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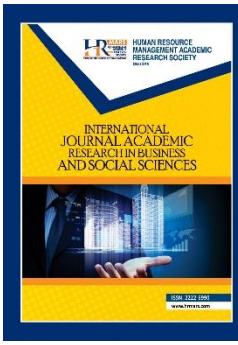
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Revisit the Relationships and Dimensions of Supply Chain Integration for Business Outcomes

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Abstract

In recent years, driven by low cost, many global supply chains have been used to realize global procurement and manufacturing chains. Obviously, supply chain integration is a practical means to be applied to various supply chain networks to improve supply chain performance. However, the global supply chain has been continuously interrupted by natural disasters, epidemics, and human error in the past few years. For example, the COVID-19 pandemic in 2020 and the blockade of the Suez Canal in 2021. These incidents have caused supply disruptions and factory shutdowns in global manufacturing and retail. With the expansion of supply chain integration, the interdependence between supply chain partners increases, and the vulnerability and risks of the supply chain also increase. Therefore, the dimensions of supply chain integration, namely internal integration and external integration, the relationship between them and their impact on business outcomes need to be further studied. The main purpose of the review is to put forward a conceptual framework of supply chain integration to study the relationship by collating the past literature.

Keywords: Supply Chain Integration, Internal Integration, External Integration, Performance, Indicators

Introduction

Supply chain integration (SCI) is a widely accepted form in the practice of supply chain management. By integrating the supply chain, manufacturers provide fast delivery, innovative, and customized products to meet customer needs. Supply chain integration refers to the strategic and high-level inter-organizational collaboration between the focal firm and supply chain partners (i.e., suppliers, distributors, retailers, and customers) that will positively impact supply chain performance, including cost, time, responsiveness, operational quality, and innovation. With the deepening of supply chain integration, the supply chain's dependence on internal and external stakeholders increases, and supply chain risks also increase. Recent examples, such as the COVID-19 pandemic and the blockage of the Suez Canal in 2021, have harmed the supply chain, such as factory shutdowns and cargo stranded. Therefore, after experiencing the global supply chain disruption, the supply chain network scale, supplier location, network management, etc., which are highly related to supply chain integration, are expected to change. Therefore, this article aims to determine the key factors

of supply chain integration and its outcomes by reviewing previous studies and establishing a supply chain integration framework for future research.

Supply Chain Integration

The definition of SCI was first introduced by Steven (1989) as an integrated supply chain that manages the material flow from three levels: strategic, tactical, and operational. At the strategic level, organizations need to set and manage long-term goals for the supply chain, such as site selection and supplier network design. At the tactical level, these goals are transformed into specific goals for guidance and control, such as material procurement, production, and transportation plans. At the operational level, these goals are then transformed into action plans and achieved, such as logistics monitoring and weekly forecasts. Base on this vertical dimension involving strategy, tactic, and operation, the SCI aims to utilize facilities, human resources, finance, and system at each level to balance the ultimate goals of high customer service and low cost. Thereafter, in the past few decades, researchers have refined the definition of SCI. Besides material flow, the integration of information flow, financial flow (Huo, 2012; Zhao et al., 2015; Tiwari, 2020), and other resources (e.g., human resources and knowledge) with supply chain partners (Stevens and Johnson, 2016) could help firms with complex supply chain networks to provide high-value products to end customers (Kang et al., 2018b). Zhu et al (2018) further proposed that SCI should concentrate on customer value-creating activities and overcome no value-added processes, which may eliminate unnecessary costs. Thus, the ultimate goal of SCI is to provide customers products with acceptable costs.

To achieve the goal of SCI, researchers suggested that SCI refers to strategic collaborations within the focal company and its supply chain partners (Porter, 2019; Shukor et al., 2020; Yu et al., 2021). Such collaborations include firm's cross-functional team collaboration (e.g., planning, sourcing, warehousing, production, and marketing) and high-level inter-organizational collaboration (e.g., information sharing, joint decision-making, and system coupling) between the focal firm and supply chain partners, i.e., suppliers, distributors, retailers, and customers (Flynn et al., 2010; Tsinopoulos and Mena, 2015; Kang et al., 2018a). Clearly, the SCI can be described as the focal firm that goes beyond the organizational internal functional barriers and strategically collaborates with external SC partners in order to fulfill end customer needs.

