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## Service integration: Supply chain integration in servitization

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1.

**INTRODUCTION** Many manufacturing firms in various industries, such as aerospace, shipyards and engineering, have shifted their focus from selling products and basic services to providing integrated products and services (called integrated solutions, product-service systems or servitized offerings) to fulfil customers' business or operational needs (Rabetino, Harmsen, Kohtamäki, & Sihvonen, 2018). This strategic transition, which is called servitization, has been a growing interest in manufacturing firms to enhance their competitive position and business performance (Baines, Lightfoot, Benedettini, & Kay, 2009). Adding services to the product offering not only affects the manufacturing firms involved but also changes the traditional manufacturing supply chain and affects intra- and inter-organisational structures (Baines et al., 2009). Over the past decade, servitization has been identified as not a solo journey but a joint strategic effort by several organisations in the supply chain (Ayala, Paslauskis, Ghezzi, & Frank, 2017; Burton et al., 2016; Martinez, Neely, Velu, Leinster-Evans, & Bisessar, 2017). Firms engaged in servitization must integrate with a network of actors that include component suppliers, intermediaries and customers (Burton et al., 2016). Because manufacturing firms do not possess all the required resources and capabilities to achieve their servitization goal, they need to collaborate with several partners that can support the design and delivery of the offering (Shah, Jajja, Chatha, & Farooq, 2020; Windahl & Lakemond, 2006). As the service business is an important source of revenue for some manufacturing firms, the service supply chain (SSC) becomes a key enabler of this transformation (Iakovaki, Srari, & Harrington, 2009). Baltacioglu et al. (2007: 112) defined SSC as "the network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services; transformation of these resources into supporting and core services; and the delivery of these services to customers". SSC can be categorised into either a service-only supply chain or a product-service supply chain (Wang, Wallace, Shen, & Choi, 2015). The service provision in manufacturing firms belongs to the product-service supply chain where physical products develop and deliver through the supply chain, but services have a significant role for most of the supply chain partners (Nagariya, Kumar, & Kumar, 2020). To develop a comprehensive picture of supply chain integration in servitization, this chapter proposes a service integration framework that explains the integration of supply chain partners to enable the integration of service business in the firm's existing value chain. The scope of this chapter is limited to manufacturing firms, and thus other SSC clusters (e.g. a logistics SSC is out of the scope of this study).

2.

### THEORY DEVELOPMENT

#### 2.1. Service integration in terms of dimensions, levels, modes and service types

As explained, the business relationships for the servitization of manufacturing firms are not limited to service units, and they require the integration and management of complex interfaces between multiple organisational units and firms (Burton et al., 2016). This section uses supply chain integration as the

theoretical lens and focuses on the extant servitization literature on intra- and inter-organisational relationships. Supply chain integration is defined as the collaborative management of intra- and inter-organisational interfaces (Flynn, Huo, & Zhao, 2010; Schoenherr & Swink, 2012). The literature on supply chain integration recognises the importance of considering both internal and external perspectives to maximise supply chain value for all the actors involved (Flynn et al., 2010). Internal integration enables external integration (Flynn et al., 2010) by facilitating the flow of products, services, information, money and decisions to increase customer value at low cost and high speed (Zhao, Huo, Selen, & Yeung, 2011). The service integration framework aims to conceptualise the supply chain integration to enable integrating service business into the firm's existing value chain. As Figure 1.1 illustrates, this framework explores supply chain integration by distinguishing the supply chain dimensions (i.e. internal, supplier and customer integration), levels (i.e. operational and strategic integration), modes (i.e. resource and information sharing) and type of services (i.e. basic and advanced services). It should be noted that Figure 1.1 is a simplified version of a supply chain and its partners; in practice, the manufacturing firm might have different types of supply chain structures and partners.

