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Resilient supply management systems in times of crisis

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Abstract

Purpose – This study investigated how organizations can maintain their supply chain (SC) resilience in situations where high-impact shocks cannot be absorbed and what capabilities are needed. The article is an empirical exploration of a socio-ecological view of resilience in the SC context.

Design/methodology/approach – The case under study in this article is that of Médecins sans Frontières (MSF) and MSF's reconfiguration of its supply management processes in response to the supply shocks during the coronavirus disease 2019 (COVID-19) pandemic. In total, 503 internal documents and ERP extractions from six databases from late 2019 to September 2020, 43 semi-structured interviews and a 3-round policy Delphi process were used to investigate this phenomenon.

Findings – The authors' results show that throughout the pandemic, MSF adapted its procurement and supply processes to cope with supply shortages at both the international and local levels of the SC. This was possible due to the organization's capacity to use its exploitation and exploration capabilities of the organization at the same time.

Research limitations/implications – This research is based on the single in-depth case study of a medical aid organization. Further research should investigate this phenomenon in commercial companies with similar or different organizational structures.

Originality/value – This study constitutes a first attempt to empirically demonstrate that the four phases of the adaptive cycle put forth in the panarchy theory constitute a suitable representation of the reconfigurations that SCs follow in response to a high-impact shock. The study also adds to the growing body of knowledge on resilience by including ambidexterity as a mechanism to achieve resilience.

Keywords Resilience, Ambidexterity, Interpretive research, Adaptive cycles, COVID-19

Paper type Research paper

1. Introduction

Resilient firms and supply chains (SCs) are more capable of managing unforeseen risks, handling SC shocks and continuing their deliveries to their customers (Ambulkar *et al.*, 2015; Zsidisin and Wagner, 2010). Previously, resilient SCs have been assumed to be robust enough to absorb shocks (shock and disruption are used interchangeably in this article, similar to

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Novak *et al.*, 2021) and to "bounce back" to their pre-shock state (Sheffi and Rice, 2005), but what happens if and when SCs can't absorb a shock? During the COVID-19 pandemic and its aftermaths, many SCs and firms were not able to respond to, absorb and bounce back sufficiently from the disruptions caused by the pandemic (also referred to as "high-impact shocks" in this article). The SCs of many firms were directly affected, triggering the need to greatly reconfigure supply partners, information-sharing and procurement and supply management approaches (Kovács and Falagara Sigala, 2021). As many firms were not able to maintain flows questioning the resilience of the existing systems/processes, the COVID-19 pandemic provides a great opportunity to increase our understanding of how organizations can maintain their SC resilience and of what capabilities are needed in situations where high-impact shocks cannot be absorbed.

In operations and SC management (OSCM) research, resilience has been assumed to result from processes and dynamics that create and retain resources (Burnard and Bhamra, 2011). However, existing resources do not always generate the capabilities that are needed to recover from disruptions (Sirmon *et al.*, 2007). The uncertainty following disruptions, such as those caused by market disruptions or environmental shocks, leads us to reconsider the value and utility of existing resources and capabilities (Helfat and Winter, 2011), partly explaining why organizations work with others across their SC to maintain the integrity of their cooperative structures and processes (Brandon-Jones *et al.*, 2014; Jüttner and Maklan, 2011). Researchers including Kahiluoto *et al.* (2020) have posited that the resilience of firms is strongly related to the resilience of their supply partners. Yet, such perspectives refer to resilience with relation to the robustness of SCs and not their capacity to adapt to high-impact shocks. Other studies have suggested that individual firms' redundancy or flexibility is more important for SC resilience in contexts where partners are loosely connected (de Sá *et al.*, 2019).

This article combines two alternative perspectives on resilience and capabilities: the adaptive cycle view of resilience from the socio-ecological literature and the ambidexterity view of organizational capabilities. The socio-ecological literature suggests that systems such as the SC system face disruptions, evolve and transform by going through rounds of adaptation and transformation (Wieland, 2021). Here, the SC is seen as a nonlinear, uncertain and complex-adaptive system (Wieland and Durach, 2021) that is linked to other socio-ecological systems operating at different levels (Wieland, 2021). As disruptions occur, different parts of the SC, including partners, systems, processes and activities, change in response to the shock and, as they change, the entire SC moves into a new set of configurations. This study empirically explored whether and how such a view of resilience manifests in the SC contexts that experience high-impact shocks.

The extant literature on the ambidexterity of firms can give us some clues about the capabilities required in high-impact shock situations. Ambidextrous firms have equal dexterity to exploit existing competences and explore new opportunities (Lubatkin *et al.*, 2006; Duncan, 1976; Levinthal and March, 1993). The ambidexterity of firms can improve the flexibility and agility of business units, projects, managerial levels and inter-organizational alliances (Birkinshaw and Gupta, 2013). The concept has not only been broadly discussed in relation to capturing market innovation (Taylor and Helfat, 2009), but also, more recently, in relation to firm resilience and SC resilience (Gu *et al.*, 2021; Wang *et al.*, 2021). The concepts of agility and flexibility and the need to respond to short-term disruptions while maintaining long-term stability are core arguments for resilience. Additionally, some of the literature on adaptive cycles points toward systems needing both exploration and exploitation capabilities for their transformation and evolution process when facing shocks (Holling, 2001). Consequently, this article aims to answer the following research question:

RQ. How can organizations leverage their ambidexterity to improve their resilience when facing supply shocks that cannot be absorbed?

This interpretive research (following the methodological suggestion in, for example, Hudson and Ozanne, 1988) studied the shock caused by the first wave of the COVID-19 pandemic, focusing on the capabilities used by an international medical humanitarian organization, Médecins Sans Frontières (MSF), also known as Doctors Without Borders, to absorb the shock and ensure the continuity of their operations. A single case was chosen due to the uniqueness of the phenomenon and the need for in-depth understanding of this complex organizational phenomenon from different perspectives over time (Ozcan *et al.*, 2017). The procurement tensions were among those that constituted the biggest disruptions faced by the organization and a great opportunity to learn from the way in which MSF faced these shocks. Responding to COVID-19 at MSF has been, first and foremost, a case of managing the disruptions of health SCs caused by regulatory changes, export bans, border controls and the closure of production lines. The results show that MSF was able to recurrently exploit current resources and explore new ones within the sourcing and procurement function to face supply shocks, increasing its resilience during the pandemic (MSF, 2020). These practices, which helped MSF ensure the resilience of their procurement and supply management system, can potentially be applied in nonhumanitarian settings when responding to large supply shocks, precisely by reorganizing SCs in response to the event and by allocating resources with different purposes to ensure continuity.

This article is organized as follows. Section 2 overviews the academic literature on firm resilience and firm ambidexterity. The methodology and the MSF case are outlined in Section 3. Section 4 presents the findings, followed by a discussion in Section 5, before concluding with some remarks.

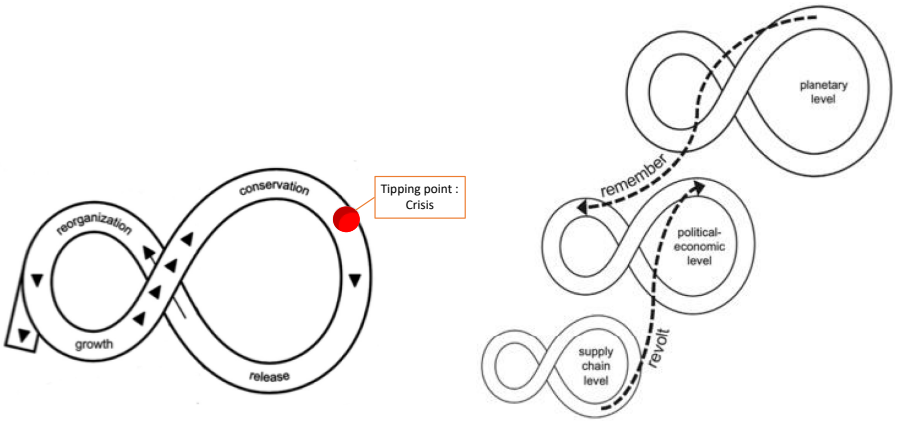
2. Theoretical background

2.1 Adaptive cycles and supply chain resilience

Previously, engineering resilience, which has been the focus of OSCM research for many years, assumes one stable state or equilibrium (Holling, 1996) to which the system should "bounce back" (Sheffi and Rice, 2005). Resilience has been referred to as the firm's ability to detect the occurrence of the disruption, absorb disruptions and withstand the effect of a shock, "bounce back" when negative impacts cannot be fully absorbed, capitalize on or learn from the experience of disruptions, build knowledge and anticipate future challenges (Blackhurst *et al.*, 2011; Jüttner and Maklan, 2011; Klibi *et al.*, 2010; Sheffi and Rice, 2005). Studies suggest that resilient firms are more effective in recovering from SC disruptions/shocks (Blackhurst *et al.*, 2011; Jüttner and Maklan, 2011; Zsidisin and Wagner, 2010).

However, this view has been challenged, suggesting that resilient socio-ecological systems (i.e. systems of interlinked nature/biological and social/human subsystems) react to shocks by changing in order not to be changed and not by aiming to bounce back (Folke, 2006). This alternative interpretation of resilience accepts that such systems can move from one state to another due to disturbances (Folke, 2006). Systems are thus suggested to go through loops of reorganization and growth in the so-called adaptive cycles (see A in Figure 1). Walker *et al.* (2002, p. 7) suggested two goals for resilience: "preventing the system from moving to undesired system configurations in the face of external stresses and disturbance" and "nurturing and preserving the elements that enable the system to renew and reorganize itself following change." Insight from adaptive cycles can help us move toward those two goals of resilience in SCs (Adobor, 2020).

