

Dynamic interplay of resilience, flexibility and reconfiguration in service supply chain

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Abstract

The research subject of this paper is the triangular trace of resilience, flexibility, and reconfiguration in the service industry of China. With structural equation modeling, the analysis takes survey responses from middle and senior level professionals working in service companies as the source of data, for the sample size being 213. Results indicate a positive link between supply chain flexibility, reconfiguration, and resilience. Greater flexibility significantly enhances resilience, while reconfiguration further strengthens this effect. Beyond theoretical insights, the study highlights the practical importance of promoting flexibility and reconfiguration to help enterprises navigate market disruptions. The results give advice to the services sector to maximize the supply chain management approach by developing the suitable ones and thus minimizing the danger in turbulent market conditions.

1. Introduction

During the era of technology and globalization, China's service sector is facing some of the most complex challenges in supply chain management (SCM) [1]. The COVID-19 pandemic has exposed the weaknesses of traditional SCM strategies, further emphasizing the need for comprehensive and flexible solutions [2]. Emerging nations, including China, have been among the hardest hit, highlighting the importance of robust SCM strategies. To swiftly adapt their supply chains, e-commerce giants such as JD.com and Alibaba turned to advanced logistics networks and adopted flexible strategies, having significantly benefited from the surge in demand during the pandemic [3][4][5].

SCM complexities are heightened by fluctuating customer expectations, technological advancements, economic shifts, policy uncertainties, supplier risks, and natural disasters [6]. Disruptions often result in increased costs, shortages, and delays [7]. With rapid growth and

digital transformation, China's service sector has expanded its role in the global economy, requiring strong supply chain flexibility (SCF), resilience (SCR), and reconfiguration (SCC) strategies [8].

SCF helps the organization move the sourcing alternatives, order amounts, and production capacity, which are essential for meeting the needs of improving demand [9]. SCC brings about changes in the approach and the processes in the business environment that are flexible to enhance resource efficiency [10]. Service supply chains encounter the reverse flows from service contingencies that do not possess the characteristics of the goods items but are their intangible, heterogeneous, and perishability nature [11]. Both SCR and SCC lessens eventualities and exerts to sustainability and competitiveness [12]. Robust supplier and customer networks amplify Scr as well. The latest findings in the domain of supply chain management accentuate the impact of adaptive supply chains (ASC) on the overall organizational performance, competitiveness, and sustainability [13]. Though the service industry in transiting economies (China's case) still lags behind, particularly with regard to the correlation between SCF, SCC, and SCR, there are some research efforts ongoing. The gap has been filled with the demonstration that in industries (like healthcare) where medical supply was in short supply during the COVID-19 pandemic, supply chains should be flexible [14].

Nevertheless, the theoretical concern has still been acknowledged with respect to the interplay of SCF, SCR, and SCC within the service sector of China [8]. Whereas the wit of fellow researchers has been directed towards the mediation effect of enterprise capabilities, in which they have been ignoring the SCM role in such a relationship as SCR and sustainability [10]. The effect of purchasing conduits on supply chains is another domain thought to be less explored [15]. The phenomenon of alliance effects on SCR in developing economy services sector has also received limited attention from the researchers [6]. This gap indicates the opportunity to close this gap and study how SCF, SCC, and SCR consequentially handle the weekends and COVID-19 in particular, and regarding my study topic of my thesis [16]. The research informs how the service sector of China provides some scalable solutions for the developing contexts that can directly be changed and redesigned to suit the particular operations of each context [17].

The current research explores the influence of SCF on SCR in the service sector of China during the pandemic and attempts to analyze the moderating role of SCC, using the DCT theoretical framework. Theoretically, it suggests ways to reinforce flexibility and customer engagement; hence, it is usable for more practical guidance on supply chain remodeling that targets the fundamental shifts in global market contexts and the digital transformation. The evident set of knowledge gained here serves as a priceless source for service firms in emerging economies, enabling them to address customer-oriented, competitive as well as managerial aspects.