The SCI structure has been widely discussed in previous literature, and there are two main approaches to conceptualize SCI. The first approach views the whole supply chain as an entirety and focuses on strategies and operations of SCI to integrate the supply chain participants and provide good quality products to customers (Son et al., 2021). Researchers stressed that collaboration, information sharing, and joint decision-making are the fundamental components of SCI (Wu et al., 2014; Bruque-Cámara et al., 2016). For examples, Angeles (2009) described SCI as operations of integrating physical flow, information flow, and financial flow. Zhao et al (2010); Wang et al (2016a) constructed a three-dimension framework, which involves strategic alliance, information sharing, and process coordination. Wang et al. (2018) further argued that a successful SCI should also consider strategic alliances and focus on long-term symbiotic effects. Scholars of this school regard the supply chain network as a whole entity and achieve overall SCI by integrating the flows (i.e., physical, information, and finance) and process coordination (e.g., manufacturing, logistics, and marketing) among the networks. All supply chain members must follow the same integrated processes and participate in all unified operations which leads to a complex network

structure. Even though supply chain operational collaboration strengthens the relationship between supply chain partners. The complexity of supply chain operation and structure significantly increases the supply chain risks, such as supply and production disruption (Cheng and Kam, 2008).

In contrast, another approach considers SCI as evolving concept through two stages: internal integration and external integration (Shou et al., 2017; Delic et al., 2019; Kumar et al., 2020). Most of the scholars who supported this thought further conceptualize SCI into three dimensions: internal integration, supplier integration, and customer integration (Kumar et al., 2017; Porter, 2019). Internal integration refers to a firm's internal function collaborations (Irfan and Wang, 2019). In addition, supplier integration and customer integration imply that the focal firm cooperates with external partners (key suppliers and customers) to integrate the strategies, processes, and practices (Kanyoma et al., 2020). In this approach, Flynn et al. (2010); Shou et al (2017) stressed that information sharing, collaborative approaches, joint decision-making, and system coupling are key activities during internal, suppliers, and customers integration. In overall, scholars of this school have divided the supply chain into several dimensions (i.e., internal and external or internal, supplier and customer) according to the organizational boundary.

As shown in Table 1, most of the studies classified SCI into internal integration, supplier integration, and customer integration (Mora-Monge et al., 2019; Perdana et al., 2019; Zhang et al., 2019). Even though some researchers have divided the external integration into process integration and product integration (Huo et al., 2014), or information flow, physical flow, and finance flow integration (Sacristán-Díaz et al., 2018), still, the key participants of SCI are suppliers and customers. Due to the popularity and rationality of SCI's internal integration and external integration, this study adopts internal integration and external integration of SCI. The internal integration and external integration (i.e., supplier and customer) have different impacts on supply chain performance (Wong et al., 2011). Huo et al (2016) found that internal integration and customer integration positively influence competitive performance. Similarly, Alfalla-Luque et al (2015) claimed that internal integration directly impacts external integration, delivery, flexibility, inventory, quality, and customer satisfaction, while external integration only directly influences customer satisfaction. Zhao et al (2015) further pointed out that internal integration has a linear and positive effect on financial performance while low-level external integration positively impacts financial performance and the opposite at high-level in Chinese manufacturing companies. Evidently, internal integration has more direct impacts on organizational performances if compared to external integration.

In conclusion, the second concept of SCI including internal integration and external integration, illustrates the primary path of supply chain integration. Also, it points out that different types of integration have different effects on supply chain performance. It is a comprehensive concept of supply chain integration. Thus, this study adopts this concept to further investigate the framework of SCI.