-----Figure 1.1 is added here-----

Figure 1.1: Service integration framework elements

Research conceptualises supply chain integration as consisting of three dimensions: internal, supplier and customer integration (Flynn et al., 2010; Schoenherr & Swink, 2012; Zhao, Huo, Selen, & Yeung, 2011). Internal integration involves cross-functional collaborative and information activities through synchronised processes and systems (Schoenherr & Swink, 2012). These synchronised processes aim to meet customers' needs as well as facilitate external integration (Flynn et al., 2010). Internal integration mainly features information system integration and cross-functional cooperation (Zhao et al., 2011). Supplier integration refers to structuring inter-organisational strategies, practices and procedures into collaborative, synchronised and manageable processes to fulfil customers' needs (Zhao, Feng, & Wang, 2015). Supply chain integration mainly involves coordination and information-sharing activities that enable the firm to understand suppliers' processes, capabilities and constraints (Schoenherr & Swink, 2012). In the context of servitization, suppliers can be divided into goods suppliers and service suppliers. Whereas goods suppliers are more active in the upstream value chain through equipping the required components of the system, service suppliers in the downstream act as intermediaries between the firm and customers to deliver some or all services. Customer integration involves collaborative and information-sharing activities between the firm and its customers; this enablesthe firm to identify expectations and business opportunities and, consequently, respond to customers' needs (Schoenherr & Swink, 2012). Customer integration decreases the threat of competitors, improves customer willingness to pay a premium price and increases customer loyalty (Droge, Jayaram, & Vickery, 2004). Supply chain integration can be considered at two levels: operational integration and strategic integration (He & Lai, 2012). Operational integration focuses on the integration of processes and information flows, and it usually occurs during a specific service activity, such as service development, sales and delivery (He & Lai, 2012). Strategic integration focuses on collaboration with external partners to create common interests, agree on a shared vision and carry out collective actions (He & Lai, 2012). Strategic integration concerns the integration of supply chain partners independently of a specific service operation and enhancethe long-term relationship (Momeni & Martinsuo, 2019). Regarding the modes of integration, supply chain integration can be carried out through two major modes: resource sharing (i.e. people, physical possessions, technologies and properties) and information sharing (Nagariya et al., 2020). While information can be considered part of organisational resources, it is defined as a separate mode to emphasise the importance of information (and knowledge) flow in the supply chain. Finally, previous literature has identified that supply chain integration needs can differ based on the type of services offered by manufacturing firms (Saccani, Visintin, & Rapaccini, 2014; Shah et al., 2020). Most of the

services can be categorised into basic and advanced services (Sousa & da Silveira, 2017). Basic services, such as installation, provision of spare parts, maintenance and repair, focus on installing and maintaining basic product functionality (Sousa & da Silveira, 2017). Advanced services, such as training, consulting, risk/revenue sharing contracts or rental agreements, focus on outcome assurance and create value for the customer beyond the basic functionality of the product (Baines, Lightfoot, Smart, & Fletcher, 2013). Advanced services are characterised by high interaction with the customer to co-create value in a way that addresses the specific customer's needs (Sousa & da Silveira, 2017). The following sections explore each dimension of service integration in terms of integration levels, modes and types of services.