In the adaptive cycle, as a system faces a shock that it cannot respond to, given its existing conservation state, it collapses and releases its elements in order to reorganize to create the environment to begin optimization and/or growth. Within the SC context, resources are continuously and productively utilized during the growth/optimization phase [1] to reach conservation. However, the rigidity that the conservation state brings poses a risk, as the current SC set-up may no longer be adapted to different shocks. The release of resources that were previously accumulated and utilized in the SC takes place, opening a window for



The adaptive cycles of resilience
(a)

Cross-scale linkages of the adaptive cycles
(b)

Source(s): Adapted from Gunderson and Holling (2002)

Figure 1.
The panarchy loops and the adaptive cycles of resilience

innovation and the testing of novel combinations. The reconfiguration of the SC's structure, processes, norms and routines leads to a new set of resources to be utilized or a different use of the previously owned resources.

Adaptive cycles can interact with one another in different ways creating a framework with dynamic cross-scale interactions or a panarchy (see B in Figure 1). Two of these interactions are links from slow and stable events in one adaptive cycle that stabilizes quick and small events in another (referred to as "remember") and, vice versa, links that would overwhelm the slow and large events (referred to as "revolt"). These two types of links between the panarchy levels are critical in creating change and sustaining/regulating the adaptive capacity of systems (Armitage and Plummer, 2010).

The front loop of the adaptive cycle, i.e. the trajectory from growth/optimization and conservation, maximizes production, while the back loop, i.e. the trajectory from release to reorganization maximizes invention (Holling, 2001). The literature on socio-ecological resilience argues that both loops cannot be maximized simultaneously. Nevertheless, other resilient systems, or, in our case, resilient SCs, must be capable of both growth and stability and change and variety. This resembles what the literature on strategic management refers to as "ambidexterity," which will be further reviewed in the next section.

2.2 Supply chain ambidexterity and resilience

The concept of ambidexterity can be traced back to Duncan (1976), who discussed the dual organizational systems needed for the alignment of current stable situations and the adaptation to new possibilities. Ambidexterity of firms is defined as "a manufacturing firm's strategic choice (i.e. managerial emphasis) to simultaneously pursue both SC exploitation and exploration practices" (Kristal *et al.*, 2010, p. 415). Such ambidexterity is necessary to fulfill an inter-temporal need that firms must both adapt to the dynamic markets for long-term success and duplicate in their existing business models for short-term success (Hershcovis, 2011). It is also suggested that ambidexterity is most beneficial under the conditions of environmental uncertainty and for larger firms with sufficient resources (O'Rilley and Tushman, 2013).

The concept has been associated with both balance and the sum of exploration and exploitation practices (Cao *et al.*, 2010; Birkinshaw and Gupta, 2013). While one stream of

literature argues that these two capabilities are sequential and inherently different, requiring the realignment of structures and processes over time (Tushman and Romanelli, 1985), a view that is also shared in the socio-ecological resilience literature (see Holling, 2001), a parallel stream argues that they can be, or even should be, compatible when performed simultaneously (Laugen and Boer, 2008). This simultaneous or structural ambidexterity entails separate structural units and different competencies for exploration and exploitation (O'Reilly and Tushman, 2008). Junni *et al.* (2013) suggested that the combination of high levels of both exploration and exploitation can lead to more favorable ambidexterity effects, rather than balancing them. Gibson and Birkinshaw (2004) suggested that ambidextrous ability is related to simultaneous exploitation and exploration, efficiency and flexibility, as well as alignment and adaptability.

Exploitation is related to the use of existing resources and associated with, for example, efficiency, selection, implementation and modifications. Exploration, on the other hand, aims to search for new resources and expand markets and can be related to risk taking, searching, experimentation, flexibility and innovation (March, 1991). Firm practices focused on exploration often target the long-term goals of the firm, while those aiming at exploitation are more focused on short-term results (Wang *et al.*, 2021).

The SC has also been found to be an important facilitator in the ambidexterity of firms and vice versa (Stevenson and Spring, 2009). Within a SC, exploitation has been connected to maintaining a relationship with current suppliers and the use and leverage of existing resources, including technologies, while SC exploration is linked to searching for solutions based on novel and creative approaches to satisfy customers (Kristal *et al.*, 2010; Patel *et al.*, 2012). In that sense, ambidexterity relates to the ability to both maintain and develop supplier relationships (Azadegan and Dooley, 2010; Im and Rai, 2008), which is referred to as the simultaneous or structural view of ambidexterity. Through continuous development of new suppliers and logistics infrastructure, redundancies can be produced in the SCs that would increase the adaptability and resilience of the entire chain (Vanpoucke and Ellis, 2019). Nevertheless, the literature has not yet explored these capabilities in the case of high-impact shocks where "bouncing back" is not enough. The COVID-19 pandemic offers a unique opportunity to study how SCs adapted, throughout the first wave, using different capabilities to ensure resilience.

3. Research design

This study focused on the COVID-19 pandemic, a disruption for which global SCs were not adequately prepared (Kovács and Falagara Sigala, 2021). An interpretive research method was used (Hudson and Ozanne, 1988) that is suited to studying a particular phenomenon in a particular place and time and focuses on "thick descriptions" and particularization rather than generalization. It also provides a "bottom-up" approach that enables potential linkages to other domains and middle-range theorizing (Darby *et al.*, 2019), making it the most appropriate method, given the theoretical background and purpose of this research. MSF was selected following information-oriented case selection, which is a technique that allows for the identification of extreme/deviant cases, maximum variation cases, critical cases and paradigmatic cases (Baharmand *et al.*, 2022). This study adopted a collaborative approach following Sabri *et al.* (2019) in which both practitioners and researchers are highly involved during the process to ensure better quality data, contextualization and relevance of the results (see Table A1 in Appendix). This approach allowed the research team to confirm their understanding of the events and enabled an independent analysis of the findings for middle-range theorization using the adaptive cycle perspective of resilience.

3.1 Case background: procurement at MSF

MSF is a medical aid organization with more than 50 years of experience in providing medical assistance to people affected by conflict, epidemics, disasters or exclusion from healthcare, with nearly 65,000 staff worldwide in more than 77 countries. It is organized around five entirely independent operational centers (OCs) that share the organization's principles and charters, medical protocols and item catalog (see Figure 2). Each OC oversees activities in multiple countries and sources medical items at one of their three European Supply Centers (ESCs). This preferred sourcing strategy is called "international procurement" and is used to guarantee the pharmaceutical quality validation of medical items and to eliminate the risks of counterfeit and fraud. "Local procurement," on the other hand, is only accepted in missions where customs regulations do not allow for the import of medical items or the emergency does not allow for international procurement to be done on time.

Approximately 80% of MSF's in-country operations, or missions, are development programs with permanent well-established SCs that support long-term activities (e.g. tuberculosis or HIV treatments, primary healthcare and maternity programs). The remaining 20% are three-month to one-year emergency missions, responding to a sudden need where there were no regular missions or where the surge of workload could not be incorporated.

International procurement focuses on the long-term collaboration between the ESCs with first-tier suppliers to ensure compliance with the high-quality requirements at the optimal costs and optimal service level. During large-scale emergencies (e.g. Haiti's 2010 earthquake or Ebola in 2015), the organization activates their "emergency mode" to ensure that the procurement function is responsive enough. Emergency validation guidelines for suppliers that still comply with extant standards exist to be adjusted to an emergency requiring strong collaboration between ESCs to optimize the use of existing resources. With a change of priorities due to an emergency, the organization is prepared to pay higher prices for immediate availability.

Despite MSF's vast experience, the COVID-19 pandemic was a unique emergency with unexpected supply disturbances. This article covers the adaptations in response to the shocks experienced during the first wave of the pandemic.

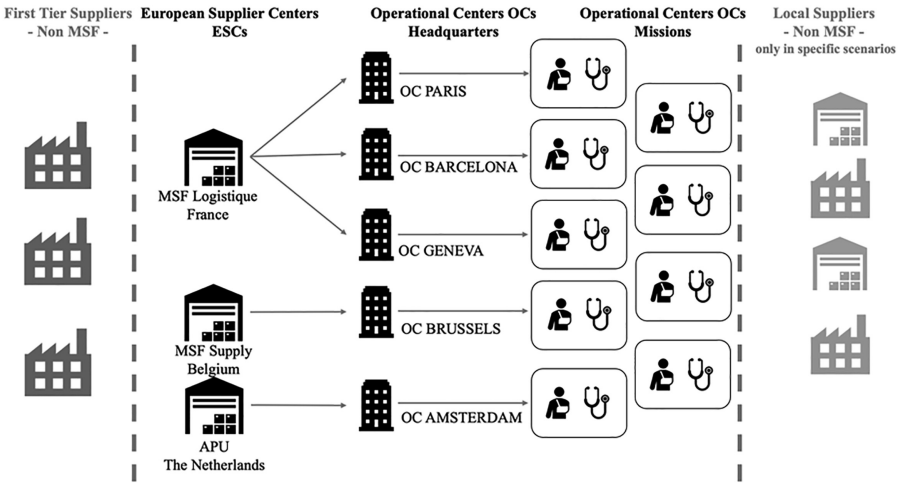


Figure 2.
The structure of the MSF procurement and supply management

3.2 Data collection

Three main sources were used for this research project: (1) secondary data in the form of 503 documents, including daily/weekly reports, internal updates, the organization-wide newsletter, meeting minutes and briefing notes from each ESC/OC issued between late 2019 and September 2020; (2) ERP extractions from 6 databases including information from January 2019 to August 2020 and (3) a set of 43 interviews and the discussions from 3 Delphi rounds. To ensure research quality and relevance, the team held bi-monthly reflective sessions to discuss and update data collection techniques.