Table 1: SCI Dimensions

References	Unidimensional	Internal Integration	Supplier Integration	Customer Integration	Partner Integration	Supply Integration	Demand Integration	Logistics Service Provider	Information flow	Physical flow	Financial flow	Process integration	Product integration
Vargas et al. (2000)		√	√	√									
Gimenez (2006)		√			√								
Kim (2006)		√			√								
Chen et al. (2007)		√			√								
Lee et al. (2007)		√	√	√									
Boon-itt & Wong (2011)		√	√	√									
Huo (2012)		√	√	√									
Feng et al. (2013)		√											
Han et al. (2013)		√		√									
Wu (2013)		√	√	√									
Finger et al. (2014)		√	√										
Huo et al. (2014)		√										√	√
Huo et al. (2015)		√	√	√									
O'Reilly et al. (2015)		√			√								
Tseng & Liao (2015)		√	√	√	√								
Zsidisin et al. (2015)		√	√										
Bruque-Cámara et al. (2016)		√	√	√									
Cheng et al. (2016)		√	√	√									
Lee et al. (2016)		√	√	√									
Sundram et al. (2016)		√	√	√	√								
Szász et al. (2016)		√			√								
Wang et al. (2016b)		√	√										
Yunus & Tadisina (2016)		√	√	√									
Ali et al. (2017)		√	√	√									
Ayoub et al. (2017)		√	√	√									
Feng et al. (2017)	√												
Shou et al. (2017)		√	√	√									
Yuen & Thai (2017a)		√	√	√									
Yuen & Thai (2017b)		√			√								
Abdallah & Nabass (2018)		√	√										
Cerchione et al. (2018)		√			√								
Chaudhuri et al. (2018)		√	√	√									
Kang et al. (2018b)		√	√	√									
Liu & Lee (2018)		√		√				√					
Oghazi et al. (2018)		√	√	√									
Robinson et al. (2018)		√	√										
Sacristán-Díaz et al. (2018)		√							√	√	√		

Shee et al. (2018)		√	√	√									
Sundram et al. (2018)		√	√	√	√								
Delic et al. (2019)		√	√	√									
Feyissa et al. (2019)		√	√	√									
Irfan & Wang (2019)		√			√								
Khalaf & El Mokadem (2019)		√			√								
Li et al. (2019)		√			√								
Mora-Monge et al. (2019)		√	√	√									
Perdana et al. (2019)		√	√	√				√					
Tarifa-Fernández et al. (2019)		√	√	√									
Zhang et al. (2019)		√	√	√									
Ataseven et al. (2020)		√	√	√		√	√						
Bokrantz et al. (2020)		√	√										
Ganbold et al. (2020)		√	√	√									
Kanyoma et al. (2020)		√			√								
Kumar et al. (2020)		√	√	√									
Shukor et al. (2020)		√	√	√									
Counts	**1**	**53**	**37**	**33**	**14**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**

Supply Chain Integration Outcomes

SCI plays a crucial role in supply chain management, and it is the essential factor of supply chain management success. Generally, for an integrated supply chain with both suppliers and customers tend to get a higher probability to achieve success than one direction of integration (Fekpe and Delaporte). Due to the nature of the supply chain partnership, SCI is considered a way to improve the performance of supply chains (Tseng and Liao, 2015; Kang et al., 2018b). The outcomes of SCI can be divided into financial performance and non-financial performance, which have been investigated widely by many previous studies.

Financial performance

As shown in Table 2, the impact of SCI on profitability (Kim, 2006; Chen et al., 2007; AL-Shboul et al., 2018; Amoako et al., 2020) is most investigated in previous studies. Notably, companies are profit-seeking. This also explains that the return on investment (ROI) (Huo et al., 2014; Zhao et al., 2015; Khan and Wisner, 2019) and growth in sales (Ataseven and Nair, 2017; Amoako et al., 2020; Novais et al., 2020) are widely discussed in previous studies. Similarly, cost (Chen et al., 2019; Amoako et al., 2020) and cost reduction (Lee et al., 2007; Shee et al., 2018; Amoako et al., 2020) are linked to financial performance of managing SCI. Furthermore, the indicators focusing on the future development trend of the supply chain, such as growth in market share (Huo et al., 2014; Zhao et al., 2015; Chen et al., 2019; Amoako et al., 2020) and growth in ROI (Kim 2006; AL-Shboul et al. 2018; Novais et al. 2020) are studied in the previous studies. Thus, the financial performance indicators measuring the supply chain capability and future development trends include profitability, ROI, cost, growth in ROI, and growth in sales.

