Understanding supply chain resilience as a multi-level framework: A systematic literature review

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Abstract. Supply chain resilience (SCRes) has received considerable attention from scholars and practitioners because organizations and supply chains are facing increasing disasters, uncertainties, and risks. They seek to survive disruptions and return to their original or a better state, and thereby achieve competitive advantage. However, existing studies investigate SCRes mainly from organizational and supply chain perspectives, which limits scholars' and practitioners' understanding and presents an incomplete picture of SCRes. Therefore, we conducted a systematic literature review (SLR) to advance SCRes knowledge through the theoretical lens of grand theory (GT). A total of 102 SCRes relevant, high-quality journal papers published between 2004 and 2023 were selected to synthesize existing knowledge and identify future research directions. Our study makes several novel contributions to existing SCRes knowledge. First, we believe that SCRes is determined by interactions between micro-level individuals, meso-level organizations, and macro-level environments. Thus, this study differs from existing SCRes studies by understanding it from the individual, organizational, and supply chain perspectives. Second, from the macro-level perspective, we conclude that SCRes is influenced by social, economic, technological, policy, and cultural environments. Third, from the micro-level perspective, employees' learning orientation, risk perceptions, self-leadership, and trust may impact on organizational resilience and SCRes. Finally, this study is one of first to apply GT to extend existing SCRes knowledge. We also suggest future research directions advancing SCRes knowledge.

Keywords: Supply chain resilience, micro-level individuals, meso-level organizations, macro-level environments, systematic literature review, grand theory

1. Introduction

Supply chain resilience (SCRes) has attracted significant scholarly and practitioner attention owing to its effective role in helping supply chains to prepare, respond, recover, and adapt to various crises, challenges, risks, and uncertainties [1]. Its development in the area of supply chain management (SCM) can be traced back to the early 2000s, when SCRes was defined as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed" [2]. However, resilience had already been well explored in other areas. For example, psychologists defined individual resilience as successfully adapting to life difficulties or mental problems, sociologists investigated resilient communities after setbacks, and material scientists explored objects' resilience to return to their original shape after being deformed [3]. Resilience, as a desirable characteristic of objects, individuals, and societies, has also been widely investigated in the area of business and management. For example, studies of SCRes have explored resilience capabilities [4], mitigation of supply chain risks by linking SCRes capabilities [5], resilience mitigation strategies [6], SCRes theory revolution [7], and SCRes performance assessment [8].

The variety of research interests contributes to the fragmented nature of SCRes, limiting understanding and hampering progress in this area. Recent literature reviews of SCRes published in reputable journals, such as [9] call for a more solid understanding of SCRes by re-examining relevant concepts, capabilities, and assessment measures to understand how SCRes can be maintained and improved over time. A bibliometric analysis of 771 SCRes papers published between 1988 and 2020 [10] reveals that five areas have received considerable scholarly attention: conceptual development and network design for SCRes, risk assessment to avoid supply chain breakdowns, measuring SCRes to enhance supply chain performance, utilizing resilience capabilities with other supply chain dimensions, and developing robustness in supply chain networks. However, few studies have considered how SCRes is built from a systems perspective. Deep knowledge of a supply chain system's ability to bounce back cannot be gained without a holistic understanding that links the elements involved in supply chains [11, 42, 43, 44].

Thus, in this study we conduct a systematic literature review (SLR) through the theoretical lens of grand theory (GT) to advance SCRes. GT is a social science approach that aims to explain social phenomenon by linking all levels of social reality. The more of reality to be examined, the more "grand" is the theory [12]. Our research question is: what forces from the micro-level of individuals, the meso-level of organizations, and the macro-level of environments can be used to determine SCRes? To answer this question, we thoroughly examined relevant high-quality journal papers published between 2004 and 2023. Our study makes several contributions to existing knowledge of SCRes. First, we contribute to understanding SCRes not only from the widely discussed organizational and supply chain perspectives, but also from the micro-level of individuals and the macro-level of environments. SCRes is the result of interactions between micro-level individuals, meso-level organizations, and macro-level environments. Second, this study summarizes research gaps and identifies potential future research directions by synthesizing 102 journal papers relevant to SCRes. Third, we contribute to GT by taking external environments, such as social, economic, cultural, technological, and policy, into consideration, whereas existing studies consider SCRes only from the individual, organizational, and supply chain perspectives.

