# Supply Chain Integration and Supply Chain Performance: The Mediating Role of Supply Chain Resilience

Arsalan Zahid Piprani[#1], Suhana Mohezar[#2], Noor Ismawati Jaafar[#3]
[1,2,3] *Department of Operations and Management Information Systems, University of Malaya, Kuala Lumpur, Malaysia*
[1]arsalanzp@gmail.com
[2]suhanamohezar@um.edu.my
[3]isma_jaafar@um.edu.my
*Corresponding author:* Email: suhanamohezar@um.edu.my

***Abstract*— The objective of this study is to examine the influence of supply chain integration (SCI) on supply chain resilience (SCRES) on supply chain performance (SCP) dimensions of large – scale manufacturing firms in Pakistan. It also examines the indirect effects of all the SCI dimensions on all the SCP dimensions through the SCRES. A quantitative approach using questionnaire survey was employed to examine the hypotheses and theoretical framework. Data were collected from 182 manufacturing firms in Pakistan and the SMART PLS version 3.2.7 was used for data analysis. The results showed that the SCI contributed significantly to the SCRES while the SCRES impacted on the SCP substantially. However, the association between the SCI and the SCP was not linear; it was determined by the level of the SCRES. This study fills the research gap by integrating the SCRES as a mediator between the SCI and the SCP.**

***Keywords*—** *Supply chain resilience, supply chain integration, supply chain performance, mediating effects*

## 1. Introduction

The competitiveness of today's supply chain is greatly influenced by the mounting global business activities, technological advancements, expanded customer requirements, and shrinking product lifecycles [1]. Consequently, market demand has become more volatile, and managing the supply chain's uncertainty is crucial [2]. In a world of extreme market dynamism, the supply chain integration (SCI) has been emphasized as a cornerstone for firms to sustain themselves [3], [4]. Firms operating at greater levels of the SCI have more tendencies to share information about the market demands and supplies, thus enabling them to be more responsive and agile [5]. Despite this, the SCI alone may not guarantee a sustained supply chain performance (SCP).

Literature indicates some inconsistent findings about the relationship [6], [7]. In a dynamic business setting, the insignificant direct effect of the SCI may be due to factors like risks or uncertainties that lead to produce non-linear relationships with performance [8]. Therefore, researchers and practitioners have begun to acknowledge the importance of the supply chain resilience (SCRES) as a crucial capability that could help firms to anticipate, prepare and respond to the volatilities happening in the supply chain [9],[3]. Undoubtedly, firms with resilient capabilities are not only able to survive in a tumultuous and volatile condition, they are also more competitive [10],[11]. For example, Ericsson lost $400 million due to its inability to switch to alternative suppliers when Phillips experienced a shutdown caused by lightning in the year 2000. In contrast, Nokia secured the continuity of its operations by swiftly switching to alternative suppliers [12]. Similarly, Cisco was also able to respond when the tsunami and earthquake hit Japan in 2011. This is because it had deployed an efficient and effective resiliency program. This catastrophic event cost a total economic loss of around $217 billion globally [13].

A number of scholars in the area of resilience had treated the SCI as one of the resilient capabilities [14], [15] that facilitated firms in overcoming the supply chain disruptions [16], [17]. Through the SCI, processes would become more visible as information flows smoothly and quickly along the network, thereby enhancing the ability of firms to respond well [18], [19]. Thus, it is believed that the relationship between the SCI and performance could be influenced by an intervening variable, the SCRES. Despite this being so, there seems to be a dearth of research focusing on the link between the SCI, SCRES and SCP. Aiming to address this gap, the current study thus attempts to investigate how the SCRES mediates the relationship between the SCI and the SCP. It is important to mention that a study by [20] had examined the relationship between integration and service performance whereas the current study is evaluating the SCRES as a mediating variable between the SCI and the supply chain performance (SCP) measures. This study is also evaluating the SCP as a multi-dimensional construct consisting of cost-efficiency, customer service and flexibility performance dimensions. By

doing this, we could examine how the individual dimensions of the SCI are related to various dimensions of the SCP.

The current study focuses on large scale manufacturing firms in Pakistan because the manufacturing sector contributes to 13 per cent of the country's GDP [21]. Despite the abundance of global demands and huge industrial potentials, the manufacturing sector in Pakistan is experiencing huge threats in the past few years [22],[23]. These threats are traced to the unrest situation of the country after the 9/11 war against terrorism, the political instability, higher cost of utilities, lack of clear investment policies and the lack of business friendly environments [24]. These challenges have exposed the country's environment to become more disruptive as observed in the 2018 Resilience Index Annual Report. Pakistan was ranked 118$^{th}$ out of 130, compared to its neighboring developing economies like Bangladesh (108), Sri Lanka (81), India (68) and China (59). Given this situation in Pakistan, there is a dire need for the manufacturing firms to constantly build their resilient supply chain capabilities in order to stay competitive. This therefore, highlights the importance of incorporating the SCRES as a mediator, particularly in this study. It is hoped that the current study could offer practical contributions to the manufacturing firms operating in Pakistan and other emerging economies. It is also hoped that the findings derived from the study could be used to expand on the limited literature of the SCRES in developing countries. Whilst developing countries constitute a significant part of the global supply chains, and they are exposed to severe repeating risks including political turmoil, corruption, poor infrastructure and unethical business practices [25], little empirical work has been done to examine this issue. This leaves the developing countries severely underrepresented.