### 2.1. Internal integration

The manufacturing firm may use different organisational structures to integrate service functions: (1) a dedicated service organisation to provide all services (Oliva, Gebauer, & Brann, 2012; Sousa & da Silveira, 2017), (2) a specific service unit to handle advanced services and (3) a functional structure managing both products and services, outsourcing some services and overseeing other services through business functions (Alghisi & Saccani, 2015; Bustinza, Bigdeli, Baines, & Elliot, 2015). However, organisational functions involved in servitized offerings usually specialise in their own activities (Oliva et al., 2012). This distinction creates conflicts over expectations, preferences and priorities that need to be overcome through integration efforts between functions (Oliva & Watson, 2011). Servitization literature has emphasised the criticality of strategic integration through linking the servitization strategy with critical processes and key practices (Rabetino, Kohtamäki, & Gebauer, 2017). The literature has also explored internal integration at the operational level. The service development process strongly depends on the cross-functional collaboration between product and service development teams (Lenka, Parida, Sjödin, & Wincent, 2018). Moreover, integrations between after-sales services and engineering functions, as well as with production, marketing (Paslauskis, Ayala, Tortorella, & Frank, 2016) and sales (Kindström, Kowalkowski, & Alejandro, 2015; Momeni & Martinsuo, 2019), have been identified as enablers for the success of servitization. Cross-functional collaboration, which occurs through both information and resource sharing, increases information flow within the organisation and in its relationship with customers, thus enhancing strategic integration with customers and revealing opportunities for fulfilling customer requirements (Kindström et al., 2015). While the scope of basic services is often limited to the service unit, advanced services usually require integration with other organisational functions (Baines et al., 2013). For example, advanced services, such as technical consulting, often require information and knowledge sharing among product development, sales units and service units; the product-service system delivery needs information sharing between project teams, service units and sales units; and modernisation and upgrades require integration between product development, sales units and service units (Momeni & Martinsuo, 2018). Internal integration is considered an important enabler of servitization, but it is insufficient for achieving the servitization goal. However, internal integration helps manufacturing firms develop external integration with other partners in the supply chain to access more resources and capabilities (Shah et al., 2020).

### 2.2. Supplier integration

As explained previously, servitized manufacturing firms collaborate with two types of suppliers in the value chain: goods suppliers in the upstream and service suppliers in the downstream. While the firm-supplier relationship has usually been treated as a dyadic relationship, it can also become triadic (Bastl, Johnson, Lightfoot, & Evans, 2012; Finne & Holmström, 2013). Especially in the case of complex systems, the supplier may provide some specific services (e.g. training, repair) directly to the customer (Bastl et al., 2012). This change makes supply chain relationships more complex and requires closer collaboration between manufacturing firms and suppliers (Finne & Holmström, 2013). Moreover, depending on the position of the manufacturing firm in the value chain, either the firm can be a system integrator that couples systems together and provides services to the customers, or another supplier can have the integrator role or deliver

some specific services to the customers (Finne & Holmström, 2013). Thus, to manage this increased uncertainty and complexity in the supply chain, manufacturing firms attempt to enhance integration with key suppliers (Shah et al., 2020). Studies on servitization in the downstream of the value chain are moving away from a dyadic interaction between a manufacturing firm and supplier by acknowledging the role of intermediaries (Karatzas, Johnson, & Bastl, 2017). The manufacturing firms use service suppliers with the necessary knowledge and capabilities as external support to overcome servitization challenges (Ayala et al., 2019). In general, the relationship between the manufacturing firm and the service suppliers can be divided into three main categories: (1) the service offering is developed by the firm and delivered by the service supplier, (2) the service offering is developed and delivered by the service supplier or (3) both the firm and the service supplier collaborate in developing and delivering the offering (Ayala et al., 2019). The choice of arrangement mainly depends on the financial objectives, the chosen level of customer relationship, the characteristics of service components and the current or targeted level of servitization (Ayala et al., 2017). Manufacturing firms make use of extensive operational collaboration with goods suppliers during the development, production and delivery of integrated products and services (Finne & Holmström, 2013). They do the same with service suppliers during new service development (Aminoff & Hakanen, 2018; Ayala et al., 2019) and service delivery (Karatzas et al., 2017). While successful collaboration between manufacturing firms and suppliers requires operational integration through frequent and open information exchange and the right operational linkages, it also needs strategic integration through developing trust-based governance, more formalised cooperative norms and reciprocal adaptation in the processes (Bastl et al., 2012; Saccani et al., 2014). Supplier integration depends more on a greater exchange of information and know-how between the firms (Martinez et al., 2017). The firms need to create strong links of information and knowledge exchange between different systems, procedures and routines (Bastl et al., 2012). Previous studies have also reported some resource sharing efforts between manufacturing firms and suppliers, such as joint engineering meetings with goods suppliers to design the offering or offer some services (e.g. training) to the end customer by the service supplier (Bastl et al., 2012). Integration with goods suppliers becomes more important for developing and delivering basic services (Shah et al., 2020). For basic services, such as maintenance that requires technical expertise (Sousa & da Silveira, 2017), integration with key suppliers can help manufacturing firms enhance manufacturing-based capabilities (e.g. production technologies for certain spare parts), thus enabling the development and delivery of basic services (Shah et al., 2020). However, recent studies in the context of digital servitization show that specific types of suppliers (e.g. software providers, platform providers) are becoming more important in developing and delivering advanced services (Kohtamäki, Parida, Oghazi, Gebauer, & Baines, 2019). However, regarding integration with the service supplier, the partners collaborate more in the provision of advanced services. For basic services, the information exchange between the manufacturing firm and service suppliers is low and limited to technical and operational aspects (Saccani et al., 2014). Delivering advanced services requires stronger integration through the exchange of technical- and customer-related information (Saccani et al., 2014). It can be argued that the position of service suppliers, i.e. having a direct connection with the customers and their service-specific capabilities, makes them the important partner in delivering advanced services (Ayala et al., 2017; Saccani et al., 2014).