Table 2: Financial performance indicators

References	Profitability	Return on investment (ROI)	Growth in ROI	Return on assets (ROA)	Sales	Growth in sales	Return on sale (ROS)	Growth in ROS	Market share	Growth in market share	Cost	Cost reduction	Financial liquidity	Overall competitive position	Overall business performance
Kim (2006)	√	√		√		√				√		√	√		
Chen et al. (2007)	√			√	√									√	
Lee et al. (2007)												√			
Huo et al. (2014)		√	√				√	√	√	√					
Zhao et al. (2015)	√	√				√	√			√					
Huo et al. (2016)											√				
Sundram et al. (2016)					√						√				
Szász et al. (2016)											√				
Ataseven & Nair (2017)	√	√				√					√				√
Yuen & Thai (2017b)											√				
AL-Shboul et al. (2018)	√	√	√						√					√	
Khan & Wisner (2019)	√	√		√		√	√								
Shee et al. (2018)					√							√	√		
Chen et al. (2019)										√					
Li et al. (2019)	√			√		√									
Amoako et al. (2020)	√					√				√		√			
Novais et al. (2020)	√		√			√	√	√							
Counts	9	6	3	4	3	7	4	2	2	5	5	4	2	1	1

Non-financial performance

As shown in Table 3, the most studied non-financial performance indicators of SCI include quality, flexibility, and delivery (Zsidisin et al., 2015; Cheng et al., 2016; Szász et al., 2016; Yuen and Thai, 2017b). In addition, most studies investigate the impact of SCI on service and fast new products introduction (Lu et al., 2017; Jajja et al., 2018; Chaudhuri et al., 2018). This could be explained that customers want better products and services, and companies need to adapt to the ever-changing market. This reason may also explain why scholars are concerned about the relationship between SCI and innovation, lead time, and customer satisfaction (Ayoub et al., 2017; Amoako et al., 2020; Novais et al., 2020).

Table 3: Non-financial Performance Indicators

References	Quality	Flexibility	Delivery	Service	Reliability	Innovation	Lead time	Cycle time	Inventory turnover	Quick response	Quickly introduce	Manufacturing agility	New technologies	Customer satisfaction	Customer positive feedback	Number of basic programs	New stores	Coordination level
Kim (2006)														√				
Chen et al. (2007)														√				
Lee et al. (2007)					√													
Wong et al. (2011)			√															
Finger et al. (2014)													√					
Huo et al. (2014)	√	√	√	√														
Zsidisin et al. (2015)	√				√													
Cheng et al. (2016)	√	√	√	√														
Huo et al. (2016)	√	√	√	√		√		√	√		√							
Sundram et al. (2016)																		√
Szász et al. (2016)	√	√	√		√		√											
Ataseven & Nair (2017)	√	√	√															
Ayoub et al. (2017)						√												
Lu et al. (2017)				√			√				√	√						
Yuen & Thai (2017b)	√	√	√															
Abdallah & Nabass (2018)												√						
Chaudhuri et al. (2018)		√																
Jajja et al. (2018)		√	√								√	√						
Shee et al. (2018)	√	√	√	√	√													
Chen et al. (2019)			√						√	√	√							
Amoako et al. (2020)														√	√		√	
Ataseven et al. (2020)																√		
Novais et al. (2020)				√		√	√				√	√						
Counts	**8**	**9**	**10**	**6**	**4**	**3**	**3**	**1**	**2**	**1**	**5**	**4**	**1**	**3**	**1**	**1**	**1**	**1**

There is increasing evidence indicates that SCI positively impacts supply chain performance in financial and non-financial, which includes cost, time, responsiveness, operation quality, innovation (Flynn et al., 2009, Yuen and Thai, 2017b; Kumar et al., 2020) and competitiveness (Frohlich and Westbrook, 2001). According to Zhu et al. (2018), customer service performance and innovation performance could be increased when focal firm collaborates well with key SC partners. In addition, other researchers linked SCI with supply chain flexibility and agility (Chaudhuri et al., 2018; Shukor et al., 2020), business performance, logistics performance (Lee

et al., 2016), and operational performance (Khanuja and Jain, 2019). However, obtaining these benefits requires tremendous organizational effort (Mora-Monge et al., 2019).

