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Digital servitization: how Italian SMEs innovate their business model.

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Introduction

Servitization is becoming an increasingly relevant strategy to differentiate and build a sustainable competitive advantage for manufacturing firms. By developing and providing service solutions, SMEs can exit the price competition and improve their economic performances; for firms in mature economies, such as the Italian one, it is crucial to avoid the commodity trap, and servitization could be an effective differentiation strategy. Alongside this less recent trend, digitalization is increasingly reshaping firms' processes and the environment in which they operate. Digital technologies such as Internet of Things, Big Data, and Cloud Computing adopted by businesses are on the rise as their accessibility increases every day. Digital technologies are to be considered as catalysts for the development of service-oriented strategies as they allow the creation of advanced services, thus, facilitating the innovation of firms' offerings. Such combination of digital and service-oriented approach is the so-called digital servitization.

Digital servitization is the integration into the same offering of product and digital services associated to that product, so the core value is not constituted only by the product or the service but by the combination of the two in the same offering. Firms can provide a variety of services from the simplest ones (e.g., repair and spare parts provision) to the most advanced ones (e.g., maximized availability, predictive maintenance, and performance optimization), different services complexity will require different firms' capabilities. Digital servitization has considerable innovation potential (especially in the case of advanced services), however, new business models must be developed to enable and support the adoption of such new perspective.

The value architecture is innovated to embody digital servitization principles. Value creation, value delivery (customer relationships management), value capture (revenue models and pricing methods), are important aspects to be analyzed when considering the business model innovation required by digital servitization. When considering the phenomenon, it is interesting to analyze the impact that it has on Italian metalworking SMEs and the resulting business model innovation. This research aims at analyzing the effects on business model that the service-oriented perspective has and the roles of digital technologies on such processes.

The analysis and the development of such topic is to be addressed to the experience matured in the Advanced International Management Course where webinars from specific firms lead to the desire to further study the topic presented. Moreover, recent contributions underline how academic research on the relation between IoT technologies and service-based business models is in its infancy. The choice of analyzing the metalworking sector comes from the fact that it is a sector that offers a variety of solutions and different strategy implementations, nonetheless, it is one of the most important traditional industries of the made in Italy, especially when considering the export aspect. Italian SMEs can exploit the industry know-how and mastery to develop advanced digital solutions to create unique value and build sustainable long-term competitive advantage.

The purpose of this work is to first identify, through the existing literature, the features of the business model innovation when applied to a digital servitization strategy and successively to obtain and analyze the insights from SMEs experience vis-à-vis the phenomenon. To do this, peer-reviewed and published research will be analyzed and confronted to obtain a cohesive review of the different aspects that characterize digital servitization. The method used to understand SMEs digital servitization integration is the case study analysis of three SMEs located in the Veneto region of Italy: Galdi, Sariv, Technowrapp. The firms have been selected considering the availability of information, the industry in which they operate, and the degree of digital servitization strategy adoption.

Given the complexity of the digital servitization trend, understanding the real-life context is useful to obtain valuable insights on the topic improving knowledge. Primary data were gathered through a structured interview with Galdi, while secondary data for all the three firms have been collected from video-interviews conducted by ConfindustriaVeneto during the "I 100 luoghi dell'industria 4.0" events. Other secondary data have been collected through the companies' websites and related newspapers' articles. The case study analysis aims at integrating the theoretical aspects with a more concrete approach to understand implications for SMEs.

In the first chapter the literature review for the servitization trend is conducted, it consists in breaking down the trend characteristics first. Servitization is identified as the transformation where manufacturers increasingly offer services that are tightly coupled to their products. Product loses its centrality in favor of services that become fundamental value-added activities. Drivers for servitization are diverse, one of the main motivations

for servitization relies on the need for firms to develop and maintain a sustainable competitive advantage as, through servitization, it is possible to differentiate the market offering. Literature identifies three primary drivers: financial drivers, strategic drivers, marketing drivers. Later in the first chapter, the relationship between business model innovation and servitization is addressed. Business model innovation is a requirement for servitization to adopt an integrated product-service business perspective. Servitization adoption has effects on firms' value architectures that is the rationale behind which a firm creates, delivers, and captures value.

Finally, important to understand are the challenges and the inhibiting factors brought by the adoption of servitization identified by the literature. Challenges are, for example, related to the differences between the service and product dimensions and to the difficulties encountered in undertaking growing responsibilities for customers' processes. Other challenges deal with the interpretation of servitization that requires a change in mindset that could lead to cultural hurdles and ask for different employees' capabilities. The need to align internal processes with the offerings and to avoid the "service paradox" is also stressed.

The second chapter deals with identifying the roles of digital technologies in a servitization context. For this purpose, the characteristics of the main digital technologies (IoT, Big Data, Cloud Computing) are first described, once the main features were defined it was possible to individuate the operational roles of such technologies in servitization. IoT is identified as the main enabling technology for servitization activities for its capabilities to connect machines and transmit data. However, it is showed how IoT, Big Data, and Cloud Computing are closely related technologies that enable each other's capabilities, so it is rare to adopt a single technology alone.

The main operational roles of digital technologies in a servitization context are monitoring, control, optimization of performances, and autonomous management. Digital technologies' capabilities enable the development of smart connected products that, thanks to connectivity, create new potential innovation opportunities. Digital servitization deals also with innovating the value proposition, there are different possible categorizations for services. Services can be base, intermediate, and advanced as they vary in complexity and completeness, moreover, they can be designed to support the product or the customer.

In the sequent section of the second chapter the strategic implications of digital technologies are identified; digital technologies can complement, replace, or extend firms' offerings portfolio by playing a smoothing, adaptation, or innovation role. In a slightly different perspective IoT-based solutions impact firms' offerings portfolio by increasing/decreasing the level of complexity, increasing the level of customization, and restructuring firms' processes. Moreover, digital technologies can influence the strategic decision to integrate both upstream and downstream or to enter completely different markets innovating the value chain. In the last section of the second chapter, the transformation stages, that literature identifies, that firms undergo when innovating their business model for digital servitization are described. Different levels of service integration correspond to different position along the transformation path; however, positioning is a dynamic process and firms can interpret multiple roles for different customers. Lastly, the formalized business models that literature identified for digital servitization strategies are discussed such as the add-on business model, the sharing business model, the usage-based business model, and the solution-oriented business model.

The third and last chapter is dedicated to the effort of understanding the practical real-life context and implications of digital servitization for Italian SMEs. The chapter begins by explaining the research design and the methods used, then, the general Italian scenario vis-à-vis digitalization, servitization, and digital servitization. The core part of chapter three deals with developing the case studies for Galdi, Sariv, and Technowrapp; the SMEs' experiences in business model innovation for digital servitization are described. Lastly the findings from the case studies are discussed and successively integrated with the features, drivers, implications, and vision of digital servitization identified by Roberto Siagri in its latest book "La Servitizzazione. Dal prodotto al servizio. Per un future sostenibile senza limiti alla crescita". Integrating such contribution helps framing the digital servitization trend while still conserving a more practical analysis approach.

Chapter 1: Servitization

1.1 Trend breakdown: definition, features, drivers

The concept of servitization has been originally identified by Vandermerwe and Rada, 1988. It relates to the transformation where manufacturers increasingly offer services that are tightly coupled to their products (Baines et al., 2007). Manufacturers have always been involved in providing services as many industrial companies provided "servicing". Servitization, however, consists in a greater involvement in services for firms; manufacturers shift from selling products to offering 'bundles' of customer-focused combinations of goods (the products in se), services (designed around the goods or delivered by the goods), support, self-service, and knowledge in delivering value in use (Vandermerwe and Rada, 1988; Paschou et al, 2020).

Support refers to activities that rotate around the goal of helping the customer in its operation, customers are supported in using the products and in benefiting from the services. About self-service, customers are incentivized to rely more on self-serving thanks to the facilitating tools provided by manufacturers. The final aspect, knowledge (or know-how), is referred as information and data that have value for customers as, for example, are necessary for problem solving activities. Although, generally, the majority of existing definitions are in agreement with the one provided by Vandermerwe and Rada (1988), in the literature, servitization is defined in other terms: going downstream, services transition, product-services systems (PSS), moving from product to solutions, service business development, service growth, service infusion, hybrid offerings. The two more pervasive terms are Product-Service-Systems (PSS) and servitization (Opresnik and Taisch, 2015). A PSS is defined as a combination of products and services, that once integrated, deliver value in use; the two bodies of research have developed separately, however, servitization can be considered as the process of implementing and selling Product-Service-Systems, so servitization definition can be improved by incorporating the PSS approach.

Firms that undergo a transformation to provide integrated products and service offerings make a conscious and explicit strategy choice, in which services become fundamental value-added activities. This process reduce product centrality as the offering is now developed around the combinations of physical products and related services; in doing so, businesses often found themselves able to exploit new opportunities developing new

effective activities. As shortly mentioned before, servitization requires to move the firm operations' center of gravity closer to the customer. Through servitization, firms move the focus down the distribution chain reducing the attention given previously to distributors/middlemen, thus creating customer centricity. Customers are increasingly provided with tailored solutions rather than simple products, the change in perspective is to provide complete outcomes for specific types of customers integrating even products from other suppliers if necessary. So, servitization calls for customer orientation. One of the effects of customer orientation is the shift from a product-oriented service offering to an offer that pursue efficiency and effectiveness of end-user's processes related to the product. Moreover, customer relationships tend to become of relational nature rather than transaction-based to establish and maintain a close relationship with the customer. The supplier does not simply provide the products but develop and maintain a long-term relationship with the customer. From what mentioned, manufacturers that embrace a servitization approach dynamically look for chances to know their customers' problems, therefore, in these cases, firms have in the installed base a fundamental resource to start from (Paiola and Gebauer 2020), in fact, information about product usage of installed base is crucial to leverage resources and capabilities for servitization.

Vandermerwe and Rada, 1988. Identified seven different drivers for servitization: setting up barriers to competitors, setting up barriers to third parties, setting up barriers to customers. As technology democratizes information and knowledge, servitization strengthens the barriers to entry for many market actors by making entry complex and costly. Servitization can be exploited to create dependency, it is especially true for cases in which preventive maintenance and remote monitoring to extend products and components life like in the case of Caterpillar and its Cat Product Link, a remote tracking and monitoring service that allows the mentioned activities reducing downtime. Other drivers for servitization are: differentiating the market offering, diffusing new innovations, and R&D and market research. Regarding the innovation aspects, it is useful to cite the examples of ABB and HP. ABB, by focusing on a specific customer segment was able to launch ABB Ability, a portfolio of digital solutions that help customers in the utilities, industry, transport, and infrastructure sectors to develop new processes to improve key metrics such as factory uptime, speed, and yield. HP, on the other end, developed "Instant Ink", a subscription service which allows consumers to subscribe to an ink cartridge and print when needed rather than buy cartridges outright. This service

was implemented as HP realized that printers' owners got often frustrated by printer cartridges drying out.

Established that the mentioned drivers list is complete, later literature, however, analyses the drivers for servitization with a different framework.

The main drivers for servitization identified by literature are three: financial drivers, strategic drivers, marketing drivers.

Providing product-related services in the product offering is shown to have the potential to produce higher profits and more stability of income. Especially in cases in which there is a high installed product base, servitization can potentially give stable revenues even when sales drop significantly. Many modern, technology advanced products have a superior life cycle, this means that revenues from product sales decrease; to maintain stabler streams of income, revenue is pushed downstream towards the service field. Furthermore, higher profitability comes from the fact that product-service combinations tend to be less price sensitive than the product alone, moreover, they are shown to be more resistant to unfavorable economic cycles. For example, MAN Truck and Bus UK, through servitization, was able to retain its leadership position, achieve high customer value scores, and increase revenue even if it acts in a market that saw product demand significantly decrease in a small number of years. MAN focuses on improving customers' fleets performance through their "Trucknology" fleet management service; integrated sensors allow to identify inefficiencies and then to reduce costs.

The strategic driver is a consequence of the steady commoditization of the markets, where price competition is ferocious mostly because of emerging markets. The need to protect market share and creating solid barriers to competitors resulted in the research of sustainable competitive advantage; services are used to differentiate manufacturing offerings providing competitive opportunities. The sustainability of the competitive advantage comes from the fact that services are generally difficult to imitate as they are less visible and more labor dependent. Lastly, the value added by related services to homogeneous physical products can give the perception of a customized product, thus, increasing customer value significantly.