Interviewees were selected using purposive sampling techniques. The "typical case" sampling technique was used to select interviewees with the cooperation of key informants. The MSF team provided a list of frontline experts (see Figure A1 in Appendix) who responded to the disruptions caused by the pandemic, constituting the sample for this research. Interviews were conducted in October 2020 with supply related staff from the three ESCs and the five sections, both in the field and at headquarters (HQs). The interviewees (designated with an R and a number) were asked to share their experience of the response to the pandemic, focusing on the timeline, the processes addressing the procurement disruptions and the coping mechanisms that were employed and what had been learned from the overall pandemic response. Interviews lasted, on average, 65 min, and were conducted online and recorded by one of the investigators and later transcribed with the help of the Qualitative Data Analysis Software NVivo12 for further analysis. The investigators also facilitated a three-round policy Delphi study between November 2020 and February 2021, with the members of MSF's Supply Chain Executive Committee and key representatives from the five sections and ESCs. Using the results from the documents and interview analysis, a preliminary operational report, aiming to identify the changes that took place during the pandemic response, was prepared and shared with the panel prior to the first round. In round #1, these findings were discussed and refined for the drafting of a questionnaire targeting MSF field staff associated with supply and procurement. Individual answers were collected, presented and discussed in round #2. The output was used as the basis for round #3, which focused on the validation of the findings and the analysis of the impact of these on the organization's response to the pandemic. A series of recommendations was formulated based on the findings from the Delphi and later shared with and reviewed by the organization. At the time of writing this article, the implementation of those recommendations was under discussion.

3.3 Data analysis

The data analysis combined different techniques, aiming to get the most out of each data set. First, the 503 documents were analyzed using summative content analysis, searching for the occurrences of words and emerging patterns regarding MSF's response to the COVID-19 pandemic. Word frequency queries were used for the manifest analysis (occurrences), while text search queries were used for the latent analysis (patterns). This analysis let us build a timeline of the events. Second, the interviews were coded using two levels (Miles and Huberman, 1994). Open coding focused on building categories based on the phases of the adaptive cycle (Gunderson and Holling, 2002) and the ambidextrous capabilities (Duncan, 1976) in that order. Here, files refer to the number of individual sources where text was found, while references refer to the number of quotes that constitute each code. Axial coding was performed using a matrix coding query, focusing on finding relationships between the codes from the open coding, particularly the capabilities and the adaptive cycle phases. The figures represent the number of references that match both codes, e.g. references to "exploitation" within a larger text coded under "growth" (see Figure A2 in Appendix).

4. Case analysis and findings: the adaptive cycle, course of events, and capabilities

Throughout the first wave of the pandemic, the organization adapted its practices, decision-making structures and SCs to cope with the different disruptions caused by the global pandemic. The evidence shows that MSF went through the different phases of the adaptive cycle as the events unfolded and as MSF restructured and allocated resources to cope with these disruptions. Further, the findings show that this capacity to constantly adapt and allocate resources was partly achieved by reorganizing and using their ambidexterity capabilities. Table 1 summarizes the results from the study, outlining the events that occurred during this first wave period of the pandemic, broken down into the adaptive cycle phases. Respective exploitation and exploration capabilities are also listed, as well as revolt and remember cross-level links.

4.1 Adaptive cycle

With the scope of our study spanning the first wave of the pandemic, our observations and analysis start with the conservation phase of the adaptive cycle before the shocks were experienced. Table A2 in Appendix shows the evidence used to describe the characteristics of each phase of the adaptive cycle.

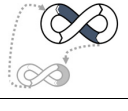
4.1.1 Conservation phase: pre-pandemic and early shocks. In the adaptive cycle, "conservation" refers to the stability and further rigidity of the system and is where the risk from disruption is at its highest level. In early January 2020, as the disease emerged in China, MSF procurement activities were performed as usual. Their supplier base includes preferred suppliers and alternative suppliers; this ensures they receive goods quickly in case of a rush order. The quality assurance team (QA) constantly cross-checked the quality and documentation at multiple points at both supplier and manufacturing sites to ensure medical standards.

With the first signs of a possible wide-spread epidemic in February, MSF started to activate existing "usual" emergency preparation procedures to ensure continuity of supply. As explained by R25 at ESC, "it took a while to get started. When it finally did, they placed orders for EPREP stock, but it took a lot of time," where EPREP refers to the emergency preparation stock that MSF orders from their suppliers ahead of an emergency. Although the risk was not imminent, this was the moment when the organization began to feel the impact of an increasingly competitive market.

Early March 2020 marked the escalation of the epidemic into a pandemic. A decision was made to increase central emergency stocks of Personal Protective Equipment (PPE) as the first COVID-19 guidelines for the field were finalized and shared with missions. It was also decided to centralize the allocation of all COVID-19 PPE to missions at the HQ level by ESCs to avoid panic ordering from the field. However, supply shortages became imminent. At this point, the ESCs were already procuring from their entire supplier base, focusing on building EPREP, placing orders in anticipation of bigger shortages and utilizing all existing resources and mechanisms. Following the World Health Organization's (WHO) declaration of a global pandemic on March 11th, several export bans were announced.

Within less than two weeks, suppliers and ESCs were in lockdown and faced government restrictions to prioritize national populations, as the EU announced export restrictions for all COVID-19 PPE without exceptions. The new regulations prevented MSF from exporting and transporting PPEs and critical items that were stored at ESCs while the international demand for PPE exploded worldwide. MSF's existing suppliers were running out of inventory, and thus, new suppliers needed to be identified (spot options). "[We] started to place orders and suppliers were responding 'I don't have any, I don't have any more, I can't give you a date.' Some even started to say, 'stop calling us'" (R19). R36 recalls that "from March we knew

Table 1.
Ambidextrous capabilities of exploitation and exploration during the Panarchy loops

Panarchy state	Events	Ambidexterity Capabilities		Timing of the events	
		Exploitation	Exploration	European Supply Center	Field
Conservation 	- Suppliers identified as preferred in the supplier base have material availability *Focus: availability, low cost, and high product quality*	- Sourcing from a pre-approved list of suppliers - Having preferred list of suppliers - High levels of quality measures for both product and suppliers	- Slow supplier assessment to increase supplier base - Sourcing decisions related to products and suppliers taken centrally - Allowing for decentral sourcing in critical situations with the authority of the central level	01/01/20 - 12/03/20	01/01/20 - 17/03/20
Vulnerability of the Conservation state	- COVID-19 declared as a global pandemic (concerns made on 30/01/2020 and officially declared on 11/03/2020) - All pre-approved suppliers low on stocks - Market indicates signs of material shortages	- Survey all validated suppliers for inventory - Sourcing from any suppliers within the pre-approved suppliers base in response to limited inventory and increasing demand	- Investigates new possibilities without contracting	13/03/20 - 17/03/20	18/03/20 - 09/04/20
Tipping point	- Surge in demand - Scarce availability on the market - Border closers in origin of supply *Focus: avoid stock-out at patient level*	- Maintain quality standards, reduce focus on cost and supplier assessment	- New purchasing structure take-over - Mutualization of procurement resources	***18/03/20***	***10/04/20***
Release ESC 	- Supply shortage - Increased demand and higher competition *Focus: immediate availability and product quality*	- Maintain high quality standards in supplier approval (but fast process) - Maintain financial validation (but eased process)	- Wide investigation of all potential supplier - Fast supplier assessment - Swift purchases upon availability - Consideration of alternative sources of supply (donation, production)	19/03/20 - 23/04/20	
Reorganization ESC 	- Suppliers with inventory out of the supplier base identified and approved - Reception on items *Focus: availability, cost, and product quality*	- Approval of some suppliers - Evaluation of best offers within availabilities form new suppliers - As soon as possible, return to highest possible quality standards - Establishment of relationship with new suppliers	- Continuation of exploration of all possible new suppliers	24/04/20 - 03/06/20	

(*continued*)

Revolt from ESC to Field	*The ESC's delay in providing materials translated to a rupture of preferred supplier from the field and the patients' demand increase created the tipping point*			***10/04/20***
Release Field	- Supply shortage - Increased demand and higher competition *Focus: immediate availability and product quality*	- Local supplier identification still restricted to within the missions' country - Emergency supplier validation - Quality standards maintain for patients' safety	- Ability for missions to purchase to any in country supplier with inventory - Emergency procurement process (no more comparative bid analysis, validation limited to fraud avoidance) - Quality validation process updates	10/04/20 - 31/05/20
Reorganization field	- Local suppliers with inventory identified and approved for ad-hoc purchases - Reception on items *Focus: availability, cost, and product quality*	- Considerations on price when multiple sources available - As soon as ESCs have inventory, ESCs are back as preferred sourcing options	- Keep looking for new local suppliers with higher quality or lower prices - Local purchase maintained for all risk of rupture	01/06/20 - 19/07/20
Remember Field to ESC	*ESC back to supplying capacity and local purchase and exceptional emergency processes are stopped*			**20/07/20**
New Growth/ Optimization	- No shortage anymore - Stocks available again at the approved suppliers - Lessons learned *Focus: low cost and high product quality*	- Sourcing from preferred suppliers within pre-approved supplier base - Supplier base update with new suppliers	- Continuous assessment of new suppliers to increase supplier base for future waves	04/06/20 onwards 20/07/20 onwards

Table 1.

already that they [suppliers] wouldn't be able to deliver, and we were already looking for others." However, documentation proving the quality compliance of new suppliers of PPE became increasingly unavailable, complicated, unreliable and mostly in Mandarin (R17).