In the remainder of this paper, in Section 2 we explain the theoretical foundation for this study, and in Section 3 we present our research methodology. In section 4 we analyze the characteristics of papers and themes relevant to the research question, and discuss these further in Section 5. Finally, in Section 6 we draw some conclusions.

2. Grand theory

GT refers to conceptual frameworks, models, and developments used to provide overall explanations of a discipline or body of knowledge. It seeks to link micro-, meso-, and macro-levels of social reality, and connects concepts and relationships to explain a large social landscape, and is thus useful for knowledge development [12]. We adopted GT in this study for two reasons. First, as highlighted by several previous literature reviews, GT has seldom been used to explore SCM issues. For example, one paper states that 12 theories are widely used to explore purchasing and supply management issues, but GT is rarely applied [13]. A similar conclusion is reached from a review of 411 papers published in six top SCM journals between 2009 and 2019 [14]. The results indicate that 15 theories are frequently used, including game theory, contingency theory, and organizational theory, and the authors suggest 30 theories (e.g., boundary-spanning theory and role theory) that might promote SCM research. However, these do not include GT. GT is widely applied to investigate societal and nursing issues and used to describe the true state of affairs in all settings. For example, [45] has applied GT to explore international relations and foreign policy. Second, existing studies of SCRes are fragmented and specialist in nature, lacking a broad vision of how SCRes is formulated and influenced by the elements involved. Thus, in this study, we conduct an SLR to understand how SCRes is determined by linking micro-level individuals, meso-level organizations, and macro-level environments.

3. Systematic literature review methodology

An SLR was selected as the methodology for this study for several reasons. First, this novel research aims to examine forces from the micro-level of individuals, the meso-level of organizations, and the macro-level of environments that might be used to determine SCRes. An SLR is suited to overcoming the fragmented nature of SCRes by exhaustively searching for relevant journal papers in a systematic and transparent way [5]. Second, SLR are widely used to explore SCRes issues by synthesizing previous knowledge, strengthening the knowledge foundation, and identifying valuable potential research directions [8,9,10]. Their wide application provided us with confidence that we could use this effective tool to answer our research question. Third, the steps involved in conducting an SLR are scientific, replicable, and systematic, thereby helping to reduce bias and generating high-quality results [15]. The SLR implemented in this study includes three steps: (1) formulation of research questions; (2) identification, selection, and evaluation of studies; and (3) analysis and synthesis of the results.

3.1 Formulation of research questions

SCRes is widely discussed, and various definitions have been suggested. For example, it has been defined as "the ability of a system to return to its original state, within an acceptable period of time, after being disturbed" [16]. One study, based on a review of 91 SCRes papers defines SCRes in terms of complex adaptive systems theory as "the adaptive capacity of a supply chain to prepare for and/or respond to disruptions, to make a timely and cost-effective recovery, and therefore progress to a post-disruption state of operations – ideally, a better state than prior to the disruption" [17]. Our initial impression was that all scholars consider SCRes as a systems phenomenon. To confirm this, we checked several literature review papers on SCRes [8,9,10] and discussed the issue with two professors in operations management. The discussion corroborated that a deep knowledge of SCRes might be obtained by re-understanding it from a systems perspective. Supply chains are complex systems involving individuals and organizations, both of which are influenced by external environments. Based on this, we formulated our research question to consider interactions: what forces from the micro-level of individuals, the meso-level of organizations, and the macro-level of environments can be used to determine SCRes?