Most prior studies show a positive relationship between SCI and various performances. But the other side of the coin is that there are some studies suggest that SCI has no relationship with performance or negatively affects the firm performance. Gimenez et. al (2012) pointed out that SCI has limited or no influence on supply chain performance while supply complexity is low. In the situation of high supply complexity, SCI negatively affects cost performance. In fact, SCI leads to increased interdependence of supply chain partners which could trigger some operational complexities and risks (Chaudhuri et al., 2019). Thus, further research should be conducted to identify the influence of SCI on firm performances and supply chain risk management.

Internal Integration

Internal integration revolves around on how focal firm integrates the supply chain functions within the enterprise, such as sourcing, manufacturing, warehousing and selling in order to meet the customer demands (Bokrantz et al., 2020; Ganbold et al., 2020). Internal integration stresses the importance of internal information sharing (Kang et al., 2018b; Shukor et al., 2020), and synergy of internal operation procedures (Delic et al., 2019; Kumar et al., 2020). This means internal integration can be further explained as integrating supply chain activities and functions such as sourcing, logistics, manufacturing procedures and marketing, among functional departments/teams within a company (Danese and Ramano, 2011; Huo, 2012; Turkulainen et al., 2017).

Some researchers found that internal integration is the foundation of external integration, i.e., supplier integration and customer integration (Tracey, 2004; Horn et al., 2014). The removal of internal barriers could reduce the challenges in external integration (Braunscheidel and Suresh, 2008). By improving the flow of information in the company, internal integration may improve the firm capability of fulfilling customer requirements, efficiency of communicating with upstream partner, and flexibility (Chen and Paulraj, 2004; Germain and Iyer, 2006; Schoenherr and Swink 2011). Internal integration concentrates on comprehensive integrated planning and controlling. It helps cross-functional teams to exploit resources in the organization and reduce non-value-added activities, as well as promote information sharing effectiveness and jointly decision-making (Flynn et al., 2010; Huo et al., 2014).

As shown in Table 4, information sharing and joint decision-making of sales forecast, production plans, production progress, and stock level are primarily investigated in previous literature (Delic et al., 2019; Ataseven et al., 2020; Kumar et al., 2020; Shukor et al., 2020). Both of these indicators focus on information interchange within the company. Similarly, data integration, enterprise application integration, cross-functional teams, and real-time searching can be linked to information flow (Yuen and Thai, 2017b; Sundram et al., 2018; Sacristán-Díaz et al., 2018). The information flow through enterprise application integration and data integration could help firms to reduce communication barriers between functional departments and improve information sharing efficiency (Sundram et al., 2018; Delic et al., 2019; Shukor et al., 2020). Establishing cross-functional teams and using periodic inter-department meetings are important ways of reducing information-sharing barriers in the company (Fekpe and Delaporte, 2019; Ataseven et al., 2020). Most of the internal integration indicators have been investigated linked to information flow. A possible explanation for this might be that, instead of functional departmentalization and specialization, all internal

activities and functions have to work together to satisfy customers (Han et al., 2013). Thus, information-related indicators are essential measurements for internal integration.

Integrating information flow and material flow within the company is the first step of internal integration (Stevens and Johnson, 2016). Besides information flow, researchers evaluated internal integration from the perspective of material flow. The degree of integration of physical flow and inventory management reflects the level of internal integration (Lee et al., 2016; Yunus and Tadisina, 2016). Furthermore, measures used to improve the fluency of information flow, such as joint decision-making and real-time searching, are also conducive to material flow (Huo et al., 2015; Kang et al., 2018b). In summary, information sharing and joint decision-making are adopted by most researchers as internal integration indicators. Other indicators are shown in Table 4, such as data integrating, enterprise application integration, real-time searching, and so on, are highly related to information sharing and joint decision-making. For example, enterprise application integration aims to achieve synchronous operational processing and information sharing by integrating internal business processes, application software, and hardware (Ganbold et al., 2020). Thus, this study adopts information sharing and joint decision-making as the key indicators of internal integration.