2. Literature Review

2.1 Conceptual Foundation and Research Framework

Fundamentally concerned with DCT, this theory contends that the edge of an organization arises from its innovative powers, its capability to adapt and restructure in the likeness of the environmental fluctuations [18]. Through the DCT, this research emphasizes that companies use adaptability and reconfiguration of businesses to get an edge over dynamic markets. SCF, SCC, and SCR are seen as practical examples of dynamic capabilities, in the process of exhibiting risk management agility lawyers who could handle an unpredictable but critical business environment

[19]. Such a manifestation of DCT concepts perfectly matches the dynamic nature of industries and supports the notion that SCF, SCC, and SCR are ability-enhances and capability-oriented propositions. Consumers have begun talking about such a theory in name of DCT and continue advocating it as a relevant one that support the study's hypotheses and as something that these capabilities contribute to making a strategic advantage in SCM.

2.1.1 Supply chain resilience (SCR)

SCR is the supply chain ability to not only inject flexibility and recover but also respond to disruption while retaining its intended function [23]. It is a demonstration of how organizations organize and allocate uncertainties to boost productivity and is considered a strategic enterprise resource [10]. In my research work, I will define SCR as the capacity of resiliency of a system to get back from the losses and restore the continuity of the supply and dominance in the market [30]. Measured through three dimensions — relocating activities, responding rapidly, or managing financial losses — SCR targets the intensified conditions facing any enterprise in a state of developing [10]. It is again in tune with the very essence of China's service sector, owing to the fact that an "Agile Comeback" is always a must to ensure the survival and growth. Such strategy will simplify the process of tackling the problem, decrease disruptions, and strengthen adaptability and competition among Chinese service companies [24].

2.1.2 Supply chain flexibility (SCF)

Supply chain flexibility refers to the adaptability of a business to accommodate the variations in supply, demand, as well as environmental issues within the company management practices [30]. SCF is used as a switching agent, in this case, for the replacement of one supplier with another, or the size of the suppliers' orders for the purpose of meeting the customers' expectations [9]. SCF should also guarantee that abilities to produce are high enough to prevent shortages even in the seasons of high demand, and there should be laborers available, even if they are required for only a short time period [9]. SCF helps organizations manage risk in case of disruption, which then enables them to respond to customer needs and realize the maximum opportunity [30].

2.1.3 Supply chain reconfiguration (SCC)

SCC is related to how firms anticipate and update their strategies to control unmanageable risks, react to shifts in the demand and supply, reduce possible dangers, and establish a proper supply network between efficiency and resilience [25]. The purpose of this study is to consider the SCC a process defined as the transformation of what the enterprise has following its resources, processes, and structure, in order for it to maintain productivity at competing levels of efficiency and effectiveness in fast-advancing markets [24]. SCC consists of five features: resources' adjustment and process restructuring, introducing assets by way of rescheduling supply chain resources, recombining resources for novel combinations, making resource choices commercially robust, and reorganizing resources to represent the demands of changing markets [26].

SCR stands for restoring ability to disturbances, SCF for the adaptability to market and consumer shifts, and SCC for the resources adjustments that are either automatic in anticipation of changes or reactive to them. Each of these theories indicates the use of specific strategies for building supply chain capabilities, controlling uncertainty, and improving them. This research applied the SCR approach of SCF by selecting a set of three items, SCF as the base of a set of five items representing service firms' elasticity, and SCC from a total of three items pertaining to the reconfiguration ability. The framework that consists of the mentioned notions is illustrated with a figure below (see Figure 1).