3.2 Identification, selection, and evaluation of studies

To gain insights into SCRes, we selected four databases - Web of Science, Science Direct, Business Source Complete, and Emerald Insight to search for relevant, high-quality journal papers because of their wide coverage of business and management journals and frequent use by scholars to conduct SCM literature reviews. We selected a publication timespan of 2004 to 2023 because SCRes began to attract research attention following the publication of an influential study entitled "Building the Resilient Supply Chain" in *The International Journal of Logistics Management* in 2004 [2]. Consistent with previous reviews of SCRes [5,8,9,10], 11 keywords were combined and searched for in titles, keywords, and abstracts: ("resilience" OR "resiliency" OR "resilient" OR "robustness" OR "mitigation") AND ("supply chain" OR "supply chains" OR "supply chain management" OR "operations management" OR "supply network" OR "supply"). The initial search produced 3,032 journal papers in English from the four selected databases. We then applied criteria to reduce the number of papers for further analysis. First, as we conducted this review mainly from a business and management perspective, we limited the search categories to management, operations research, management science, and business. This left 1,430 papers. Second, we required the selected papers to have been published in high-quality journals, as defined by the Chartered Association of Business Schools (CABS) in 2021. Therefore, only papers published in journals rated 3, 4, or 4* by CABS 2021 were included for further analysis resulting in 722 papers published in 33 journals, including *Journal of Operations Management*, *Journal of Supply Chain Management*, *Production and Operations Management*, and *Journal of Business Logistics*). Finally, we recruited three PhD students with interests in SCRes to check each paper's title, abstract, introduction, and conclusion, and remove papers irrelevant to SCRes, including purely mathematical modelling papers, and supply chain risk assessment papers. This resulted in 102 papers for further analysis.

3.3 Analysis and synthesis of results

Thematic analysis was employed to generate SCRes themes. This method was selected because it is useful for summarizing the key features of a large dataset, is a highly

flexible and transparent process, and generates unanticipated insights [18]. The three PhD students were asked to code each paper using NVivo 13, and identify and categorize themes. We then synthesized the results and identified potential future research directions.

4. Literature analysis

This section examines how SCRes can be determined by synthesizing existing studies and categorizing themes into the micro-level of individuals, the meso-level of organizations, and the macro-level of environments based on grand theory. We then present our theoretical framework, which open avenues for future research.

4.1 SCRes forces relevant to the meso-level of organizations

First, we discuss capabilities that might be used to build SCRes from the meso-level of organizations because this topic is already well-developed. Prior to this, it is necessary to explore organizational resilience, which has laid the foundation for SCRes. Numerous understandings of organizational resilience are suggested. For example, one paper proposes that organizations may implement different strategies to achieve organizational resilience [19], such as, training and simulation in the preparedness phase, effective communications across supply chain stakeholders and evaluation of supply chain disruption outreach in the response phase, and maintaining employee support, continuity risk and resilience management, and reviewing the resilience strategies adopted in the recovery phase. By adopting these organizational strategies, resilience capabilities such as vertical and horizontal collaboration, supply chain re-engineering, agility, risk awareness, and knowledge management, can be achieved across the supply chain. Another paper highlights that organizational resilience depends on several critical aspects, including materials and networking, learning and culture, investment finance and cash flow, leadership, and strategic and operational flexibility [20]. In a literature review that systematically summarizes organizational resilience, it is argued that resilient behaviour, resilience resources, and resilience capabilities enable organizations to respond to disruptions [21]. As a result of learning and adapting from past disruptions, and renewing their existing resource and capability configurations, organizations can continue to strengthen their resilience.

Amongst diverse scholarly understandings of SCRes, several principles are widely viewed as building SCRes, including supply chain re-engineering, supply chain collaboration, agility, and a supply chain risk management (SCRM) culture. Within these, various capabilities are identified such as flexibility, redundancy, trust, information sharing, visibility, velocity, leadership, and innovation [20]. For example, horizontal collaboration amongst producers and vertical collaboration between processors and retailers may mitigate supply, demand, process, and control risks [22]. Several useful resilience strategies can be used at the supply chain level, including multiple suppliers, collaboration with supply chain partners, supply chain mapping, backup transportation, and flexible network design [23]. One paper presents a new understanding of how to strengthen SCRes, based on a case study of JD.com [24]. The results indicate that support provided by digital platforms, coordinating with suppliers, promoting projects to reduce unhealthy inventories, redistributing logistics networks, modifying processes for last-mile delivery, and taking social responsibility have been

essential in helping supply chains to recover from the COVID-19 pandemic. A study involving semi-structured interviews in multiple industries concludes that Industry 4.0 technologies strengthen SCRes and leverage competitive advantage for supply chains [25].