The use of services for selling more products is generally understood as a marketing opportunity, the marketing driver derives from the fact that especially in B2B and/or industrial markets customers are increasingly demanding for services, services then

affect purchasing decisions. The increasing demand for services comes from the tendency to build flexible firms, with less but more solid core competences, and high technological complexity; this trend is responsible for the outsourcing of service activities. In this context it useful to cite the example of Xerox, a manufacturing company successfully offering advanced services; Xerox repositioned itself as an enterprise for business process and management. Xerox offer document publishing and production services, document management, and business process outsourcing; for example, it provides Hertz learning solutions including curriculum content, administration, and learner support services.

Finally, providing services creates customer loyalty and induce repeat sale, solidifying and intensifying the contacts with the customer, the supplier can offer other products and/or services as well as develop more tailored offerings as it gains insights into the customer's needs.

1.2 Business Model Innovation for Servitization

Literature discusses the relationship between products and services in a firm's performance optic. Ivanka Visnjic Kastalli and Bart Van Looy (2013) analyzed such relationship considering the servitization perspective. In the research, reciprocal and positive revenue relationship between products and services is evaluated as an indicator of complementarities. However, complementarity is contingent upon the capability of the firm to innovate the business model, setting up practices and processes that help prevail the innate substitutive effects of services on products facilitating complementary feedback. Business model innovation is the search and implementation of new logics for its value components; business model innovation may occur whenever the company modifies or improves at least one of its value dimensions. Business model innovation activities can range from incremental changes in individual components of business models, extension of the existing business model, introduction of parallel business models, to disruption of the business model, meaning that the existing one is replaced with a fundamentally different one (Khanagha et al. 2014). Business model innovation is both a requirement and an effect (as new capabilities are enabled) for servitization.

To achieve long-term profitability, manufacturing firms in a servitization context are required to adopt an integrated product-service business model that enables the forming of reciprocal spillovers between products and services; an example of such spillovers is the transformation of information generated by the service orientation into useful

product insights that can create value. Complementarity between products and services is reinforced by customer proximity that must be fostered by managerial practices. Moreover, integrating the product-service perspective in the business model requires to view services as strategic complement to products this means that necessary investments must be made; in that perspective, economies of scale and learning effects in services are to be pursued as well. Services considered simply just as an add-on will likely hinder potential revenue growth, limited by the installed product base; on the other end, services must not also become unrelated to the product, as economies of scope and complementary aspects will lose their value creation potential. As it will be better discussed later on this research, firms can decide where to position themselves on the product-service continuum where firms can be involved in different levels of service provision; when the service immersion is low, higher profits are registered as product-service firms can exploit the nearest existing service opportunities. On the other end, a moderate level of involvement requires higher investments in the organization design and reengineering of process that are generally not compensated by revenue, this is associated with diminishing profit margins. When the scale of service activity is high the relationship between degree of involvement and profit margins returns positive, the costs of investment are outweighed by economies of scale, economies of scope in products, and service-learning effects. The relationship between performances and the degree of servitization is then identified to be U-shaped as positive outcomes appear to be in the early stages of service involvement or once a relevant mass of services is achieved. This relationship, however, can assume a different form depending on the industry and on the nature of the service range.

To better understand the business model innovation concept, it is useful to analyze the effects of servitization in reconfiguring the value architecture, that is the rationale behind which a firm creates, delivers, and captures value. For each element, activities, resources, and partnerships constitute the requirements for a successful value architecture.

1.2.1 Value creation

The first aspect of the value architecture that is affected by servitization is value creation. Value creation concerns the way organizations meet customers' expectations aiming at designing an offering that can better satisfy customers' desired attributes (Lepak et al., 2007). In a servitization strategy the value is created by the combination of product and

service into the same offering, so a product centered positioning is ineffective in sustaining such strategy development. Manufacturers must develop a service-oriented approach if they want to gain the benefits of a servitization strategy. Literature stresses the co-creative nature of value creation in servitization; co-creation is understood to be mainly between manufacturers and customers, however, key partnerships with a wider variety of actors beyond customers are needed to effectively support value co-creation. In servitization customers have an active and relevant role in the creation of value proposition, co-creation guarantees alignment between value creation and customers' dynamic goals. To effectively co-create value, manufacturers must perform specific key activities: Production activities such as development of product-service offering and development of value proposition; Problem-solving activities like the identification of customers' desired attributes, customer relationship management, and service-led innovation (use the feedback from customers to upgrade the product-service offering); Platform activities to ensure internal coordination and preventing external opportunistic behaviors. Relational capabilities and digital platforms are the key resources for value creation, these resources are necessary to coordinate activities and partnerships; relational capabilities refer to customer-oriented soft skills such as consulting and marketing competences. Digital platforms are crucial as services bring value to the customer but at the same time, they can become the channel of data and information gathering. Information gathering and utilization can foster business feedback that enables internal improvements such as: costs reduction, increase of productivity and gain of flexibility. Key partnerships, on the other end, have the capability of integrating resources, such as information, otherwise unavailable; for example, firms can overcome weaknesses in specific capabilities in providing services to customers by partnering with intermediaries.

One of the most important aspects for value creation in servitization is organizational culture, this is true because the relationship between behaviors and values is crucially important to implement a service strategy (Gebauer et al, 2010). Servitization requires both a service and a product approach, developing an organizational culture that considers these two orientations potentially leads to conflicts. This means that, in developing a product-service oriented culture, inertia is experienced. Business model innovation should be considered in its different levels of complexity of the twofold implementation (A.G. Frank et al. 2019).

Table 1. Peculiarities of value creation for Servitization

Value creation	Key activities	***Production activities***: offering development
		Problem-solving activities: customers' needs identification, CRM, service-led innovation
		Platform activities: internal and external coordination
	Key resources	***Relational capabilities***: customer-oriented soft skills
		Digital platforms: channels of data and information gathering
	Key partnerships	***Integrating resources capabilities***: integrating resources, otherwise unavailable to overcome weaknesses

1.3 Value delivery and value capture: customer relationships and revenue models in Servitization

1.3.1 Value delivery

Value delivery deals with understanding customers' operations and then providing them with the tools that will allow to experience the value proposed. In servitization, because of the more intangible nature of the value proposition, value creation and value delivery are concepts difficult to differentiate as associated activities, resources, and partnerships are strictly related. This means that value delivery deals with making sure that value created is fully experienced by customers ensuring their dynamic goals satisfaction. In the value delivery process, the delivery of advanced services requires co-location near customers' operations, this will allow to assess customers' usage experiences and to reach internal and external alignment of goals and interests; also, roles and duties across the supply chain must be clearly defined. The progressive cumulative knowledge of customers' experiences is a key resource to reduce risks and anticipate uncertainties, potentially improving offerings. For the same reasons, partnerships among actors in the firms' networks must foster integration and information sharing.

Value delivery in the servitization context deals particularly with customer relationships, this is true especially because in providing high value services providers are required to

take on greater responsibilities for the core processes of the customer. Literature underlines the shift that manufacturers undergo in their customer relationships. Servitization tends to create closer provider–customer relationships characterized by co-creation logic, long-term commitment, and greater investment in the relationship (Kamalaldin et al, 2020). Thus, a shift from transactional to relational interaction occurs (Reim, Sjödin, & Parida, 2018). Transaction based relationship are becoming weaker and ineffective to sustain a true product-service innovation; a relational model of interaction with the customer means that firms have a more customer focused center of gravity. Information is exchanged easily, in larger quantities, from which better knowledge is extracted. Provider-customer relationship becoming a co-creating one means that roles need to be redefined in order to reduce ambiguities in the process and, so, conflicts (Sjödina, Parida, Wincent, 2016). Literature focused on providing solutions to arising provider-customer conflicts in the servitization environment. Kindstrom and Kowalkowski, 2014 provide capabilities that providers and customers must develop to support the relationship: adaptiveness implies that the actors make adaptations to reach initial fit between their needs and capabilities, moreover, changes are necessary as parties are exposed to changing business conditions; customer embeddedness refers to the firm's capability to develop close, long-term relationships that will allow the provider to obtain information and guidance about customer's operations, policies, and political landscape; proactive-reactive balancing capability to determine how to act in different situations; firms should not focus solely on creating close relationships at the expense of acquiring new ones. Reim, Sjödin, Parida, 2018 analyzed the relationship between provider and customer from an agency problem perspective. Customer's adverse behavior or conflicts arise because of different goals or because of high monitoring costs, in this scenario manufacturers need to develop strategies to efficiently tackle the problem:

- the monitoring mechanism refers to behavior-oriented contracts in agency theory, mechanisms are developed and implemented to analyze customer behavior, checking if it complies with agreed responsibilities and obligations.
- the sharing mechanism, similar to output-oriented contracts, this is because the revenues or profits as well as risks are shared with the agent.
- the third alternative is the trust mechanism, this mechanism means that no specifications about customer obligations are made as monitoring data is not used

against the customer. The main reason for using this mechanism is to maintain a good customer relationship.

Table 2. Peculiarities of value delivery for Servitization

Value delivery	Key activities	***Co-location*** near customers' operations.
		Alignment of goals and interest with the entire supply chain; ***duties*** and ***roles*** must be clearly defined as well.
	Key resources	Progressive ***cumulative knowledge*** of customers' experiences.
	Key partnerships	***Networks*** to foster integration and information sharing.
	Customer relationships	Shift from transaction-based to ***relational*** relationships. ***Customer focused*** center of gravity, co-creation logic, and long-term commitment.

1.3.2 Value capture

Value for the customer does not necessarily mean equal value for the manufacturer, retaining value (both monetary and non-monetary) is a potential challenging task. In servitization, manufacturers can capture a diverse range of value definitions: - Economic value, that is the financial benefit that manufacturers gain from servitization such as higher profits and stabler revenue streams; - Strategic value, that refers to the increased sustainability of the competitive advantage provided by servitization like stronger market position; - Knowledge value, that consists in the opportunities for innovation that servitization helps to create and the competitive advantage deriving from their exploitation (i.e., increasing market intelligence); - Personal value, that is the value extracted from the relationships based on trust and mutual benefit with customers, for example the value of customer retention. Since the mentioned value outcomes can be captured and replicated by different actors, firms need to develop appropriate isolating mechanisms to maximize value retention within their boundaries and to create barriers against the replication of value by third parties. The degree to which a specific isolating mechanism is appropriate depends on the situation in which it is implemented and for

what type of value it is designed. Literature identifies two isolating mechanisms principles for servitization: offering format and offering content. These principles are to be followed throughout the value creation and delivery processes. Offering format deals with the pricing of the product-service offering and its presentation. Adequate offering presentation and pricing for the right customer creates a barrier for value slippage as it increases the customer's willingness to adopt the manufacturer's solution. Offering content refers to the composition of the product-service offering (life cycle, physical installed base, digital data assets), manufacturers can lock in customers thank to continuous innovations in the offering enabled by the knowledge about the installed base and customers' usage experiences; future offering upgrades lead to unique competitive advantage.

Integrating services into a firm's portfolio can create some frictions, this is because business logics processes are changed. Moreover, new types and magnitudes of risk are to be taken into account as firms push forward the integration approach and increasingly assume new responsibilities, especially when outcomes or results are to be delivered. This is converted into costs, examples of such costs are the cost for product breakdown, wear and tear, and opportunistic customer behavior. Opportunistic customer behavior is to be considered an adverse behavior; literature shows that servitization increases the likelihood of such customer behavior that undermine firms' operations. If not handled properly, for example through specific contracts, those risks may undercut firm's revenue stream and lead to "service paradox" where servitization generates lower revenues than costs.

To ensure an effective value capture process and to protect themselves from risks of the "service paradox", firms are required to develop a sustainable revenue model. A revenue model deals with the determination of revenue sources as well as their volume and distribution in order to capture value from the product-service integration. The innovative aspect of servitization calls for an innovative approach also for the revenue model, literature identified that innovative revenue models generally can assume usage-, performance-, or value-based paradigms and usually involve long-term relationships with customers.

Linde et al. 2020 identified two main principles to develop a sustainable revenue model:

- Agile Development. It means that in designing and developing the revenue model it is required to adopt a trial-and-error learning approach where constant and rapid feedbacks are incentivized. It is characterized by micro progression of service offerings. It means that, to better utilize its limited resources, a manufacturing firm deals with one customer's need at a time instead of adopting a full coverage of advanced service contracts. A micro progression approach means also to continuously adapt the revenue model elements as new advanced technologies are continuously tested.
- Cocreation With Customer(s) is characterized by three aspects: trust building between provider and customer(s); risk and reward sharing; creation of commitment.