Table 4: Internal integration indicators

References	Information sharing	Joint decision-making	Data integration	Enterprise application	Cross-functional teams	Real-time searching/integration	Use common metrics of performance	High responsiveness	Communication frequency	Internal logistics	Inventory management	Resources sharing	Department\Functions integration
Huo et al. (2015)	√	√			√								
Tseng & Liao (2015)	√	√	√										
Lee et al. (2016)	√			√				√		√			
Yunus & Tadisina (2016)	√		√		√	√					√		
Feng et al. (2017)			√										
Shou et al. (2017)	√	√											
Yuen & Thai (2017b)	√	√		√	√								
Abdallah & Nabass (2018)				√				√					√
Chaudhuri et al. (2018)	√	√											
Kang et al. (2018b)	√	√											
Liu & Lee (2018)				√						√	√		√
Robinson et al. (2018)		√											√
Sundram et al. (2018)	√			√									
Sacristán-Díaz et al. (2018)	√		√	√		√				√	√		
Delic et al. (2019)	√		√		√	√			√				
Feyissa et al. (2019)	√	√			√				√			√	
Irfan & Wang (2019)			√	√	√	√					√		
Li et al. (2019)	√			√									
Tarifa-Fernández et al. (2019)			√		√		√		√				
Zhang et al. (2019)		√							√				√
Ataseven et al. (2020)	√	√			√		√						
Bokrantz et al. (2020)	√	√					√						
Ganbold et al. (2020)					√				√				
Kumar et al. (2020)	√	√											
Shukor et al. (2020)	√	√		√		√							
Counts	**17**	**13**	**7**	**9**	**9**	**5**	**3**	**2**	**5**	**3**	**4**	**1**	**4**

External Integration

External integration refers to a firm achieves collaboration with external supply chain partners (Irfan and Wang, 2019; Robinson et al., 2018). External integration focuses on collaboration between the company and external partners in information sharing, project participation, quality improvement to achieve better supply chain performance. (Zhang et al., 2019). Most

studies classified external integration into supplier integration (Table 5) and customer integration (Table 6) and used not precisely the same indicators for evaluating these dimensions. Supplier integration focuses on the efficiency and flexibility of cooperation between the focal firm and suppliers, while customer integration is related to key customers' knowledge cooperation in market information (Perdana et al., 2019; Li et al., 2019). Although supplier and customer integration are different in theory, they are related in practices and research (Tarifa-Fernández et al., 2019).

As shown in Table 5, most researchers found that information sharing, joint decision-making, system coupling, and developing collaborative approaches are the primary indicators used to evaluate the degree of supplier and customer integration (Kang et al., 2018b; Zhang et al., 2019; Bokrantz et al., 2020). Sharing information with suppliers and customers about sales forecast, production plans, order tracking and tracing, delivery status, and stock level leads to higher efficiency, accuracy, and customer satisfaction, which in turn increases the trust among participants (Oghazi et al., 2018; Agarwal and Narayana, 2020; Boer and Boer, 2020). A high level of trust between supply chain partners positively affects SCI processes and helps the company build stable relationships with suppliers and customers (Mora-Monge et al., 2019). Further, developing collaborative approaches refers to build up a long-term relationship and sharing risk or revenue with suppliers and customers (Liu and Lee, 2018; Delic et al., 2019; Li et al., 2019; Shukor et al., 2020). Long-term relationship and sharing risk or revenue help supply chain partners generates knowledge in terms of understanding and predicting other's behavior patterns, such as motivations, capabilities, and attitudes, which reduces information asymmetry (González-Benito et al., 2016; Prajogo et al., 2020). With the extension and stability of the supply chain cooperation relationship, mutual trust between participants has been developed. The suppliers and customers will better understand the core company's behavioral patterns and product supply (Oke et al., 2013).

Joint decision-making implies suppliers and customers involved in projects like the product and process design, quality improvement, and cost control of the focal firm (Lee et al., 2016; Yunus and Tadisina, 2016; Shou et al., 2017; Sundram et al., 2018). Joint decision-making allows firms to take advantage of different specialized capabilities from supply chain partners, accumulating experiences, thus reducing costs (He et al., 2017). Furthermore, joint decision-making creates mutual trust between supply chain partners to avoid misunderstanding and conflict (Zhang et al., 2021). System coupling can be defined as the focal firm collaborate with suppliers and customers by using collaborative techniques, such as vendor managed inventory (VMI), just-in-time (JIT), Kanban, and continuous replenishment (Feyissa et al., 2019; Irfan and Wang, 2019; Tarifa-Fernández et al., 2019; Ganbold et al., 2020). System coupling enables the focal firm to share information, such as forecast, sales revenue, demand variation, inventory, production plans, with external partners, thereby improves the supply chain's information flow and material flow (J.S. et al., 2019).

