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Supply Chain Integration and Manufacturing Firm Performance: The Mediating Role of Innovation Performance

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Abstract

The purpose of this study is to examine the effect of supply chain integration (SCI) on innovation performance (IP) and firm performance (FP). In addition, this study seeks to examine the effect of IP on FP, as well as the mediating effect of IP on the relationship between SCI and FP. The study analyzes survey data gathered from 213 manufacturing firms belonging to different industry types in Jordan. The study constructs were assessed for validity and reliability, and it was ensured that acceptable levels of these tests were obtained. Structural equation modeling was used to test the study hypotheses. The findings showed that SCI positively and directly affects IP and FP. Furthermore, IP positively and directly affects FP, and it positively mediates the relationship between SCI and FP. This study addresses an evident gap in the available literature regarding the relationships among SCI, IP, and FP in the context of manufacturing firms in a developing country. It also offers important implications for the managers of manufacturing firms to improve the IP and subsequently enhance the FP.

Keywords— Supply chain integration, Innovation performance, Firm performance, Structural equation modeling, Manufacturing firms, Jordan

Introduction

In today's turbulent business environment, manufacturing firms are striving to improve their performance by strengthening their supply chain management (SCM) processes. To enhance the SCM of firms, the concept of supply chain integration (SCI) was developed (Lii and Kuo, 2016; Ataseven and Nair, 2017). SCI can be defined as a coordinated collaboration between different functions inside the organization on one hand and between the organization itself and its outside partners of suppliers and customers on the other for the purpose of effective management of materials, services, information, money, and decisions (Flynn *et al*., 2010; Chang *et al*., 2016; Kang *et al*., 2018). The extant literature has provided a plethora of empirical evidence pertaining to the effect of SCI on firm performance (FP) (e.g., Droge *et al*., 2004; Cao and Zhang, 2011; Tseng and Liao, 2015; Thai and Jie, 2018; Hendijani and Saei, 2020). However, there is an apparent gap in the literature about the effect of a firm's SCI on its innovation performance (IP). Moreover, the mediating role of IP in this relationship is still under-researched.

SCI is highly acknowledged by researchers and practitioners in the field of operations management and SCM in a time spanning over two decades. It is a well-known concept in developed countries, yet it did not receive the deserved level of popularity in developing countries. Hence, the domain of this study is the supply chains of manufacturing firms in a developing country, Jordan. Due to the growing desires of domestic and foreign customers, there is a high pressure on Jordan's manufacturing sector to increase its competitiveness, which calls for more interest in research and development (R&D) activities, development of new products, and enhancement of innovative performance. However, Jordan is overcrowded with several manufacturing firms in each industry. These firms are just copying each other and provide the same products to reap quick profits without incurring any efforts caused by providing innovative additions. Given Jordan has a small local market compared to large and highly competitive foreign markets, the survival of some industries would be at stake if these firms continue to fight viciously on price premium without taking innovation into consideration. Such a situation may affect the performance of Jordanian manufacturing firms due to dissatisfied customers and not being able to compete in the national and international markets. Despite the efforts undertaken by the Jordanian government to identify the factors that can enhance the performance of Jordanian manufacturing firms, the situation remains unpromising. From the SCM perspective, a firm's SCI can be a critical capability that may potentially improve its IP and subsequently the FP.

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Taken together, the current study aims to extend the existing literature by proposing a set of hypotheses that are integrated into a theoretical model to explain how SCI, working through IP, contributes to FP. This model is then examined by analyzing data collected from Jordanian manufacturing firms. The findings of this study complement those of previous studies on the relationship between SCI and performance and provide both theoretical and practical insights.

2. Literature Review

2.1. Supply chain integration (SCI)

Competition today is not among firms but rather supply chains (Li *et al*., 2006; Heizer *et al*., 2013). According to the US Council of Supply Chain Management Professionals (CSCMP, 2021), the supply chain links all channel partners (i.e., suppliers, manufacturers, distributors, retailers, and customers) together starting with unprocessed raw materials and ending with the final consumer who uses the finished goods. The supply chain is mainly concerned with not only materials flow but also information and money flows through the channel partners (Sundram *et al*., 2018). Nowadays, firms' strategic efforts to improve the efficiency and effectiveness of supply chain activities and processes depend heavily on SCI (Chang *et al*., 2016), which is also known as "supply chain cooperation" (Montshiwa, 2018) and "supply chain collaboration" (Jimenez-Jimenez *et al*., 2019; Yang and Lin, 2020).