In developing a revenue model, firms must align value creation, capture, and cultural values (Classen and Friedli, 2021). Revenue models' implementations are various, literature discuss specific revenue models configurations:

- Freemium, that allows to target different customer's segments. It consists in offering basic packages at zero price to price-sensitive customers while offering to performance-sensitive customers advanced packages at positive price (Classen and Friedli, 2021). An example of such implementation is the subscriptions with free trial configuration.
- Indirect revenue model, that consists in bundling smart services with physical services such as spare part provision, maintenance agreements, and outcome-based contracts. This is a monetization strategy for services that are expected to be included in equipment sales without extra charge (Classen and Friedli, 2021).
- Pay-per-use agreements. They differ from the traditional rental services as they drive the provider to focus on what is valuable to the customer even if they are implemented using typical fixed time-rate fees services in which the customer acquires the right to use a product for the contracted period (Rapaccini 2015).

A relevant example in this context is the one of Rolls-Royce, engines manufacturers for some years has offered a service package whereby customers pay by the hour according to the amount of time an engine is in flight. The TotalCare service package rents engines to customers, Rolls-Royce monitoring the data from engines is able to predict maintenance problems, saving costs both for them and for customers. The benefits that

Rolls-Royce gains comes from the alignment between the customers' needs and the offering, its presentation and pricing.

Literature seems to indicate that when a manufacturer agrees to meet performance guarantees, ensure availability of the equipment, and cocreate value, a much more dynamic, with continuous adjustments, designing process is required. A revenue model suited for capture value from digital services is agreed to be highly customized where the increased risks are accounted for in extended customer contracts.

Table 3. Peculiarities of value capture for Servitization

Value capture	Values to retain	***Economic*** value: higher profits; stabler revenue streams
		Strategic value: sustainable competitive advantage
		Knowledge value: innovation opportunities
		Personal value: customer retention
	Isolating mechanisms to retain value	***Offering format***: adequate offering presentation and pricing for the right customer.
		Offering content: composition of the product-service offering (life cycle, physical installed base, digital data assets).
	Principles for sustainable revenue model	***Agile development***: micro progression of service offerings; continuous development and adaptation of revenue model elements.
		Co-creation logic: trust building between provider and customer(s); risk and reward sharing; creation of commitment

1.4 Challenges and inhibiting factors

Challenges brought by the adoption of servitization strategy identified by the literature are several; one of the most forthcoming is the difficulties encountered by firms in designing services to be integrated with the product. Services are different in nature from

physical products and can be challenging defining them, the service dimension requires firms to face competition outside the usual domain where new rivals sometimes can be even firms' own suppliers, distributors, and customers. Undertaking activities previously performed by customers can be challenging and can represent a risk factor that can undermine potential profits. Traditional manufacturers can struggle in transforming toward a service-oriented culture required to effectively offer product-service combinations and to meet customer expectations. The capability meeting customers' expectations is crucial to stay competitive and gain the benefits of servitization; it is the case of Alstom where its services are based on the principle of "lost customer hours". The key aim is to minimize the length of delays caused by train failures, and to minimize the number of passengers affected. As part of the contract, Alstom incurs financial penalties if customers are let down during busy times. Thus, supporting the customers' need for a reliable, quality service is the main challenge that manufacturers like Alstom must face.

Strong product and/or technology orientation is ineffective to deliver integrated offerings, so, changes in the mindsets of firms' employees are necessary; these changes create cultural hurdles. Cultural changes are required also when shifting from a transaction-based to relationship-based value creation, the number of staff members who interact with the customer increases and long-standing practices and attitudes could be found to be inadequate. In the transformation, firms can experience organizational inertia and resistance, this happens as some specific areas within the organization find difficult to understand the service strategy or fear the infrastructural change. Especially in stressful situations, organizations tend to revert to a focus on product rather than the entirety of the integrated offering.

Delivering integrated offerings, as mentioned before, requires a more customer-centric approach meaning that a greater number of customers touchpoints will occur. The consequence will be that a broader range of employees will be exposed to customer interaction, to deal with it effectively the personnel must possess the necessary capabilities and tools. Communication strategies must be developed to avoid misunderstandings that may occur on the part of both the provider and the customer, imbalance in expectations can arise especially when the value proposition is described and when contracts and negotiations are discussed.

Another identified challenge is the need of process and strategic alignment. First of all, product and service design internal processes must be aligned for designing integrated

offering and to effectively respond to customer needs. As well as designing processes, performance measuring must be supported by knowledge sharing across the organization and the development of a common language; for example, metrics once designed for product-centered organizations will not be suitable for measuring product-service provision and for measuring organizations' effectiveness and efficiency in delivering integrated offerings. Tools and techniques must be developed to assess internal processes and capabilities. Regarding strategic alignment, firms must invest resources to build a common mindset and language and to make sure that the organization as a whole has a shared understanding of the value creation approach. Service provision and transformation towards offering integrated solutions are severely undermined by the absence of internal cooperation and the above-mentioned factors.

Literature identifies another challenge in the relationships between integrated offerings providers and their suppliers, the higher degree of cooperation between providers and customers calls for a different degree of cooperation even between the providers and its supporting network. Customer centricity derived from the provision of product-service combination requires some changes in the attitudes towards upstream players; suppliers might not be in the right position to support the offering of integrated, this can be true especially if transactional relationships are maintained and knowledge-sharing routines are not built. In other words, changes in product-service providers' relationships with customers may be not reflected in the relationships with the providers' suppliers.

Firms can face difficulties in benefiting from the financial potential of an increased service offering, in such cases higher costs due to the service provision do not correspond to higher returns. This phenomenon is generally named as "service paradox" and it caused by organizational, cultural, and behavioral dimensions. One of the cognitive aspects of such phenomenon is the overemphasis that managers put on tangible characteristics of the offering as more obvious than the intangible nature of services; moreover, cultural and cognitive biases against services and service-related values (e.g., flexibility) exist as they are in contradiction with traditional manufacturing goals such as standardization. If the economic potential of extending service provision is not understood all along the firm, investment would be inevitably limited. Finally, managers' risk aversion nature will hinder service extension, providing certain types of services, especially if customized and relationship-intensive, is challenging and generally requires the development of different set of capabilities.

Chapter 2: Digital Servitization

2.1 Digital technologies overview: IoT, Big Data, and Cloud Computing

The third wave of IT is often indicated as the 4.0 Industrial revolution, a new frontier in business competitiveness; technologies such as IoT, Big Data, and Cloud Computing are reshaping the marketing and management strategies of firms through digitalization. Management methods and processes are radically changing as IT is becoming an integral part of the product itself. Sensors, processors, software are embedded into the products that benefit from a dramatic improvement in functionality and performance, new technological possibilities are now unlocked. For example, through IT and digitalization, it is possible to create coordinated, real-time information sharing techniques that will benefit greatly decision-making and strategic planning. Businesses integrating 4.0 strategies to compete and survive need to rethink and redesign their management, organization, and production practices; business models for smart solutions entail the combination of various products, services, software, and analytics (Porter & Heppelmann, 2014).

To better understand the focus of the research it is useful to clarify the characteristics of the digital technologies before discussing their impact on servitization. Internet of Things is arguably the fundamental enabling technology for the development of smart products-services in the servitization context, this is due to its capability to transmit data from/between products and systems. The term “Internet” underlines the virtual network vision of the technology, while the term “Things” refers to the physical devices integrated in the network. Many definitions of IoT exist in the literature based on different perspectives (engineering-related or business-related).

In IoT objects are provide with Radio Frequency Identification (RFID) systems and Wireless Sensor Networks (WSNs); RFID enables the design of microchips for wireless data communication, while WSNs are low-cost, low-power, miniature devices for use in remote sensing applications. IoT enables innovative application thanks to the ability to share information across platforms through a united framework, the ability to share information is given by the interconnection of devices. Devices are able to interact and cooperate with each other, this is the technological ground that allow the transformation of single objects into smart and connected products. As anticipated before, advances in

microprocessors technologies and broadband communication have enabled the digitalization of functions and capabilities of products typical of the industrial age.

From a technological perspective, companies are required to build a multilayer technology infrastructure if new solution opportunities are to be created through the combination of hardware and software. The core layers that compose such an IoT infrastructure are usually three: the thing or device layer, the connectivity layer and the IoT cloud layer. At the device layer, specific hardware, such as sensors and processors, software applications and operating systems are embedded in the physical thing in order to manage and operate its functionalities. At the connectivity layer, network communication and communication protocols enable the communication between the product and the cloud. And at the IoT cloud layer, device communication and management software are used to communicate with and manage the connected things, IoT applications are developed and executed through application platforms. Finally cutting across all the layers, software tools manage security and identity issues as well as the integration of the IoT system with the existing business systems (for example, ERP and CRM systems) (Porter and Heppelmann 2014). The other main conceptualization of IoT solutions architecture consists in three layers too: hardware and firmware (sensors, actuators, communications, and microcontroller); middleware (cloud server, protocols, and time series database); application software (web services and dashboard).

The challenges raised by IoT are both of technological and business nature, in fact as it will be discussed IoT effects are at the operational level as well as the strategic level. From a technological perspective the challenges are mainly rising from the necessity to integrate a range of different information and communication technologies (both hardware and software). Some of the challenges in this context relate to energy supply, identification and addressing, security and privacy, standardization, internet scalability.

The impact of IoT ecosystems cannot be analyzed without considering technologies that not only support the ecosystem but also enable the majority of digital services that will be discussed. Connectivity among devices create a flow of data exchange that is unmatched by previously ICT tools, such magnitude of data is useful only if stored, managed, and analyzed correctly. Big Data generated by IoT have three features: abundant sources generating masses of data; data generated by IoT is, in the majority of cases, semi-structured or unstructured; data of IoT is useful only when it is analyzed. IoT is not sufficient to generate value as volumes of data must be transformed into useful

knowledge, in order to so, data needs a thorough analysis using specific techniques. Many experts of IoT realize that the effectiveness of IoT is deeply dependent to the effective integration of big data and cloud computing. IoT and Big Data are recognized to be interdependent and should be jointly developed as: IoT drives the high growth of both quantity and category of data and the application of Big Data technology to IoT also accelerates the research advances and business models of IoT.

The term Big Data refers typically to the following types of data (Dijcks, 2013): (a) traditional enterprise data, (b) machine-generated / sensor data (e.g., weblogs, smart meters, manufacturing sensors, equipment logs), (c) social data. More generally Big Data refers to datasets which could not be obtained, stored, and managed by classic database software. In the last 20 years academics provided different definitions of Big Data, tackling the issue from different perspectives. In 2001 Doug Laney, an analyst of META (presently Gartner) proposed a 3Vs model (volume, velocity, variety) to describe the characteristics of Big Data. In 2011, an IDC report defined big data as "big data technologies describe a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling the high-velocity capture, discovery, and/or analysis." (Gantz J. and E. Reinsel. 2011) This definition indicates the most critical problem in Big Data, which is how to discover values from datasets with an enormous scale, various types, and rapid generation.

In the recent literature it is possible to observe a relative agreement on the 5Vs model: volume, velocity, variety, verifiability, and value. Volume is referred as the incredible amount of data produced by the interactions between devices (a single jet engine can generate 10TB of data in 30 minutes (Dijcks, 2013)), data scales become increases rapidly; if the commercial value of big data is to be exploited at its maximum, then data collection and analysis must be conducted rapidly and at the right time. These requirements constitute the challenge in regard to data velocity.

An important aspect in such technology is the increasing sources of data that interacts, thus, making available numerous types of unstructured, semi-structured, and structured data. This is because IoT technologies are increasingly applied to diverse devices, therefore, IoT systems are becoming more and more varied. The fourth characteristic is the quality itself of the data gathered and how to effectively verify it. Lastly, the fifth aspect is the capability of extracting commercial value and useful knowledge from data. To extract value, Big Data users focus on the analysis aspect, specific forms of analytics are

performed in these cases. The collection of tools and techniques include predictive analytics, data mining, statistical analysis, complex SQL, data visualization, artificial intelligence, natural language processing, and database capabilities that support analytics. Other than data reuse through analytics, Big Data create value for the firm in another simpler way: sell obtained "private" data to other third parties. In this case data is exploited as a new product that generates revenues, data sell constitutes a new revenue stream.