Amongst several SCRes research streams, the first is Industry 4.0 technology-enabled SCRes. Keywords relevant to this stream include digital technologies, Industry 4.0 and specific relevant technologies (e.g., big data analytics, blockchain, and artificial intelligence), and technological capabilities. For example, the internet of things is said to be an effective tool for managing supply chain risks because it contributes to process transparency and management [26]. The second stream is mitigation of supply chain risks by employing SCRes capabilities. Relevant keywords include antecedents, capabilities, collaboration, robustness, innovativeness, culture, trust, visibility, and agility. The third stream links SCRes with other terms, including sustainability, Industry 5.0, and disruptions such as COVID-19. The fourth relates to discussion of the conceptual development of and pathways to SCRes [27,28]. The fifth examines supply chain risk assessment to provide foundations for building SCRes, and the sixth evaluates SCRes capabilities, factors, or enablers for effective allocation of resources.

4.2 Impact of SCRes forces from the macro-level environments

At the meso-level of organizations, various SCRes themes have been investigated. However, very few studies have explored SCRes from the perspective of the external environment, as highlighted by a recent review of the literature on organizational resilience and SCRes [9]. From a review of 399 papers and book chapters published between 1977 and 2014, it is concluded that few insights have been gained into how to build SCRes beyond the organizational level of analysis. Therefore, more studies of industrial, policy, and societal factors that might promote SCRes are required. According to two studies, SCRes is a systems phenomenon, and should thus be understood from a systems perspective by linking individuals, organizations, and supply chains [37,38]. However, these papers neglect to address understanding of SCRes from the external environment perspective, for instance as a socio-ecological system. Nevertheless, several studies consider environmental factors that may influence SCRes. For example, the result of an exploration of the role of a country's cultural value orientation on SCRes building in the context of COVID-19 indicate that a hierarchical cultural value orientation contributes to building resilience in supply chains, whereas an egalitarianism cultural value orientation contributes to organizational resilience building [1]. In the belief that external environments may help to achieve SCRes, one study assesses the impact of social capital on SCRes using data collected from 265 Turkish firms [295]. The results indicate that social capital has a positive effect on SCRes, mediated by absorptive capacity and marketing-SCM alignment. Another study indicates that environmental taxes may have positive effects on green technology adoption, and that the latter may foster SCRes. In dynamic environments with unavoidable disruptions, establishing a resilient supply chain depends on both internal and external resilience [31]. Internal resilience refers to organizational resilience, whereas external resilience refers to the resilience of supply chain stakeholders and society. Based on data from 185 Chinese manufacturers, one study finds that SCRes may be positively impacted by the joint effects of social control and green supply chain management practices [32]. Finally, it is suggested that normative pressures stemming from professional and industry associations may force organizations to adopt big data

analytics [33], and the latter has positive effects in establishing resilient supply chains [34].

4.3 Impact of SCRes forces from the micro-level of individuals

SCRes from the micro-level perspective of individuals has received little scholarly attention. Organizations and supply chains exhibit resilience because individuals are able to implement various resilience strategies. For example, knowledge management practices and a risk management culture may be critical for building SCRes [35]. Thus, regular meetings with supply chain stakeholders to acquire knowledge, special training programs to enable employees to analyze and understand newly acquired knowledge, and consistently applying new knowledge to solve operational problems are essential. It is suggested that a multilevel understanding of SCRes should be developed, including individual-, organizational-, and supply chain-levels [36]. At the individual level, individuals' learning orientation, employees' trusting disposition, and self-leadership may affect organizational resilience and SCRes. Individuals' perceptions of risk should also be taken into consideration when seeking to understand SCRes from an individual perspective [37].

4.4 A theoretical model of SCRes ecosystem

Based on our review of relevant SCRes papers, we build a theoretical framework to understand SCRes from a systems perspective by linking the micro-level of individuals, the meso-level of organizations, and the macro-level of environments (see Figure 1). At the macro-level, we believe that external environments, such as social, economic, policy, technological, and cultural environments, may influence individuals' behaviour, and thus impact on organizational resilience and SCRes building. For example, France's egalitarianism and intellectual autonomy cultural value orientation may make individuals more willing to collaborate with others and interested in joining voluntary groups, with positive effects for supply chain knowledge mobilization [4]. Organizations' and supply chains' adoption of Industry 4.0 technologies maybe driven by policy [39]. At the meso-level, organizations exhibit resilience in adopting different strategies in response to changes in the external environments. When organizations begin to share information, knowledge, and finance and collaborate with other organizations, the whole supply chain may develop resilience capabilities in the face of disruptions. Both organizations and supply chains become resilient as a result of employees' actions within each organization. Thus, at the micro-level, employees are affected by the external environment and organizational strategies. Employees who show willingness to share knowledge, build trusting relationships with others, and establish self-leadership and accurate risk perceptions, will contribute to organizational resilience and SCRes establishment.