SCI is the degree to which an organization collaboratively manages intra- and inter-organization processes through information integration, synchronized planning, operational coordination, and strategic partnership with supply chain members (Flynn *et al*., 2010; Liu *et al*., 2016). This means that SCM requires integration of processes not only internally within an organization but also externally across suppliers and customers (Chang *et al*., 2016). Therefore, scholars classified SCI into internal integration and external integration, and they sometimes use the term "Total SCI" to refer to both of them (Beheshti *et al*., 2014; Abdallah *et al*., 2017). Internal integration focuses on cross-functional collaboration within firms, while external integration includes both supplier integration and customer integration (Stevens and Johnson, 2016; Ayoub *et al*., 2017; Kang *et al*., 2018). In summary, SCI has three main dimensions: internal integration, supplier integration, and customer integration (Mackelprang *et al*., 2014; Ayoub *et al*., 2017; Kang *et al*., 2018; Boer and Boer, 2019; Sharabati *et al*., 2020; Subburaj *et al*., 2020). These dimensions represent internal, upstream, and downstream operations of the supply chain respectively (Beheshti *et al*., 2014; Ayoub *et al*., 2017).

2.2. Innovation performance (IP)

IP is a valuable organizational capital and an intangible resource that is impossible to imitate (Hung *et al*., 2010). Among many definitions over time, innovation has recently been defined as an overall organizational approach that aims to create improved value by generating and developing new ideas in terms of new products or services, processes, marketing methods, and managerial systems (Chen *et al*., 2010; Lee *et al*., 2019). In accordance with the Organization for Economic Co-operation and Development (OECD) *Oslo Manual 2018* (OECD and Eurostat, 2018) and the related literature (e.g., Rajapathirana and Hui, 2018; Kafetzopoulos *et al*., 2019; Lee *et al*., 2019; Ramadani *et al*., 2019), the main four types of innovation are product innovation, process innovation, marketing innovation, and management innovation. OECD and Eurostat (2018) admitted that the firm should provide a "significant" change by comparing both new and improved innovations to the firm's existing products, processes, marketing, or management systems. In literature, the four innovation types are enormously discussed either individually or in combination. These types are divided into two main categories: technological (sometimes called technical) innovations and non-technological innovations (Damanpour *et al*., 2009; Heij *et al*., 2020). Technological innovations include product innovation and process innovation (Ayoub *et al*., 2017; Ramirez *et al*., 2018; Arranz *et al*., 2019; Heij *et al*., 2020), while non-technological ones include marketing innovation and management innovation (Ramirez *et al*., 2018; Ungerman *et al*., 2018).

2.3. Firm performance (FP)

FP is considered a multidimensional concept as its indicators are related to financial ratios, production, customer, marketing, among many other issues. Until now, there is no consensus among scholars and practitioners about the appropriate definition of FP (Miller *et al*., 2013). For instance, Sezhiyan and Nambirajan (2010) defined FP as a set of managerial and critical methodologies that allow firm managers to attain one or more pre-selected goals. According to Gharakhani and Mousakhani (2012), FP is the ability of a firm to create outcomes and actions at an

acceptable level. In addition, Luxmi (2014) defined it as the difference between actual outcomes of a firm and its planned ones. Due to its multidimensionality, academic scholars confronted many difficulties to build appropriate and measurable FP constructs (Miller *et al*., 2013). Although subjective and objective measures of FP are provided in the literature (Richard *et al*., 2009; Silvestro, 2014), subjective measures are more preferable by business management researchers (Sezhiyan and Nambirajan, 2010; Bwaliez and Abushaikha, 2019; Subburaj *et al*., 2020). In line with these researchers, a set of subjective measures were used in this study.

3. Theoretical Background and Hypotheses Development

3.1. Theoretical background

Figure 1 demonstrates the theoretical model directing the current study. This model suggests that a firm's SCI offers the prospect of improving FP directly and indirectly through its IP. Furthermore, unlike earlier studies that investigated the impact of a firm's IP on its SCI (e.g., Seo *et al*., 2014; Lii and Kuo, 2016; Neutzling *et al*., 2018), the current study posits the opposite, which is the impact of a firm's SCI on its IP. Likewise, a positive effect of a firm's IP on FP is proposed.