Big Data presents many technical challenges when implemented; literature has identified six characteristics of such technology responsible for those challenges:

- Data representation: data representation is crucial to enable efficient operations on datasets. Inefficient data representation significantly reduces the value of data to the point in which data analysis is inhibited. The challenge of data representation comes from the fact that different datasets differ from each other in type, structure, semantics, organization, granularity, and accessibility; efficient data representation means to reflect the above-mentioned data characteristics to make data more meaningful for user interpretation.
- Redundancy reduction and data compression: data generated by some technologies (for example sensors) are highly redundant. Filtering and compressing such data reduce the indirect cost of the entire system without affecting the value of the data.
- Data life cycle management: data are generated at unprecedented rates and scales and since a lot of the value of data comes from data freshness, importance principle should be developed to decide whether a specific data should be stored or not. This is because such scale of data is complex to be stored and supported, this is the so-called pressing challenge.
- Analytical mechanism, expendability, and scalability: analytical systems must be designed to efficiently process heterogeneous data within a limited time. The analytical system must be able to support present and future datasets. As datasets are expanding and becoming more complex the algorithm developed must process increasingly expanding and complex datasets.
- Data confidentiality: this challenge deals with the potential safety risk incurred when sensitive data are managed. This is because many providers rely on third party professionals to analyze datasets due to limited capacity, depending on the

type of data, proper protection must be ensured before delivering the data to the third party that processes the data. An example of potential sensitive datasets are transactional datasets as they can contain information such as credit card numbers.

- Energy management: clearly, more and more electric energy is consumed as data volumes increase because of the energy required to perform analytical, processing, and transmission activities. The energy consumption of computing systems is of great interest for both economy and environmental reasons. So, consumption control systems shall be implemented for Big Data while ensuring performance.
- Cooperation: Big Data analysis is a multi-faced activity that comprises different tasks requiring experts in different fields to cooperate. Individuals employed in these activities must be supported by a comprehensive network architecture that allows individuals to fully exploit their expertise, to cooperate, and to conduct the analysis.

The support necessary for the storage and processing of Big Data is given by Cloud Computing (CC), Cloud Computing deals with providing computing capacity for Big Data applications by using computing and storage resources. Like IoT and Big Data, also CC is closely related (to the extent to which they can be considered overlapping technologies) to Big Data as the emergence of one technology accelerates the development of the other technology. Storage and computing capabilities of CC allow to successfully manage, improve the efficiency of acquisition, and analyze Big Data. In short, Cloud Computing is utilized to meet the requirements on infrastructure for Big Data. However, CC and Big Data differ in two main aspects, the first one is the fact that CC changes the IT architecture while Big Data influences business decision-making. This is the reason for the second main difference that is the target technology user that is the CIO for Cloud Computing and the CEO for Big Data. The two interdependent technologies operate at different levels in an organization as CC provides system-level resources while Big Data's operations, smoothened by CC, are in the upper level.

Due to the strong interdependencies that exists between these three technologies it is important to underline that when discussing about IoT the adoption and development of Big Data and CC are implied even if not specified.

2.2 The role of digital technologies in Servitization: Smart Connected Products and digital services

In understanding the role of digital technologies in servitization it is necessary to analyze the capabilities enabled by such technologies at the operational level.

2.2.1 Operational roles and Smart Connected Products

Exploiting IoT features, a firm can gather in-depth information about how the product is used, thanks to that IoT can potentially enable a firm to offer innovative product and service offerings, and in redesigning their current business models based on this information (Rymaszewska, Helo, & Gunasekaran, 2017). Literature focuses on operational capabilities of IoT when embedded in business processes.

IoT applications are event-driven and reactive as they are established to react on events from the physical environment, applications are also dynamic and adaptive as configured depending on the situation at run-time. It emerges that operational roles of IoT can be grouped in four categories, each category is a precondition of the next one.

Monitoring is the first group of roles; it is also the simplest one, sensors embedded in the product allow a firm to keep real-time track of the product's conditions and changes occurring in the external environment. How the product is used is also potentially tracked, this is helpful in different cases, warranty compliance issues being one of them. Monitoring helps the provider with useful information about operating characteristics of the product, thus, improving and speeding up the product design innovation cycle.

Control, or, more specifically, remote control means that the product embedded with IoT allows firms to monitor the product to diagnose and rectify or repair non-complex problems remotely. Remote control also allows the customization, in a more cost-effective way, of product performance by the customer, that is empowered to remotely control the components of the product.

Optimization of performance is the third area of roles; IoT-embedded devices and products capture the insight and operational data of the products that, once processed by data analytics and algorithms, enable the dramatic improvement of output, utilization, and efficiency (Porter, Happelmann, 2014). Moreover, thanks to the monitor activities allowed by IoT, proactive maintenance can be offered. In proactive maintenance, digital technologies are used to monitor and gain specific and detailed product insights, this

helps firms to deal with problems of machines or products before they occur. Real time product information gives the supplier the possibility to respond promptly to product breakdowns minimizing interruptions, providing the right technician with the right spare parts. Efficiency and first-time fix rates improve as intervention costs decline.

The most advanced level of operational capabilities of smart connected devices is the autonomous management. Combining monitoring, control, and optimization allows IoT-embedded products to conduct autonomous operations, automated decision-making, and self-diagnosis (Suppatvech et al., 2019). In the most advanced scenario products can decide whether to perform particular functions such as self-maintenance without human intervention (Ardolino et al., 2016). This is possible thanks to algorithms that utilize data about the products' performances, and, in this case, human operators would have simply a monitoring role.

The roles described enable the development of new innovative products that are now feasible, both technically and economically, as sensors and batteries benefited from technological breakthroughs (miniaturization, energy and performance efficiency, ubiquitous wireless connectivity). Those products are the so-called smart connected products, the elements characterizing such products are three: physical components (the "things" that make the products like mechanical and electrical parts); smart components (sensors, software, processors that constitute the operating system); connectivity components such as ports and antennae enabling connections with the product (wired or wireless), connectivity can be one-to-one, one-to-many, and many-to-many. Smart components enable new capabilities for the physical components while connectivity enables smart components to exist outside the physical product itself enhancing its value. Connectivity allows the information exchange that made such products so innovative.

2.2.2 Digital Servitization

From the digital technologies' characteristics and the roles they play in the development of smart connected products it is possible to observe multiple intersections between the phenomena of digitalization and servitization. Literature shows how digitalization and servitization have been inherently involved in the same business model approaches, this is because, for example, IoT can be integrated to smooth and tackle a series of challenges coming from servitization. IoT can solve the challenges that arise from the needs of close collaboration with the customer, proposing new customer interaction structures and

allowing co-creation of value aligned to customer needs. Important is the aspect of the capabilities that digital technologies give to firms to capture in depth information about the customer, product usage and performances, and to generate valuable knowledge. Based on such knowledge, it is possible to design innovative products and services and redesign the business model accordingly. New smart and digital forms of service are possible through the help of digital technologies and, especially, manufacturers can enable servitization through digitalization.

However, digitalization can be thought not only as an enabler but also as a catalyst and driver for servitization; this is because digital technologies facilitate the provision of product-service offerings beyond the traditional ones emerging from the traditional servitization perspective. One of the major boosts that digitalization gives to servitization is the fact that digital technologies allow to identify and eventually virtualize the relevant tangible and intangible assets of a manufacturing. So, digital technologies are majorly implemented to provide basic product-related services, but leading firms are using them also in the ideation and creation phase of the product-service and not only in the execution and delivery phases. For example, business optimization services to help reach optimal performance levels are enabled by digital technologies. The trend is to move from remote monitoring solutions to optimization and control ones with the ideal final step being the implementation of autonomous systems based on artificial intelligence. However, many companies are still dealing with the challenges presented by data collection, warehousing, analytics, and prediction.

Technology shape servitization strategies and the way in which firms are providing a wide spectrum of services belonging both to the product-level and the customer-level. The two phenomena (digitalization and servitization) combined give birth to the concept of digital servitization, that is "the transformation in processes, capabilities, and offerings within industrial firms and their associated ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies such as the Internet of Things (IoT), big data, artificial intelligence (AI), and cloud computing" (Sjödin, Parida, Kohtamäki, & Wincent, 2020).

2.2.3 Services (value proposition)

Literature has focused on identifying the different type of services that service-providers can develop in their portfolio offerings. Mathieu 2001 identifies two categories of

services: Service Supporting the Product (SSP) and Service Supporting the Customer (SSC). In this research the two categories of services are considered in a digital servitization perspective. SSPs are services that benefit the product, usually they require a relatively low intensity of the relationship with the customer and a low degree of customization. This is because the predominant variables are physical evidence and process. SSPs are delivered by exploiting the monitoring and control capabilities enabled by IoT elements. Effective monitoring and control lead to better operational reliability, that is to maximize availability. This type of services is crucial in the case of complex, demanding operations, where the costs of non-conformity are considerably high (A. Rymaszewska et al 2017). Condition-based maintenance, for example, thanks to IoT-enabled machine-to-machine communication, through systematic monitoring allows to perform maintenance at the optimal time, thus decreasing maintenance frequency (A. Rymaszewska et al 2017).

On the other end, SSCs have as predominant variables the people (and so the direct recipient of the services), this requires a high degree of customization that results also in a high level of intensity of the relationship with the customer. SSCs are the most relevant in a digital servitization environment as they provide a powerful means of differentiation that customers recognize, also, because they are services that increasingly predispose high intensity of the relationship and high customization. Relationship management and customization are essential areas to develop skills on because the research suggests that the ability of the providers to develop an SSC is linked to the strength of the relationships they have formed with their clients (Mathieu, 2001).

Baines and Lightfoot (2013), basing on the SSP/SSC distinction provided a distinction between base, intermediate and advanced services. Less complex types of service offerings (base and intermediate) are for example product maintenance activities. Advance services have been defined as “a capability delivered through product performance and often featuring; relationships over extended lifecycle, extended responsibilities and regular revenue payments” (Baines & Lightfoot, 2014).

Another insight is given by Story et al. (2017) that suggests that “advanced services should be seen as complex, flexible, offerings; developed in order to rapidly respond to customers' needs, by providing performance-based services that support these customers' dynamic and evolving activities”. Given their complexity, advanced services, in particular, can have a major impact on both manufacturer and customer operations

(Baines & Lightfoot, 2013). Advanced services create value mainly through data analytics, information, and collaboration, especially when real-time information flow seamlessly between people, between people and things, and between things. Operations optimization is an example of an advanced service where organizations analyze the gathered data in-house using business intelligence techniques thus enabling the creation of value.

2.3 Strategic roles of digital technologies and business model formalization

2.3.1 Strategic Roles of digital technologies

Like mentioned in the case of servitization, adoption and integration of digital technologies for the development of smart connected products and digital services is to be supported by business processes reengineering and business model innovation. The interdependence between technological progress and business model is widely discussed in the literature, for example Chesbrourgh & Rosenbloom (2002) argue that to benefit from the commercialization of a technology spillover, businesses do not only need to manage technical uncertainty, but they need to implement effectively an adequate business model to match technology and economic environment. Technological innovation without a commercialization strategy does not guarantee business success and new product development efforts should be coupled with a business model defining their 'go to market' and 'capturing value' strategies.

IoT architectures when integrated in firms' processes, have considerable effects on firms' strategies. In this optic, Gerpott and May (2016) identified three roles of IoT architectures: smoothing, adaptation, and innovation; what differs a role to another is the extent to which offerings are complemented, replaced, or extended. The first two roles are incremental as they complement the firm's current business model while the third role enables radically new functionalities of products and/or services, generating a new sales category.

IoT components in a smoothing role are not a part of the core product-service, the initial preexisting offering is not changed significantly, rather the IoT components' role is pivotal to initiate a sequence or transactions. Therefore, the smoothing role is also perceived as an enabler role. Some preexisting processes are made easier, less time-consuming, and,

so, cheaper. In this case the IoT component reduce the number of interactions necessary to carry out a transaction, thus, smoothing sales processes and reducing transaction costs.

The adapting role is similar to the previous one as it does not modify the core functionalities of the product-service, its role is rather to significantly increase the value of the product-service enabling additional functionalities for the product or service without being the main value driver. An example of innovation role is the one played by sensors that allow the implementation of tracking and tracing of shipments, the key functionality (the movement of the physical good) is not altered by the integration of the IoT component, in fact, the added value is given by the service that allows to identify the current location of the shipment.

The innovation role refers to the fact that service and/or product innovation, in this case, is only possible thanks to IoT components integration. In this case digital technologies are the main value driver as they open unknown opportunities for value creation or make tasks, previously difficult to be achieved, convenient. Functionalities enabled by IoT have not been previously offered as they depend on IoT, examples are automated temperature and energy consumption remote monitoring in a smart home environment.

