signals	Tang (2006), Pettit et al. (2010), Urciuoli et al. (2014), Cardoso et al. (2015), Das and Lashkari (2015)
	Contingency re-routing. Using alternative routes (transportation) as a contingency measure in case of the threat of disruption to the current route, e.g. turbulence and bad weather at sea	Wang et al. (2016)
	Creating redundancy. The strategic and selective use of spare capacity and inventory that can be used to cope with disruptions, e.g. spare stocks, multiple suppliers and extra facilities	Rice and Caniato (2003), Sheffi and Rice (2005), Tang (2006), Zsidisin and Wagner (2010), Azevedo et al. (2011), Ponis and Koronis (2012), Kristianto et al. (2014), Saenz and Revilla (2014), Urciuoli et al. (2014), Wang et al. (2016)
	Demand management. Mitigating the impact of disruptions by influencing customer choices through, e.g. dynamic pricing, assortment planning and silent product rollovers	Tang (2006), Urciuoli et al. (2014)
	Ensuring supply chain agility. The ability to respond quickly to unpredictable changes in demand and/or supply	Christopher and Peck (2004), Carvalho et al. (2012), Ponis and Koronis (2012), Scholten et al. (2014)
	Increasing flexibility. The ability of a firm and supply chain to adapt to changing requirements with minimum time and effort	Rice and Caniato (2003), Sheffi and Rice (2005), Tang (2006), Pettit et al. (2010), Zsidisin and Wagner (2010), Azevedo et al. (2011), Ponis and Koronis (2012), Geng et al. (2014), Ambulkar et al. (2015)
	Increasing velocity. The pace of flexible adaptations that can determine the recovery speed of the supply chain from a disruption	Carvalho et al. (2012)
	Increasing visibility. The ability to see through the entire supply chain (all nodes and links) so as to effectively respond to a disruption	Pettit et al. (2010), Brandon-Jones et al. (2014), Saenz and Revilla (2014)
	Supply chain collaboration. The ability to work effectively with other supply chain entities for mutual benefit, e.g. sharing information and other resources necessary for response and recovery	Rice and Caniato (2003), Ponomarov and Holcomb (2009), Pettit et al. (2010), Jüttner and Maklan (2011), Ponis and Koronis (2012), Leat and Revoredo-Giha (2013), Brandon-Jones et al. (2014), Scholten et al. (2014), Geng et al. (2014), Scholten and Schilder (2015)
	Use of information technology. Information technology enhances connectivity and supports other resilience strategies, e.g. visibility and collaboration, which can help in coordinating responses to disruptions	Kong and Li (2008), Mensah et al. (2015)

information (Jüttner and Maklan, 2011) and horizontal collaboration between suppliers may increase supply chain risk through collusion (Choi and Krause, 2006). Finally, flexibility through multiple sourcing and the opening of many branches by firms may also culminate in liquidity risk (Jüttner and Maklan, 2011).

In summary, two important gaps can be identified in the literature:

1. There is a need for further empirical work on SCRES, particularly across a network of firms and in a developing country context. Developing countries are an important player in global supply chains and face supply chain disruptions, yet they are underrepresented in the literature. As will be briefly highlighted in Section 3.2, developing countries have specific practices and conditions that may either produce threats of disruption or hinder the implementation of certain resilience strategies.

2. There is a need to understand the relationships between the various strategies proposed for building resilience. It is not just that such strategies may reinforce or contradict each other, but that some seem to subsume others, and all have various kinds of unintended consequences once organisations start to implement them in particular situations.

3. Method

3.1 Research design

This paper responds to the need for more empirical research into SCRES and the need to expand current understanding of SCRES to include developing country contexts. The nascent state of the literature on SCRES in general, and particularly in developing countries, calls for a qualitative, exploratory study (Saunders et al. 2009). We are interested in what

manufacturing firms perceive to be the threats to their supply chains; the strategies they adopt to build resilience; the outcomes of implementing these strategies; and, importantly, how threats of disruption, resilience strategies and outcomes are interrelated. These are favourable conditions for adopting the case study approach (Stuart *et al.* 2002), as it enables a thorough examination of complex, real-life phenomena leading to new, in-depth insights (Eisenhardt, 1989; Yin, 2009). Exploring the interrelatedness of threats, strategies and outcomes would be much more difficult using other common empirical methods, such as a cross-sectional survey. The value of the case study approach to our research will become further evident in our findings. In particular, informants disclosed some of the unethical practices that occur in supply chains that affect SCRES, including corruption, theft and product counterfeiting. Obtaining this insight was possible by meeting the informants face-to-face and building a rapport with them. It is unlikely that this insight would have been obtained using, for example, an online survey.

Our qualitative case study approach generates explanation from analysis rather than testing prior hypotheses, and this allows us to develop our particular line of theorising about SCRES (Ketokivi and Choi, 2014). A multiple case study approach is adopted. This aids external validity, guards against observer bias (Voss *et al.* 2002; Barratt *et al.* 2011), aids triangulation and creates more testable and robust theory (Eisenhardt, 1989; Yin, 2009).

3.2 Context and case selection

We studied a network of 20 manufacturing firms located in Kampala (the capital of Uganda) and the surrounding industrial areas of Wakiso and Mukono – where the majority of Uganda's manufacturing firms are located (Uganda Bureau of Statistics Report, 2011). Uganda is a landlocked country in sub-Saharan Africa located between Southern Sudan, Kenya, Tanzania, Rwanda and the Democratic Republic of Congo. It has a population of approximately 34.9 million and an income per capita of $706, with 19.7 per cent of people living below the poverty line (World Bank Report, 2015). Uganda's manufacturing sector is growing, but it currently accounts for just 18.4 per cent of GDP – compared to 48 per cent for services and 26.2 per cent for agriculture (World Bank Report, 2015). Manufacturing is heavily reliant on imported materials and is faced with challenges like high interest rates, poor transportation infrastructure, inadequate skills and power shortages (Obwona *et al.* 2014). Further, unethical behaviour in commercial transactions is common. Employees in Uganda are said to value their social identity more than professionalism, and pressures within social relations sometimes produce dishonest behaviour between buyers and suppliers (Ntayi *et al.* 2012). Other problematic practices include adulterating products, mixing good and poor-quality products and refusing to pay suppliers post-delivery (Ntayi *et al.* 2012). More generally, Uganda is considered one of the world's most corrupt countries, suffering from the politics of patronage and interference with the rule of law (Mbabazi and Yu, 2015).