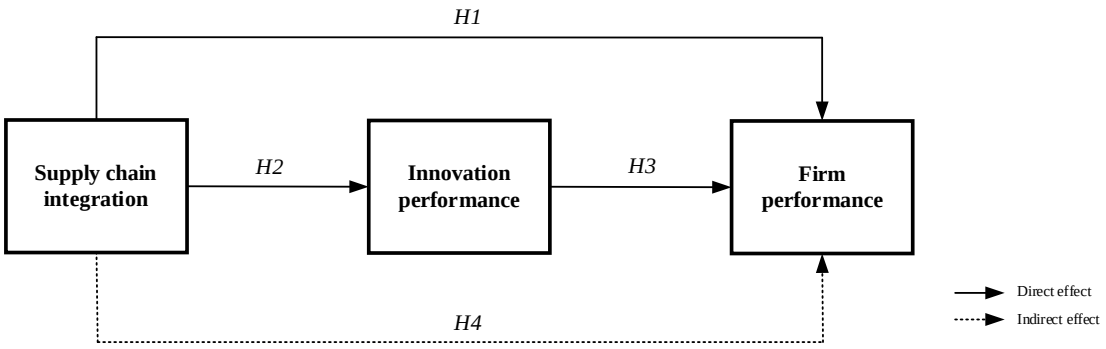

Figure 1: Theoretical model

3.2. Hypotheses development

3.2.1. SCI and FP

Existing literature has provided sufficient evidence regarding the positive effect of SCI on FP. For example, Droge *et al*. (2004) found that the joint use of internal and external integration practices has a synergistic effect on FP. Beheshti *et al*. (2014) also confirmed that total SCI is beneficial to financial performance. Regarding the SCI dimensions, Flynn *et al*. (2010) found that internal integration is directly related to both operational and business performance, customer integration is directly related to operational performance, and the interaction of customer and supplier integration is related to operational performance. Ataseven and Nair (2017) found that all SCI dimensions have a significant impact on a firm's financial and operational performance. Hendijani and Saei (2020) also showed that internal and process dimensions of SCI have a positive impact on both financial and operational performance. Furthermore, Subburaj *et al*. (2020) found that all SCI dimensions significantly affect the organizational performance of micro, small, and medium enterprises. Based on this overview of existing literature, it is hypothesized that:
H1. SCI positively affects FP.

3.2.2. SCI and IP

In the existing literature, few studies pointed out that a firm's SCI has an impact on its IP. For example, Kumar *et al*. (2020) found that SCI has a direct impact on IP. Likewise, Yang and Lin (2020) revealed that SCI has a very high effect on green IP. Moreover, Jimenez-Jimenez *et al*. (2019) found that SCI has a positive impact on technological innovation in two ways: incrementally and radically. Regarding the SCI dimensions, some researchers indicated the positive impact of internal integration on product innovation (e.g., Wong *et al*., 2013; Xian *et al*., 2018). While some other researchers indicated the positive impact of external integration on technological IP, such as Wang *et al*. (2018) who argued that knowledge from external networks of a firm can improve its IP in terms of patent creation, as well as Wong *et al*. (2013) who found that external integration has a positive effect on product innovation. Moreover, several studies asserted the pivotal role of supplier integration in helping firms to develop and launch innovative products and services (e.g., Luzzini *et al*., 2015; von Haartman and Bengtsson, 2015; Jajja *et al*., 2017).

However, Ayoub *et al*. (2017) found that not only supplier integration but also customer integration positively affect technological innovation, and Xian *et al*. (2018) found that only external integration with a firm's customers boosts product innovation. Although some studies in literature attempted to investigate the impact of SCI on product and/or process innovations, they are contradicting in some ways and still inadequate about the impact of SCI on IP as an aggregated unit. In summary, the literature review of the related studies revealed a strong need for further empirical research about the impact of SCI on IP. Accordingly, the following hypothesis needs to be investigated:
H2. SCI positively affects IP.