4.1.2 Release phase and tipping point of the ESC and field operations. "Release," in the adaptive cycle, refers to the point of collapse and further dissolution of the system. By late March and into early April, the breaking point had been reached and the cascading effect of the official declaration of the pandemic and succeeding global restrictions imposed by governments had begun. Following the shutdown of the Indian market, most suppliers also ran out of stock or were unable to send products to Europe. Expected supplies lowered, suppliers deferred deliveries without new dates, factories closed and transport problems accumulated (Minutes_ESC_3003). In the newsletter from March 27th, the organization informed its members that "[field] outstanding orders of face masks [to the ESCs] [could] not be filled until August" and also that there was "a risk of generic drug shortages as domestic production may halt." That estimation proved correct, as 60% of the order lines with COVID-19 items that had the status "on order" or "packed" in February 2020 still had that same status in March 2020. At the time of the June update, nearly 40% still had that status.

It was the first time that the organization faced such a dire situation. Supply became a core priority, and the objective was to "continue chasing suppliers for the critical items" (Minutes_ESC_0304). To support the new objective, "a Procurement Task Force [was] created to gain a complete picture of global availability of PPEs and align ways of assessing suppliers (lead buyers are expected to lead the risk assessment of suppliers' offers)" (Newsletter_Intersection_0704). However, it was extremely difficult to find suppliers with inventory. The FFP2 market was "dry" and there were "many offers with a poor quality" (Minutes_ESC_0604). Despite the efforts of the Procurement Task Force trying to source and creating new contacts with new suppliers (Minutes_Intersection_1004), the "current referenced suppliers [had] no capacity in the coming months" and "the situation remain [ed] highly critical with no new order in the pipe for delivery before October" (Minutes_ESC_1504). This situation had an impact on the activities undertaken at a lower level of the MSF SC.

As the delivery times from the ESCs to the field became longer, the missions were pushing the limits of international sourcing, creating a vulnerable state at the field level that was still performing business "as usual" (i.e. a cross-scale link to the conservation phase at the field level). On April 10th, MSF enabled local procurement for medical items for all its missions, which represented a shock to the system at the field level. This exceptional measure was previously only allowed for certain countries where custom regulations did not allow import or on an ad-hoc basis for specific emergencies. The usual restriction of local medical procurement is a deliberate choice to limit the risk of low-quality medicines or counterfeit medical products that could potentially harm patients. Lifting this restriction was not a decision taken lightly, but it was the best option to avoid a lack of PPEs at the patient level. Nonetheless, emergency procurement always follows strict validation processes to ensure medical quality and acceptable costs. This induced a peak in local procurement between March and June 2020.

From April 10th to April 17th, each OC initiated a first level of reconfiguration of their local procurement according to their own existing processes and resource constraints. "We realized we [the HQ] need to survive until the end of July, until the missions receive[d] the first [international] supplies" (R20). This required the operations teams to update tools to ensure timely information-sharing across the organization and facilitate the allocation of the limited remaining critical items at ESCs to countries with disrupted local markets through urgent shipments.

From the end of April to mid-May, additional reconfiguration took place, as the traditional local procurement practices were not avoiding stock-outs at the patient level while the

demand grew and supply shortages were worldwide. The local market volatility required swift procurement practices to avoid loss of opportunities, i.e. limited stock going to the highest bidder paying in cash. New mechanisms were rapidly put in place from the field, including simplified validation processes, local quality validation by medical coordinators with the same quality standards, a global envelope system for COVID-19 items instead of strict budgeting and the production of local basic PPE and face shields.

4.1.3 Reorganization phase. Reorganization refers to restructuring the system and further innovation. From April 23rd onwards, MSF's focus shifted toward ensuring the application of the highest standards possible based on the growing list of newly validated suppliers. The new configuration included (1) multiple new spot orders from approved Chinese suppliers; (2) new contracts with new European suppliers of PPE, some of which were delivered directly to Dubai after the testing of samples; (3) orders resulting from the Red Cross joint tender to be delivered in China and (4) the participation in a WHO/UNICEF/UN/MSF tender for PPE items with worldwide distribution of PPE through an allocation mechanism. R36 explained, "I think we will keep them [newly found suppliers], because anyway the crisis is not over, we still need them and anyways, it's good to keep multiple sourcing possibilities." All this led to the adjustment of the PPE forecast model (Newsletter_Intersectional_2404) and was complemented by the possibility of resuming orders from preferred suppliers, as restrictions were gradually being lifted (Minutes_ESC_2904). The clearest evidence of this new state is that "supply" was no longer an item on operations reports, meaning that all shortages and possible disruptions were addressed with the mechanisms previously identified, tested and integrated.

Here, a cross-case interaction between the two adaptive cycles took place as a result of the changes made at the higher level. Shortly after the new procurement alternatives at the field level started to pick up, the efforts at the ESC started to show results. Missions were receiving information about incoming shipments directly from ESC as per before the disruption, so the teams were already looking for new suppliers while waiting for all orders to be met. Missions could be more selective regarding the new suppliers, progressively going back to traditional sourcing from the ESCs as the preferred choice. Local procurement went back to normal, mostly exclusively for nonmedical items, as the simplified local purchase procedure was not going to be extended (Newsletter_OC_0406). Nevertheless, the newly added suppliers remained on the emergency list for future events, and as ESCs were able to meet the demand, the field returned to exclusive medical procurement from ESCs, thus completing the adaptive cycle at the field level and continuing with traditional day-to-day activities.

4.1.4 A new growth/optimization phase. With some legacy from the previous cycle, the new adaptive cycle starts with the growth and exploitation of the new structure. By early June, supply was sufficient to cover need, former suppliers were reactivated as inventory was available again and some newly identified suppliers were incorporated into the supplier portfolio with new agreements. By the end of July, all ESC orders had arrived, ending local procurement. As a result, it was said, "the OCs are recalculating their estimated needs for the coming month. It is expected that the originally expressed needs will go down significantly" (Newsletter_Intersection_1405).

Further, the Procurement Task Force was dismantled and support was limited to "ensuring the forward of the last proposals received to the appropriate buyer and QA, cleaning the email box and the central file in order to have all the information available and understandable by all, and managing the last tender for gloves until the 19th of June (if confirmed)" (Newsletter_OC_1106). On June 30th, the last COVID-19 Internal Update was issued, stating that "as COVID-19 procedures and information-sharing has now been for the most part integrated in the regular work of OCs and platforms, the International COVID-19 Support Team (ICST) will be dismantled on June 30" (Newsletter_Intersection_3006). The local procurement activities continued until July, when some sections at HQ were able to

capitalize on the lessons learned and reflect on the next steps in case of a new wave. This represented the end of the first wave of COVID-19 at the ESC level.

4.2 Ambidexterity of the organization in adapting to the shocks

As the organization adapted to the different shocks of the first wave of the pandemic, its resources were allocated differently to ensure continuity and to investigate new options that allowed them to face the constant disruptions. In this setting, "exploitation" refers to the efficient use of the existing supplier base and staying within that limit and "exploration" refers to exploring new markets and reaching out to new suppliers outside the supplier base, despite higher prices, lower service level or adapting the quality validation process for a quality guarantee to deal with shortages. At MSF, these two activities take place simultaneously to differing degrees in every phase of the cycle due to the organization's need to both respond to emergencies and ensure the continuity of operations. Table A3 in Appendix shows the evidence used to describe the capabilities used in each phase of the adaptive cycle.

4.2.1 Starting with high exploitation and low exploration. At the beginning of the COVID-19 pandemic, MSF started by optimizing the current version of its emergency mode, focusing mostly on the exploitation of current resources and beginning to explore new options. The decision was made to avoid exploring suppliers in markets the organization was not familiar with or without European-style medical QA documentation, basically "forgetting about China, India and Asia markets" (Minutes_ESCs_2802). Rather, the orientation was toward discussing the use of "EPREP of PPE with existing suppliers" (Minutes_ESCs_0402). Until the end of February, the ESCs managed to place their orders with preferred suppliers. However, mostly due to the organization's experience in dealing with emergencies, they also started to discuss possible solutions to cope with potential shortages if the epidemic were to spread out of Asia.

As the pandemic advanced, the ESCs kept a careful watch on the situation and the market as confirmed by their preferred A-List suppliers' warnings or high risks. ESCs contacted suppliers of all ranks regarding their procurement capacity, establishing a plan B in case of a declared emergency. The ESCs were "already looking for new suppliers in February, because I have mails asking our suppliers about PPEs [. . .] so we were not in emergency mode yet, but we already started to feel that it was growing and that we needed to prepare" (R36). However, they also started to explore new options by brainstorming next steps for worse-case scenarios, including sourcing from other markets. By late February, Turkish suppliers informed the organization that they would "only confirm new orders in June 2020" (Minutes_ESCs_2802).