The firms participating in the study have been anonymised and are referred to as AU, BU and so on through to TU, with Figure 1 illustrating the network of firms studied and their brief profiles, including the number of interviewees per firm and the

formal and informal linkages between the firms. Following the principles of theoretical sampling (Eisenhardt, 1989; Dubois and Araujo, 2007), the studied firms had to be in a developing country and connected to one another in a supply network. Sampling was also based on emerging findings. For example, it was decided that competitors and part-government-owned firms should be incorporated to reflect the recurring themes from the initial interviews of unfair competition and corruption. Access began with JU, a brewery where one of the authors had previously worked and where it was known that several supply chain disruptions had been encountered. Employees from JU later facilitated access to three of their suppliers: two sugar manufacturers (FU and GU) and one packaging materials producer (DU). The data collected from DU, which is the largest manufacturer of packaging materials and other paper products in Uganda, revealed disruptions that affected their customers. Hence, their customers were contacted (i.e. BU, FU, PU, IU, TU, QU, SU, EU, OU, RU, CU, AU, NU, MU and KU). Some of these companies also supplied one another. For example, GU and FU supplied beer manufacturers IU, JU and TU and EU supplied HU, which also supplied OU. The number of companies studied (20) was determined following the principle of theoretical saturation – when no new categories or dimensions emerged from additional data (Manuj and Pohlen, 2012).

3.3 The interview protocol

Open-ended questions (for semi-structured interviews) were formulated to probe new areas that would emerge in the course of data collection, as suggested by Manuj and Pohlen (2012). The first main theme concerned what manufacturing firms in Uganda perceived to be the threats of disruption to their supply chains. This theme probed different categories of threats of disruption, e.g. supply-side threats, customer- or demand-side threats, firm-level threats and threats external to the supply chain. For each threat discussed, interviewees were also asked about the strategies adopted to build resilience and, for each strategy, they were further asked about the outcomes of implementation, i.e. whether a strategy was successful or had adverse effects. Further probing was undertaken where informants' accounts suggested threats and strategies were connected, to understand how and why such interrelatedness comes about and what it could mean for SCRES. A pilot study was conducted using face-to-face interviews with three professional managers who had occupied senior positions in manufacturing firms. This helped refine the protocol in terms of its clarity and focus. The final version of the semi-structured interview guide is provided in the Appendix.

3.4 Data collection

In total, 45 semi-structured, audio-recorded, face-to-face interviews lasting approximately 1 h each were conducted with managers and other key personnel knowledgeable in supply chain-related functions. Multiple interviewees per firm were used wherever possible to minimise bias. Interviewees were chosen from different authority levels and consisted of 1 managing director, 1 general manager, 33 managers and 10 officers in functions related to supply chain, procurement, logistics, operations, marketing and distribution. Interviews were transcribed before the transcripts were sent back to the

Figure 1 Network of firms studied and their profiles (including existing formal supply arrangements, potential supply and informal/social relationships)
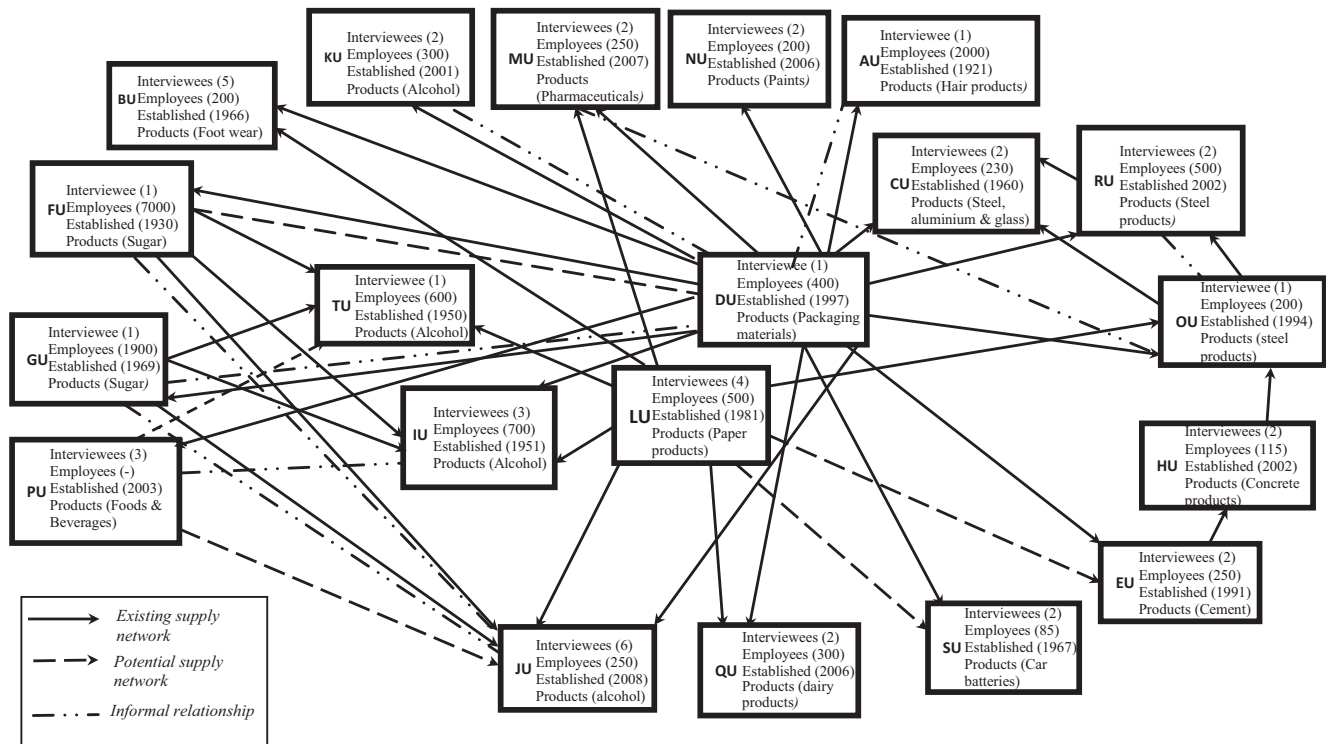
interviewees for validation. We moved back and forth between data collection and analysis so the ideas emerging from the data were reconfirmed in new data and new ideas were further confirmed by the already collected data, as recommended by Morse *et al.* (2002).

3.5 Data analysis

The unit of analysis was a supply network fragment, i.e. some portion of the supply network that respondents referred to as their "supply chains". Data were analysed following grounded analysis principles. The aim was to avoid being constrained by prior theory, to remain open to being surprised by the data and to make sense of the emerging surprises (Ketokivi and Choi, 2014). Repeated readings of the transcripts were first conducted to understand the data and identify data fragments that referred in some way to certain aspects of our research questions. Data analysis was then undertaken at two levels, as described below.

First, there was a reductionistic analysis to develop a category structure for the data. There were three high-level categories: supply chain threats, resilience strategies and strategy outcomes. A lower-level set of categories was also developed through cross-case analysis (Barratt *et al.* 2011), comparing different instances of the same code. The category structure was refined by identifying differences and similarities among the categories (Strauss and Corbin, 1990), followed by merging and eliminating to reach consistency, as recommended in Miles *et al.* (2014).