3.2.3. IP and FP

The existing literature has provided sufficient evidence pertaining to the positive effect of a firm's IP on FP (e.g., Vázquez *et al*., 2001; Walker *et al*., 2015; Jajja *et al*., 2017; Arranz *et al*., 2019). For example, Darroch (2005) found that a more innovative firm performs better than a less innovative one, and Garcia-Morales *et al*. (2007) argued that successful innovation allows firms to maintain their competitive advantage effectively. Ramadani *et al*. (2017) argued that innovation activities are endogenously associated with FP. Likewise, Rajapathirana and Hui (2018) concluded that managing a firm's innovation capability effectively helps in delivering more effective innovation outcomes, which in turn generate better performance for the firms. Additionally, Wang and Wang (2012) confirmed that a firm's innovation contributes to its operational and financial performance. Ramadani *et al*. (2019) found that product innovation has a positive impact on FP in transition economies, while Lee *et al*. (2019) found that not only product innovation but also process innovation have direct and positive effects on FP. These arguments lead us to the following hypothesis:
H3. IP positively affects FP.

3.2.4. The mediating effect of IP on the SCI-FP relationship

No previous studies have directly explored the IP's mediating effect on the SCI-FP relationship. On one hand, extant literature provides somehow evidence regarding the role of a firm's SCI in enhancing its IP. For example, Didonet and Díaz (2012) argued that manufacturing firms devising successful SCI strategies are expected to have high levels of information-based linkages that boost their IP, and some researchers found that collaboration and integration among supply chain partners have a significant role in the innovation process of a firm (e.g., Kaminski *et al*., 2008; Zeng *et al*., 2010). On the other hand, several studies have shown a positive effect of a firm's IP on FP (e.g., Wang and Wang, 2012; Slavković and Babić, 2013; Kafetzopoulos *et al*., 2019). As knowledge is a critical factor in promoting innovation (Wang and Han, 2011; Slavković and Babić, 2013; Jin *et al*., 2015), integrating with internal and external partners in the firm's supply chain facilitate the inflow of knowledge that leads to enhanced IP (Ayoub *et al*., 2017), which in turn improves FP (Wang and Wang, 2012; Slavković and Babić, 2013). Furthermore, Khalil *et al*. (2019) found that innovation positively mediates the relationship between SCM practices and organizational performance. Building on the previous discussion, the following hypothesis is developed:
H4. IP positively mediates the relationship between SCI and FP.

4. Methodology

4.1. Population and sample

The manufacturing sector was targeted to conduct this study due to its innovation-intensive activities. The population for this study comprises all manufacturing firms in Amman, the capital city of Jordan. The Amman Chamber of Industry (ACI) was contacted to get a list of manufacturing firms with their detailed information. According to ACI (2020), there are 1200 manufacturing firms located in Amman and they are classified into 10 industrial types. The sample size that is suitable for this population is 292 (Sekaran and Bougie, 2016). This study considered each individual manufacturing firm as a unit of analysis, such that one respondent was targeted from each firm.

The data collection was performed in May, June, and July 2020. Due to the coronavirus disease 2019 (COVID-19) during this period, different lockdowns, closures, and restrictions were imposed by the Jordanian government. Since the COVID-19 status made it problematic to apply the simple-random sampling technique, the convenience sampling technique was used in this study by targeting 300 manufacturing firms to fill in a structured questionnaire sent by e-mail. Those firms were selected from different industrial types distinguished by ACI (2020) to ensure an adequate representation of the manufacturing sector in Amman. These industrial types included plastic and rubber,

engineering, electrical, and information technology, therapeutics and medical supplies, textiles and garments, and others.

The participants were from the top and middle managerial levels who have responsibilities related to SCM with access to firm-level information. As a result, the participants had managerial positions representing general managers, deputy general managers, supply chain managers, operations managers, plant managers, R&D managers, and others. Ultimately, 244 filled questionnaires were received. After eliminating the questionnaires with missing responses, the final sample comprised 213 usable questionnaires representing a response rate of 71%. This response rate is considered high compared with other empirical studies conducted in Jordan and used a similar distribution method (e.g., Al-Tahat and Bwaliez, 2015; Bwaliez and Abushaikha, 2019; Sharabati *et al*., 2020; Rifai *et al*., 2021; Ta'Amnha *et al*., 2021a, 2021b, 2021c). The high response rate is due to the rigorous follow-up of the questionnaire's distribution process by the researcher himself through contacting the participants by phone before and during the distribution process.