In early March, the organization increased the use of its resources by assessing the status of the system, particularly in terms of "supplies for the next 6 months" and "the level of care and potential interventions based on weaknesses they [saw] in public health systems" (Minutes_Intersection_0603). As PPE shortages from Rank A suppliers started to rise, the organization slowly moved down the supplier base, compromising either in cost or delivery and exhausting existing procurement options. In parallel, the teams started to face several issues because of the newly established export bans. Special authorizations, "export licenses," specific procedures to export and the risk of the material being requisitioned by the state were some of the bottlenecks found and addressed (Minutes_Intersection_0403). The decision was still to "use our current systems [. . .] e.g. extending current contracts etc." (Minutes_Intersection_0603).

At the same time, the rigidity of the system started to show its limits, particularly in dealing with continuously increasing restrictions. MSF quickly realized that they were reaching a breaking point. The need to start thinking, assessing and deciding on every

possible option to ensure the continuity of supply was evident to try to prepare the organization for a worst-case scenario. During the March 13th Intersection meeting, the "feeling that this [was] the beginning of the epidemic" was expressed, along with the realization that "mitigation, alone [was] not working." Different novel actions including "contingency plans" for ongoing operations, "working on multiple levels trying to identify sources," "working on new strategies and trying to identify alternative providers" and even "trying to lobby the French Ministry of Health to get an exception" were undertaken to find alternatives to the existing way of working. By March 18th, Indian supplies were no longer available following a government decision to stop all commercial activity until further notice, but a possible sourcing from new suppliers – not previously identified or validated – from Dubai and China was suggested as a possible solution.

By March 23rd, the organization was engaging in both exploitation and exploration activities at the same level, as the risk of global PPE shortages eventually worried field operations despite the efforts made by ESCs to use and replenish EPREP. At the ESC level, efforts were directed to find substitutes and complemented with the possibility of local purchase in case of shortages. The missions were encouraged to consider unprecedented sources of medical supply, including borrowing and regional or local purchase, but always following the same validation process employed by pharmacists at the OC level. The procurement strategy for PPE remained "1st source: own stock, 2nd source: local purchase, 3rd source: regional and 4th source: international" (Email_OCtoField_3103). Nevertheless, the pressure on many missions started to rise (Newsletter_intersection_1004) to the point that missions "reached a critical situation with supply in the field" (Minutes_Intersection_1004).

4.2.2 Shifting to high exploration and low exploitation. Essentially, this moment that coincided with the point of collapse of the adaptive cycle was MSF's first attempt at "working on creative ways of PPE procurement" (Minutes_Intersection_2003). Contrary to the traditional practices at MSF, the new strategy focused on finding "small quantities left and right, and not only big supply" (Minutes_Intersection_1004). The organization explored many unexplored markets for all types of suppliers, facing several complications with unfamiliar document types (often in Mandarin) and resulting in the reviewing and sorting of hundreds of suppliers in a very short time. For this, ad-hoc procurement alternatives were scaled up in entirely new ways, including building on a pre-existing emergency ESC collaboration practice to create a new procurement structure dedicated to identifying new suppliers, i.e. a dedicated QA/buyer duo focusing on one critical item for each ESC, to provide "a coordinated and efficient response from the procurement function to the MSF movement with regards to the sourcing of critical COVID-19 items" (Minutes_ESC_2503), accepting a donation of masks from a private donor (Minutes_ESC_1604), considering and supporting local production of "masks, face shields, ventilators that could be used by local companies or grassroots makers" (Newsletter_Intersection_3103), joint procurement with other organizations like UNICEF (Minutes_Intersection_1004) or ICRC (Minutes_ESC_1604) or even accepting goods that needed repackaging (Minutes_ESC_1704).

All these efforts resulted in significant progress in procuring some quantities of PPE, covering "the needs of our missions for 5–6 months according to the latest forecast" (Newlsetter_Intersection_2404). As a result, "serious leads have been made with mask suppliers and we are waiting for the confirmation of the orders" (Newsletter_OC_2504). Notwithstanding the difficulties experienced in sourcing PPE, MSF continued to procure goods following the core procurement standard. Additionally, and despite different disruptions causing the breaking up of the current procurement structure, a form was "sent to the 50 biggest suppliers for having situation update" (Minutes_ESC_2003) to secure "essential supplies in the long term, by engaging in high-level negotiations with existing and new supply partners" (Newsletter_Intersection_1704). Traditional procurement practices were still attempted, for e.g. one tender for the five OCs was launched on April 5th for half

filtering masks type FFP2/KN95/N95 standards and reusable face shields (Minutes_ESC_0604), and the purchasing strategy was redefined "to include a focus on current suppliers and better coordinate the ongoing work to identify new suppliers" (Minutes_ESC_1504). However, most of the effort was put into finding different unexplored solutions.

On April 10th, with critical COVID-19 items still unavailable, a series of novel alternatives was put in place, aiming to find the best solution to ensure continuity of supply for the missions. For instance, local purchase solutions for PPE, with the support of MSF's pharmacists and supply technical referents, were encouraged when feasible (Newsletter_Intersection_1704) and also "donations of PPE [could] be accepted (after quality check) for the coming 3 months" (Email_OCtoField_1004). Further, "the Medical Director [. . .] allowed [. . .] the local purchase [of] a limited list of COVID-19 related articles without asking HQ for prior approval" (Email_OCtoField_1004) but without compromising on the quality requirements. A simplified local purchase procedure was issued for noncritical COVID-19-related items, which were valid until May 31st. The organization also supported "temporarily alternative options to the MSF standard IPC recommendations for use of masks until the supply chain is replenished" (Email_OCtoField_1004). In an email sent to all the missions, the OC explained, "exceptional Medical Local Purchase (MLP) validation [applied] only for an agreed list of COVID-19 items. All other items [had to] go through normal MLP procedure and the standard authorization framework" (Email_OCtoField_1004). This ensured the use of "the best quality masks and PPE currently available" in each mission and allowed exceptional measures to be discussed with technically referent medical products and operations directors in cases where alternative options were not available.

By late April, as the exploitation of traditional procurement practices and high standards had been reinstated worldwide, the exploration of new supplier identification continued, but alternative solutions were explored less. The procurement task force maintained their full capacity for supplier identification, with the QA/buyer teams identifying new suppliers as fast as possible. However, some remaining alternative solutions were maintained for critical items such as gowns, a market that went out of stock by the end of May, with no deliveries foreseen until September or October 2020. MSF participated in a joint tender with ICRC (Newsletter_Intersection_2105) to select suppliers and pre-screen received offers while, at the same time, investigating new options that resulted from repurposing, e.g. IKEA adjusting its manufacturing line to produce gowns and being able to scale up to 1M per month (Newsletter_Intersection_2105).

The newly identified practices at both the ESC and field level started to be integrated into MSF's traditional procurement practices and extended to the newly added suppliers. By the end of April, most orders were placed and being processed as planned (Minutes_ESC_3004). The new suppliers were being considered for potential partnerships and the organization went back to the normal assessment of suppliers, with the difference that there was more supply than demand. For instance, a tender for FFP2 masks resulted in eleven offers, of which three fitted the requirements and the leads for the remaining quantities were positive (Minutes_ESC_1505). Further, long-term sourcing was reconsidered while the organization also still participated in joint tender efforts. In early May, the organization was discussing the possibility of securing monthly mask deliveries from one supplier until the end of the year to reduce costs (Minutes_ESC_0605). By the end of the month, and while 250,000 FPP2 masks were secured from a new supplier in Europe "at a good price and short lead-time" (Newsletter_Intersection_2105), MSF was taking part in the PPE consortium tender to procure 100,000 FFP2 masks.

By mid-June, some of the novel procurement alternatives were still being evaluated or employed. These included "waiting for UNHRD to get the global proposal for the PPE," missions having "own fabrication to cover their needs," mapping suppliers or continued sourcing of PPE locally (Minutes_Intersection_1506). With the supply coming directly from

the ESCs being secure now, where "most of the mask order[s] were either ready [from the ESC] to ship in or already shipped in the missions" (Newsletter_OC_2905), the field had rapidly gone back to the normal uses of resources and procurement processes. With "the sourcing of critical items (PPE and others) [being] secured for the near future" (Newsletter_Intersection_3006), the field resources concentrated on ensuring the continuity of activities.

4.2.3 Back to high exploitation and low exploration. With the new structure and the end of exceptional measures to cope with supply shortages, MSF started to optimize sourcing again, including sourcing from the new validated supplier list. Procurement activities continued as before the pandemic, and evidence of a change of focus (from COVID-19-related items to everyday issues) appeared. At this point, all ESC minutes confirmed that routine work was back as the core focus. At the same time, MSF started to foresee potential risks with regards to critical items (e.g. gowns) in parallel to ongoing work and, therefore, assessed other possible sourcing options (Newsletter_OC_2905). This was also the case with export permits, as some constraints pushed the organization to find alternative transport solutions (Minutes_ESC_0406).