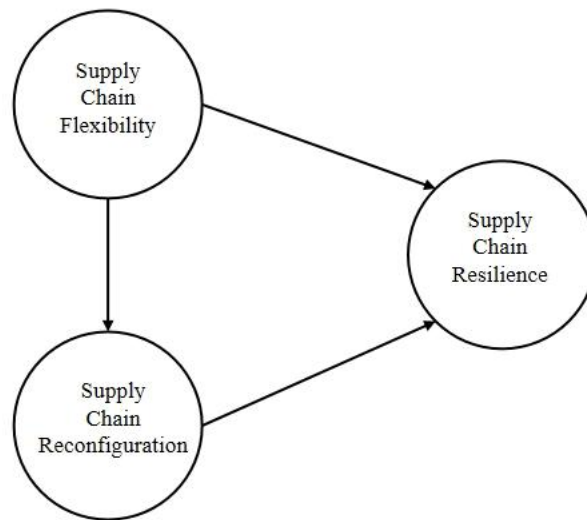


Figure 1. Triangular model of supply chain resilience

2.2 Hypotheses Development

SCF strengthens SCR by allowing enterprises to respond and adjust to the rapid fluctuations in the markets, the customers' preferences, and the ever-changing environment. Research from authors such as Brusset and Teller [27] claims the transaction as a means to prevent risk and increase adaptability. SCF as the robust ally of the circular economy implementation increases all economic performances, while the initial goal of sustainability is realized [26]. Research data show that SCF supports SCR by allowing early, reliable, and trackable communication and interaction among supply chain entities for effective resource and process reconfiguration, which leads to better effectiveness and efficiency [17]. Enhanced SCF, leveraging big data analytics and supply chain integration, provides even more flexibility for resources and process adaptation in conditions of uncertainty. It is another benefit for firms to apply this to the pact of supply chain risks [9]. Financing supply chain strengthening through ability to adapt to uncertain and complex circumstances is regarded as a recent trend ([30]. It enhances SCF's role in the SCR strengthening process. Hence:

H1: Supply chain flexibility (SCF) has a significant positive impact on supply chain resilience (SCR).

SCF is part and parcel in terms of companies' competition in the market framework, clients' choices, and the environment. The article of Dubey et al. [30] (2018) identifies SCF as a necessary tool that enables businesses to be in a position to quickly and neatly adapt to changes from the market due to customer needs. This proficiency is channelized into the flexibility of proactive SCC interventions whenever disruptions or fluctuation occur [9], which helps sidetrack human and financial resource reallocation, revise the process, run continuous improvement, and stand obstacles. Sreedevi and Saranga [6] (2017), who used an empirical approach, provided insights into SCF's coverage of shapes, which had supply, manufacturing, and distribution/logistics flexibility, being involved in the trend of vernacular markets with infrastructure in an early development stage. SCF not only collaborates on the resource and process redesign [17] activities, through cross-department decision-making [3] [26], but also aids in stakeholder communication and coordination [16]. These findings point to the contribution of SCF parts in improving firms' resilience to unexpected disruptions in the supply chain through SCC activities.

H2: Supply chain flexibility (SCF) has a significant positive impact on supply chain reconfiguration (SCC).

SCM not only enhances operational productivity but also introduces flexibility and robustness. It enables supply chains to detect and respond to changes, effectively addressing risks and ensuring continuity. By leveraging inventory and data, supply chain technologies (SCT) strengthen the ability to monitor complex environments, optimize structures and processes, and ultimately enhance resilience. Empirical studies, such as Al Naimi et al. (2020), demonstrate how effective collaboration can mitigate disruptions in high-risk regions like Qatar, where a responsive and proactive strategy proves vital. In manufacturing, Nwodu et al. (2022) emphasize the importance of adaptability—such as rapid design changes—while Zidi et al. (2022) highlight the role of capacity adjustments and strategic communication. These findings suggest that supply chain collaboration (SCC) functions as an integrated “pulse,” transforming capabilities to withstand market volatility. Similarly, in the service sector, SCC positively influences supply chain resilience (SCR), reinforcing the link between strategic adaptation and long-term stability in SCM.

H3: Supply chain reconfiguration (SCC) has a significant positive impact on supply chain resilience (SCR).

3.Methodology

Focusing on large-scale organizations, the research employed a structured questionnaire targeting middle and senior managers in Chinese service firms—those with frontline roles and decision-making authority over supply chain operations and learning. Their responses reflected SCF, SCR, and SCC practices based on organizational performance. To ensure data validity, measures such as monitoring IP address, location, and response time were applied. The sample met the minimum threshold recommended by SMART PLS 4, with further data refinement conducted through SPSS.