4.2. Questionnaire design

A structured questionnaire was used to collect primary data from the targeted sample of Jordanian manufacturing firms in order to empirically test the proposed theoretical model of the current study. The questionnaire comprised 5 measurement items about each identified construct. All items were chosen such that they achieved a high Cronbach's alpha (α) coefficient in their original studies, which means that they had a high level of internal consistency reliability. Table 1 shows the final list of these items with their sources in the literature. Respondents were asked to indicate their degree of agreement with each questionnaire item on a five-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Table 1:
Construct validity and reliability analysis

Item number	**Construct (source) / Item description**	**Factor loading**	**Validity and reliability**
	Supply chain integration (Li et al., 2006; Zhao et al., 2013; Abdallah and Nabass, 2018)		
SCI1	Our firm has a highly integrated information system to link the internal departments.	0.673	CFI = 0.93; IFI = 0.93; TLI = 0.91; SRMR = 0.05; Cronbach's α = 0.880; composite reliability = 0.914
SCI2	Our firm regularly solves problems jointly with its suppliers.	0.781	
SCI3	Our firm strives to establish long-term relationships with its suppliers.	0.695	
SCI4	Our firm is frequently in close contact with our customers.	0.842	
SCI5	Our firm involves our key customers in the product design and development stage.	0.784	
	Innovation performance (Kafetzopoulos et al., 2019)		
IP1	The level of newness and uniqueness of our products is high compared to key competitors.	0.863	CFI = 0.91; IFI = 0.92; TLI = 0.94; SRMR = 0.07; Cronbach's α = 0.882; composite reliability = 0.919
IP2	Our firm introduced new or improved machinery and equipment for producing products ahead of key competitors.	0.725	
IP3	Our firm implemented new or improved computer-based administrative applications.	0.688	
IP4	Our firm implemented new or improved organizational structures.	0.719	
IP5	Our firm made significant changes in product packaging, promotion, pricing, and distribution methods.	0.697	
	Firm performance (Bwaliez and Abushaikha, 2019)		
FP1	The profitability of our firm has exceeded the key competitors.	0.871	CFI = 0.92; IFI = 0.93; TLI = 0.92; SRMR = 0.04;
FP2	The productivity of our firm has exceeded the key competitors.	0.649	
FP3	The market share growth of our firm has exceeded the key	0.776	

	competitors.		Cronbach's α = 0.792; composite reliability = 0.923
FP4	The overall growth of our firm is better than that of competitors.	0.684	
FP5	The customers are satisfied with our products compared to key competitors.	0.844	

4.3. Questionnaire fitness

Prior to performing the data analysis, questionnaire fitness was assessed by checking the validity and reliability of its constructs. The validity measures whether the questionnaire items are really measuring what is supposed to be measured, while the reliability measures the extent that the researcher will get the same results when repeating the study with the same questionnaire and conditions (Thornhill *et al*., 2009).

Regarding the questionnaire validity, three types of validity checks were performed: content, face, and construct validity. Since the questionnaire items were drafted in their original studies from different scholarly works, we can ensure content validity. To ensure face validity, the draft of the questionnaire was reviewed by four academic professors and five managers of manufacturing firms in Jordan. Thereafter, some modifications were made according to their notes and suggestions in order to ensure that all questionnaire items became unambiguous, appropriate, and acceptable to respondents. To ensure construct validity, the construct's unidimensionality, convergent validity, and discriminant validity were checked.

First, the unidimensionality of the main constructs was assessed through the confirmatory factor analysis (CFA) which was conducted by finding the comparative fit index (CFI), the incremental fit index (IFI), the Tucker-Lewis index (LTI), and the standardized root mean square residual (SRMR). As shown in Table 1, the CFI, IFI, and LTI values are above the recommended cut-off value of 0.9, and the SRMR value is below the recommended cut-off value of 0.08 (Hu and Bentler, 1999). Second, convergent validity was assessed by finding the factor loading of each individual questionnaire item and the average variance extracted (AVE) of each construct. The factor loading of each questionnaire item exceeds the minimum cut-off value of 0.5 (Anderson and Gerbing, 1988), as shown in Table 1. Additionally, the AVE value is above the minimum cut-off value of 0.5, as shown in Table 2, which implies strong convergent validity (Fornell and Larcker, 1981). Third, the discriminant validity of the constructs is tested by measuring the degree to which each construct and its items are different from another construct and its items. Table 2 shows that the square root of the AVE value for each construct is greater than the correlation between any pair of constructs. Thus, strong discriminant validity can be assumed in this study (Fornell and Larcker, 1981).