## 2. Literature review

This section reviews previous studies related to the supply chain integration, supply chain resilience capabilities, and supply chain performance. The lack of research noted in this area is then emphasized.

### 2.1 Supply chain integration

Literature [4], [26] has mostly divided the supply chain integration (SCI) into three different types: internal integration, supplier integration, and customer integration. Internal integration (II) refers to the coordination across different functions, namely procurement, manufacturing, marketing and finance [27]. It provides an overview of the firms, enabling the managers of each business unit to obtain accurate information on customer orders, production plans, work-in-process, inbound and outbound goods as well as financial and accounting information. Supplier integration (SI) refers to the extent of coordination between manufacturers and their suppliers in making decisions related to capacity planning, demand forecasting, inventory management, and replenishment as well as the flow of materials. In contrast, customer integration (CI) refers to the extent of coordination between manufacturers and their customers in making decisions related to demand forecasting, production planning, order tracking, and product delivery [28]. The ultimate goal of the SCI is to create a seamless business process across the supply chain network, thereby serving as a competitive weapon [25].

Supply chain scholars and practitioners [27], [29] have greatly accentuated the importance of integration and collaborative arrangements with the supply chain partners. However, there are studies [5], [30] that documented some inconsistent empirical findings. These inconsistencies could be attributed to the various SCI conceptualizations employed in those studies. In examining the SCI, most of the existing studies appear to decompose it into individual constructs (i.e. internal, supplier and customer integration [5]. In contrast, there are also empirical works that treated the SCI as a single construct [7], [31]. Furthermore, Resource Based View (RBV) theory seems to be an established theory used to explore the relationship between the SCI and the SCP; it appears that within a dynamic and turbulent environment, having excess resources that are rare and imitable may not guarantee competitiveness. In fact, manufacturing firms need to be responsive by being able to reconfigure their supply chain practices. Hence, the RBV theory may not be able to explain how the SCI could lead to the SCP, whereby mixed findings were recorded [32].

### 2.2 Supply chain resilience

Supply chain resilience (SCRES) facilitates firms into quickly responding to any unforeseen changes and in restoring their operations by combining and reconfiguring the firms' available resources and capabilities. Within the literature, there is no universal definition of the SCRES [33]. For instance, [34] viewed the SCRES as the capability of the network or system to get back to the desired level of performance after experiencing a shock or vulnerability in a supply chain. In a more recent study, [35] viewed the SCRES as the capability of the organization to rapidly react to any vulnerabilities in the supply chain, and to get back to a normal state after the event had occurred. Despite the different descriptions of the SCRES, it appears that the general impression of the SCRES is similar. Consistent with this train of thought, the current study also defines the SCRES as the capability of

supply chains to rapidly react to disruptions so as to quickly reinstate operations to the pre-disruptive state or to an improved state.

Considering the increasing number of interconnected supply chains existing at the global level, and the dynamic nature of businesses, it is not surprising that the body of literature on the SCRES is growing. A review on the literature focusing on this area highlighted various enablers and factors that influenced the SCRES [9], [33]. It appears that some scholars [36] used the multi-dimensional constructs to represent resilience. For instance, [36] conceptualized resilience as two dimensions: agility and robustness. In a more recent work [3] employed supply chain risk management, redundancy, visibility, suppliers and customers collaboration as resilience whereas [37] incorporated risk management culture, agility, integration and supply chain re-engineering to represent resilience. In contrast to this practice, there were scholars such as [38], [39] who conceptualized resilience as a uni-dimensional construct. The present study takes into account the SCRES as a single dimension which incorporates items such as firm ability to respond at the time of disruption, and firm ability to connect and maintain control during the recovery stage of resilience. These measures are important in the developing countries contexts which are more prone to supply chain disruptions [40].