5. Discussion

This research aimed to answer how organizations can leverage their ambidexterity to improve their resilience when facing supply shocks that cannot be absorbed. The MSF response to the COVID-19 pandemic shows how an organization reacted to, and coped with, the different shocks that the global pandemic brought and which of their ongoing practices could not absorb those shocks. The organization changed its procurement and supply management organization and process to include a different configuration of centralized and decentralized procurement structure with changed decision-making criteria, internal restrictions and added resources. The particularity of this case is that, in addition to the need of ensuring the continuity of regular operations (their ongoing medical activities), they also had to provide COVID-19-related support; closing the ongoing missions was not an option due to the life-saving nature of their activity. The empirical context of this case was explored using the concepts of panarchy and the adaptive cycle developed in the socio-ecological literature and the organizational ambidexterity concept that revealed some interesting insights for SC resilience toward high-impact shocks.

For MSF, both exploration and exploitation took place simultaneously in each phase of the adaptive cycle and at two different levels of the organization to cope with shortages and to anticipate future disruptions. This finding adds to the previous observations in the literature that have discussed SC resilience: the engineering literature suggests that systems absorb environmental shocks to maintain stability and to allow exploitation of their resources; in contrast, the literature on social-ecological resilience suggests that systems transform and adapt to environmental shocks through two separate and sequential functions or capabilities (exploitation and exploration) to become resilient.

The complex organizational structure of MSF, with a mix of centralized and decentralized procurement and decision-making, created a time lag between experiencing the release and reorganization at these two levels. This resulted in two cross-level linkages between central and decentral procurement, where, first, the events following the release at the central level destabilized the conservation state at the decentral level and contributed to the release there, and later, the stability gained preceding the reorganization at the decentral level contributed to stability at the central level and, consequently, the stability of the whole organization, similar to Gunderson and Holling's (2002) "revolt" and "remember" links, respectively. Thus, our findings suggest the addition of another layer to the panarchy loops in the SC context and within complex organization structures adding to the existing literature (e.g. Wieland, 2021;

Novak *et al.*, 2021; Sauer *et al.*, 2022), as we saw evidence of revolt and remember links between different levels of a firm's SC and at different times (see Figure 3).

The two functions of exploitation and exploration thus followed this time lag in the experienced shocks, explaining how the organization utilized the two capabilities simultaneously. These findings are in line with the suggestions from simultaneous or structural ambidexterity (O'Reilly and Tushman, 2008, 2013), showing how the capabilities and resources are separated in structural units as they each experience the need for exploration and/or exploitation. Exploitation capabilities at MSF corresponded to higher degrees of supply base utilization and familiarity, including established supplier lists and preferred pre-approved suppliers, clear quality measures in product and supplier selection and contingency plans for times of supply shortage and disruptions. Our results show that these capabilities, within a procurement and supply management system, can contribute to the continuity of supply through maintaining conservation and ensuring reorganization compliance to go back to a new sustainable state of growth/optimization when high-impact shocks disrupt the system to the extent that its current processes do not suffice. On the other hand, exploration capabilities corresponded to the lack of familiarity with the supply base and low utilization of suppliers and can include an increase in the resources allocated to market scanning, increased flexibility in quality measures and supplier selection and improved vertical information-sharing. These capabilities support a switch from conservation to release and from release to reorganization, which contributes to the resilience of supply.

The organization still shifted between exploitation and exploration capabilities to maintain supply and organizational resilience at each respective level (see Figure 4). Mapping this shift in the adaptive cycle suggests that exploitation capabilities are used more in the front loop phases of the cycle, with higher levels of familiarity with their supply base, while exploration capabilities are most likely to appear after the tipping point and during the back-end loop with low supply familiarity. This shift is triggered by the different requirements of release and reorganization, compared to conservation and growth. Both ambidexterity capabilities and supply based familiarity are directly related (represented by the red line), with more exploitation needed at times of high supply familiarity and more exploration at times of low supply familiarity (i.e. shifted at the tipping point of the adaptive cycle). The less

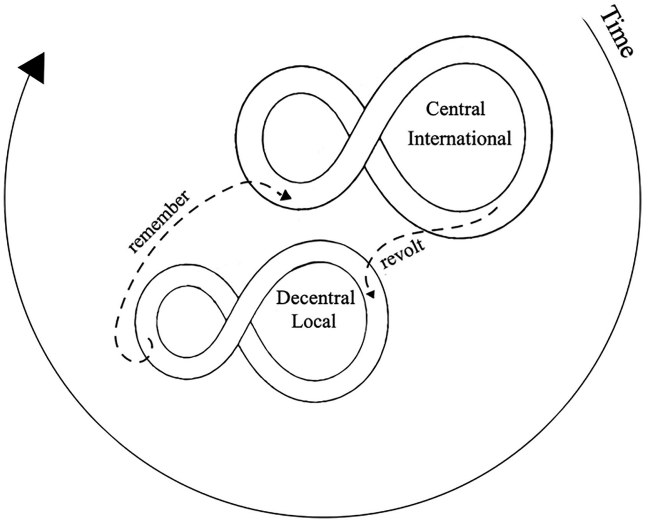


Figure 3.
Revolt and remember cross-level linkages in SCs

utilized capability and the associated supply knowledge/practices do not completely enter dormancy but are rather reorganized in other parts of the organization (e.g. central versus decentral/different functions or different decision-making levels).

6. Concluding remarks and implications

This study presents a novel empirical exploration in OSCM, showing how organizations dealing with high-impact SC shocks can leverage their ambidextrous capabilities to improve their resilience by combining two alternative perspectives, compared to the dominant schools of thought of the SC literature on resilience: (1) adaptive cycles from the social-ecological literature and (2) organizational ambidexterity. Our results show that the reorganizations in response to the shocks, in our case, stemmed from the complementary use of exploitation and exploration capabilities, which contributed to a well-managed response to the COVID-19 disruptions.

6.1 Research implications

The complexity of the case organization, in terms of the multi-unit, multi-country network of its offices and operations, resulted in a lagged experience of the shocks, contributing to a reorganization of resources and decision-making that allowed a parallel use of exploration and exploitation functions. Through simultaneous ambidexterity, the organization was able to face significantly increased "high-priority orders," staff absenteeism, supply shortages and fewer transportation options that hampered procurement and supply management and still ensure the continuity of supply at both the international and local levels. Nonetheless, the findings also suggest a shifting point between the dominating capability corresponding to the tipping point of the adaptive cycle, from conservation to release and reorganization.

Our findings contribute to the literature on the socio-ecological view of resilience in SCs (Wieland, 2021) by empirically demonstrating the adaptation of an SC system to the high-impact shocks of COVID-19. We extend this stream of theory and contribute to the current debate on how ambidextrous organizations can exercise exploitation and exploration capabilities at the same time. The findings of this study also contribute to the OSCM literature by showcasing how procurement and supply management systems can be reconfigured in times of crisis (adding to the works of, e.g. Pereira *et al.*, 2020), as an add-on to the existing systems, to increase the resilience of SCs. This study suggests that an adaptive and transformative perspective of SC resilience (Feizabadi *et al.*, 2021) can result in a more successful closing of the demand-supply gap in crises that cause high-impact shocks to the SC. Finally, this research contributes to developing theory on humanitarian operations literature, particularly on how the procurement and supply management structures from humanitarian organizations can become more responsive to disaster situations (e.g. Moshtari *et al.*, 2021; Pazirandeh, 2011).

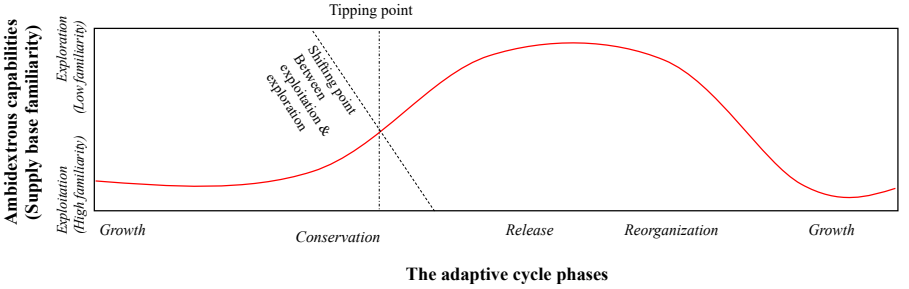


Figure 4.
A schematic illustration of the shift between ambidexterity capabilities for resilient procurement and supply management

6.2 Practical implications

Our findings provide insights for managers to increase their SC resilience in times of high-impact crisis through an adaptive perspective in response to disruptions and a resource allocation perspective to increase SC ambidexterity. First, the empirical illustration of the adaptive cycle following the COVID-19 disruption depicts the SC as adaptive, as opposed to robust. As shown, the SC adapts in phases to a disruption, suggesting that managers can anticipate that a disruption will cause the release of their existing working methods and, thus, plan for the necessary reorganization. Organizations can, therefore, introduce new strategies, such as process modularization, task force teams or ad-hoc structures ahead of a reorganization, as these would allow for faster decision-making and increased adaptability. The perspective of having a reorganization after the release opens the door for lessons to be learned, for new ways of doing things to be capitalized on and for strengthening the resilience of a chain. Second, rather than a complete switch between exploration and exploitation activities, evidence shows that it is important to maintain ambidexterity during the response to shocks by reallocating resources and capabilities to different parts of the organization. For instance, organizations can maintain a strategic vigilance during the growth or stable phases and ensure the maintenance of good practices during crises to better reactivate them after the disruption. This would support the allocation of tasks within organizations, ensuring that the variation of the ratio between the resources dedicated to exploration and exploitation activities is appropriate and in line with the phases of disruptions.