The second integrative level of analysis involved using the transcripts to identify the dynamic, causal connections between the threats (and conditions that lead to threats), strategies and outcomes that had been described by the

interviewees. This produced a second network – not of firms but of conditions leading to a threat, threats, strategies and outcomes – that cut across firms. In this additional network, each node is a condition, threat, strategy or outcome with incoming and outgoing links. The edges linking the nodes are causes. The full network was constructed using Gephi software but this network is too large and densely populated to enable the clear labelling of nodes and links, and so presenting it in its entirety would add little value. In Section 5, we will present Table IV that summarises the data, and we will describe two fragments of the full network to illustrate the nature of the interconnectedness. It was at this point in the analysis that we found many of the inter-relationships themselves also needed explanation – and the importance of context in explaining these inter-relationships led us to adopt an embeddedness perspective (Section 5.3). For example, threats such as corruption, product counterfeiting, unfair competition and dishonest employees originated from the supply network's embeddedness in a developing country characterised by weak political and legal controls.

4. First-level analysis: categorisation of threats, strategies and outcomes

This section briefly outlines the first-level analysis, where data are categorised according to supply chain threats, SCRES strategies and corresponding outcomes. This categorisation is illustrated in Table II.

Supply chain threats were divided into the following two types:

Table II Taxonomy of endogenous and exogenous threats to the supply chain, SCRES strategies and outcomes

Threat, strategy or outcome	Examples
Supply chain threats	
Endogenous	
Supply-side	Long distance sourcing triggered threats, limited local supply market, product counterfeiting*, poor-quality raw materials, dishonest suppliers, raw material delays and shortages, financial difficulties of suppliers, supplier delivery failure, reputational risk
Firm-level	Machine breakdowns, owner management behaviour, dishonest employees*, insufficient skilled manpower, poor internal coordination, poor-quality products, payment threat (to suppliers/labour), Financial difficulties (focal firm), procurement risk, poor customer delivery performance
Demand-side	Power asymmetries related threats (stronger customers), dishonest customers/distributors*, Payment threat (from customers), financial difficulties of customers, order cancellations, demand variations, customer characteristics, reputational risk
Exogenous	
Geo-political	Political instabilities*, geographical location (landlockedness), national politics, government policy, weak legal system, corruption*, product counterfeiting, in-transit raw material theft, communication barriers, natural disasters
Economic	Informal sector, unfair competition*, poor transport infrastructure, unstable taxation, exchange rate fluctuations, power shortages
SCRES strategies	
Operations- and supply chain-focussed	
Supply management	Backward integration, outsourcing, appropriate supplier selection, alternative transportation, multiple sourcing, supplier development, maintaining strategic stocks, buying instead of making (temporarily), effective contracting, local sourcing, order splitting, enhancing proximity to suppliers, procurement management, quality management, exclusive sourcing, inter-branch stock transfer
Demand management	Creating customer flexibility, customer incentives, inventory management, product recalls, demand forecasting
Financial management	Borrowing from customers, effective credit management, insurance
Human resource management	Employee training
Product management	Manufacturing flexibility, ensuring product security
Relational- and integration-focussed	
Relationship management	Co-opetition, collaboration with government, collaboration with customers, collaboration with suppliers, Informal networking
Information management	Risk communication, market intelligence, increasing product knowledge, improving visibility, using information communication technology
Outcomes	
Operations- and supply chain-focussed strategy outcomes	
To the supply-side	Poor-quality raw materials, limited flexibility to switch suppliers, raw material delays and shortages
To firm operations	Financial difficulties (focal firm), stock theft, loss of control, labour turn-over, confidentiality risk
To demand-side	Distributor complacency, reduced customer base, poor customer delivery performance
To entire supply chain	Product counterfeiting, reputational risk
Relational- and integration-focussed strategy outcomes	
To supply-side	Limited flexibility to switch suppliers, supplier complacency, raw material delays and shortages
To firm operations	Confidentiality risk
To demand-side	Poor customer delivery performance

1 Endogenous threats originating from within the supply chain, which were then further divided into: supply-side threats of disruption originating from upstream; firm-level threats originating from within the focal company; and demand-side threats originating from downstream.

2 Exogenous threats originating from outside the supply chain, which were further divided into: geopolitical and economic threats.

From the interview data, it became clear that interviewees had a broad understanding of the term "threat". Some responses

referred to threatening events and others to threatening conditions that produced or compounded a threat. Table II revealed that the case study firms are mostly concerned with smaller in scale, chronic threats of disruption, e.g. product counterfeiting, raw material delays, financial difficulties, machine breakdowns, etc. rather than large-scale discrete events. Only 5 interviewees highlighted natural disasters, while 17 referred to machine breakdowns and 20 to raw material delays and shortages. In Table III, we provide example quotations from the interviewees for the six categories of threats marked with an asterisk in Table II. These specific threats appear particularly relevant to the context of the study. For example, the threat of political instabilities arose from being located in a landlocked country and relying on politically unstable Kenya as a transit route to a sea port. This makes political disruption that impedes transportation to, and through, Kenyan ports a problem for Ugandan suppliers and distributors. The threats were also often inter-related. For example, JU reported that the threat of financial difficulties results in late payment to workers. In retaliation, workers cause new disruptions, e.g. by destroying machines and deliberately producing poor-quality products. The analysis of this inter-relatedness will be developed further in Section 5.

Table II also includes a detailed list of the SCRES strategies applied by the firms, and the outcomes of implementing strategies where possible – not all strategies had specified outcomes in our data. From the outcomes, it is clear that the interviewees were mostly concerned with adverse or unexpected outcomes of adopting a particular strategy, e.g. side-effects or new threats, although clearly there will be positive outcomes of adopting SCRES strategies. Further, the strategies reported are also evidently inter-related – threats lead to strategies, which can sometimes have adverse outcomes that require further

strategies to deal with them, and potentially further negative side-effects. This inter-relatedness of outcomes, like the inter-relatedness of threats, appears fundamental to how supply chains behave when any attempt is made to intervene in them. The second-level analysis, in the next section, is therefore focused on the interconnectedness of threats, strategies, and outcomes.

5. Second-level analysis: interconnectedness of threats, strategies and outcomes

The interviews and first-level analysis revealed instances of interconnectedness between threats, strategies, and outcomes. The second-level analysis therefore involved:

- identifying all instances in the data when informants described a causal connection between, or among, the threats (and associated conditions), strategies and outcomes identified in Section 4; and
- assembling these into a causal network, as briefly described in Section 3.5.