### 2.3. Customer integration

Services have a relational nature (Windahl & Lakemond, 2006), thus the role of the customer in servitization is paramount (Kindström & Kowalkowski, 2009). On one hand, in order to integrate services into the product offerings of manufacturing firms, firms need to acknowledge customers' needs and integrate different components to deliver higher value to customers (Oliva & Kallenberg, 2003). On the other hand, customers are considerably engaged in the service production flow (Chen, Kerr, Tsang, & Sung, 2015). Customer integration occurs at both the operational level and strategic level. Previous studies have explored operational integration through customer engagement and co-creation of value, especially during

service design and development (Chen et al., 2015; Windahl & Lakemond, 2006). Servitization also encourages strategic integration with customers to help manufacturing firms increase customer readiness, understand the current and future needs of customers, utilise the customer's inputs and resources in developing the offering, create demand and maintain long-term strategic agreements with customers (Shah et al., 2020). Customer integration has a broad scope and includes different modes of integration, such as information sharing and customer resource sharing, including customers themselves, physical possessions, data, technologies and properties (Alghisi & Saccani, 2015; Chen et al., 2015; Moeller, 2008). Basic services, such as installation and maintenance, are characterised by a transaction-based nature and a low-intensity relationship between the firm and customer (Saccani et al., 2014; Sousa & da Silveira, 2017). Customers are not usually involved in the service process and expect that the manufacturing firm possesses the manufacturing-based capabilities (i.e. technical expertise) required for these services (Saccani et al., 2014). Customer integration becomes more important in offering advanced services (Shah et al., 2020). Advanced services have a relationship-based nature that demands service-specific capabilities, such as expertise in designing and delivering service processes and the ability to design services and products jointly (Sousa & da Silveira, 2017). For delivering advanced services, such as outcome-based contracts, the manufacturing firm becomes more dependent on the customer and its resources (Ng, Parry, Maull, & McFarlane, 2011). Because the manufacturing firm does not have much control over customers, the provision of advanced services strongly depends on the flow of information between the firm and the customer (Ng et al., 2011).