When considering digital servitization, the peculiarities of IoT-based solutions impact the firm's offerings portfolio. Literature about business model innovation shows that new offerings can be developed by either revisioning the portfolio or by extending it. Portfolio revision is to add functionalities to the offering without changing the existing value proposition, it deals with:

- Increasing/decreasing the level of complexity defined as the number and interrelatedness of process steps, customers are able to reduce or increase their involvement in the process as digital technologies alter the visibility of processes. An example of such innovation is the Amazon dash button. Complexity is reduced thanks to IoT application, customers benefit from a reduction in the ordering process while the value creation process remains unchanged.
- Increasing the level of customization by providing tailored offerings through the integration of IoT technologies.
- The evolutionary advancement that is to restructure the current process through incremental evolution without revolutionizing the outcome, this is the most radical form of portfolio revision. An example of process restructuring is Car2Go,

a car rental service that, while maintaining the value creation paradigm of a traditional car rental, rearranged the steps in which value is created. The IoT integration allows to avoid the process of picking-up and leaving the vehicle to a limited number of outlets, moreover, users do not need to make a reservation.

Extending the portfolio means to increase the degree of vertical integration both upstream and downstream, or to add new offerings that are unrelated to the current market addressed that will require new value chains. Extension within the current value chain can be made by integrating vertically, upstream extension enables the integration of the current offering into a broader system that enlarge the spectrum of applications of the current product and/or service, this also gives the foundation for the upstream integration of processes. Uber can be used as an example when considering the company's desire to integrate self-driving cars into their service portfolio. The key service of Uber is to bring together passengers and drivers and process the payments, however, substituting human drivers with self-driving cars Uber will exploit IoT components to manage its fleet without drivers, thus integrating upstream processes into their offering portfolio.

When vertical integration is done through downstream extension, IoT-enabling offers incorporate tasks and activities that used to be performed by other market players, thus, downstream value chain elements are integrated into a firm's offering. This occurs, for example, when the customer's necessity to purchase from another independent provider is replaced by a functionality of IoT. An example is the already mentioned instant ink program by HP. IoT functionalities replace the need for the customers to purchase from intermediary independent supplier as connected printers automatically order replacement ink cartridges. By integrating downstream, HP does not only manufacture printers and cartridges but also proactively distribute to the customers as a separate service offering.

The option that requires a new value chain is to enter in a new market not previously before, new products, services, and processes can be created to target a new market by combining firm's core capabilities and IoT application. For example, Google is investing in developing a self-driving car, by leveraging the existent competences on collection and analysis of big data the firm is extending its portfolio toward a completely new market.

2.3.2 Business model transformation path

Digital servitization requires a transformation from a product orientation to a more service-centered one. The transformations that firms undergo in developing a digital servitization strategy do not suddenly happen in a short period. Literature identifies the so-called "product-service continuum" where the different positions correspond to different levels of service development and integration, the positions are generally conceived to be from traditional manufacturer to service providers where service integration is the main value driver. Opportunities and challenges are different for each position along the continuum so companies must reposition themselves depending on their competences.

Positioning along the continuum is a dynamic process, moreover, firms can interpret multiple roles for different customers at the same time. The choice made by manufacturers are shaped by servitization, digitalization, and firm's characteristics. Lerch and Gotsch (2015) provide a transformation framework that considers four stages:

- Manufacturer: it involves providing obligatory product-related services, such as installation and/or maintenance and repair. Digital technologies are used to support such services and they have almost no impact on differentiation.
- IT-based services: at this stage digital technologies are used to improve existing service offerings. Examples are remote monitoring and remote control. Services are then provided faster, more efficiently, and with better quality.
- Pure digital services: digital technologies enable new service opportunities, including software-based simulations, virtual or augmented reality applications, and digital technical analyses. Providing novel services means to extend the firm's offerings companies and significantly enhance the performance of the product or service that is the core offering.
- Digitalized PSS: manufacturers develop digital technologies solutions to be integrated in the product-service system, thus, creating intelligent, independent operating systems optimizing availability and operations while reducing resource inputs.

Each stage represents an equilibrium point for companies; increasing competition, external forces, or internal developments can trigger innovation, destabilizing the system

and moving the manufacturer along the transformation path until a new equilibrium is reached.

In respect to the service transformation paths that manufacturers undertake, Kowalkowski et al. (2015) provide a model that takes into consideration the multifaceted and multidirectional nature of digital servitization. Offerings' repositioning is not unidirectional, instead companies can occupy different positions along the service transformation continuum at the same time to satisfy different customers (Ardolino et al. 2018). Product-service providers interpret different role outside the conventional services and goods dichotomy (Kowalkowski et al. 2015). The model is composed by three service transformation paths: becoming an availability provider, becoming a performance provider, becoming an industrializer.

An availability provider expands its offering by bundling product and services previously sold separately, service-level agreements include services that are both product-oriented (maintenance, repair) and process-oriented (training, process analysis) (Kowalkowski et al. 2015, Ardolino et al. 2018). An example coherent with the strategy of an equipment supplier that undertakes the availability provider path is Piaggio. The firm has recently started to offer scooter sharing services in Milan and Rome in collaboration with Fiat Chrysler Automobiles and ENI. To comply with free-floating mobility solution's requirements, Piaggio underwent a process of product redesign. The scooters have been embedded with sensors and actuators that make the renting process as well as the scooter localization smooth.

A performance provider involves offering even more advanced solutions which solve strategically important customer-specific problems thanks to specific competences and infrastructure. In providing performances a supplier addresses long-term strategic objectives and ensures the achievement of requested performances. Offerings can be situation-specific, so, complexity and risk increase significantly for the provider, therefore such solutions are not usually offered in a standard portfolio. A relevant example in this case is the one of KONE, leading manufacturer of elevators, automatic doors, and gates. In the last decade KONE has rethought its mission as a company dedicated to people flow. KONE invested in developing smoother, safer, and more personalized and integrated "people flow" systems for small and large buildings. The firm also provides full risk contractual services on the installed base, taking over the responsibility for achieving a contractually agreed availability level of elevators.

Lastly, Kowalkowski et al. 2015 identified the characteristics of the industrializer, that differs dramatically from the previous expansion. Departing from the customization concept, firms capitalize their capabilities built in delivering complex, risky, advanced offerings by providing a product-service system standardized in different elements. In doing so, firms are able to reach more customers and benefit from economies of scale. The business model of Canon Italia represents the path of an availability provider that industrializes its product service offer to sell it as a commodity. In fact, the firm offers document management solutions in the form of pay-per-page contracts. IoT-based technologies embedded in the machines enhanced connectivity, meters are sent regularly to the company's ERP enabling the maximization of equipment uptime. Service contracts include planned maintenance as well as replenishment of consumables.

From the research it emerges that product-service systems suppliers must balance the expansion and standardization activities and take advantage of the standardization-customization interplay in the different roles.

2.3.3 Business model formalization

A substantial portion of the different dimensions of business model innovation has been taken into account by Suppatvech et al. 2019. Considering the degree of innovation (radical or incremental) that digital servitization strategies required, four different business models framework have been formalized. The first one is the so-called add-on business model. In this case, personalized services and additional functions are offered bundled with the physical product. This corresponds to the traditional PSS categorization; adopting digital technologies, manufacturers can: provide sensor-based hybrid offerings; facilitate product-related service provision, improving efficiency or decreasing complexity; leverage customer data provider to offer customized services or enable integrated offerings to the customer; provide the additional service or information on-demand. In an add-on business model perspective, the provider offers, exploiting digital technologies enabled capabilities, digital services in addition to the utility of existing physical goods or services; for example, a firm can leverage IoT components to help process customer orders more efficiently and facilitate just-in-time procurement.

The second business model is the sharing business model, the underlying concept is similar to the one of rent, in fact, customers pay for using or accessing a product for a limited amount of time, which allows different users to continue using the product when

it is available. Differently from the concept of renting, the sharing business model generates more changes of ownership and shorter use periods, this also means that asset utilization increases. A representative example of the sharing business model are the car-sharing services (like the already mentioned Car2Go) where the customer will be able to access the car at the nearest available public parking point thanks to the IoT technology that allows the customer to readily locate the nearest car. Literature shows that this business model is implemented only in the B2C environment for the moment (Suppatvech et al. 2019).

The third business model identified is the so-called usage-based business model. In this case digital technologies are used to track customers' usage and charge them accordingly; the provider is responsible for delivering the agreed amount of usage. The provider can implement the already discussed pay-per-use strategy or the subscription one, where the customer pays a fee for unlimited access to the product or service, restricted to the time span of a subscription. Examples of such business model archetype can be found in the previously mentioned Rolls-Royce case as well as in the Canon case.

The fourth and last business model is the solution-oriented business model; exploiting digital technologies the provider is enabled to offer solutions to customers. Integrated solutions are developed to satisfy specific customers' needs supporting their operations and increasing efficiency. Provider and customers, in this case, make agreements concerning the specific outcome or result to be obtained through services. Solution-oriented business model can be built upon two different types of strategies: availability and optimization/consulting. Availability concerns the guaranteed continuous utilization of the product offered, this means that the provider is responsible for the maintenance and support that allow the uninterrupted usage during the contract. The possibility of implementing such business model is given by the capability of collecting and processing real-time data enabled by digital technologies. The optimization/consulting service strategy can be considered the quintessential advanced service strategy; digital technologies are utilized to monitor and to analyze customers' usage patterns and, consequently, to provide solutions to improve and support the customers' core operations. As seen before, this kind of solutions ask for a different customer relationships management approach, favoring a closer relation based on long-term contracts rather than transactional based relationships. Customers, instead of buying ownership of the

product (e.g., machinery), pay for the integrated solution to a business function through long-term contracts.

CHAPTER 3: Case studies analysis

This chapter is structured by first describing the general scenario in which Italian manufacturing firms are inserted by observing market indicators for digital solutions in 2020, thus also considering the impact of the Covid-19 outbreak; the attention is given especially to the above-mentioned technologies adoption (IoT, Big Data, and Cloud Computing). Secondly, attention is given to the peculiarities of digital servitization and its mitigating role in facing the challenges posed by the pandemic to Italian manufacturing firms.

Once the overall scenario is briefly described, the analysis is devoted to observing how selected firms interpret and develop their offerings vis-à-vis the peculiarities of digital servitization. The objective to reflect the unique Italian manufacturing context requires to consider the dynamics of digital servitization at the SME-level, particularly in fundamental export sectors such as machinery production, processing plants, and filling systems.

3.1 Methodology

It is appropriate to provide the main methodological guidelines for the realization of this research briefly describing the characteristics of the methods adopted as well as the motivations.

The method used is the case study analysis of three SMEs located in the Veneto region of Italy: Galdi, Sariv, Technowrapp. The three firms are metalworking SMEs that conduct an important part of their business abroad.

The choice of adopting the case study analysis method has been made considering the complexity of the digital servitization trend. By understanding its real-life context, it is useful to obtain deeper insights on the issue. Considering more than one case in a cross-case perspective allows to understand a larger class of similar units. In this way it is possible to define the effects and the theoretical aspects presented in the literature review, then having a better knowledge of the topic of digital servitization.

The case study was organized by collecting and processing a variety of data both primary and secondary. Primary data have been collected only for the Galdi case being the most substantial one when considering digital servitization. Primary data have been collected through structured qualitative interviews with the aim of investigating the drivers, the

internal transformations, the mindset, and the challenges that the firm faced dealing with the trend. Secondary data were gathered through online research, mainly through video-interviews conducted by ConfindustriaVeneto during the "I 100 luoghi dell'industria 4.0" events where founders, CEOs, and heads of departments revealed interesting insights relative their business model innovation process in relation to the trends of digitalization and servitization. Other secondary data have been collected through the companies' websites.

The interview was the main source of information for the Galdi case, it has been carried remotely via Google meeting. The interview was conducted with the digital services manager and the after-sale manager.

Interviews enable to gain a deeper knowledge of the phenomenon under study, it allows also to favor flexibility and variety of contributions. The tool of interviews is not a standardized approach, thus does not allow to generalize the results and the answers as the sample analyzed is non-representative. However, this approach has been selected as it leads to more useful interactions.

The case study aims at integrating the theoretical concepts related to digital servitization identified in the first two chapters. Case studies analysis in this research has the goal to give a concrete perspective of the theoretical aspects and to understand the implications for SMEs willing to undertake a servitization strategy integrated with digitalization.

In particular, the main objectives pursued in developing of the case study are the following:

- Understand each firms' experiences in innovating their business model to servitize digitally.
- Analyze what drives firms to adopt digital servitization strategies.
- Understand the current situations in which firms find themselves and how and if they will continue the digital servitization direction.
- Investigate how firms interpret the change in mindset for value creation. Attention is given also to the human capital aspect.
- Analyze how firms manage customers relationships and the how the sales approach is perceived.

- Analyze what are the main challenges and inhibiting factors that firms face in digital servitization strategies implementation and identify the measures adopted to overcome them.