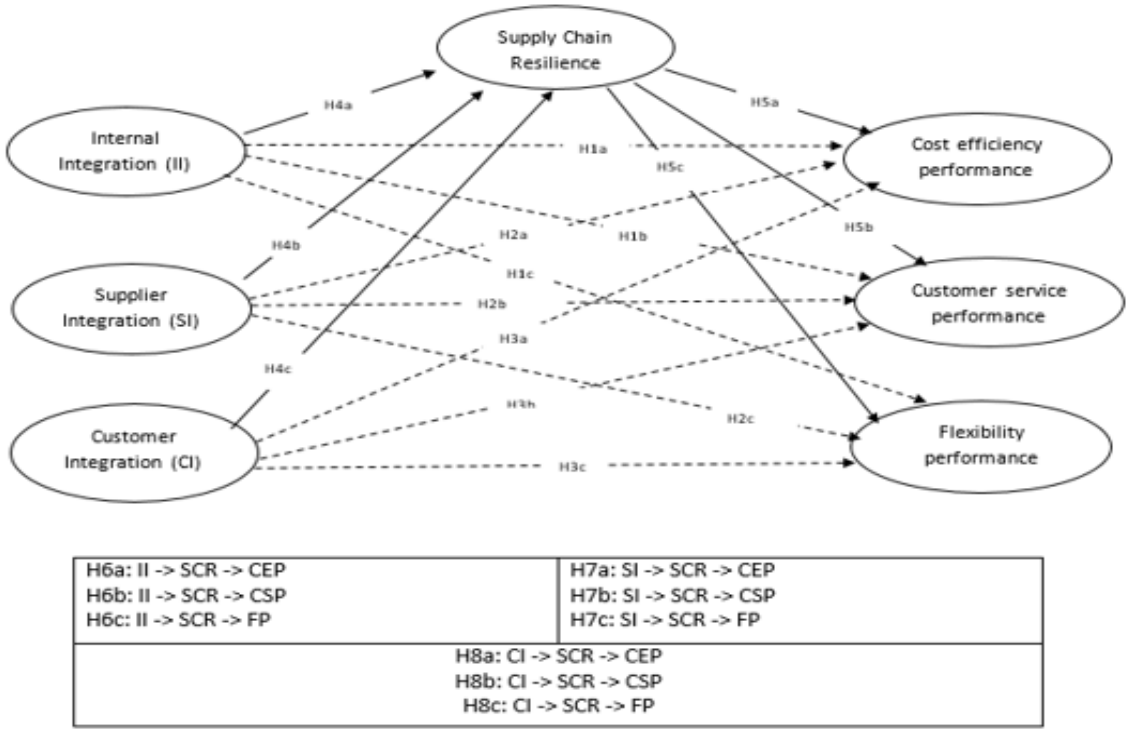
### 2.3 Supply chain performance

The supply chain literature has mainly employed two types of performance measures – costs or a combination of costs and non-costs performance (i.e. customer responsiveness, flexibility). Costs measures may include inventory costs and operating costs whereas non-costs performance may include indexes such as lead time, quality, fill rate, stock-out probability, and firm ability to switch productions and to introduce new products. Ref [41] proposed three performance measures for supply chains. They include: resource, output and flexibility. These were later adopted by many scholars [42] to measure the supply chain performance (SCP). Resource measures are the fulfilment of cost efficiency goals, such as cost optimization in productions, warehouse and logistics. Output measures are the fulfilment of goals which are related to customer service like response times, product quality, on-time delivery, customer complaints and customer satisfaction. Flexibility measures are related to adjustments in product quantity, product mixes and adjustments in the capacity to better serve the customers. In another study, [43] had categorized the SCP into supply chain flexibility and supply chain efficiency whereas others have adapted [41]'s performance measures by categorizing these into customer efficiency performance and customer service performance [44], efficiency and effectiveness [45].

Following [41], this study will use both costs (cost efficiency) and non-costs (customer service and flexibility) performance. By incorporating the non-costs performance, the impact of both the SCI and the SCRES on the SCP on the day-to-day manufacturing and supply chain operations can be seen more clearly [26], [46]. Managerial perceptions were used to capture these performance dimensions rather than accounting measures due to the limitation of the financial data available. This would have made it impossible to quantify the performance. Furthermore, these measures are more historically oriented, thereby limiting its ability to predict future performances [47].

## 3. Theoretical framework and hypotheses development

The present study is based on the framework proposed in Figure 1. This framework was established based on the dynamic capability theory (DCT) which is an extension of the RBV. According to the DCT, firms achieve a competitive advantage by integrating, creating and reconfiguring their resources. Within the supply chain management literature, the DCT has been noted in a number of studies. For instance, [48] had utilized this theory to examine how different types of visibility affect the SCRES, and consequently on performance. In another study, [14] had used this theory to investigate how lower order capabilities could enhance resiliency in the supply chain. In the context of this study, the application of the DCT is based on the assumption that firms need to be responsive by reconfiguring their supply chain practices, and to move towards tighter integrations with the suppliers and customers.




Direction of the arrows represents the direction of a positive relationship

**Figure 1.** Hypothesized research model

### 3.1 Supply chain integration and supply chain performance

The DCT posits the importance of integrating the business processes, so as to better align and reconfigure its resources with the speedily altering business dynamics [49]. Literature [26], [46] seemed to emphasize the SCI as a key driver for enhancing firm performance. Of all the integration types, II plays the most important role in improving firm performance. Undoubtedly, firms with improved internal integrative capabilities can better coordinate and collaborate between their departments. This allows manufacturers to disseminate and develop the external knowledge obtained from the suppliers and customers. With better integrative mechanism within the organization, firm cam improve its process efficiency and flexibility [50] manufacturing flexibility [51], quality [52], agility [5] and delivery performance [28]. Based on the arguments above, the following hypotheses were formulated:

**H1a:** II has a positive influence on CEP.
**H1b:** II has a positive influence on CSP.
**H1c:** II has a positive influence on FP.

In an integrated supplier environment, firms that willingly share information and knowledge is characterized by long-term relationships, open communication, trust, commitment as well as shared risks and rewards [4]. Effective SI could help to reduce the variances in product quality [53]. In turn, this would improve delivery time and product reliability. Moreover, a better exchange of information with suppliers can reduce the burden of carrying more capital on the inventories [32], thereby facilitating buyers into making operation decisions, such as replenishment and delivery schedules [54]. This consequently helps in enhancing flexibility and the delivery of the SCP. Based on these arguments, the following hypotheses were formulated:

**H2**a: SI has a positive influence on CEP.
**H2b:** SI has a positive influence on CSP.
**H2c:** SI has a positive influence on FP.