The most important nodes in this network, in terms of the number of incoming and outgoing links to the nodes, are given in Table IV. The network consists of 90 nodes in total, but space precludes showing the entire table. Therefore, Table IV is limited to the nodes with over ten links (22 nodes) and a further five nodes that are particularly relevant to our discussion. There are certain nodes with large numbers of both incoming and outgoing links – such as the threats of raw material delays and shortages (25 links in or causes and 29 links out or outcomes), financial difficulties (for the focal firm: 18 links in and 12 links out) and poor-quality raw materials (8 links in and 13 links out). Such nodes have many antecedents and many consequents, e.g. being a side-effect of a strategy aimed at managing some

Table III Sample categories of threats with evidence from the interviews

Category	Example quotations
Product counterfeiting	"Counterfeiting is becoming a disaster in our supply chain . . . sometimes our raw materials are mixed with stones. In the last few months, we found people with a large inventory of sand mixed with cement in our packaging" (Procurement Manager for EU)
Dishonest employees	". . . Late payment to workers . . . They . . . destroy machines, destabilize the processes and produce poor quality beer intentionally. Sometimes we are unable to supply or we supply spoilt beer. Machine breakdowns are caused by . . . workers. . . But it becomes hard when the breakdown is due to employees' intentional actions" (Procurement Manager for JU)
Dishonest customers/distributors	". . . Dishonest customers . . . after entrusting the distributor with goods worth millions, they disappear, refuse to pay or switch to competitors. But we forward to the legal department to handle such cases. But sometimes these cases vanish due to corruption [bribery]" (Assistant Sales Manager for LU)
Political instabilities	"When there was political violence in Kenya, all manufacturing companies in Uganda ran out of stock of raw materials . . .Our raw materials could not be delivered via Mombasa. By the nature of our location in Uganda, whenever there are elections in Kenya, we expect violence . . . because we are a landlocked country" (Procurement Manager for PU)
Corruption	"We are in touch with the government and Uganda Revenue Authority to handle counterfeiters. But they [counterfeiters] may be part of the investigators. They get a lot of profit and can bribe Uganda Revenue Authority and government staff" (Export Manager for BU)
Unfair competition	"Our competitors set aside a lot of money and bought our empties [bottles] so that we fail to produce due to a lack of packaging materials. Even our employees or customers would sell our empties to the competitors. . There have been times when we have a shortage of empty crates - the competitors buy and keep them so that we cannot produce. We could not fulfil our customers' orders" (Sales and Marketing Manager for JU)

Note: Categories relate to asterisks in Table II

Table IV Nodes in the network of conditions, threats, strategies and outcomes ranked according to total number of links (sum of links into and out of the node)

Rank	Node	Links into the node	Links out of the node	Total no. of links
1	Raw material delays and shortages	25	29	54
2	Financial difficulties (focal firm)	18	12	30
3	Poor customer delivery performance	21	6	27
4	Poor-quality products	8	13	21
5	Reduced customer base	20	1	21
6	Poor-quality raw materials	10	10	20
7	Product counterfeiting	7	13	20
8	Payment threat (to suppliers/labour)	5	14	19
9	Machine breakdowns	6	12	18
10	Demand variations	4	13	17
11	Unfair competition	5	12	17
12	Collaboration with suppliers	8	7	15
13	Government policy	0	13	13
14	Risk communication	13	0	13
15	Dishonest employees	1	11	12
16	Supplier delivery failures	3	9	12
17	Corruption	0	11	11
18	Dishonest customers/distributors	1	10	11
19	Dishonest suppliers	0	11	11
20	Limited local supply market	0	11	11
21	Order cancellations	7	4	11
22	Reputational risk	8	3	11
38	Power shortages	0	8	8
46	Insufficient skilled manpower	0	6	6
58	Natural disasters	0	5	5
82	Geographical location (landlockedness)	0	2	2
85	National politics	0	2	2

other threat. Such highly connected threats (or hubs) are difficult to control because they influence resilience in multiple ways. Interestingly, the top-ranked nodes in Table IV are all threats that are internal to the supply chain, which suggests that the most important threats to SCRES are perceived to be endogenous rather than exogenous. Moreover, most are chronic, continuous problems, e.g. product counterfeiting, machine breakdowns, demand variations, supplier delivery failures, etc. A discrete and potentially catastrophic threat like natural disasters, for example, had only five outgoing links (and no clear causes). An analysis of the links between nodes showed that there are a relatively small number of nodes with a large number of links. For example, there is only one node with over 30 links, 2 nodes with 26-30 links, but 68 nodes with 10 or less links each. To give a better idea of the qualitative nature of the relationships in this network, we describe two fragments of the network in Sections 5.1 and 5.2.

### 5.1 Example network fragment one: effects of limited local supply market on SCRES

The first example starts with the threat of a limited local supply market (see Figure 2, beginning from the box to the left-hand side labelled "limited local supply market"). Sixteen firms (AU, CU, EU, FU, HU, IU, JU, KU, LU, MU, NU, PU, QU, RU, SU and TU) highlighted the threat of a limited local supply market. Twelve of these firms

argued that this leads to long-distance sourcing, resulting in the upstream threat of delays and shortages of raw materials and spares. If a firm runs out of raw materials, this can halt production, which then disrupts the downstream network. In CU, long-distance sourcing causes communication and information flow problems, which make it difficult to establish collaborative relationships with suppliers, causing further delays and shortages. Some firms (e.g. AU, FU, LU and PU) respond to raw material shortages from long-distance sourcing by maintaining strategic stocks. But this increases stock holding costs, including the costs of theft, and ties up working capital, particularly for expensive materials and spares. This results in the threat of running into financial difficulties. AU's Marketing Manager stated:

> Our source of raw materials is far away. So we keep stocks for at least five months to cater for delays. For example, materials arriving from Japan can take three months, which ties [up] our capital and creates financial problems.

Further, the financial difficulties resulting from maintaining strategic stocks mean firms fail to pay suppliers or customs on time, resulting in a circular effect – the return of (further) material delays and shortages. JU's Procurement & Logistics Officer explained:

> We place orders, but deliveries are delayed due to a lack of finances, for example to pay for customs clearance – sometimes because money is tied [up] in inventory [...] [we] lack enough raw materials and this affects our production.

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Figure 2 Effects of limited local supply market on SCRES
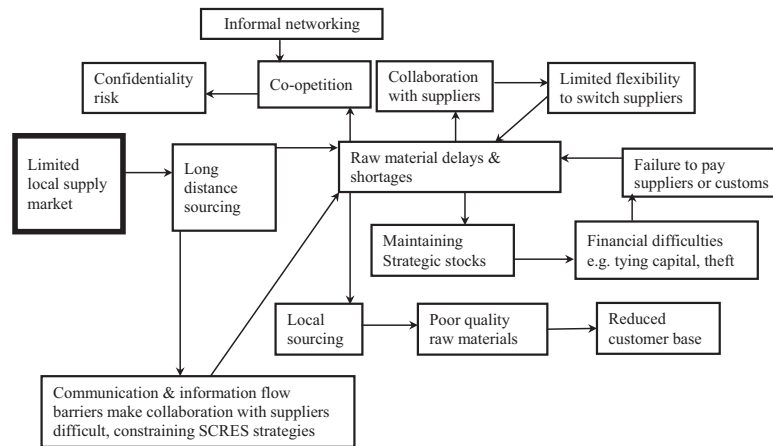
Firms such as IU, KU, PU and RU indicated that they use local sourcing to mitigate the disruptions caused by long distance suppliers, but they conceded that this compromises quality, which negatively affects their downstream customers. Some companies (e.g. AU, CU, JU, LU, MU, PU, RU and SU) indicated that they mitigate delays by developing collaborative relationships with suppliers, but AU, JU and PU argued that forming deep relationships limits flexibility to switch suppliers when faced with a crisis, causing further delays and shortages.

LU, PU and RU also reported that co-opetition, a form of collaboration with rival firms, helps create resilience against raw material delays and shortages. Interviewees claimed that they borrow materials from other firms (without interest) and replace the goods when their consignment arrives. PU's Procurement Manager stated:

> We work together with our competitors by getting raw materials from them and replacing them when ours are delivered [...] This kind of arrangement is facilitated by our networks as managers. We know each other and we communicate during crises to bail each other out.