3.2 Italian scenario

3.2.1 Italy's position regards digitalization

The pandemic has obviously affected majorly industry macroeconomics indicators; in 2020, production and revenues diminished by the 11,4% and 11,5% respectively for Italian industrial firms. Worse climate of trust and indicators contraction slowed down investments in ICT solutions that reached 7,9 billion euros (-4,8% in respect to 2019). However, the flection registered by the digital market is far softer than the one registered by the entire economy. Especially in the first part of the pandemic, digital technologies played a crucial role in guaranteeing production continuity and remote working diffusion. Moreover, during the sanitary emergency, some digitalization's strategic priorities assumed an increasingly higher relevance like, for example, customer engagement optimization and operating efficiency in relation to production processes and supply management. Therefore, industrial firms focused on adopting Operation Technologies, Cloud platforms, IoT, and Business Advanced Analytics solutions.

Industry 4.0 market, that combines also above-mentioned solutions, in 2020, reached a value of 2.904,2 million euro (-4,2% in respect to 2019); investments increasingly focus on revolutionizing internal processes that are becoming more and more based on data sharing to be valued in a business optic. Firms are working to develop solutions and platforms to exploit data in a predictive perspective and to optimize various business activities (commercial, production, logistic).

Nonetheless, in the first semester of 2021 the digital market reached a value of 36.069 million euro, an improvement of 5,7% in respect to the same period of 2020. Digitalization has a crucial role for the recovery, innovation, and improvements of economic performances of Italian firms.

In the next two years, investments in digital solutions and services are expected to recover thanks to the discussed trends but particularly thanks to the measures projected by the PNRR. The industrial sector is expected to be one of the main beneficiaries of such resources for a total of 13 billion; the most impacted areas are expected to be the enabling

technologies for the Factory 4.0 and Supply Chain as well as monitoring systems such as sensors integration also in a predictive perspective. At the infrastructural level, technologies such as Cloud Computing are going to benefit from the PNRR's resources. Two different scenarios of the PNRR's impact are delineated:

- Best case scenario. This scenario lays on the assumption that the 100% of the available resources are utilized. The incidence of the resources provided by the PNRR are estimated for 29,2 billion in the 2021-2024 period; the growth indicators for the digital market are estimated to be equal to 10,6% in 2022, 6,1% in 2023, and 4,1% in 2024.
- Worst case scenario. This scenario assumes that the only the 50% of the available resources are utilized. The incidence of the resources provided by the PNRR are estimated for 20,5 billion in the 2021-2024 period; the growth indicators for the digital market are estimated to be equal to 7,9% in 2022, 5,6% in 2023, and 4,5% in 2024.

In the industrial sector the demand for digital is expected to grow in 2022 by the 6,3% (+0,5% in respect to 2021) for a total of 8.895 million euro. The investments are expected to be focused on Cybersecurity, Factory 4.0, Data Analytics, Supply Chain agility, data gathering as well as an increasing focus on customer-related projects.

A relative new trend catalyzed by the effects of the pandemic is the attention now given to cybersecurity. Cyberattacks are rising both in numbers and in economics damages, this is associated to the fact that, with the pandemic, firms increasingly relied on remote working and on the cloud. Globally, in 2020, severe attacks registered were 1.871 (+12% in respect to 2019); economics damages of Cybercrime in 2020 were equal to 945 billion dollars. Given this, in Italy, investments in Cybersecurity are estimated to grow by the 12,4% in 2021, by the 13,1% in 2022, and finally reaching an expenditure greater than 2 billion in 2024.

For the sake of the research, it is useful to understand more specifically the trends for Italian industrial firms relative to Internet of Things, Big Data, and Cloud Computing adoption. The IoT market in 2020 registered for the first time a contraction in respect to the 2019, precisely -3,1%, for an expenditure equal to 3.393 million euro. The negative trend is caused by the cancellation/postponement of programmed projects in the first stages of the pandemic emergency. The IoT market will recover its usual positive trend,

both because of the necessity to recuperate the digital manufacturing activities postponed and because of the potential effects of the PNRR and 4.0 Transition program on the modernization of the Italian industrial production system.

Regarding Big Data the market reached a value of 1.152 million euro in 2020, an increment of the 8,7% in respect to 2019. An even more positive trend is expected for the next two years with a potential double-digit growth; the pandemic situation showed how valuable is a correct data usage and management both in crisis and in everyday business situations. Firms that already started data-driven business activities found it easier to face the shock caused by the Covid 19 outbreak, this the reason that pushed Italian firms to sustain the investments in technologies to manage Big Data, moreover, such investments underline the necessity of the definition and the integration of a data strategy. The Big Data market is estimated to reach the value of 2 billion euro with a 12% annual growth in the 2022-2024 period.

From the Anitec-Assinform annual report "Il Digitale in Italia 2021" it can be observed how in 2020 Cloud Computing solutions have been adopted by the 38,3% of the firms. the market grew by the 18,8% reaching a value of 3.898,5 million euro. The causes are to be found in the firms' necessity to respond rapidly and effectively to the challenges posed by the pandemic enabling, for example, the remote working processes. However, the growth is also caused by less contingent factors like firms' strategic choices and the firms' need to modernize their architectures. The Cloud Computing market in 2024 is estimated to be valued at 7 billion euro with an average growth of 18% in the 2021-2024 period.

With the Piano Transizione 4.0 the Italian government aims at incentivizing private investments in material and immaterial goods that can favor the digital transition with particular attention at the digital competences' improvement. Incentives assume the form of tax credits:

- Tax credit rate for 4.0 material goods (e.g., systems and machines for product/process control) is 40% for investments lower than 2,5 million euro, 30% for investments between 2,5 and 10 million euro, and 10% for investments between 10 and 20 million euro.
- Tax credit rate for 4.0 immaterial goods (e.g., AI and Machine Learning applications, reengineering of production systems based on connectivity and information exchange) is 20% for investments up to 1 million euro.

To understand better the Italian situation in relation with digital servitization it useful to observe the Desi index 2021, the instrument used by the European Commission to measure Member States' digital progresses. The general progresses of Italy (from the 25th to the 20th place) are not reflected in the sphere of digital competences; human capital remains the biggest hurdle as Italy scores 35,1 points (25th place) while the UE average is 47,1. Digital competences levels are low in respect to the UE average, in fact, only the 22% of people between 16- and 74-years old possess advanced digital competences (31% in the UE). ICT specialists are the 3,6% of the total employed (4,3% in the UE), the European Commission identifies the cause in the low sector attractivity as only the 1,3% of the Italian graduates choose ICT disciplines. From the specialized training perspective provided by the firms only the 15% of Italian firms offers ICT training to its employees while the EU average is 20%. As underlined also by the report, the lack of digital competences can limit the firms' innovation capability and the population's possibility to access to digital services. The report suggests focusing more on human capital; for example, education and retraining are to be pursued especially in high technology intensive firms.

On the other hand, Italy scores relatively high in the integration of digital technologies (10th in the EU) thanks to the SMEs digitalization. 69% of Italian SMEs have, at least, a basic digital intensity; for example, the 38% of firms utilize cloud services. However, Italy lacks in the application of Big Data technologies (9% against the EU average of 14%) and in the use of AI-related technologies (18% against the EU average of 25%).

3.2.2 Italy's position regards servitization and digital servitization

The relevance of servitization in Italy has been demonstrated also during the Covid-19 outbreak, the consequences of the pandemic have affected greatly SMEs' business. A recent study published in the Italian journal of management shows how Italian SMEs have faced the challenges of pandemic with diversification and servitization. The cluster analysis identified four groups (clusters) of SMEs that during the emergency have developed response to challenges.

The first cluster represents those SMEs (10,5% of the sample) that during the pandemic did not show any corrective strategy both in diversification and in servitization terms. Those firms did not invest in R&D and kept a low intensity of interaction with their customers simply asking for a price reduction.

The second and third cluster (27,3% and 25,3% of the sample respectively) represent those SMEs that activated strategic responses based on an intermediate degree of diversification and servitization. These firms demonstrated to be reactive to some extent by investing in R&D activities to quickly respond to new challenges by designing new products/services as well as to shape their post-Covid strategy. Customers, during the pandemic, asked for more personalized and/or more innovative products/services; the requests about price reductions were still common. A good portion of both clusters incremented the adoption of digital technologies specially to improve relationships with customers, employees, and suppliers. Investments in digital technologies is confirmed as significant also in the post-pandemic future to improve production processes or to innovate proposed offerings.

The fourth and last cluster (37,0% of the sample) groups the SMEs that interpreted the Covid-19 crisis as an opportunity to embrace a high level of diversification and servitization. 20% of firms in the cluster improved their turnover during the pandemic (the most among the sample). Strong investments in digital technologies were made to significantly improve customer relationships as well as investing in R&D activities to develop new products/services. For most of the firms in this cluster digital technologies will have an important strategic role in improving their business processes.

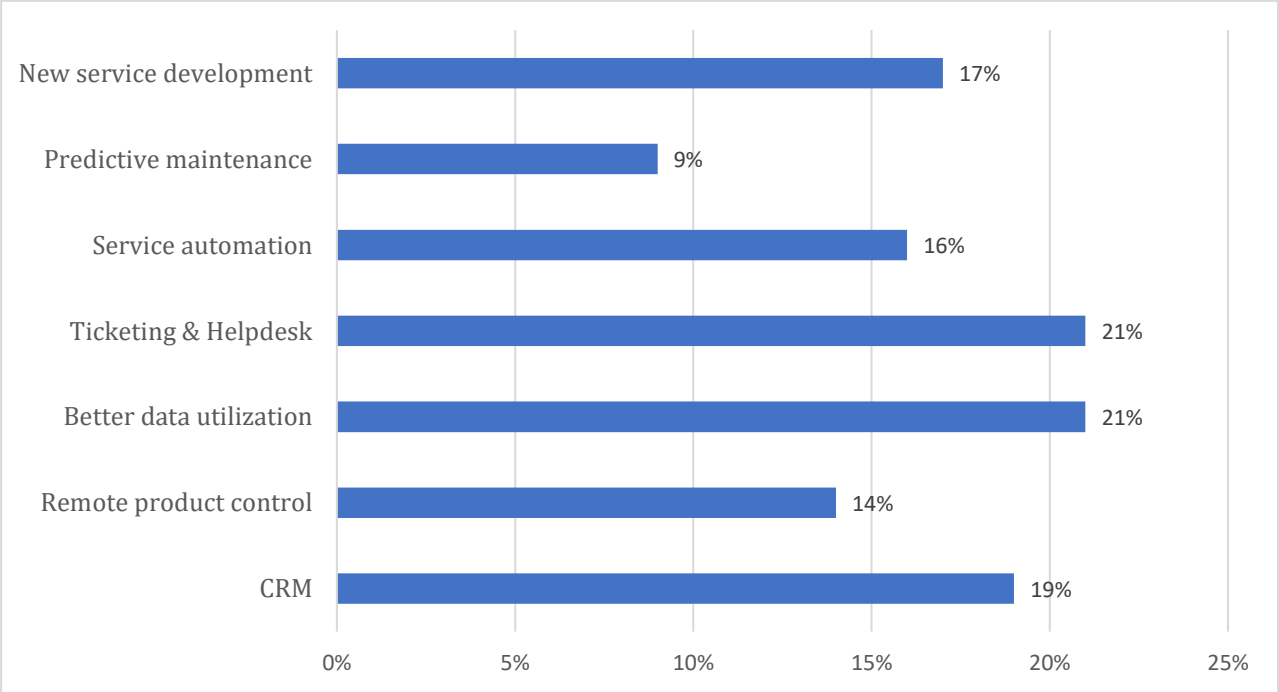
Digital servitization features have been tested in different occasions by the literature, what it is interesting to observe is the role played by such trend in the current pandemic scenario. Adrodegari, Perona, and Saccani, in May 2020 analyzed the role of product-services in mitigating and in facing the effects of the pandemic. The research, supported by the Laboratorio RISE, by the ASAP Service Management Forum, and by SWITCH, involved 180 firms (145 classified as product-centric) operating in the capital goods or durable consumer goods sectors. The scenario is alarming on all fronts, nonetheless businesses related to services and product-related services are expected to suffer much less than product related businesses. In the research services are considered to be spare parts sell, reactive/preventive/proactive maintenance, consultancy, client training, and operativity optimization.

As mentioned in the previous chapters, service offerings suffer less economic cycles (service offerings are anti-cyclic in some cases), moreover, diminishing product sale opportunities could require increasing service provision given the fact that installed base will get older. Advanced services are the ones less hit by the crisis as they are: necessary

for customers' operations, complex to replicate externally or internally, and contractually binding. In the same way alternative revenue models like pay-per-use and pay-per-performance perform better than the pure sell business models.