Customers can provide fresh, innovative and practical ideas for new product development as they specify their needs and requirements by clarifying the types and characteristics those products should have [5]. Through CI, firms can penetrate into the customers' firms and understand their products, culture, and market, thereby allowing firms to respond precisely to the market needs. This will help to reduce the need for rework and scraps which are often caused by misunderstanding customer needs. The information shared by the customers on accurate demand information can further enhance firms to become responsive and flexible towards market demands, through improved forecasting

accuracy [4]. Based on the arguments, the hypotheses were formulated as:

**H3a:** CI has a positive influence on CEP
**H3b:** CI has a positive influence on CSP.
**H3c:** CI has a positive influence on FP.

### 3.2 Supply chain integration and supply chain resilience

Internal integration improves the coordination mechanism between the functional areas, thus resulting in improved cross-department communication, and improved business performance and attainment of organizational goals [55]. Moreover, there is a greater need for II when the firms want to proactively deal with supply chain disruptions. An effective internally integrated organization has a smooth and structured information mechanism among the departments. This helps in reducing the likelihood of disruptions. Based on this argument, the hypothesis was formulated as:

**H4a:** II has a positive influence on SCRES.

It is critical for the firms to align and synchronize their business processes and activities with their supply chain partners in order to improve the continuity of the supply chain operations [56]. Under extreme turbulence, the organizations cannot effectively respond to the unforeseen changes without any collaborative arrangements between the partnering firms [10], [57]. Furthermore, the collaborative arrangements with suppliers and customers through an integrative capability can promote transparency in the system. This also assists firms in creating visibility across the supply chain network. Consequently, firms are better prepared to face any unforeseen changes well in advance, thereby enabling them to bolster resilience in the supply chain. Based on this, the hypotheses were formulated as:

**H4b:** SI has a positive influence on SCRES.
**H4c:** CI has a positive influence on SCRES.

### 3.3 Supply chain resilience and supply chain performance

A resilient supply chain network not only alleviates the capabilities of firms to absorb disruptions, but also to speedily recover and return to normal conditions. This can influence firms' performance [11], [34]. It is evident from literature that the more time a firm takes to react to any turbulence; the greater the damage would be [58]. The reason is because these disruptions can cause a decrease in firm performance [18]. In another study, [15] studied the resilience phenomenon in relation to the service performance in 3PL companies. They found a positively significant influence on service performance. In a nutshell, it can be argued that firms with greater levels of SCRES were better at detecting potential risks and threats. Based on this, the hypotheses were formulated as:

**H5a:** SCRES has a positive influence on CEP.
**H5b:** SCRES has a positive influence on CSP.
**H5c**: SCRES has a positive influence on FP.

### 3.4 Mediation analysis

Literature on the SCRES and the DCT mentioned that a firm operating in a highly dynamic environment needs to coordinate, integrate, combine, and reconfigure its resource base with the changing business environment in order to acquire a competitive standing in the market [59]. The SCI is one of the ways that could enable the firm to create synergistic effects across the supply chain network. This can be achieved by the firm through building a collaborative relationship with its supply chain members [60]. By effectively and efficiently incorporating the integration across the supply chain networks, the firm can stay competitive in numerous areas of capability [61]. This can also ensure the firm's sustainable performance. Nonetheless, in today's dynamic business environment, firms which rely solely on integrations across the supply chain network may not always achieve a sustainable SCP. For that matter, the SCRES plays a crucial role towards the firm's success and its survival [38], [33]. Firms with a resilient mindset are better able to prepare and respond to the disruptions [62]. As discussed above, the SCI is one of the vital enablers in building resiliency within the supply chain. This would assist the firms into reducing uncertainties in the business environment, thereby resulting in better financial returns [11], service performance [18], and competitive performance [63]. In hypothesis H1a through H5c, we had attempted to investigate the significance of resilience as an outcome to different types of SCI and as an antecedent to CEP, CSP and FP. Based on this; we proposed that the SCRES has a mediating effect in the relationship between the different types of SCI and SCP components:

**H6:** SCRES mediates the relationship between II and (a) CEP, (b) CSP, (c) FP.
**H7:** SCRES mediates the relationship between SI and (a) CEP (b) CSP, (c) FP.
**H8:** SCRES mediates the relationship between CI and (a) CEP (b) CSP, (c) FP.

# 4. Methodology

## 4.1 Operationalisation of constructs

A quantitative approach using the questionnaire survey was employed to test the theoretical model and the hypotheses developed. All the measurement items were adapted from previous literature (see Table 2). SI was measured by using six items which were adapted from [4], [64] -[66]. These items measured the extent of the collaborative efforts practiced between firms and their suppliers. In contrast, II and CI constructs were adapted from [64]. The items measuring the SCRES which was used as a mediator in this study were adopted from [56]. These items were related to the preparedness of the supply chain for unforeseen events, quick response to disruptions, firm's connectedness with partners, and the maintenance of the control mechanism. This study utilized three performance parameters of the SCP, the CEP and the CSP constructs which were adapted from [44]. However, the FP was operationalized by means of four items which were adapted from [67], [68], and [32]. All these constructs are reflective in nature as determined through the decision criteria proposed by [69].