PLS-SEM was adopted because of its robust applicability of examining complex models and its importance for predictive or explanatory purposes in exploratory research. This method can work even with small samples that do not follow a distribution law, making it suitable. [31]. The software's advanced analytical features further support its application [29]. To gather empirical data, a comprehensive questionnaire survey was developed using established scales, adapted and translated into Chinese for relevance to the service industry. A pre-test with three professors specializing in survey and supply chain research ensured clarity and relevance. The final questionnaire comprised five index items for SCF [9], three for SCR [10], and three for SCC [10](see table 1). Data collection occurred in three rounds over three months, from September 30th to December 30th, 2022. With ethical approval (Approval No. BS-NIT-2022-01) and informed consent, 213 valid samples were collected through virtual platforms despite COVID-19 challenges.

Table 1 Structure Items

Supply Chain Reconfiguration (SCC) [10]	
SCC1	We reconfigure resources and processes based on dynamic environments.
SCC2	We can successfully reconfigure supply chain resources to develop new productive assets.
SCC3	We can effectively integrate and combine existing resources in this supply chain to form novel combinations.

Supply Chain Flexibility (SCF) [9]

- SCF1 It is possible to switch the procurement of items from one supplier to another.
- SCF2 Can change supplier order quantity
- SCF3 Different shipping methods are available to deliver products to customers.(deleted)
- SCF4 Production capacity is sufficient to meet the growth in demand.
- SCF5 Overtime or temporary workers can cope with short-term fluctuations in demand.
- SCF6 Because setup costs are relatively low, most suppliers are able to produce small quantities.

Supply Chain Resilience (SCR) [10]

- SCR1 We can respond to changes brought about by supply chain disruptions.
- SCR2 We can respond quickly to supply chain disruptions.
- SCR3 Our company's supply chain is well prepared to deal with the financial consequences of supply chain disruptions.

Note: SCC, supply chain reconfiguration; SCF, supply chain flexibility; SCR, supply chain resilience

Table 2 Sample characteristics

Classification	Attributes	Frequency	Proportion (%)
Business Category	Health and social work	4	1.9
	Residential services, repairs and other services	3	1.4
	Financial industry	21	9.9
	Wholesale and retail industry	39	18.3
	Accommodation and catering industry	14	6.6
	Information transmission, software and information technology services industry	25	11.7
	Transportation, warehousing and postal services	12	5.6
	Culture, education, sports, entertainment industry	60	28.2
	Other service industries	35	16.4
Enterprise size	Less than 50 people	71	33.3
	50-99 people	35	16.4
	100-299 people	30	14.1
	300-1000 people	26	12.2
	1,000-10,000 people	27	12.7
	More than 10,000 people	24	11.2
Position	Boss/Director	56	26.3
	High-rise manager	39	18.3
	Middle level manager	118	55.4
Working years	less than 1 year	13	6.1
	1-5 years	69	32.4

Education level	6-10 years	74	34.7
	11-15 years	26	12.2
	16-20 years	13	6.1
	More than 20 years	18	8.5
	High school/technical secondary school or equivalent education	11	5.2
	College degree or equivalent	43	20.2
	Bachelor's degree or equivalent	101	47.4
	Master's degree or equivalent	52	24.4
	PhD or equivalent	6	2.8
	Age		
	18-25 years old	10	4.7
	26-35 years old	113	53.1
	36-45 years old	60	28.2
	46-55 years old	28	13.1
	56-65 years old	2	0.9

4.Results

For an overview of sample characteristics in the Chinese service industry, please refer to Table 2.

4.1 Descriptive Statistics

Table 3 given ahead presents the descriptive statistics of research data.

Table 3 Descriptive statistics of variables

Structure	Variable name	Mean	Range[minimum value; maximum value]	S.D.	Skewness	Kurtosis
SCC	SCC1	3.940	[1;5]	0.845	-0.603	0.385
	SCC2	3.920	[1;5]	0.868	-0.588	0.219
	SCC3	3.960	[1;5]	0.865	-0.404	-0.408
SCF	SCF1	3.990	[1;5]	0.895	-0.817	0.469
	SCF2	3.880	[1;5]	0.983	-0.625	-0.190
	SCF4	4.020	[1;5]	0.887	-0.741	0.314
	SCF5	3.960	[1;5]	0.956	-0.906	0.720
	SCF6	3.890	[1;5]	0.894	-0.537	-0.008
SCR	SCR1	3.850	[1;5]	0.875	-0.521	0.092
	SCR2	3.850	[1;5]	0.897	-0.501	-0.064
	SCR3	3.820	[1;5]	0.946	-0.570	0.081

4.2 Trust Level Evaluation

Table 4 shows all AVE values exceed 0.5, confirming the model's predictive relevance and robust construct measurements. Using the Fornell-Larcker criterion, Table 8 further validates discriminant validity, with AVE square roots surpassing inter-construct correlations.