The research shows that even before the Covid crisis there was great attention given to the development of digital servitization solutions, the pandemic significantly accelerated an already-existing process. The main processes activated/accelerated by the Covid pandemic are diverse.

Figure 1. Digital servitization projects developed during the Covid-19 crisis by the questioned firms



Source: Adrodegari, Perona, and Saccani, May 2020

In understanding the impact of digital servitization on Italian manufacturing firms it is useful to discuss how these firms are developing digital product-service solutions to interpret a new role in their respective market sector. In this section the solutions by Small-Medium Enterprises are examined to better describe the Italian scenario and the more practical aspect of digital servitization.

3.3 GALDI case study

Galdi was born as Galdino Candiotto designed and built his first filling machine, that particular machine was built to satisfy a specific need of the family dairy: shifting from

glass-bottled to carton-packaged milk, thus opting for a more flexible, economic, and sustainable solution. Today Galdi is a B2B metalworking firm that designs and manufactures gable top filling solutions focusing on the highest food safety standards and on repeated performance of their machines over time. Galdi provides value-added solutions for the filling and packaging of milk, dairy products, fruit juices, liquid eggs in Gable Top cartons and it is committed to ensuring customer satisfaction through ongoing relationships.

Galdi combines constant improvement with a client-centered approach aiming at offering an increasing range of resources and solutions to its clients that add value to their business, both before and after the sale. Firm's values defined are the respect for people, for society, and for the environment, these values are transmitted to all stakeholders. In this perspective Galdi's machineries are designed to reduce their environmental impact, operating costs, and consumption.

About 10 years ago the firm began an innovation transformation path to interpret a new role in its sector: from being a simple machinery producer and seller to being a solutions provider for its customers. To adopt the right solutions to servitize, Galdi had to change company's mindset first, the service proposed must be the most complete as possible to offer solutions that responds effectively to customers' needs. Servitization is for Galdi a prerequisite of its market as services are crucial to succeed in its sector but also as, through services, Galdi can lock-in the customer. Service selling is very different from product selling, it is a process that requires time, collaboration with customers, knowledge of customers' needs, trial-and-error process to find the best solution, and to focus on customization.

The transformation process is a continuous process, the demonstration of this is the fact that during the years services increased both in quantity and in completeness. An example is the downstream service offerings made possible by a new acquisition; Galdi recently acquired a firm that deals with the secondary packaging, doing so allows Galdi to provide a potentially complete service offering, selling not only machineries but complete production lines.

Another strong example of the transformation to solution provider is the birth of a new start-up developed internally, the start-up deals with the packaging design (Gable top shape and print) and the potential contamination analysis for the customers' products shelf-life.

The two above mentioned examples exemplify the process of taking increasingly more responsibilities for customers' processes that go beyond the simple task of selling a filling machine.

Another effect of the servitization transformation is the fact that one of the main goals for Galdi is to interpret a consultancy role for its current and potential customers. For this reason, different consultancy services are developed and offered: consultancy for the design of the Gable top packaging, consultancy for the optimization of the production line, training, microbiological testing, and consultancy for potential upgrades.

Galdi proposes diverse offering formulas considering customers' needs, maintenance contracts can vary in service completeness and in responsibility undertook by Galdi in guaranteeing performance continuity. For example, the Free2service formula is the most complete maintenance contract, other than extending the warranty, it allows customers to completely entrust the management of spare parts and the organization of maintenance operations to Galdi. Another example of a maintenance contract offered is the Smart formula; it provides for periodic visits by a specialized technician at discounted rates, defining the frequency of the interventions with the support of Galdi's technicians, it is possible to maintain constant performance over time.

Consultancy services and maintenance contracts allow Galdi not only to monitor machines performances but, most importantly, also to maintain a constant relationship with the customer, relationship continuity is fundamental for Galdi to sell assistance services, spare parts but also production line upgrades and other services.

For Galdi's vision everything can be a service, even machines can, this is shown perfectly in the implementation of a pay-per-use service where Galdi sells the Gable top packaging directly to the customer, in this case the price of the product is composed by the cost of: the rented machine, maintenance, and related services.

The transformation to solution provider is supported by the service strategy embodied by the firm; thanks also to a digital shift, Galdi is now capable of offering physical services combined with tailor-made, high-added value digital services.

Offered services along with filling machineries are diverse, other than physical services like consultancy, training programs, and maintenance, Galdi offers digital services that provide high value for the customer:

- Machine health system (MASH) is a filler monitoring system which aims at: offering a detailed view of the machine's efficiency; anticipating and preventing downtimes; providing detailed production data; improving the work of operators and maintenance technicians. The system has been implemented in 2017 considering the importance of efficiency for performance and for Overall Equipment Effectiveness. The system summarizes machineries' production data and translate them, through a cloud platform, in a useful language for the operators. Thanks to a user-friendly interface it is possible to examine machineries' hourly/daily/weekly performances as well as the respective MME ("Machine Mechanical Efficiency") percentage. Moreover, it is possible to enter detail to observe specific areas of performance. Such data are accessible through any device: PC, smartphone, tablet, integrated with management systems such as ERP (Enterprise Resource Planning), MES (Manufacturing Execution System), PLM (Product Lifecycle Management), and CRM (Customer Relationship Management). Thanks to MASH it is possible to: identify downtimes and their causes, improve filler's efficiency as well as operators' efficiency, share relevant production data synthesis. The system helps significantly operators to have a better overview, their work is considerably sped up.
- When intervention quickness is crucial, the client can benefit from the TYE ("Through Your Eyes") service. It is the remote video-assistance system designed to annul distances and to reduce intervention times. Thanks to the camera sharing Galdi's expert can remotely guide the maintainer intervention with vocal or textual indications in real-time. Moreover, through augmented reality the operator can eventually point to specific machine's areas and share files and videos with the correct procedure to be followed. The service can be already included in the maintenance contract as well as acquired in single tickets or voucher.
- The Web-Factory-Acceptance (Web-FAT) service allows customers to participate remotely and in real-time to the FAT. The filler set-up is accompanied with a detailed explanation by a Galdi's expert. The service comprises: live performance check, complete machine starts procedure, packaging test validation, and remote DYE test training and final report.
- E-Portal: a platform designed to rapidly manage the orders helping customers at optimizing time and reducing the errors. A platform where customers can find and

acquire machines' spare parts and their relative manuals, machines' 3D manuals, wiring diagrams and settings. Through the platform it is possible to suggest the right quantities of products to acquire, moreover, the availability of the product in the warehouse is indicated. If the product is not readily available then the lead-time is indicated, in this way Galdi helps customers in the organization of its processes by giving them as much information as possible.

The motivations behind the development of the E-Portal and the future prospective of such platform are interesting to be discussed.

The Galdi's sector specificity requires a great focus on the after-sale process especially when considering the weight it has on the total turnover (30% of the total). The spare parts provision is a focal business point for the firm; in 2021, around 5 million Euro of the 20 of turnover came from spare parts sales. With the goal of supporting this business, in 2011 Galdi started to implement the E-Portal with the vision of creating an e-commerce platform that would offer the same services as a traditional one (e.g., Amazon). To obtain these results Galdi must develop yet some missing functions: the possibility of tracking the shipment status utilizing a tracking number and the integration in the platform of orders documentation such as the receipt or the transport bill. The E-Portal has been developed also to smooth Galdi's internal activities. By designing services that optimizes both customers' and provider's processes, the platform allows to simplify by a great extent the orders management as the documentation about every order is uploaded in the firm's system semi-automatically.

By providing an increasingly more complete offering, Galdi was able to acquire market leader customers (e.g., Parmalat, Campina). In Galdi's experience, bigger customers tend to entrust second parties for their non-operational activities while smaller firms try to pay amounts as small as possible and to maintain a relative degree of autonomy. A trend seen especially during the pandemic, when continuity of production was the most important aspect for smaller firms, particularly for the cases where customers' location made difficult to maintain a physical presence.

Bigger clients search for services as complete as possible, even the most complete maintenance contract (Free2service) is not enough for such customers; Galdi developed a personalized offering where more services where proposed: consignment stock and a dedicated technician with intervention times of 4 hour maximum 24 hour a day. Without complete solutions it would be impossible for Galdi to sell their products to big customers,

especially for the specificity of its sector where the deterioration of raw material is a significant challenge. Digital services are mainly required to big firms while smaller ones are often less sensible to those services; the digital service valued the most by small sized firms is the TYE as even in the absence of physical presence they can benefit from Galdi's expertise.

To successfully undergo through such transformations in its business model, Galdi faced three main challenges: attract and keep the adequate human resources, gather useful data and information to be able to propose the right services to the customers, communicate the value of its advanced services to customers.

Regarding the human capital aspect, the human resource department must select accurately personnel that is aligned with the firm's ambitions and cultivate the same passions; the firm collaborated with diverse institutions, among which universities, to attract the right talents. Once selected, human capital must be retained, it is also for this reason that continuous training is considered a priority as well as employees' welfare. Human resources have been crucial to develop the new business perspective, this is because, to innovate the business model, teams of young technology-savvy engineers and experts already inside Galdi have been constituted. The two guidelines, communicated to the teams, to be followed in developing firm's strategy were: alimentary security and support to the customer in machinery usage. Human resource management has been a crucial aspect to be able to integrate business strategy along all the production chain (design, finished product, after-sell), thanks also to the relatively restrained number of employees Galdi, as a solution, facilitate the continuous interaction between the personnel. A lot of attention is given to training; both technical/operational (software and machinery related) and soft skills-related (personal growth) courses are provided.

The relevance of the human capital is also shown in the service development, by integrating skilled employees in specific departments Galdi is able to implement advanced high-value solutions. For example, the figure of data scientist is crucial to perform the activities related to machines connectivity, data gathering, and to extract value from data. Another clear example of the importance of human capital is the figure of the microbiologist that enabled the development of microbiologic consultancy service.

As already mentioned, information and data gathering has been and still is a crucial aspect for Galdi. In this perspective, building a network is fundamental to study the example of

success and to obtain information, thus, fostering innovation. In this direction also 4.0 technologies can interpret a crucial role, for this reason, already before the Calenda plan, technology and digitalization shape the process to become a solution provider. Moreover, 4.0 technologies in recent years have become more accessible, allowing also "pocket multinational firms" like Galdi to start a digitalization process. Galdi shaped its digitalization process considering 3 factors: processes, competences, tools. These elements have been redefined and, in some cases, searched externally (like in the case of data modelling outsourced to Amazon web services), in the process the IT department embodies a crucial role coordinating all the departments. Specialist software have been adopted maintaining as a pivot the preexisting CRM software (the most utilized among employees). Integrating software with the CRM, an important quantity of information regarding clients, machineries, claims, marketing campaigns have been gathered in a centralized achieve available to every employee.

As mentioned, data gathering is crucial for a wide array of activities like the implementations of new solutions and to offer an excellent use and maintenance experience. In this perspective, since 2017, Galdi has realized its own IoT infrastructure. Thanks to IoT it is possible to gather thousands of data from installed machineries and production lines.

After the human one, data is the most important capital, necessary to develop the sales strategy and to define the service offerings. From here the necessity to protect data from cyber criminality, the capability to protect comes from users' awareness and from the right tools. Moreover, the approach maintained regarding future cyber-attacks is to ask yourself "when it will happen what will I do?" rather than "will it happen?".

Nonetheless the innovation brought by the integration of digital technologies in the implementation of services, Galdi has noticed how what truly works is the combination of such digital services with more traditional ones. This is because one of the great challenges that Galdi faces in the digital service offerings is the fact that customers seem initially satisfied with the proposition of these kind of solutions but are not keen on paying for them. Customers often appear to not perceive the true value of digital services; the lack of digital competences and digital awareness by customers and the challenges of communicating such value are the main causes.

To overcome these problems, Galdi uses digital services to promote other more traditional services, digital services work almost as a marketing tool. The clearest example are the measures undertook in regard to the MASH service; particularly in the early stages when Galdi struggled because some customers did not even connect their machines to the system if not invited to. This obviously created a significant obstacle to the service sales but also it inhibited the capability of Galdi to gather a sufficient data quantity for machine monitor and for the development of new innovative solutions to solve those problems Galdi adopted two main strategies:

- It made MASH a freemium service, the basic version is free for every customer while the more advanced functions, like push notifications on the state of the machine, are for a fee. Often MASH is combined to the more traditional consultancy service where a Galdi technician, thanks to the data gathered through MASH, can examine machine's performances (for example one time a month) and then discuss them in a meeting with the customer and suggest actions to improve performances.
- Galdi, basically, bypassed the customer's connecting action basing machine connectivity on LDE (3G, 4G) regardless of the customer's desire of benefiting from the service.