## 4.2 Population and sampling

The population of the study entails large scale manufacturing firms located in Karachi, Pakistan. The primary reason for choosing Karachi as the region of this study is because large scale manufacturing setups are mainly concentrated in this city, and it also contributes the most towards the country's GDP[1]. In this study, the unit of analysis is the company. The researchers engaged Karachi Chamber of Commerce and Supply Chain Association of Pakistan (SACP) to identify and to contact the large scale manufacturing organizations that were registered with the Securities and Exchange Commission of Pakistan (SECP). This approach is argued to be relevant in the context of emerging countries such as Pakistan as it helped to ensure the reliability and credibility of data obtained [30]. From this approach, a list encompassing 515 companies was obtained and the questionnaires with stamped envelopes were distributed via the mail service to the key respondents. The key respondents were the supply chain professionals who were involved in managing the supply chain operations, namely production, distribution, logistics and quality functions.

Of the 515 questionnaires mailed out, 204 responses were received, resulting in a 39.6 per cent of response rate. A finale screening eliminated 22 sets of questionnaires due to incomplete or invalid responses. Hence, only a total of 182 useable and valid sets of questionnaires were included for data analysis. The demographic characteristics of the samples are presented in Table 1. Majority of the informants were from the textile manufacturing industry which employed more than 750 employees.

**Table 1.** Demographic characteristics

| Demographic characteristics | Percent |
|---|---|
| ***Manufacturing sector*** | |
| Textiles | 21.40 |
| Food and Beverages | 13.74 |
| Pharmaceutical | 10.99 |
| Automotive and allied | 10.44 |
| Chemical and adhesive products | 7.69 |
| Engineering | 6.04 |
| Cable and Electric goods | 5.49 |
| Steel and Allied | 4.40 |
| Cement | 4.40 |
| Paper and Board | 3.85 |
| Leather and Tanneries | 2.20 |
| Synthetic and Rayon | 1.65 |
| Tobacco | 1.65 |
| Glass and ceramics | 1.65 |
| Farming | 1.10 |
| Vanaspati and allied | 0.55 |
| Furniture and wooden | 0.55 |
| Others | 2.20 |
| ***Annual sales (PKR)*** | |
| Less than 500 million | 4.4 |
| 500 - 999 million | 18.1 |
| 1 - 5 billion | 22.0 |
| 5 - 10 billion | 24.2 |
| More than 10 billion | 31.3 |
| ***Age of the organization*** | |
| < 5 years | 1.6 |
| 5 - 15 years | 7.1 |
| 16 - 30 years | 52.7 |
| 31 - 50 years | 31.9 |
| > 50 years | 6.6 |
| ***Number of employees*** | |
| Less than 250 | 2.2 |
| 250 – 499 | 9.3 |
| 500 – 749 | 17.6 |
| 750 – 999 | 38.5 |
| More than 1000 | 32.4 |

[1] Pakistan Economic Survey, 2018

### 4.3 Non – response and common method bias

It is important to evaluate the non-response bias as the response rate was only 39.6 %. The independent t-test was used for the non-response bias assessment by comparing the early and late responses, as suggested by [71]. The early respondents were those who had returned their responses within the first month prior to the gentle reminders. The late respondents were those who had returned their responses after the stated response time period, i.e., after the gentle reminder was given. The independent t-test results demonstrated that all the p-values were above 0.05 which indicate an insignificant difference between the two samples. This establishes the fact that there was no non-response bias in the dataset.

However, there was a potential for the occurrence of common method bias (CMB) since the data were collected from only one source [72]. The study opted for procedural remedies at the time of the questionnaire development in order to reduce the potential bias, thus statistical techniques [73] were applied to examine whether the CMB had significantly influenced the results. Firstly, the independent and dependent variables were presented using different scales so as to reduce the CMB effect. Secondly, the respondents were promised confidentiality by clearly specifying this as a statement on the cover page of the survey questionnaire. In addition to these procedural remedies, statistical measures were also performed. First, we performed the conventional technique of measuring the CMB through [74] single factor test. The results showed that single factor accounted for 38.18% of the total variance, showing that the CMB did not influence the result of the overall analysis [72]. However, this technique has been criticized in recent literature [75], and it is no longer acceptable in modern literature, hence the marker variable technique, which has been widely adopted and recommended in recent literature [73] was applied. In the current study, we also incorporated the social desirability scale of four items as marker variables. It is then followed by evaluation of $R^2$ with and without the marker variables. The results showed an insignificant change (<10%) in $R^2$, demonstrating the insignificance of the common method variance in the dataset.

## 5. Results and analysis

The study employed the SEM (structural equation modeling) by using partial least squared method for the assessment of the inter relationship among the different latent variables. This helped to test the theoretical model which has been widely recognized and used in supply chain risk management and resilience studies [14], [39].

### 5.1 Measurement model

The measurement model was assessed through the confirmatory factor analysis by using the SMART PLS. As specified in Table 2, all the items loaded significantly with values of above 0.5, having the composite reliability value of 0.865 to 0.947, and having an average variance extracted (AVE) value of greater than 0.5. These figures showed that all the items used in this study satisfied the convergent validity [76]. The significance of the items used was evaluated through the bootstrapping procedure with re-samples of 5000. The results indicated that all the items were significant at $p < 0.01$. The discriminant validity (see Table 3) was also performed to ensure that all the constructs were significantly different from each other, and did not portray the same phenomenon that was embodied by other constructs in the model [76]. The analysis was conducted by using contemporary technique of HTMT. The results demonstrate in Table 3.0 reveals that all HTMT values are less than conservative $HTMT_{0.85}$ criteria, which establishes that there is a strong evidence of acceptable discriminant validity. In total, the measurement model demonstrated adequate convergent and discriminant validity.