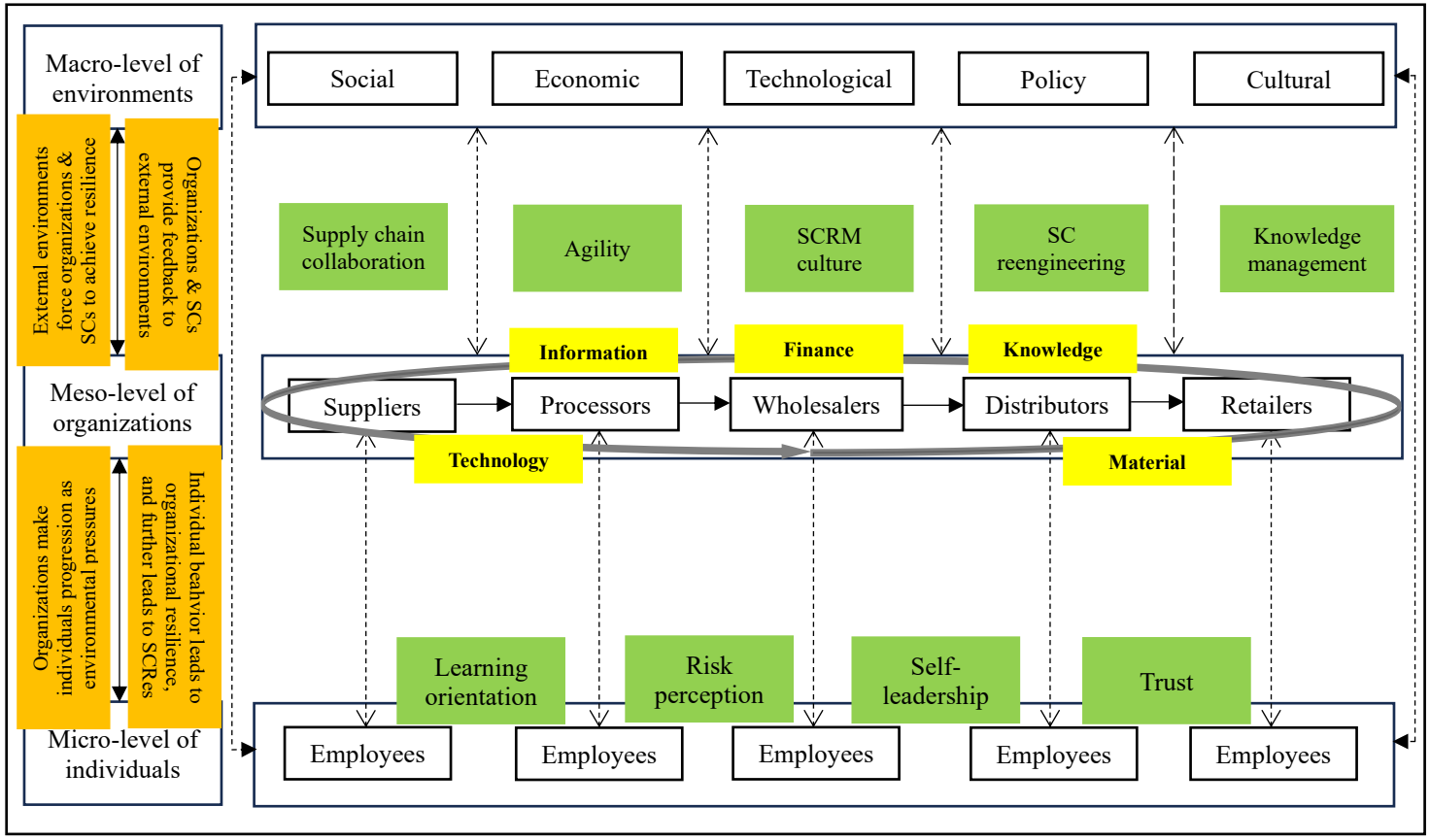

Figure 1 A theoretical framework for understanding SCRes from a systems perspective