Table 4 Measurement model assessment results.

Structure	Project	Loading	Indicator reliability	Average variance extracted	pA
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SCC	SCC1	0.938	0.880	0.888	0.937
	SCC2	0.953	0.908		
	SCC3	0.937	0.878		
SCF	SCF1	0.849	0.721	0.698	0.897
	SCF2	0.834	0.696		
	SCF4	0.850	0.723		
	SCF5	0.788	0.621		
	SCF6	0.855	0.731		
SCR	SCR1	0.930	0.865	0.889	0.938
	SCR2	0.946	0.895		
	SCR3	0.951	0.904		

4.3 Validity Analysis

Table 5 shows HTMT values below 0.90, confirming discriminant validity.

Table 5 HTMT standards

	SCC	SCF	SCR
SCC			
SCF	0.886		
SCR	0.896	0.863	

4.4 Structural Model Fitting

Table 6 confirms the model's good fit, no multicollinearity, and strong explanatory power. The model shows SCF and SCC significantly enhance SCR, with satisfactory explanatory power (see Figure 2). Table 7 confirms the measurement tool's reliability and validity (see Figure 2).

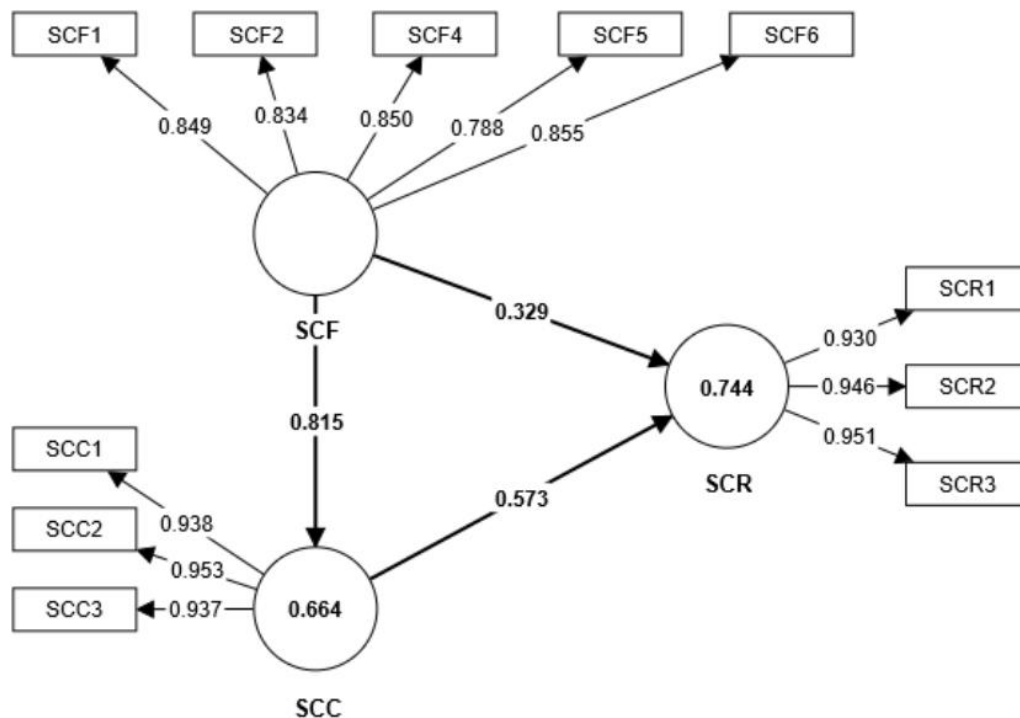


Figure 2. The results of the supply chain reconfiguration triangle model

Table 6 Structural model evaluation results

Path	Variance inflation factor	Path coefficient	97.5% bootstrap bias corrected confidence interval	Significant(p<0.05)
SCC -> SCR	2.974	0.573	[0.387;0.742]	Yes (0.000)
SCF -> SCC	1.000	0.815	[0.747;0.865]	Yes (0.000)
SCF -> SCR	2.974	0.329	[0.168;0.496]	Yes (0.000)