**Table 2.** Measurement items and reliability and validity assessment

| *Scale Items* | Loading[b] | AVE | CR | Cronbach's α |
|---|---|---|---|---|
| ***Internal Integration (II)*** | | *0.756* | *0.939* | *0.918* |
| We use inter-department teams to solve problems | 0.870 | | | |
| Internal management communicates frequently about goals and priorities | 0.923 | | | |
| Our firm encourages openness and teamwork | 0.876 | | | |
| Formal meetings are routinely scheduled among various departments | 0.918 | | | |
| When problems or opportunities arise, face to face formal meetings never occur | 0.750 | | | |
| ***Customer Integration (CI)*** | | *0.626* | *0.892* | *0.851* |
| Our customers give us feedback on meeting their expectations | 0.879 | | | |
| We constantly seek demand information from our key customers | 0.848 | | | |
| Customers are actively involved in our new product development process | 0.755 | | | |
| We share our inventory levels with our major customers | 0.770 | | | |
| We share our production plans with our major customers | 0.689 | | | |
| ***Supplier Integration (SI)*** | | *0.656* | *0.905* | *0.870* |
| We have a high degree of strategic partnership with our key suppliers | 0.836 | | | |
| We share our production plans with our key suppliers | 0.772 | | | |
| We share our inventory levels with our key suppliers | 0.785 | | | |
| We have high corporate level communication on important issues with key suppliers | 0.860 | | | |
| We have closely integrated information systems with key suppliers | 0.795 | | | |
| ***Supply Chain Resilience (SCRES)*** | | *0.847* | *0.947* | *0.930* |
| Our firm's supply chain is well prepared for unexpected events | 0.928 | | | |
| Our firm's supply chain is able to adequately respond to unexpected disruptions by quickly restoring operations | 0.921 | | | |
| Our firm's supply chain has the desired level of connectedness among its members during disruptions | 0.913 | | | |
| Our firm's supply chain has the ability to maintain control over structure and function during disruptions | 0.920 | | | |
| ***Cost efficiency performance (CEP)*** | | *0.698* | *0.902* | *0.858* |
| Minimize material cost | 0.782 | | | |
| Minimize storage cost | 0.832 | | | |
| Minimize total cost of distribution (including transportation and handling costs) | 0.881 | | | |
| Minimize total cost of manufacturing (including labor, maintenance, and re-work costs) | 0.844 | | | |
| ***Customer service performance (CSP)*** | | *0.702* | *0.922* | *0.894* |
| Customer order fill rate | 0.829 | | | |
| On time delivery | 0.847 | | | |
| Customer response time | 0.848 | | | |
| Product Quality | 0.791 | | | |
| Customer satisfaction | 0.872 | | | |
| ***Flexibility performance (FP)*** | | *0.615* | *0.865* | *0.792* |
| Flexibility to change volume | 0.795 | | | |
| Flexibility to change product mix | 0.799 | | | |
| Flexibility to adjust capacity in short time | 0.790 | | | |
| Flexibility to introduce new products into production in short time | 0.753 | | | |

**Table 3.** HTMT results

| | CEP | CI | CSP | FP | II | SCRES | SI |
|---|---|---|---|---|---|---|---|
| **CEP** | | | | | | | |
| **CI** | 0.547 | | | | | | |
| **CSP** | 0.849 | 0.649 | | | | | |
| **FP** | 0.415 | 0.604 | 0.519 | | | | |
| **II** | 0.663 | 0.754 | 0.711 | 0.46 | | | |
| **SCRES** | 0.606 | 0.753 | 0.658 | 0.62 | 0.706 | | |
| **SI** | 0.484 | 0.714 | 0.519 | 0.691 | 0.616 | 0.724 | |

## 5.2 Structural model

Assuming that the measurement model is reliable and valid, the structural model was then formed and examined by using the SMART PLS 3.2.7 version. The structural assessment was conducted in terms of the path coefficients, their significance through bootstrapping technique and the $R^2$ values. The $R^2$ values of the dependent variables and the mediating variables were greater than 0.33. This is considered as moderate. The direct effects of II, CI and SI on CSP, CSP and FP were tested. The effects of II on CEP ($\beta = 0.404$, $p < 0.01$) and CSP ($\beta = 0.382$, $p < 0.01$) were noted to be significantly positive whilst its impact on FP was insignificant ($\beta = -0.087$, $p > 0.1$). Hence, H1a and H1b were supported whereas H1c was rejected. This study showed that the impact of the SI on CEP ($\beta = 0.025$, $p > 0.1$) and CSP ($\beta = -0.011$, $p > 0.1$) was not significant whereas its impact on FP was significant ($\beta = 0.379$, $p < 0.01$). Therefore, H2a and H2b were rejected and H2c was supported. However, the effects of the CI on CEP ($\beta = 0.039$, $p > 0.1$, CSP ($\beta = 0.15$, $p > 0.1$ and FP ($\beta = 0.162$, $p > 0.1$) were also not significant. Hence, H3a, H3b and H3c were rejected.

We tested the mediation effect by using the bootstrapping re-sampling method as suggested by Preacher and Hayes (2008). We utilized the bias-corrected and accelerated confidence interval bootstrapping approach that generated 5000 samples. This indicates that the decision of accepting or rejecting alternative hypotheses was based on confidence intervals. If the zero was placed in between the lower and upper bound limits, then it would indicate that the indirect effect was zero, hence it can be considered as insignificant, thereby rejecting the respective hypothesis.