In summary, as shown in Table 5, information sharing, joint decision-making, collaborative approaches, and system coupling are adopted by the most researcher in prior studies. Most of the indicators shown in Table 5 can be linked to these four indicators. Take communication as an example, communication is to share information with others, so communication relates to the level and frequency of information sharing. Similarly, joint decision-making improves supply chain performance by involving suppliers and customers in projects. This definition establishes a connection with the improvement. Thus, this study adopts information sharing, joint decision-making, developing collaborative approaches, and system coupling as the key indicators of external integration.

Table 5: External integration indicators

	Supplier integration										Customer integration								
References	Collaborative approaches	Information sharing	Joint decision-making	System coupling	Improvement	Communication	Close cooperation	Inventory sharing	Function integration	Real-time operations	Information sharing	Joint decision-making	Communication	System coupling	Collaborative approaches	Responses	Customer feedback	Customer demands	Delivery
Huo et al. (2015)	√		√		√	√						√	√		√	√	√		
Tseng & Liao (2015)											√		√				√		
Lee et al. (2016)	√	√	√								√	√		√					
Yunus & Tadisina (2016)	√	√	√	√							√		√	√					
Feng et al. (2017)		√									√					√			
Shou et al. (2017)	√	√	√	√							√	√		√	√				
Yuen & Thai (2017b)																			
Abdallah & Nabass (2018)	√	√			√						√		√				√		
Chaudhuri et al. (2018)	√	√	√	√							√	√		√	√				
Kang et al. (2018b)	√	√	√	√							√	√		√	√				
Liu & Lee (2018)													√	√	√			√	
Robinson et al. (2018)									√										
Sundram et al. (2018)			√									√							
Sacristán-Díaz et al. (2018)																			
Delic et al. (2019)	√	√	√	√							√	√		√					
Feyissa et al. (2019)	√			√						√			√			√			
Irfan & Wang (2019)				√										√					
Li et al. (2019)	√	√									√				√				
Tarifa-Fernández et al. (2019)	√	√			√						√			√					
Zhang et al. (2019)	√				√	√												√	√
Ataseven et al. (2020)	√	√	√			√	√				√	√			√	√		√	
Bokrantz et al. (2020)		√	√		√		√												
Ganbold et al. (2020)	√	√	√	√				√			√		√			√			
Kumar et al. (2020)	√		√		√	√						√				√	√		
Shukor et al. (2020)	√	√	√	√							√		√	√					
Counts	**16**	**14**	**13**	**9**	**6**	**4**	**2**	**1**	**1**	**1**	**14**	**9**	**8**	**7**	**7**	**6**	**4**	**3**	**1**

Conclusion

This review highlights the relevant content of supply chain integration in manufacturing industry. The extensive review has clarified the framework of supply chain integration, which can be divided into two dimensions, namely internal integration, and external integration. In

addition, this review also lists the critical indicators of two dimensions: information sharing and joint decision-making for internal integration and information sharing, joint decision-making, developing collaborative approaches, and system coupling for external integration. This study indicates that a complete supply chain integration should include internal integration and external integration. In the process of internal integration, we should pay attention to the smooth communication of internal information within the organization and give full play to the role of various functional departments for joint decision-making. In external integration, in addition to information exchange and joint decision-making, long-term strategic partnerships and system coupling should also be established with supply chain partners to improve the performance of the integration. In addition, researchers may conduct empirical research based on this framework to verify its rationality. Practitioners can use this framework to sort out the integration process and improve integration performance. This review only covers the manufacturing supply chain. Therefore, the integration framework of different types of supply chains may be different, which is worthy of further study. In addition, besides suppliers and customers, supply chain partners also include distributors, carriers, and other participants who provide related services, so further expansion of the scope of external integration may provide different insights and perspectives.

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