Table 7 Cross Loadings

	SCC	SCF	SCR
SCC1	0.938	0.760	0.789
SCC2	0.953	0.765	0.794
SCC3	0.937	0.778	0.795
SCF1	0.723	0.849	0.688
SCF2	0.659	0.834	0.692
SCF4	0.718	0.850	0.717
SCF5	0.570	0.788	0.530
SCF6	0.716	0.855	0.677
SCR1	0.819	0.773	0.930
SCR2	0.800	0.760	0.946
SCR3	0.755	0.714	0.951

4.5 Hypotheses Testing

Structural model analysis supports all hypotheses (Table 8), showing SCF positively impacts SCR (H1) and SCC (H2), while SCC also enhances SCR (H3), partially mediating the SCF-SCR relationship. These results confirm the model's robustness and emphasize the importance of strengthening SCF and SCC to boost SCR in Chinese service industries. Detailed results are in Table 6.

Table 8 Fornell-Larcker criterion

	SCC	SCF	SCR
SCC	0.942		
SCF	0.815	0.836	
SCR	0.841	0.796	0.943

5. Discussion and Conclusion

This study examines the interplay between SCF, SCR, and SCC within the Chinese service industry, contributing to SCM research. It confirms that resilience, flexibility, and reconfiguration are essential for optimizing SCM [16]. Strong positive relationships among these factors extend previous findings [19][16]. SCF enhances SCR by improving resilience against disruptions, while its role in SCC further emphasizes flexibility's importance in the service sector [9]. SCC also positively impacts SCR, supporting resilience during crises like COVID-19 [10].

5.1 Theoretical Implications

SCF relationships are studied in this research following DCT, adding SCR and SCC into the

equation, thus, introducing a new model that consists of three components, that is increased SCF along with SCR and finally upgraded SCC. It deviates from existing supplier chain network studies that both use supply chain analysis in the service sector. Empirical evidence from mid and higher management representatives from various sectors take us back to sector being heterogeneous and that SMEs also play a major role. The findings show the need for adaptable and functional supply chains, which are specific for the services in countries that are still developing, like China. This research contributes to the theory of SCM through revealing how resilient and responsive supply chains are affected by digitalization and market demands. Empirical evidence is also provided to improve the insight into service sector behavior and develop the policies for diverse national economy[26][16]. The article thus affirms a contextualized SCM, which addresses the nation-specific challenges in emerging markets.

5.2 Practical Implications

The study here, therefore, has the objective of building a triangular dynamic model to determine the interaction mechanism among SCF, SCR, and SCC in China's service industry. Findings insist that industry strategies be revisited with an eye to restraints on demand and social distancing during COVID-19. Sending and retrieving back resilient supply chains cope with unpredictable challenges efficiently, hence with fast operational recovery supporting restructuring. Flexibility is one of the main keys to success, particularly to keep up with market trends and consumer requirements. The strengthening of SCF, SCR, or SCC will contribute to the realization of better supply chain performance. Supply chain managers' advanced strategies should be twined with managing supply chain flexibility, elasticity, and recombination thoroughly, particularly in defect situations. Prioritizing SCF facilitates faster reconfiguration, helping firms mitigate risks and adapt to market turbulence. Companies should assess their SCF, optimize internal resources, and enhance recovery capacity. Enhanced SCF strengthens adaptability to market volatility and challenges. Firms with strong supply chain flexibility and elasticity can implement effective SCC strategies, reducing risks and achieving a balance between efficiency and resilience. Strategies should be tailored to industry characteristics, company size, and market goals for competitive advantage.

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