This co-opetition strategy, based on informal networks and social relations, is not part of the formal supply chain. It therefore shows how SCRES may emerge from a mutual interaction between the system and other independent, rival systems. The data also show that this is facilitated by the embeddedness of the supply network, as will be explained in Section 5.3. Informants from LU, for example, reported that they exchange information with competitors to mitigate threats, e.g. reporting on dishonest distributors. But it was also revealed that co-opetition can present confidentiality risks. For example, PU's Brand Manager stated: "We do not collaborate with some of our competitors for confidentiality reasons". PU's Procurement Manager also indicated that some competitors use their informal, social networks to bribe government officials to evade or pay fewer taxes, which results in unfair competition.

The effects described above produce non-linearity, in that there is no simple, linear relationship between the disturbances experienced by the supply network and the reliability and availability of the final product – because they are mediated by a series of adaptations and effects within the network. This non-linearity seemed clear to the informants. For example, IU's Finance Manager explained:

> [...] a quality problem was initially seen as small but later turned out to affect the whole supply chain. It started from the supplier with poor quality materials, meaning we produced poor quality items, which we delivered to customers. The complaints that followed, including litigation, affected our entire system.

The threat of a disturbance (delays and shortages of spares and raw materials) is shaped by another threat (limited local supply market), which triggers a condition (long distance sourcing), with the adaptation to this (e.g. maintaining strategic stocks) creating other threats (such as financial losses from tying capital up in stock). This in turn can lead to other threats and circular effects, including the reoccurrence of the original threat (e.g. raw material delays and shortages) but with different antecedents (e.g. a failure to pay suppliers or customs). Firms such as CU further revealed that they find it difficult to implement SCRES strategies (e.g. collaboration with suppliers) against other threats due to communication barriers and poor information flow created by long distances from suppliers. Thus, a particular condition can affect resilience through multiple routes – first, by producing threats; and second, by constraining the implementation of other resilience strategies.

This analysis shows that the consequences of a particular threat and/or condition, as well as the mitigating strategies, can propagate through the supply network. Thus, in the process of trying to attain resilience, risk shifts or migrates rather than being resolved, e.g. as one threat becomes transformed into another. This migration of one kind of risk to another is generally accompanied by a movement from one point in the supply network to another (e.g. from upstream to downstream) – and this will be further revealed in the second example. In this first example, an attempt to mitigate a threat originating from the supply side caused firm level threats, such as financial difficulties, which affected both the upstream and downstream supply chain.

### 5.2 Example network fragment two: the threat and consequences of dishonest employees

The second example starts with the threat of dishonest employees (see Figure 3, beginning from the box to the top left-hand side labelled "dishonest employees"). Twelve firms (GU, LU, IU, TU, JU, KU, EU, HU, BU, AU, NU and PU) indicated that dishonest employees disrupt the production and

Figure 3 The threat and consequences of dishonest employees
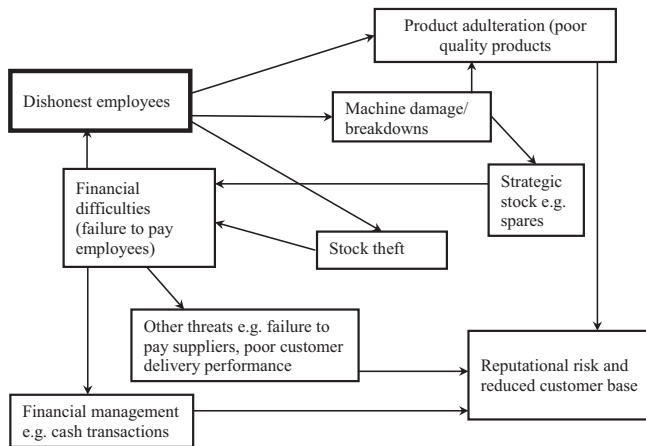
delivery of their products through, for example, product adulteration, which leads to poor-quality products that affect a firm's reputation with its customers; malicious machine damages (leading to breakdowns), which also affect product quality and require stock holding (with its associated problems); and stock theft, which has direct financial implications for the firm. Firms such as BU, EU and HU argued that the culture of dishonesty through connivance is deeply entrenched in employees. But dishonest behaviour is sometimes caused by the late payment of salaries (due to financial difficulties). For example, JU's Regional Sales Manager explained that their field-based sales personnel sometimes disappear with company money when salaries are delayed. Likewise, the Procurement Manager of JU, a brewery, commented that workers: "[...] stop working, destroy machines, destabilize the processes and produce poor quality beer intentionally. Sometimes, we are unable to supply or we supply spoilt beer". Such behaviour produces an obvious non-linearity for the network, whereby relatively minor perturbations become amplified through cycles of repeated delay and protest, as evident in the closed loops of causation in Figure 3. Indeed, TU's Trade Marketing Manager explained:

> Late staff payment is a problem that started small but has eventually affected the whole supply chain. Production is affected, the market is affected and we fail to get cash inflows to pay our suppliers.

Firms such as BU attempt to overcome financial difficulties so they can pay employees by using financial management strategies (e.g. by reducing customer credit limits and demanding cash payments). But this leads to reputational risk and the loss of customers, further reducing financial inflows.
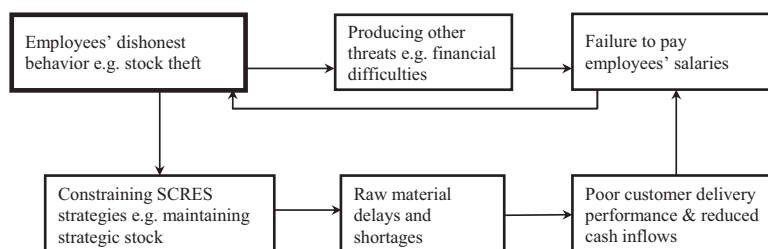
BU's Export Manager noted: "The company policy makers have decided to demand cash transactions and this has made some customers abandon us and shift to our competitors, further reducing our sales revenue".

Employee misbehaviour is a disruption threat in its own right, but it also produces other threats, e.g. financial difficulties, and limits the implementation of SCRES strategies against other threats. For example, stock theft hinders the use of strategic stocks for safeguarding against shortages and delivery failures, as noted by HU's Marketing Manager:

> Sometimes, we store a lot of cement but we have thieves [employees] [...] sometimes we run out of stock unexpectedly, affecting clients and the company [...] we cannot fulfil the orders, which reduces our cash flows.

Respondents from JU argued that a loss of income owing to employee misbehaviour results in further staff payment problems, which in turn leads to further misbehaviour – a vicious cycle, as illustrated in Figure 4 (beginning from the top left of the figure).