With the presence of the mediator, the results revealed that II ($\beta = 0.261$, $p < 0.01$), SI ($\beta = 0.318$, $p < 0.01$) and CI ($\beta = 0.320$, $p < 0.01$) were all positive; they also significantly influenced the SCRES. Therefore, H4a, H4b and H4c were supported. The results also showed the significant effect of the SCRES on CEP ($\beta = 0.257$, $p < 0.01$), CSP ($\beta = 0.260$, $p < 0.01$) and FP ($\beta = 0.226$, $p < 0.05$). Hence, H5a, H5b and H5c were supported. The bootstrapping analysis which used the no sign changes option revealed that the indirect effects of all the integration types with each performance parameters were positive and significant. The mediating or indirect effect of the supply chain resilience was most significant in the relation between the external integration types (supplier and customer integration) and cost efficiency and customer service performance. The indirect effect was significant and positive in the relationship between the external integration types and flexibility performance ($\beta = 0.072$, $p < 0.05$) whereas the indirect effect was weak in the case of the relationship between internal integration and flexibility performance ($\beta = 0.059$, $p < 0.1$). Table 4 provides the summary of the results presented in the mediated model which also indicate the direct and indirect effects.

**Table 4:** Path coefficients of direct and indirect effects for the mediation model

| Hypotheses | Direct effect | Indirect effect | BC (Lower) | BC (Upper) | Supported (Yes / WS / No) |
|---|---|---|---|---|---|
| H1a: II → CEP | 0.404*** | | | | Yes |
| H1b: II → CSP | 0.382*** | | | | Yes |
| H1c: II → FP | -0.087 ns | | | | No |
| H2a: SI → CEP | 0.025 ns | | | | No |
| H2b: SI → CSP | -0.011 ns | | | | No |
| H2c: SI → FP | 0.379*** | | | | Yes |
| H3a: CI → CEP | 0.039 ns | | | | No |
| H3b: CI → CSP | 0.150 ns | | | | No |
| H3c: CI → FP | 0.162 ns | | | | No |
| H4a: II → SCRES | 0.261*** | | | | Yes |

| | | | | | |
|---|---|---|---|---|---|
| H4b: SI → SCRES<br>H4c: CI → SCRES | 0.318***<br>0.320*** | | | | Yes<br>Yes |
| H5a: SCRES → CEP<br>H5b: SCRES → CSP<br>H5c: SCRES → FP | 0.257**<br>0.260***<br>0.226** | | | | Yes<br>Yes<br>Yes |
| H6a: II → SCRES → CEP<br>H6b: II → SCRES → CSP<br>H6c: II → SCRES → FP | | 0.067**<br>0.068*<br>0.059$^{\tau}$ | 0.022<br>0.019<br>0.010 | 0.139<br>0.149<br>0.155 | Yes<br>Yes<br>WS |
| H7a: SI → SCRES → CEP<br>H7b: SI → SCRES → CSP<br>H7c: SI → SCRES → FP | | 0.082**<br>0.083**<br>0.072* | 0.028<br>0.032<br>0.020 | 0.163<br>0.154<br>0.146 | Yes<br>Yes<br>Yes |
| H8a: CI → SCRES → CEP<br>H8b: CI → SCRES → CSP<br>H8c: CI → SCRES → FP | | 0.082**<br>0.083**<br>0.072* | 0.029<br>0.027<br>0.023 | 0.169<br>0.167<br>0.152 | Yes<br>Yes<br>Yes |
| **$R^2$ values: SCRES – 0.606; CEP – 0.423; CSP - 0.488; FP – 0.389** | | | | | |

*Notes:* II: Internal integration, SI: Supplier integration, CI: Customer integration, CEP: Cost efficiency performance, CSP: Customer service performance, FP: Flexibility performance, SCRES: Supply chain resilience, BC: Bias corrected; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$; $\tau$ $p > 0.1$ but value of 0 is not in range of BC; ns: not supported

Yes: supported with p-value < 0.1, 0.05 or 0.01, WS: Weak support with p-value > 0.10 but BC zero value is not in between lower and upper bound limits; No: Not supported

## 6. Discussion

This study had utilized the DCT to determine the relationship between the SCI, the SCRES and the SCP. It extended on previous empirical works by focusing on how the SCRES mediated the relationship between the SCI and the SCP. In this study, we found that the II, SI and CI were relatively important in building the SCRES. The empirical results also indicate that all three integration types affected the SCRES, which explained 60.6% of the SCRES variance. This signifies a strong predictive accuracy [76]. The finding is in accordance with the studies conducted by [14],[15]. By comparing the three types of integration, we found that the impact of the external integration was much greater on the SCRES. This is not surprising, considering the geo political situation of Pakistan. Firms in Pakistan are currently experiencing more than their fair share of uncertainties in the business environment such as terrorism, floods, earthquakes and political instability [78]. These uncertainties can be damaging to the manufacturers in Pakistan; they could cause the firms' inability to serve their customers. Some of the firms may even end-up withholding their excessive inventories. This situation forces the local manufacturers to counteract such challenges by reconfiguring their supply chain practice. In conjunction with this, the manufacturing firms in Pakistan were expected to integrate with their suppliers and customers as a means of achieving resilience. Through external integration, they could be provided with more real-data that would allow them to reduce variability, and the ability to respond quickly to any disruptions. Therefore, better and sound collaborations with the channel members is the key for these firms to continue their operations, and to reduce the detrimental effects of the volatilities happening in the supply chain.