6.3 Limitation and future research

The findings of this article are limited, not least to the case boundaries of the study, which offer opportunities for future research. The case organization in this study is a nonprofit service organization from the health sector, calling for the extension/validation of our findings to other for-profit or nonhealth-related contexts. The specificity of the case organization, in terms of it being a multi-unit, multi-country network of operations and offices, also limits the findings with respect to the cross-level linkages of panarchy, calling for more studies on other types of complex SC networks and organizations. Specifically, further research should look into how loosely coupled/complex adaptive organizational structures enable resilience through ambidexterity.

Note

1. In the literature, this phase is often referred to as exploitation. We choose the growth/optimization label in light of Gunderson and Holling's (2002) vocabulary to avoid confusion with the ambidexterity capability of exploitation.

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(The Appendix follows overleaf)

Appendix

Collaborative project phases	Collaborative research features/Elements
PHASE 1: Forming a collaborative research team of humanitarian logistics practitioners and academics	• A project team with representative of all sections and supply centers was created and referred to as "MSF team." Two researchers from the academic team complete the team
PHASE 2: Understanding the context and purpose of humanitarian logistics research problem	• Co-identification of the rationale and scope: COVID-19 pandemic disruptions and coping mechanisms • Joint formulation of the purpose of the research, expected outputs, and identification of possible units of analysis • Researchers are immersed, embedded in the humanitarian field, and they have access to the practitioner's system • To ensure rigor, one of the academics monitors and observes the rigor of the entire research process, nonparticipatory
PHASE 3: Data collection (by academics)	• Secondary data: 503 documents, situation reports, mission strategies, taskforces meeting minutes, observations, focus group discussions • Quantitative data: ERP extractions on mission orders, critical items for the pandemic response, items at risk of a shortage, monthly order status, monthly local procurement per mission, and average monthly local procurement, per mission, from 01/2019 to 08/2020 • Qualitative data: 43 interviews, field questionnaire, and Delphi study • Triangulation of data collection from multiple sources: MSF documents and website, international COVID-19 situation report, interviews form field teams from multiple locations, and interviews of HQ staff
PHASE 4: Practitioner orientation	• Practitioners briefed on research tools and methods • Academics to prepare and present preliminary analyses • The structured data are communicated to the research team and to the practitioners
PHASE 5: Collaborative data analysis	• Identifying analysis tools (Excel and NVivo) and techniques by researchers • Data are collaboratively analyzed by academics and practitioners: Delphi iterations • Triangulation by the academics in the analysis phase • Establishing a logical chain of evidence by academics
PHASE 6: Joint planning for action	• Co-identification of changes to be made and strategies and practices for change management • Co-developing of recommendations and intervention plans

Table A1. The collaborative research process in this study

Source(s): Adapted from Sabri *et al.* (2019)

Adaptative cycle phases	Adaptive cycle Timing of events ESC	Timing of events field
I. Conservation phase: pre-pandemic and early shocks	01/01/20–17/03/20	01/01/20–09/04/20
Conservation refers to the stability and further rigidity of the system and is where the risk from disruption is at its highest level		
Sources: **22** documents (16 meeting minutes, 5 newsletters, 1 public communication) **19** respondents (R2, R3, R8, R14, R16, R18, R19, R21, R25, R26, R29, R31, R32, R33, R34, R36, R37, R38, R40)		
"In February and March, we were still at a normal pace." R36		
"We started to get the emergency orders from December, and I remember them very well because I was really in the beginning and then he went in the same rhythm during January, and it kept moving during February as well. And then came March and the ruptures [stock-outs]." R17		
"I guess in January we started looking at PPE requirements. And so that started with working with the medical department about defining what PPE was necessary." R28		
"So end of February, early March, we realized the missions would be ordering certain items that were really critical for COVID. So, we talked to avoid a situation where it would be first come first served." R14		
"At first, we were working with our lists of suppliers with prices and with quality compliance. The supplier's info and prices were all in the system." R19		
"We were feeling more and more pressure from the purchasing team that informed that supplier wouldn't be able to deliver on time or at all." R39		
"Before March, we were still treating it as a normal emergency protocol. I changed mid-March, when I joined the taskforce." R14		
"At the beginning, we were asking [the ESC] how much was their inventory for each and each article, until it was too complicated. [. . .] We tried to centralize the orders at the ESCs until mid-March. Then we had to have an allocation system in place." R16		
"We [the field] were not placing orders at that moment [mid-March]. So, we were just inventory checking, trying to see how it was coming to the country. [. . .] Our 6-month order was already placed." R07		
II. Release phase and tipping point of the ESC and field operations	19/03/20–23/04/20	10/04/20–31/05/20
Release in the adaptive cycle refers to the point of collapse and further dissolution of the system		
Sources: **71** documents (39 meeting minutes, 27 newsletter, 1 public communication, 4 emails) **all 43** respondents		
"Our suppliers weren't delivering anymore. We couldn't ship. There weren't any more planes. So, at the ESC, all our normal organization fell like a house of cards." R19		
"The procurement team was placing orders, and suppliers were answering 'I don't have anything anymore, I can't even give you an estimated date.' Some suppliers were even saying 'stop calling us.'" R19		
"None of our usual suppliers were able to supply us with anything." R21		
"The second half of March was pure madness." R07		
"The main issue, that started with the mask and extended to all [Covid-19] items were sourcing. Because all our usual suppliers let us down. And we needed to find new ones, with all the difficulties that it entails, including sorting through the crazy and not-so-crazy offers, and go through quality validation." R33		
"After a week, 10 days, we realized that what was in place was not going to be enough. We needed to sit down the 3 ESCs and 5 OCs and find a new way." R31		
"The Core ExCom acknowledges that MSF finds itself in a critical situation in supply in general, with a specific concern for PPE (surgical and respiratory masks in particular)." Minutes_ExCOM_200420		
"We [ESC] had requests for millions of masks and no supply available. We were trying to offer the few alternatives we had, but even then, how do you allocate the limited quantity." R11		
"And the main suppliers that [the ESC] usually buy from couldn't commit to the quantities that we were looking for, but also to the prices that they usually supply to us. So, we need to look at other markets, China. Basically, Asia and stuff like that." R14		
III. Reorganization phase	24/04/20–03/06/20	01/06/20–19/07/20
Reorganization refers to restructuring the system and further innovation		
Sources: **80** documents (46 meeting minutes, 33 newsletters, 1 email) **all 43** respondents		

(*continued*)

Table A2.
Evidence supporting the adaptive cycle phases

Adaptative cycle phases	Adaptive cycle Timing of events ESC	Timing of events field
"It was a bit of an unorganised process at first, but then in April there was the procurement task force that was set up." R14 "The situation was dire, we needed a coordination entity, so we created the emergency procurement task force under the MSPP. [. . .] we needed that strategy; we were close to a worldwide stock out." R31 "I don't think we could have managed without the taskforce." R16 "We split the critical items procurement between the ESCs. Thankfully we had that repartition, otherwise we wouldn't have been able to handle the workload. [. . .] We had never worked like this; it was a fully new set-up." R25 "We immediately gave instruction to the field that for a couple of months it would be difficult to supply from international supply chains so that they needed to be self-sufficient as possible." R29 "We changed the steps because normally the suppliers used to contact either the buyer or the QA. What changed is the point of entry. We implemented a point of entry common for the three supply centers. So, this person strictly worked on filtering the counterfeit suppliers and the fake suppliers. So, with the filtering, instead of receiving 20 new suppliers, we [Quality Assurance] received like 10. [. . .] And also, we split the COVID items between the buyers. So [ESC1] are responsible for the gowns and gloves and we [ESC2] were responsible for the masks." R17 "In May, we were starting to have 3 months horizon. End of June we could start a 6-month planning." R15		
IV. New growth/optimization phase With some legacy from the previous cycle, the new adaptive cycle starts with the growth of the new structure Sources: **40** documents (33 meeting minutes, 7 internal letters) **14** respondents (R2, R6, R7, R14, R16, R19, R21, R25, R33, R36, R37, R38, R40, R41) "July was back to normal for procurement." R02 "July things went back into place. Things went back to normal structure." R06 "By the end of July, it was the new normal." R14 "July, we still get some trouble, but I think for the COVID items, we are getting more availability, but the commitment is not immediate. The commitment to the delivery will remain longer. But the taskforce identified suppliers that are committing." R32 "Right now, we are in a phase where we still need to source items, but we can breathe, we have some buffer." R33 "As the souring of critical items (PPE and others) has been secured for the near future for most of the items (and improved for others) the C-19 Procurement Task Force is revising the ToR, reflecting the change in the circumstances and ensure relevance with the recent requirements." Newlestter: Intersection_200630 "The relaxed local procurement process ended on May 31st and will not be extended." Newlestter_OC_200604 "I think we'll keep the suppliers that we identified." R36	04/06/20 - onwards	20/07/20 - onwards

Table A2.