In general, the data again showed that interventions in the form of strategies aimed at responding to threats do not have simple, self-contained outcomes. Adaptations and consequences propagate over time and space. And the relationships between the threats experienced by the network and the ultimate effects are evidently non-linear and generally stochastic. The result is the *migration* of supply chain risks and a process of continuing adaptation. This still leaves the question of what lies behind this interrelatedness. We have observed how the initiating threats in our examples above, and many of the causal influences that have been discussed, characterise the Ugandan context. It is the context that seems to produce the difficulty of partitioning the different elements of resilience – the multiple threats and strategies. This is supported by Table IV, where most of the nodes that have no incoming links are grounded in the context, e.g. government policy, corruption, insufficient skilled manpower and geographical location (landlockedness). Hence, an embeddedness theoretical framework is adopted in Section 5.3 to understand how the presence of the supply network, or part of it, in a developing country affects its resilience. Section 5.4 then focuses in more detail on the phenomenon of risk migration, which appears to arise from the embeddedness of the supply network.

5.3 The embeddedness perspective on SCRES

Embeddedness is a multi-disciplinary concept that has been given a number of different meanings (Polanyi, 1944; Granovetter, 1985; Halinen and Törnroos, 1998; Hess, 2004). For example, Hess (2004) defined embeddedness:

Figure 4 A vicious cycle – dishonest employee behaviour constraining other SCRES strategies

[. . .] as the set of social relationships between economic and non-economic actors (individuals as well as aggregate groups of individuals, i.e. organisations), which in turn create distinctive patterns of constraints and incentives for economic action and behaviour.

Meanwhile, Halinen and Törnroos (1998) defined embeddedness as "companies" relations with, and dependence on, various types of networks. What is common to all definitions of embeddedness is the idea that economic actors exist in, and are influenced by, networks of relationships with other economic or non-economic actors, either directly or indirectly (Choi and Kim, 2008). Thus, embeddedness can be both voluntary and involuntary. Researchers from different disciplines have provided different perspectives to explain who is embedded in what. For example, economic sociologists maintain that economic behaviour, individuals and companies are embedded in networks of ongoing social relations (Hess, 2004). Organisational and business studies scholars argue that firms and networks are embedded in time, space, social structures, markets, technological systems, and political systems, while economic geographers stipulate that firms are embedded in networks and institutional settings of local or regional geographical scale (Hess, 2004).

Scholars have suggested various categories of embeddedness. For example, Halinen and Törnroos (1998) proposed six types: social, political, market, technological, temporal and spatial embeddedness. Meanwhile, Hess (2004), drawing on Polanyi (1944), Granovetter (1985) and Halinen and Törnroos (1998), proposed three categories: network (including structural and relational), societal (including cultural and political) and territorial embeddedness. This particular categorisation seems especially relevant to our findings, although our interest here is not in the way that a supply chain embeds a particular organisation, but in the way the supply chain is embedded in a developing country – thus we do not include network embeddedness. In contrast, most prior supply chain research that has adopted an embeddedness perspective, with the recent exception of Wu and Pullman (2015), has focused almost exclusively on network (structural and relational) embeddedness. Moreover, prior work has portrayed embeddedness as an entirely positive phenomenon or facilitator (Choi and Kim, 2008; Gligor and Autry, 2012; Kim, 2014). Indeed, embeddedness can improve collaboration, adaptation and responsiveness (Uzzi, 1997). However, embeddedness can also be a source of constraint, e.g. by promoting unethical practices (Granovetter, 1985) and increasing vulnerability to exogenous shocks and information asymmetry (Uzzi, 1997). This can be clearly understood if we consider the broader context, in which the supply network is embedded, rather than how the supply network embeds entities within it. We focus on the following three categories of embeddedness:

- *Cultural embeddedness*: The collective understanding of beliefs, values and symbols, which provide scripts that guide economic strategies and goals (Dequech, 2003).
- *Political embeddedness*: The manner in which economic institutions and decisions are shaped by a struggle for power that involves economic actors and non-market institutions, including national policies and state legal frameworks (Hardy *et al.* 2005).
- *Territorial embeddedness*: Concerning the geographical location of business, e.g. proximity, and different

networks of relationships in that location (Halinen and Törnroos, 1998).

Table V summarises the key aspects of embeddedness contained in the data, where much of the focus is on cultural embeddedness and the associated threats. As can be observed from Table V, the three categories can overlap. For example, although a factor such as corruption can be analysed from a cultural perspective – where people may view it as a norm – it can also be argued to be a political factor arising from a weak legal system, government policy or a lack of political will. Similarly, factors such as a weak legal system could be perpetuated by culture, such as when the civil society legitimises bribery. Further, a supply network may be embedded in political and cultural milieus due to its territorial embeddedness, e.g. being located in a generally underdeveloped continent experiencing political immaturity and economic constraints.

We found some evidence in our data that embeddedness can enable SCRES. For example, we described earlier a specific kind of co-opetition, where competitors borrow raw materials from each other to mitigate raw material delays. This co-opetition is facilitated by the actors' involvement in informal networks, which develop in a supportive cultural context. However, it was also found that embeddedness is a source of threat. Firms such as BU and CU attributed specific threats, such as delays and damage to fragile consignments – as a result of poor transportation infrastructure – to the embeddedness of the supply network in a political and cultural context that exacerbates corruption. JU's Procurement Manager argued:

> This poor road network should be attributed to a lack of political will and corruption in African countries including Uganda. It is public knowledge. Corruption has now become part of the government and our daily activities. No bribe, no service, no survival.

Other threats were found to originate from territorial embeddedness, such as being located far away from the source of raw materials and in a landlocked country, which creates vulnerability to political instabilities in the transit route country. For example, PU's Procurement Manager explained:

> "When there was political violence in Kenya, all manufacturing companies in Uganda ran out of stocks of raw materials [. . .] They could not be delivered via Mombasa".

It was also found that some SCRES strategies yielded unexpected adverse outcomes as a result of embeddedness. For example, maintaining strategic stocks to guard against the raw material delays and shortages that result from long-distance sourcing can become ineffective owing to the cultural acceptability of theft by employees. Further, although informal networking can create resilience against certain threats (e.g. financial difficulties and raw material delays) and reinforce strategies (e.g. co-opetition), it can also act as a barrier to SCRES due to cultural and political embeddedness (e.g. when firms use their informal networks to avoid taxes). JU's Procurement and Logistics Officer stated:

> Some competitors lobby the government and dodge or pay low taxes. There is corruption in government where beneficiaries pay less or no tax and end up charging a lower price, which affects our customer base.