5. Discussion

In this study, we adopt GT to re-understand SCRes by linking the micro-level of individuals, the meso-level of organizations, and the macro-level of environments. We thus make several theoretical contributions. First, previous studies explore SCRes mainly from a meso-level perspective to identify various SCRes principles, capabilities, and capability factors that can be applied at the organizational level, such as adoption of Industry 4.0 technologies, a SCRM culture, information sharing across organizations, and redundancy [1,5,20]. A few studies [36,38] call for more research to understand SCRes at individual, organizational, and supply chain levels, but neglect to appreciate that SCRes can also be influenced by the external environment. In our study, we consider that organizational and supply chain levels can be incorporated into a grand organizational level because supply chains consist of networks of relevant organizations with close connections. Thus, our study complements existing SCRes research by understanding SCRes from the environmental as well as organizational and individual perspectives. Second, this study appears to be the first to explore SCRes using GT. Previous studies focusing on SCRes make conceptual advance by utilizing dynamic theory [27], applying information processing theory to understand the moderating effects of supply chain disruptions on performance outcomes [40], or adopting a contingent resource-based view to understand how contingencies can support or hinder organizational resilience [41]. However, GT seems to be neglected. This study takes an initial step toward applying GT and illustrates that successful SCRes relies on interactions between micro-level individuals, meso-level organizations, and macro-level environments. Third, in this study we find that the external environments, including social, economic, policy, technological, and cultural environments, and individual factors such as learning orientation, self-leadership, risk perceptions, and trust may influence the establishment of organizational resilience and SCRes.

We identify several potential directions for future SCRes research. First, this study differs from existing studies that understand SCRes from the individual, organizational, and supply chain levels. In our view, SCRes depends on interactions between micro-level individuals, meso-level organizations, and macro-level environments. However, the question of which forces originating from the micro- and macro-levels may influence SCRes building remains unsolved. For example, in this study, we conclude that social, economic, technological, policy, and cultural environments may impact on SCRes building. However, the literature does not clarify how these macro-level forces may influence individuals, and thereby foster organizational resilience and further trigger SCRes. To gain a holistic understanding of SCRes, it is necessary to link the micro, meso, and macro-levels. Thus, future studies might explore which individual- and environmental-level forces may influence organizational resilience and shape SCRes, and how they do so. Second, existing studies devote attention to developing SCRes from the organizational perspective, but offer little insight into interactions between organizational resilience and SCRes. For example, how does an organization trigger SCRes after it has built its own resilience? What practices should organizations adopt to trigger resilience at the supply chain level? Further empirical research is required on the mechanisms between organizational resilience and SCRes. Third, employees are critical for organizational resilience

development. However, less understood is what practices employees should adopt to achieve resilience at the organizational and then the supply chain level. Empirical studies are needed to understand the relationship between individual practices, organizational resilience strategies, and SCRes capabilities.

6. Conclusion

In this study, we systematically selected 102 high-quality journal papers from four different databases to re-analyze and deepen understanding of SCRes. Through the theoretical lens of GT, this study contributes to understanding SCRes by linking micro-level individuals, meso-level organizations, and macro-level environments, rather than focusing simply on individuals, organizations, and supply chains.

Although we adopted a rigorous research methodology, this study has several limitations that might be tackled in future research. First, we only considered high-quality journal papers published in CABS 2021 rated 3, 4, and 4* journals. Therefore, important SCRes studies published as conference proceedings or book chapters may have been overlooked. To tackle this issue, future studies might include relevant conference papers and books to generate a more comprehensive understanding of SCRes. Second, we considered journal papers from four databases and believed to cover the widest range of business and management publications worldwide, but important publications not included in these databases may have been omitted. Thus, future studies might consider other databases, such as Taylor & Francis Online, IEEE Xplore, and Proquest Business Collection. Third, 11 keywords were used in this study to extract relevant journal papers. However, other keywords closely connected with SCRes were not included, such as keywords relating to the four SCRes phases of anticipation, resistance, response and recovery, and adaptation. Future studies might include more SCRes keywords in selecting publications for analysis.

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