Ambidexterity of MSF in adapting to the COVID-19 shocks Ambidexterity phases	Timing of events ESC	Timing of events field
Phase A: A phase of high exploitation and low exploration	01/01/20–17/03/20	01/01/20–09/04/20
High Exploitation - ensuring continuity Sources: **21** documents (18 meeting minutes, 2 internal newsletters, 1 public communication) **14** Respondents (R2, R3, R10, R14, R19, R21, R25, R29, R31, R32, R33, R36, R38, R40) "The concern is not about supply *per se* but mainly on equitable allocation. The question is not only around shortages but how to deal with the shortage." Minutes_ESCs_200228 "Of course, the first thing you do is look at your existing supplier base and see what you can still buy there and what you can secure there, because there you know, the quality of the product." R26 "We put a rush on having available inventory in Dubai, in Merignac, and we prospected our suppliers." R31 "Form sent to the 50 biggest suppliers for having a point of situation." Minutes_ESC_200303 "The missions tried to push for international purchasing for too long. They should have switched to local procurement earlier." R13 "At first, we had to make sure that regardless of the ongoing pandemic, the purchase of items was made according to the processes and respecting all medical matters, processes and all this." R10 Low Exploration- investigating new options Sources: **6** documents (5 meeting minutes, 1 internal newsletters) **14** Respondents (R8, R10, R14, R16, R19, R21, R25, R26, R31, R32, R33, R36, R38, R40) "We kept some scan of the environment. We could try to anticipate some orders, and some new suppliers before the situation got all so surreal." R32 "We were already looking for new suppliers early February. We were not in emergency mode yet, but we were feeling things started to get bigger, and we needed to prepare." R36 "Mid-February, the procurement team started to explore contingency plans for potentially key articles." R21 "We spent 3 or 4 weeks trying to organize the MSPP platform when we could sense market was tense. And then all sudden, we received 450 offers from suppliers, even though they were not manufacturing masks before." R19 "We were securing inventory in the emergency stock." R33 "I immediately secured 8/9 months of PPE for our regular TB projects [. . .] because TB patients are long-term and extremely vulnerable." R37 "At the very beginning, the MSPP wasn't mature enough to take over, it was just getting structured in case." R25		
Phase B: A shift to high exploration and low exploitation	19/03/20–03/06/20	10/04/20–19/07/20
High Exploration - investigating new options: COVID-19 taskforce and local procurement Sources: **100** documents (75 meeting minutes, 21 newsletters, 3emails, 1 public communication) **39** respondents (R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R24, R25, R26, R28, R29, R30, R31, R32, R33, R35, R36, R37, R38, R39, R40, R41, R42)		

(*continued*)

Table A3. Evidence supporting the ambidexterity in the different phases of the adaptive cycle

Ambidexterity of MSF in adapting to the COVID-19 shocks Ambidexterity phases	Timing of events ESC	Timing of events field
"Regarding procurement, helplessness and frustration led to innovation." R01 "We had to put quite a few things in place. It was not easy, we [ESC procurement team] were not used to working this way. But we managed." R11 "We [regional supplier center] had to find new suppliers. We had suppliers, but their capacity was not adequate with our needs, so we had to identify new ones." R12 "Normally we [ESC] ask for the European Quality Certificate and some of these new suppliers were only providing quality certificates from China. So, we had to was really a learning curve. It was this was the first time." R17 "We had a lot of creative solutions." R17 "All the procurement, all searching for new suppliers, it needs quite a lot of follow up, because the situation is very volatile, there is nothing taken for granted." R32 "Besides the prioritization at ESCs, the two main things [to manage the crisis] was the taskforce and the local procurement authorization." R16 "What helped us was the taskforce. [. . .] We reorganized and coordinated in the procurement platform. This collaboration was never done like this before." R17 "[April's priority 1] using alternative approaches such as local purchase, or production of key items, and calling all MSF sections to request or identify opportunities to secure donations or loans. Exploring innovative/ alternative mitigating measures to minimise the impact of PPE shortages." (Newsletter_intersection_1704) "We had to purchase on the Chinese market, and it was totally new for us. We didn't know either the US norms or the Chinese norms. I was all new for us." R25 "We had never done a collaboration between one purchase from one ESC and one QA from another OC, and it worked really well." R25 "So, from the moment we restructured, one ESC takes care of that item, the other ESCs takes care of that item, and we mix the teams of QA and purchaser, it really helped having a global mindset to purchase for all the OCs. It was a little long to put into place, because normal each purchaser and QA only work for their supply center." R33 "We developed quite a few new tools to cope with the covid orders." R37 "We also implemented, that never happened before, inspections before transfer of goods. We had to do it with all the new suppliers." R25		
Low Exploitation - ensuring continuity: maintaining relationships with long-time suppliers Sources: **54** documents (41 meeting minutes, 13 newsletter) **27** respondents (R2, R3, R4, R6, R7, R10, R12, R14, R15, R16, R17, R18, R19, R21, R24, R25, R26, R29, R30, R31, R32, R33, R36, R37, R38, R40, R41)		

Table A3. (*continued*)

Ambidexterity of MSF in adapting to the COVID-19 shocks

Ambidexterity phases	Timing of events ESC	Timing of events field
"[April's priority 2] Securing essential supplies in the long term, by engaging in high-level negotiations with existing and new supply partners." (Newsletter_intersection_1704)		
"From the beginning, we put in the orders to the ESC. Where there was a massive delay, I was asking update to the taskforce [. . .] Those orders are shipped now. So, we knew that for these first six months we would have to monitor with the local procurement and the local stocks." R34		
"We are still focusing on suppliers' reliability, identification of manufacturers and manufacturing sites, as well as quality." R04		
"We had to remind everyone that procurement is still done a certain way. The field could purchase locally, but they had to follow the validation process. And international procurement was handled only by the ESCs, the field was not allowed to purchase in China." R06		
"We tried to maintain the quality validation process as much as possible. Exceptions were drawn, if we were sure about the manufacturer, if it was a manufacturer with a long medical supply experience." R17		
"So this time when there was a massive lack of stock everywhere worldwide [. . .] we still tried to pull the orders all together to make like joint orders." R32		
"We didn't lower our standards. It was a high stake. We could have, but I don't think it would have been a good idea, because the only thing it would have done would be to have purchased fully useless materials at very high prices." R31		
"When constraints in Europe increased, we increased inventory in [this ESCs' warehouse in] Dubai. [. . .] It's always worked well in Dubai." R31		
"My financial authorized was increase, but over [certain amount] purchases still had to validated by the administration council." R19		
"We didn't disturb the normal ordering process or procedure or for items that were not linked to COVID. They [ESC] still had the capacity to prepare those for us." R14		
"We asked MSF Logistique to prepare as much as possible from everything from our regular cargoes, the ones that we place for regular operations. For the COVID's related for regular mission and of course or the emergency we purchased locally." R07		
Phase C: Back to high exploitation low exploration	04/06/20 - onwards	20/07/20 - onwards
High Exploitation - ensuring continuity		
Sources: **36** documents (29 meeting minutes, 7 newsletter) **10** respondents (R2, R6, R7, R12, R14, R19, R21, R33, R36, R38, R40)		
"In June/July, we were back to normal supply from ESCs, and we kept the new suppliers if needed." R12		
"So June, [. . .] we were negotiating with the suppliers and the buyers as well, negotiating huge quantities. Because [before the crisis] one mask costs like ten cents. And during the crisis it was costing like three euros. So, there was this financial game that we know that it works like this. And the buyers were fighting for that." R17		
"In July, the suppliers were validated, we were back to the normal way of validating them and had a sufficient supplier base." R25		
"We need to really to follow up to have good relations with suppliers are good terms, commercial terms and where they can take some my responsibilities." R32		
Low Exploration - investigating new options		
Sources: **4** documents (3 meeting minutes, 1 newsletter) **8** respondents (R5, R19, R21, R25, R33, R36, R38, R40)		
"We will continue to explore the possibility for new suppliers for oxygen concentrators in the region [Latin America]." R05		
"So June, we were still validating new suppliers." R17		
"We are sourcing already for the second wave." R33		

Table A3.

MSF Units	Interviewees' Department and Speciality						
	Supply Chain Management					Operations	Medical
	General*	Procurement	Purchasing	Management	Other SCM specialty		
European Supply Centers		**5** (R19, R24, R33, R38, R40)	**3** (R27, R32, R36)	**6** (R11, R21, R26, R30, R31, R37)	**3** (R18, R39, R42)		**2** (R17, R25)
Operational Centers-HQ	**2** (R03, R14)	*activities conducted at ESCs*		**9** (R00, R06, R16, R20, R23, R29, R34, R35, R41)	**1** (R15)	**3** (R01, R09, R22)	**1** (R02)
Operational Centers-Field	**6** (R04, R05, R07, R08, R13, R28)	**2** (R10, R12)					

**Including Procurement and Purchasing activities*

Note(s): In bold the number of respondents, in brackets the respondents' identification numbers

Figure A1.
Interviewees' profile description

Open Coding Structure :

	Description	Files	References
Capabilities	Ambidexterous Capabilties		
Exploitation Capabilities	Use of existing resources and/or preferred ways	109	146
Exploration Capabilities	Use of new resouces and/ or ways	108	155
Level	Level at which the activities take place		
International	At ESCs level	160	243
Local	At Field level	38	49
Phase	Adaptative Cycle Phase		
Growth/Optimization 1 Phase	Phase of business as usual	9	16
Conservation Phase	Phase of pushing business as usual to the max	25	40
Release Phase	Phase post breaking point of crisis management	71	111
Reorganization Phase	Phase of restructure post accute crisis phase	80	103
Growth/Optimization 2 Phase	Phase of new business as usual	40	50

Axial Coding: *in number of references*

Adaptative Cycle Phase	Ambidexterity	
	Exploitation Capabilities	Exploration Capabilities
Growth 1	12	3
Conservation	29	11
Release	15	77
Reorganization	48	71
Growth 2	48	5

Figure A2.
Coding structure

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