Table V Aspects of embeddedness revealed in the data: political, cultural and territorial embeddedness

Category	Components and sample evidence from the data	Examples of associated threats
Political embeddedness	*Political instabilities* e.g. within Uganda and the neighbouring countries like Kenya	Raw material delays and shortages
	National politics e.g. political networks and patronages perpetrating corruption	Unfair competition
	Government policy e.g. on counterfeits where the government standards body (Uganda National Bureau of Standards) recommends the use of counterfeits rather than fight them	Product counterfeiting
	Weak legal system, e.g. Weak or absence of laws, including on copyright, and judicial corruption causing copyright infringements	Product counterfeiting
Cultural embeddedness	*Corruption*, e.g. bribery, conflict of interest, connivance, political favouritism and lack of transparency	Poor transport infrastructure
	Informal sector, e.g. managers in some industries are not willing to formerly register their businesses mainly to avoid taxes. About 80% of actors in the dairy industry are unregistered	Reduced customer base and financial difficulties
	Unfair competition, e.g. firms use connivance to sabotage their competitors' supply chain operations. For example, they collude with suppliers so as not to deliver raw materials to their competitors or at least to deliver late	Raw material delays and shortages
	Product counterfeiting, e.g. compounded by a culture where government employees responsible for fighting counterfeiting are themselves counterfeiters and local suppliers who deliver counterfeit raw materials	Reputational risk
	Dishonest suppliers, e.g. some local suppliers are dishonest and unreliable. They are deceptive about their capacity and they accept orders that they fail to deliver	Supplier delivery failure
	Dishonest customers/Distributors, e.g. some customers connive with company employees and either manipulate the prices and share the difference or load more quantity into lorries/containers than bought	Financial difficulties
	Negative perceptions of overseas suppliers, e.g. some overseas suppliers have a negative perception of firms from African countries (e.g. corrupt, likely to collapse) leading to denying them trade credit	Reputational risk and raw material delays and shortages
	Dishonest employees, e.g. employees steal company money, deceive customers, deliberately produce poor-quality products and cause machine breakdowns, sometimes as a retaliation against low and delayed salaries	Poor customer delivery performance
	Owner/Management behaviour, e.g. owner managers have a culture of intervening in professional activities, such as procurement, making duplicate purchases or purchasing poor-quality items	Procurement risk
	Customer characteristics, e.g. many Ugandan customers are willing to buy counterfeit products knowingly (as long as they are cheaper)	Product counterfeiting and reduced customer base
Territorial embeddedness	*Geographical location/Landlockedness*, e.g. Political chaos in Kenya disrupts the flow of raw materials	Raw material delays and shortages
	Spatial proximity, e.g. overseas sourcing of most raw materials and long distances from the suppliers	Communication barriers

Being voluntarily embedded in one aspect sometimes implies automatic embeddedness in another. In the data, for example, being (voluntarily) territorially embedded in a landlocked country (e.g. as a location decision) implies also being embedded in the conditions of the transit neighbouring country involuntarily. This shows that embeddedness can be complex (e.g. a combination of territorial and political), and this can produce threats that would not occur if the embeddedness were simple. Being embedded in a landlocked country need not be a threat to a firm's SCRES in itself or political instability in a neighbouring country.

5.4 Supply chain risk migration
Our findings demonstrate that threats and strategies are interrelated in a more complex way than a given threat simply leading to the adoption of a particular strategy. The strategies adopted to build SCRES may produce adverse outcomes in the form of new or former threats, either at the same or a different point of the supply network. Equally, resilience strategies may conflict or mutually reinforce each other. The relationships between supply chain phenomena, and the points where they occur in the supply chain, were reportedly caused by the factors emanating from the context in which the supply chains are situated. This suggests that the way the supply chain becomes a

system is explained by its embeddedness – because it is the embeddedness that produces or explains the nature of many of the relationships between threats, strategies, etc. This embeddedness contributes to the phenomenon of risk migration in the supply chain that was noted earlier; risk migration implies that resilience is an unending process of responding and adapting both to threats and to the outcomes of prior adaptations.

The supply chain risk migration matrix introduced in Figure 5 illustrates that, in the process of creating SCRES, a threat can migrate from one form to another and/or from one point in the supply network to another. The horizontal axis in Figure 5 represents the threat (T), while the vertical axis represents the point in the supply network (N), e.g. in the upstream or downstream. The bottom left-hand quadrant (T1NA) represents the initial network point NA, which is threatened by T1. An attempt is therefore made to mitigate threat T1. Risk migration may manifest in three forms, i.e. T2NA, T1NB or T2NB. The bottom right-hand quadrant, T2NA, shows the transformation of a threat T1 into another threat T2 at the same point in the network NA. For example, mitigating the upstream threat of raw material delays and shortages by keeping strategic stocks resulted in financial difficulties, leading to another upstream threat of loss of reputation for suppliers owing to a failure to pay them. The top left-hand quadrant, T1NB, shows the migration of original threat T1 to a different point in the network (NB). For example, mitigating the threat of financial difficulties resulting from defaulting customers by demanding cash payments resulted in a reduced customer base and cash inflows – leading to an upstream threat of failure to pay suppliers (financial difficulties). Finally, the top right-hand quadrant, T2NB, shows the migration of a threat (T1 to T2) and of the point in the network where the threat is experienced (NA to NB). For example, to mitigate the upstream threat of dishonest suppliers who adulterated products and supplied poor-quality materials, some companies screened quality at suppliers' sites and conducted audits. But this caused raw material delays, which disrupted production schedules and led to the downstream threat of late delivery to customers and a reduced customer base.

It is important to be aware of the phenomenon of risk migration when implementing strategies to build SCRES. The matrix in Figure 5 reminds us that threats and strategies are

Figure 5 Supply chain risk migration matrix in the continual process of creating resilience
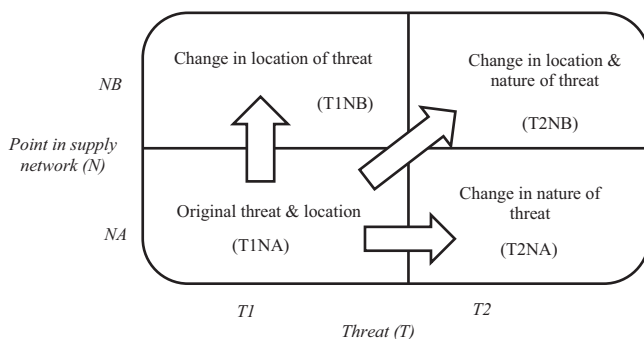
interconnected. The fact that SCRES strategies produce unexpected adverse outcomes informs managers that SCRES should not be viewed as a static phenomenon; the capacity to adapt should be built into the system so it has the flexibility to respond to different manifestations of threats.

6. Discussion and conclusions

Few empirical studies on SCRES have been reported in the literature, and those that have been conducted have focused on a developed country context. There has been a need to investigate the perceived threats of disruption to supply chains in developing countries and developed countries and to examine how firms attempt to create resilience to these threats. While prior SCRES empirical studies have emphasised large-scale, discrete, catastrophic and exogenous threats (Rice and Caniato, 2003; Jüttner and Maklan, 2011; Johnson *et al.* 2013), our findings suggest that firms in a developing country are mainly concerned with smaller in scale, chronic threats of disruption, many of which are endogenous. Non-linearities inherent in the supply networks mean that these chronic threats may have considerable consequences for resilience. This adds to our understanding of what is perceived to be important to building SCRES.