Table 2:
Descriptive statistics and discriminant validity

Study variable	Mean	SD	AVE	SCI	IP	FP
SCI	3.94	0.62	0.679	(0.824)		
IP	3.68	0.74	0.740	0.356**	(0.860)	
FP	4.04	0.69	0.692	0.461**	0.276**	(0.832)

Notes: n = 213, $^{**}p < 0.01$, Square root of AVE is in parentheses.

Regarding the questionnaire reliability, Cronbach's α coefficient and composite reliability were used to evaluate the reliability of each construct (Hair *et al*., 2017). Both Cronbach's α coefficient and composite reliability are a reflection of how well the different questionnaire items complement each other in their measurement of different aspects of the same concept (Litwin, 1995). As shown in Table 1, Cronbach's α and composite reliability values are above the minimum cut-off value of 0.7 for all the study constructs, which indicates acceptable construct reliability (Nunnally and Bernstein, 1994; George and Mallery, 2010).

5. Results and Discussion

5.1. Direct effects results

Structural equation modeling (SEM) was run using the analysis of a moment structures (AMOS) software version 24.0 to test the proposed relationships. To test hypothesis *H1* concerning the effect of SCI on FP, the mediator IP was removed from the model. The results demonstrated that the total effect of SCI on FP was significant and positive ($\beta = 0.324$, $p < 0.01$), thus hypothesis *H1* was supported. Thereafter, the mediator IP was added back, and the SEM with the full model was run to test the remaining hypotheses. The results demonstrated that the direct effect of SCI on FP was still significant ($\beta = 0.246$, $p < 0.01$). This indicated that the mediator IP may only partially mediate the effect of SCI on FP (Baron and Kenny, 1986). SCI showed a significant and positive effect on IP ($\beta = 0.158$, $p < 0.01$). Hence, hypothesis *H2* was supported. The effect of IP on FP was significant and positive ($\beta = 0.163$, $p < 0.05$), thereby providing support for hypothesis *H3*.

5.2. Indirect (Mediation) effect results

To test the mediation hypothesis *H4*, the bootstrapping re-sampling approach was carried out (Shrout and Bolger, 2002). One of the advantages of using bootstrapping technique is that it can be applied with large and small samples and does not presume normal distribution of the indirect effects (Hayes, 2009). As advised by Hayes (2013), a total of 5,000 bootstrap samples were selected with 95% bias-corrected confidence intervals (CIs). If the upper limit of confidence intervals (CI_{UL}) and the lower limit of confidence intervals (CI_{LL}) do not include zero, then the hypothesis regarding the indirect effect is supported. If the two limits include zero, then the hypothesis concerning the indirect effect is not supported because this indicates that the indirect effect is zero with 95% confidence (Hayes, 2013). The results pointed out that the indirect effect of SCI on FP via IP was 0.078 ($p = 0.006$; $CI_{LL} = 0.015$, $CI_{UL} = 0.164$). Therefore, the results supported hypothesis *H4*. These results clearly indicated that, in addition to the direct effect of SCI on FP, a significant and positive indirect effect also exists through IP. The total effect of SCI on FP equals the direct effect of SCI on FP plus the indirect effect of SCI on FP through IP (0.324 = 0.246 + 0.078). Table 3 presents a summary of the results of the tested hypotheses.

Table 3:
Summary of results

Hypothesis	**Path**	**Direct model**	**Mediated model**	**Bias corrected bootstrap 95% confidence interval**		**Result**
				Lower	**Upper**	
H1	SCI → FP	0.324^{**}	0.246^{**}			Supported
H2	SCI → IP	Not estimated	0.158^{**}			Supported
H3	IP → FP	Not estimated	0.163^{*}			Supported
H4	SCI → IP → FP	Not estimated	0.078^{**} (indirect effect)	0.015	0.164	Supported

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$

5.3. Discussion of results

The results emphasized the important role of SCI in increasing the performance levels of Jordanian manufacturing firms. These results show that manufacturers in a developing country context can gain valuable performance benefits by adopting effective SCI. These results are consistent with previous studies that revealed similar findings in manufacturing firms in developed countries (e.g., Flynn *et al*., 2010; Wong *et al*., 2011; Yu *et al*., 2013; Beheshti *et al*., 2014; Alfalla-Luque *et al*., 2015; Boer and Boer, 2019; Hendijani and Saei, 2020).