### 3. DISCUSSION

#### 3.1. Theoretical contributions

The supply chain of manufacturing firms relies on information, resources and collaboration among different partners (Nagariya et al., 2020). Supply chain integration, i.e. strategic collaboration with supply chain partners (Zhao et al., 2015), has been underscored in the operations and product manufacturing literature (Flynn et al., 2010). Offering services to customers also requires close collaboration with different internal and external organisations (Nagariya et al., 2020). The close relationship with customers has been especially emphasised in several studies (e.g. Chen et al., 2015; Moeller, 2008). However, a servitized offering is different from a pure product or pure service offering in terms of the variety of involved resources (Shah et al., 2020). The increased number of partners expands interdependency, creating more complexity, uncertainty and tensions in the supply chain (Burton et al., 2016; Shah et al., 2020). This study contributes to the discussion on supply chain integration in servitization literature by providing a big picture of the supply chain integration dimensions, the levels and modes of integration and the integration needs in relation to the type of services. The service integration framework integrates different aspects of supply chain integration that need to be considered in the servitization context. The service integration framework depicted in Figure 1.2 highlights that providing integrated products and services to customers is about understanding not only the nature of the offering and its responsibility for certain functions but also the nature of the interaction and collaboration between functions (Ng et al., 2011).

-----Figure 1.2 is added here-----

#### Figure 1.2: Service integration framework

To create value for the customer and other firms in the supply chain, manufacturing firms attempt to integrate several supply chain process activities within the firm and with other firms in the supply chain (Katunzi, 2011). When managing collaboration with internal and external organisations, the manufacturing firms focus on the following three dimensions: internal integration, supplier integration and customer integration. First, manufacturing firms need continuous collaboration and information flow within the firm (Oliva & Watson, 2011) because the provision of integrated products and services is not limited to individual functions but requires the collaboration of all functional departments, such as sales, production,

procurement and services (Shah et al., 2020). Second, manufacturing firms need strong relationships with suppliers to utilise their information, resources and capabilities to ensure the successful development and delivery of new products and services (Ayala et al., 2019). Third, close collaboration with customers helps manufacturing firms develop a deep understanding of customer demands and utilise customers' resources in the process of developing and delivering services (Kindström & Kowalkowski, 2009). Service integration occurs at two main levels: operational and strategic. As presented in Figure 1.2, manufacturing firms need both operational and strategic integration between different functions in the firm to ensure that the servitization goal is reached. The strategic alliance between functions enables smooth operational collaboration (Rabetino et al., 2017), and operational integration facilitates external integration to access more resources and capabilities needed for the servitization strategy (Shah et al., 2020). While the need for strategic collaboration with suppliers has been acknowledged, manufacturing firms utilise more operational than strategic collaboration with suppliers (Bastl et al., 2012). Manufacturing firms are less willing to share strategic information with suppliers (Bastl et al., 2012) and also have less control over the adaptation of goals and processes (Momeni & Martinsuo, 2019). The provision of services also requires both operational and strategic integration with customers. While operational collaboration helps manufacturing firms fulfil the specific needs of customers (Kindström & Kowalkowski, 2009), strategic integration enables long-term relationships with customers, increases customer readiness and develops new products and services (Shah et al., 2020). The need for supply chain integration varies based on the type of service (Saccani et al., 2014). Basic services require less integration efforts, and their provision is usually limited to supplier integration to provide spare parts and deliver services to customers (Shah et al., 2020). On the other hand, advanced services require various types of information and resource sharing between multiple partners within the supply chain, especially with customers (Chen et al., 2015; He & Lai, 2012).

### 3.2. Managerial implications

The concept of service integration explained in this chapter is appropriate for managers to identify the intra- and inter-organisational interfaces that are involved in the integration of products and services. Bundling product and service components cannot always guarantee that the servitization goal will be achieved, but manufacturing firms must pay attention to the supply chain and consider all partners as crucial actors for integrating service business in the value chain of the firm. Different elements of service integration presented in the framework would be helpful when executing the servitization strategy to identify neglected or improvement-needed areas. Managers need to identify the key partners in the supply chain for each type of offering that enable or facilitate the successful development, sales and delivery of the services. Identifying these key partners, their roles and their impact will help managers focus their resources on enhancing the key relationships in the supply chain. Depending on the supply chain structure of the firm (e.g. presence of a service supplier), all dimensions are equally important as they complement each other and facilitate successful servitization.

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