Of all the performance dimensions, resilience appears to have the greatest influence on the CSP followed by CEP and FP. This finding is similar to the previous studies conducted by [36] and [15]. The results showed that manufacturing firms in Pakistan experience greater CSP, as compared to the FP and CEP, when observed through the SCRES. This result is expected as the current study had found that the CI contributed to a larger impact on the supply chain resilience. The degree of closed relationships with customers had allowed the country's manufacturing firms to obtain accurate and real-time demand information in the downstream supply chain. Such information enabled the firms to be more responsive towards customer needs. Manufacturing firms in Pakistan with high resilient capacities have better abilities to sense disruptions and changes in the market. This also showed that customer satisfaction is the supply chain's primary goal. Although the impact of the SCRES on the CSP appears to be greater, the significance of the SCRES on the other two dimensions – FP and CEP, cannot be denied. Perhaps, as the manufacturing firms achieved higher CSP, they would gain the FP and CEP as well. Hence, in this study, we could safely

conclude that firms with a focus on building resilience into their system would greatly benefit by improving customer service, cost and flexibility performance of the supply chains.

Despite the importance of the SCI in enhancing the SCP [27], [28], the current study found that the impact was dependent on the SCRES. As reported in this study, the effect of the II on the FP was not significant. Yet, the II only had a marginal impact on the FP through the SCRES. Similarly, we also found that the impact of the external integration on the SCP for dimensions such as costs and customer service can only be demonstrated if the firms had resilience. These results indicate that the association between the SCI and the SCP was not linear. Indeed, it was determined by the level of the SCRES. The benefits of the external integration would not be translated into performance unless firms inculcate resiliency into their system. Hence, the findings suggest that firms with resiliency in their system produced positive effects in improving the CEP, CSP and FP dimensions. In the context of Pakistan, manufacturing firms are experiencing external major threats, which require them to have better collaborations with the supply chain partners. Furthermore, firms operating in a dynamic environment must build their integration capabilities at both the internal and external levels so as to be resilient to these dynamic changes [15], thereby enhancing their performance. This finding appears to support the contentions made by a few scholars such as [37].

## 7. Conclusion, managerial implications and future research

The findings obtained from this study would add value to the supply chain management literature. It extends the knowledge on how the potential benefits of the SCI can be reaped by manufacturing firms in Pakistan. While it is known that integrating between supply chain members internally and externally could cut down the influence of supply chain disruptions caused by uncertainties, this study has also shown that such practices may not necessarily translate into the SCP within the context of emerging economies, such as Pakistan. This study has filled the knowledge gap by demonstrating how the SCRES serves as a mediating role between the SCI and the SCP.

The findings of this study also highlight the need for manufacturing firms to not only concentrate on investing in integration practices, but also to take note on how they could improve their resiliency. Resiliency allows the Pakistani manufacturing firms to handle disruptions effectively, and to continue to provide the expected services and products to customers. The resiliency capability is particularly important for firms in emerging economies such as Pakistan. Although emerging economies appear to represent a crucial part of the global supply chains, they are experiencing the shattering effects of supply chain failures. Problems such as natural catastrophes, product counterfeits, political instability, including dissenting activities from different groups, corruption, transportation infrastructure and other unethical business practices tend to be acute in this part of the world (Stevenson and Busby, 2015). It therefore, follows that manufacturing firms in Pakistan should be concerned about developing their resiliency capabilities, due to the globally connected world as well as the repercussions and significant effects of human consequences.

Having said this, the resiliency capabilities can be promoted through intense integration between different units in a firm and with supply chain partners. Collaborations and strategic partnering may permit accurate information flow and knowledge exchange across the whole supply chain network. In turn, this would help in facilitating the firms to oversee the entire supply chain process. In this way, these firms would also be able to sense any disruptions and to respond to them in a timely manner. This is important as failure to react promptly to the unforeseen circumstances may lead to deterioration in supply chain performance, thereby affecting firm competitiveness.

Although this study provides insights into the SCI, the SCRES and the SCP of manufacturing firms in Pakistan, it also faced some limitations. First, since this study focused on Pakistan, the findings may not be generalized to other countries and contexts that possess different characteristics and values. Second, the study incorporated all types of manufacturing sectors in order to generalize the findings across all manufacturing industries of Pakistan. Future studies could therefore, focus on one industrial sector and compare it with other developing economies so as to gain a more meaningful outcome on the role of the SCRES in the relation between the SCI and the SCP. Third, the study banked on only one source of information from each manufacturing organization in order to investigate the current framework which involved the SCI, the SCRES and the SCP. It could be more reliably investigated by either multiplying the informants from the same company or by using a dyadic or triadic approach that involved both buyers and suppliers. Future studies may incorporate either one of these approaches so as to augment the validity and generalizability of the outcomes. Finally, the research has utilized cross-sectional data which do not allow us to investigate the dynamic nature of both the SCI and the SCRES. Future research may thus resort to longitudinal data which can capture resiliency at the pre – disruption, at the time of disruption and post – disruption phase, with associated enablers and outcomes.

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