The results also revealed that SCI is positively related to IP. These results indicated that SCI represents an opportunity for manufacturers in developing countries to improve their IP. The results are in line with some previous findings (e.g., Jimenez-Jimenez *et al*., 2019; Kumar *et al*., 2020; Yang and Lin, 2020). However, these results are inconsistent with the findings of some other previous studies. For example, regarding internal integration, Wong *et al*. (2013) ascertained that it is not associated with product innovation, and Ayoub *et al*. (2017) revealed that internal integration has an insignificant effect on technological innovation. Regarding supplier integration, Handfield *et al*. (1999) indicated that it is inadequate and even risky for some situations. Likewise, Fine (1998) asserted that supplier

integration may reduce product innovation instead of enhancing it. Regarding customer integration, Hamel and Prahalad (1994) suggested that it does not affect the IP of the firm because customers cannot anticipate future changes, Un and Asakawa (2015) indicated that R&D collaborations with customers have no impact on process innovation, and Ding and Huang (2019) revealed that customer knowledge integration negatively affects process innovation.

Furthermore, the results showed that IP has a significant effect on FP. These results are consistent with several previous studies (e.g., Pinho, 2008; Wang and Wang, 2012; Kafetzopoulos *et al*., 2019; Lee *et al*., 2019). However, these results are inconsistent with some other studies. For instance, Matanda and Schroder (2002) found that innovation has a negative effect on business performance. Likewise, Stojčić and Hashi (2014) found a negative statistical coefficient between IP and FP in the case of firms, which have product-only innovation.

Finally, IP proved to partially mediate the effect of SCI on FP. This indicates that Jordanian manufacturers heavily rely on their IP to enhance their FP. IP is a key factor that motivates the firm to integrate with its supply chain partners to seek their new and innovative ideas, which can then be exploited to boost their FP. In other words, IP plays a catalyst role in the relationship between SCI and FP, as collaboration and close relationships with supply chain partners provide manufacturing firms with access to the different experiences, knowledge, capabilities, and skills required for improved IP, which will be translated into enhanced IP.

6. Conclusions, Implications, and Limitations

6.1. Conclusions

In this study, a theoretical model has been developed to investigate the impact of SCI on FP directly and indirectly through the IP of Jordanian manufacturing firms. This study sheds the light on an issue that is still debated in the existing literature regarding the relationships among SCI, IP, and FP, as most of the previous studies were mainly theoretically based and lacked empirical evidence, especially from a developing context such as Jordan. The results of this study showed that SCI and IP positively affect FP. They also showed that SCI positively affects IP. Furthermore, it was proved that IP positively mediates the SCI-FP relationship.

6.2. Theoretical implications

The current study makes various theoretical contributions that extend the existing body of knowledge. It sheds the light on a debatable issue in the literature regarding the impact of SCI on IP and FP. This study reconsiders the assumed direct effect of SCI on performance. It builds on earlier findings related to the SCI-performance link (e.g., Flynn *et al*., 2010; Subburaj *et al*., 2020) by showing the impact of SCI on FP either directly or indirectly through IP. In addition, this study extends the work of other researchers by investigating the proposed relationships among SCI, IP, and FP via a single model that was examined in the manufacturing sector in a developing country context.

6.3. Practical implications

Managers can find useful implications from this study. Managers of manufacturing firms can use the findings of this study in order to enhance the IP of their firms, through integrating resources and capabilities within their firms (i.e., internal functions) and outside them (i.e., external suppliers and customers). This means that they can utilize SCI for the purpose of introducing innovative products, processes, marketing methods, and management systems, which will ultimately benefit the FP.

6.4. Limitations and future research

This study has its limitations, some of which will serve as the stimulus for future work. First, due to the COVID-19 pandemic and the related closures, this study relied on the convenience sampling technique. This may have limited the generalizability of the obtained results. Future studies could utilize the simple-random sampling technique to confirm the findings of the current study. Second, the focus of the current study was on Jordanian manufacturing firms from different industries. The main reason to cover different industries was the limited number of firms belonging to one industry type in Jordan. Future studies could be conducted in one industry type and/or other countries to explore the proposed relationships. Third, one respondent was targeted from each firm. Despite the wide

use of this approach in the extant literature, this may have affected the generalizability of the results. The current study's findings could be confirmed by future studies applying a multiple-informant approach in which a number of informants including managers and employees participate from each targeted firm.

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