Against this backdrop, our study makes the following main contributions:

- Our findings show that resilience, and the conditions that influence it, requires an understanding of the interconnectedness of threats, strategies and their outcomes. This is different to the perspective typically adopted in the extant literature where it appears to be suggested that resilience is about identifying threats and determining corresponding strategies (Pettit *et al.* 2010). In contrast, our study suggests that resilience is not linear and is a continual process, which logically suggests that it is non-stationary and can be gained or lost over time. This relates to the phenomenon of supply chain risk migration, whereby implementing a resilience strategy may produce another threat, either at the same or a different point in the supply network. The concept of risk migration can be traced to the risk literature (Grabowski and Roberts, 1997; Alcock and Busby, 2006), but it has not previously been expressly considered in SCRES research.

- Our findings highlight that resilience requires that consideration be given to the context in which the supply chain is embedded. The embeddedness perspective emphasises how the environment brings about the connections between threats, strategies, and outcomes. Prior empirical SCRES research has focussed only on the strategies for building SCRES (Hohenstein *et al.* 2015) without systemically considering the threats that provoke such strategies and their outcomes. Moreover, our study goes beyond previous supply chain research where embeddedness has been portrayed as a purely positive concept, and beyond its prior primary focus on the structural and relational dimensions of embeddedness (Choi and Kim, 2008; Gligor and Autry, 2012; Kim, 2014). Further, although embeddedness has been linked to supply chain risk (Song *et al.* 2012), and to both adaptation and responsiveness (Uzzi, 1997), it has not

previously been applied to facilitate understanding of SCRES.

6.1 The importance of context

The literature on SCRES has thus far focused on the developed world; hence, this work contributes towards providing greater representation in the SCRES literature of developing country contexts. These countries typically lag behind, for example, in terms of the level of industry maturity, business practices, governance structures and infrastructures. Thus, the threats faced by firms and supply chains in developing countries, and the way in which these threats are handled, may differ from the developed country context that has been largely studied in the SCRES literature, but further research has been required in developing country contexts to explore this.

The particular setting for this study has been the developing country of Uganda where informants were especially concerned about the resilience of their supply chains to relatively small-in-scale, chronic problems – far less so with the large-scale, catastrophic events emphasised in the literature (e.g. hurricanes, terrorism, etc.). The theory frame of embeddedness has proven to be an important lens for making sense of the conditions, threats, strategies and outcomes encountered in the Ugandan context. Table V, for example, identified the political, cultural and territorial aspects of embeddedness that were revealed in the data and that contributed in some way to the threats that manifested in the fragment of the supply network that we have studied. In this work, important territorial aspects included landlockedness, political aspects included political instability and a weak legal system, and cultural aspects included corruption and product counterfeiting. It seems likely that the combination of aspects contained in Table V will be relatively unique to Uganda, but other contexts will feature some of these aspects and potentially others that are not identified in these data. Hence, further research is required in other developing country contexts, including from an embeddedness perspective. Of course, aspects of embeddedness were also evident in how firms responded to the threats, including co-opetition, whereby competitors borrow raw materials from each other to mitigate raw material delays, which was linked to the importance of social ties and informal networks that develop in Uganda's cultural context. It is important that this, more supportive aspect of the context that we have studied is not overlooked.

Although the work is situated in Uganda, it is argued to be of wider relevance, and not only because of the global nature of supply chains and the flow of goods into and out of Uganda to other nations around the world. We have demonstrated how understanding the political, cultural and territorial context in which a supply network is embedded is key to understanding the threats of disruption to the supply chain and the interrelatedness of threats, strategies and outcomes. Embeddedness creates complexity in the threat-strategy-outcome network, and this constrains resilience, as it means it is difficult to intervene in the system in a definite way – aspects of embeddedness create unanticipated outcomes from an intervention. This reflects the more general principle of the importance of context and its influence on operations- and supply chain management-related phenomena such as

resilience. Moreover, although the particular underlying causes of the phenomenon we have identified may be specific to Uganda, supply chain risk migration is argued to be a much more widely relevant phenomenon that will be important in other settings than Uganda.

6.2 Managerial implications and future research

This study revealed that threats of disruption and SCRES strategies are interconnected. Strategies should thus not be considered in isolation because their implementation may either reinforce or contradict other strategies. If they reinforce each other, such strategies could be applied together as a bundle to maximise their complementarity. Managers should be aware of potential risk migration from one threat to another when crafting strategies to build SCRES. Equally, the potential for risk migration across the supply network means that rather than looking at their operation in isolation, managers should look at the supply chain holistically because actors along the chain are so interconnected. Managers should also be aware that the threats to the resilience of their supply chains are not necessarily large-scale discrete events – they are also events of continuous possibilities. Hence, they should not underestimate seemingly small but chronic events because they are capable of gradually weakening the supply network, resulting in either major consequences (due to non-linearity) or a reduced capability to respond to future catastrophic events. Furthermore, this study is not only of relevance to managers in developing countries but also to global sourcing managers buying from developing countries. Managers in general need to be aware of the context in which their supply chains are embedded if they are to understand the potential threats and the conditions that might render their SCRES strategies ineffective; mapping out the kind of network we have used in our analysis may be a useful approach for managers in understanding the interconnectedness of threats and the consequences of their interventions.

Although our case study approach provides rich data, it has focused on a specific network of firms in a narrow range of industries and within a single country. It thus has limited generalisability. It was also cross-sectional in nature, which limits our understanding of the longitudinal process of adaptation in building SCRES. We found that SCRES involves continuously adapting to smaller-in-scale, chronic threats and to the consequences of such adaptations, which depict SCRES as a dynamic process rather than a static attribute of a supply chain. This requires longitudinal observation to understand fully, and longitudinal data are also needed to understand how resilience is gained or lost over time. Finally, Figure 5 illustrated the supply chain risk migration phenomenon identified in the data. This could be further developed in future research. For example, the vertical axis refers to the point in the supply network where a threat is located (or has migrated towards), i.e. NA vs NB. This could be expanded to reflect both up- and downstream migration or to indicate the proximity/distance from the previous point where the threat was located. The horizontal axis refers to the threat encountered and whether this is the same threat as before or whether mitigation has created a new threat, i.e. T1 vs T2. This could be expanded, for example, to reflect changes in the probability or impact of a threat on the supply network.

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Appendix. Semi-structured interview guide

General information

1 Interviewee information.
2 Job title and description.
3 Years spent in the position and company.
4 How does your role link in with the supply chain decision-making processes?
5 Company information.
6 Company name and industry sector.
7 Business starting date.
8 Number of employees and average turnover for the last two years.
9 Nature of operation (incl. multinational or domestic, mode of entry).
10 What is the nature of your products, e.g. standard, variety, customised?
11 Your major suppliers (main countries/regions).
12 Your major customers (main countries/regions).
13 Strategic objectives of this company (e.g. cost leadership, differentiation, focus on a particular segment, etc.)

Supply chain threats, resilience strategies, and outcomes

1 Please describe the threats to your supply chains.
2 Supply related threats originating from suppliers.
3 Firm-level threats originating from the focal firms but affecting the upstream or downstream.
4 Customer-related threats originating from the downstream.
5 External threats originating from outside the supply chain.
6 What strategies do you apply to build resilience against each of the threats you mentioned?
7 Demand management strategies.
8 Supply management strategies.
9 Relationship management strategies.
10 Information management strategies, etc.
11 What are the outcomes of implementing each of the resilience strategies?

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