Thanks to an analysis of the preexistent business model and of the already gathered data from the CRM, Galdi was able to shape the solution provider vision: changing completely the sales approach, from indirect sales through a channel to a direct type of sale; this conclusion derives also from the necessity of maintaining the contact with customers to understand their real necessities and of exploiting information to develop new ad hoc products. In this perspective, human capital is crucial to correctly interpret the approach of transmitting the firm's know-how directly to the customer bypassing the channel.

Galdi assessed the needed soft skills as well as the existing customer relationships through interviews with existing clients to better understand their management also based on customers' typology. After that, sales personnel have been trained towards a consulting perspective. The salesman figure has changed in a figure close to a consultant one that accompanies the customer in the choice process. The change in perspective requires a continuous process of incremental improvements; however, Galdi in a five-year

span was already able to rely on the 80% of direct sales, the starting point was 80% of sales from indirect channel.

Through the interviews conducted with customers, Galdi was able to observe that the website is the main channel through which potential client "meet" the firm, its products, and its services. For this reason, the website is continually updated, it is designed to be interactive through calls to action that facilitate gathering information about what aspects the customer is interested about. Such information is then elaborated by the marketing sector, data are then used to contact the client in the right way.

In the 2021 spring Galdi has been selected as one of the 13 winning firms of the Bando Innovazione, Ricerca Industriale e Sviluppo Sperimentale published by Smact Competence Center that groups 41 partners (Universities and research centers in the North-East). The subscribed project has as main goal the development of a virtual model based on digital twins for the formation of packages for the Food & Beverage sector. Thanks to IoT, AI, and monitoring systems, it is possible to recognize in time process drifts and/or out-of-control situations and to correct them in real-time. The next step for Galdi is to progress from a preventive maintenance system to a predictive maintenance one and to develop alerts programs enabling the prevention machinery performance. Such project, to be attainable, a great quantity of data is necessary. Moreover, different challenges are to be faced:

- Infrastructure connectivity: connect all the machines and transmit data, make the machines autonomous with 2 connectivity levels (LTE and wired) and eventually wi-fi to face security, logistic, technical problems of the clients.
- Data quality: build a flexible, upgradeable, and reprogrammable infrastructure as complex machines such as the one from Galdi send thousands of variables and data at the same time. For this reason, it is impossible to know priorly what is valuable for the business. To solve such challenges, Galdi is developing a completely open-source infrastructure based on market standards that will allow to manage in a centralized and automized way installed machines.
- Transforming data into value for the business: collect the feedbacks on data from technicians (whose knowledge must be digitalized) for 2-3 years circa to have a productive system.

While waiting to gather the correct quantity of data, Galdi is developing the intermediate step that is to transition from a programmed approach to a personalized one. It is a ready to use system that utilize customers' and technicians' feedbacks regarding the machines to change maintenance intervals of every single component. To do so, Galdi needs to combine the information obtained thanks to the MASH with the ones obtained through actions on machines made by technicians, in fact, every spare part substitution and/or reparation is registered into Galdi's system. This is necessary as the lifespan of specific machines' elements can depend on the usage and/or on the type of product for which they are utilized. For example, depending on the percentage of limestone in water specific elements can vary in position and usage.

The programmed maintenance if integrated with the MASH and with the information from technicians' actions can evolve into personalized maintenance improving the response to customers' requirements. The goal is to minimize operating costs as well as downtimes. The next and last step will be to develop an automatic system that will be able to gather and interpret data and to present valuable insights for technicians and final customers, maintaining machines' performances as high as possible.

During the pandemic, like suggested by the general scenario and trends, Galdi suffered a decrease in product sell. However, service sell suffered less as the business model developed around the concepts of servitization helped the firm to shorten the distances with the customers and keeping a relationship continuity. Moreover, Galdi was able to overcome the challenges brought by the emergency by selling advanced services that were less required before and to develop new services. During the Covid-19 emergency, Galdi developed: the microbiologic consultancy service, the creation of tickets for the helpdesk service to be eventually combined with the TYE, and the remote training service where the physical presence is substituted with the help of digital technologies.

3.4 SARIV case study

Sariv is a metalworking firm located in Cittadella near Padova, with a turnover between 8 and 9 million of euro it employs 45 employees. Its core business is the production of blind rivets, and it sells them especially abroad (80% of its product sales are abroad) to automotive firms (60% of its product sales); all the automobiles produced in Europe, excluding Japanese brands, integrate Sariv's products (Ferrari, BMW, FIAT, Renault, etc.). The current firm's CEO began its experience in the company in the September of 2008 in

the middle of the economic crisis, at the time the firm employed 15 workers (12 blue collars and 3 white collars) and in the first period of CEO's management it was performing at the 50%. Given the difficult situation the firm had to find a new effective strategy to differentiate from its competitors and survive. Being the product a commodity, the competition from the far east was fierce and differentiation was a difficult task given the simplicity of product's nature.

So, the strategy implemented to differentiate from competitors was initially to focus on the opportunity to diminish the perceived risk for its customers, presenting them risk management data that showed the difference in respect to far east competitors.

To do so, the firm had initially to undergo a software selection and a roadmap conceptualization of its production processes. Then, the first task to be completed was the creation of a machine network that, thanks to the integration of PLC technologies, was able to communicate whether machines were working or not. Doing so, Sariv was able to gather enough data to demonstrate customers that its processes were under control and that the price gap between Sariv's products and its competitors was justified by the guarantee that a small product, like the rivet, would not create any sort of problem to customers' processes. The first step could be summarized in two concepts: reduce inefficiencies and demonstrate that to customers.

Firm's focus was to improve the traceability of processes, traceability is now total thanks to the fact that every item is marked by a barcode. The production process is now completely traceable from the raw material to the finished product as well as machines status, maintenance programs, and machines' spare parts. This reduces by a great extent human errors. Later developed connectivity allows Sariv to collect billions of data that, if exploited correctly, can help improve performances.

The rebirth of Sariv is identified by the CEO when Renault had a problem with a Chinese brand's rivet, consequently it visited Sariv's plant remaining pleasantly surprised by the quality and control level of the production process.

Sariv continued implementing digitalization and, in 2012, the firm became paperless, process' or operational situation's parameter changes are controlled in a database that transmits related information to machines' screens, thus, reducing significantly risk of errors. Moreover, through the integration in the machines of sensors and lights, the quality control aspect is made more flexible, to satisfy specific customers' requirements,

and more precise, diminishing the probabilities of human errors and reducing drastically non-conformities. Quality control intervals can vary depending on the requests made by customers. Before this specific innovation the most common error occurred in the situation in which the product did not follow the correct pipeline; now thanks to total traceability through barcodes even if an operator happens to act in the wrong position the machine would not allow him/her to operate in the said machines.

Moreover, Sariv automatized the warehouse that contains around 5000 pallets. The automatic warehouse is integrated with the ERP system, and it manages itself automatically. The integration with the ERP allows Sariv to have univocal data relieving the operator from many routine decisions. The ERP communicates the action to be made to the warehouse's database that will automatically communicate to the operator the required product and quantity. In this way decisions where variability can be set to zero are automatized allowing operator to focus on other more complex activities.

The digitalization process underwent by Sariv began way before the so called "piano Calenda" where incentives were given to firms investing in the 4.0 technologies. This, says the CEO, even if it did initially inhibit financial benefits, gave Sariv a relevant competitive advantage as first mover being digitalization a process that requires a significant amount of time. The initial challenge was specially to change the well assimilated practices that employees had followed for a significant amount of time (some workers had a 20-year experience). Digitalization for Sariv is then a continuous process that requires incremental improvements, a more disruptive approach would not be feasible as workforce must be retrained both in technical and soft skills, moreover new profiles were necessarily introduced. Those new elements are especially digital natives with deep knowledge in statistics and great confidence with the use of Excel; the importance of digital natives justifies the low average age of employees (under 30 years old). This also justifies the increase in white collars employees since 2008 (from 3 to 20 elements).

Along with digitalization, Sariv implemented a service strategy that currently constitutes the major gain factor, in fact, Sariv's revenues are coming especially from the design and consultancy services. Until 2008 the catalogue of products was standard, and the competition factor relied only on price, now Sariv produces customized products that responds to specific customers' requirements. For example, a car manufacturer such as BMW explains to Sariv the specific product's applications (like which parts are to be fixed together) leaving to the provider the task of designing the specific rivet. This reflects the

market trend where big automotive companies collaborate with their specific suppliers of their ecosystems instead of relying on transaction-based relationships. Combining its know-how and digital technologies Sariv is able to analyze customers' requirements and to propose the final product. Consultancy services help clients to describe the problematic that must solved, in this way Sariv can propose the most fitting customized solution, maximizing the value for customers.

The differentiation factor is then composed by the digitalization of processes for increased control capabilities and by the servitization approach where customers benefit from a customized product even if this product is considered, as the Sariv's CEO puts, "a poor product".

One of the factors that allowed Sariv to undergo such transformation is the fact that the process has been conducted completely internally. To sustain the quickly changing dynamics and specially to maintain firm's specificities it was necessary to adopt software that were able to preserve Sariv's capabilities and characteristics. For example, with this perspective, in 2011, the firm chose the MES software that could adapt its features to Sariv's core business and not vice versa. Other than the necessity to have an internal control of the process, it was important to conduct the transformation with a top-down approach as resistance to change would stop the renovation when facing the numerous adversities that inhibit project implementation.

Nonetheless the importance of internal control of transformations, Sariv, as a pioneer, had to largely collaborate with specific suppliers which accompanied the firm in its innovation acting as business partners. Moreover, to improve employer branding and attract the necessary human resources, Sariv collaborates with universities.

Cybersecurity is a crucial aspect for Sariv business, this is because, with digitalization of processes, the opportunities for cyberattacks are exponentially increased. Moreover, offering designing and consultancy services means that the firm is in possession of potentially sensible customers' data. Sariv is legally obliged to protect customers' data through specific contracts, so the risk brought by cyberattacks is even greater, therefore Sariv implemented security measures at every level. Cybersecurity is now one of the main factors of expenditure in Sariv while in 2013 investments for cybersecurity were equal to almost zero.

The vision for the next future is to increase ulteriorly the digitalization of processes as well to offer an increased level of customization to customers. Digitalization will allow to multiply the opportunities of flexibility for the workforce while maintaining the current competitive advantage coming from the combination of servitization and digitalization.

3.5 TECHNOWRAPP case study

Technowrapp is a firm specialized in envelopers and transport systems (elevators, conveyor belts, etc.) for pallets, it is also specialized in the development and installation of entire plants to move and package the product. Transport and envelop systems are tailor made to maximize the satisfaction of customers' requirements; the firm deals with the entire plant development process: design, presentation, FAT, installation. The firm is represented in 67 countries with 1200 working plants, the turnover is generated mainly in Italy while the destination of the plants is usually abroad (around for the 60% of the cases) Technowrapp collaborates with international market leaders like Nestlè, Coca Cola, Pepsi Cola, Unilever, Colgate, Monsanto, Ikea, operating in various sectors (food and beverage, tissue, chemical, pharmaceutical, pet food, etc.).

When the firm was founded in 2002 the market did not need a new firm for the packaging of pallets, so, the necessity to differentiate was immediate; customization was chosen as the main differentiation factor. To be able to design tailor made plants Technowrapp need to focus in listening to the customer to gain insights into his/her needs. Listenability has become the company's vision; it requires to focus in understanding the needs of what surrounds the firm. Listenability deals with developing the ability to create through listening to the customers' requirements, to the employees' ideas and critiques, to the information provided by machines.

Pursuing the vision of listenability has effect on various aspects of firm's business model. When dealing with the external environment Technowrapp's collaborators must be prepared in a way in which everyone is able to interact effectively with customers. The customer can ask for specific information directly to the personnel most prepared regarding the issue, potentially reaching to every single Technowrapp collaborators. As the opportunities for interaction between employees and customers increase drastically, human resource must be trained in this perspective. An office completely dedicated to listening the customer has been set up. The Customer Experience office, once a machinery/plant has been installed or a maintenance activity performed, contacts the

clients with the goal of understanding what it can be done to improve their experiences. As said by the Technowrapp's CEO, training and formation underlined how it is the provider that must adapt to customers' requirements.

The focus is also on internal communication; employees are incentivized to exchange points of view and to voice their ideas and perplexities. For example, an employee can communicate his/her ideas about products or processes improvements to the manager, if the manager happens to refuse the proposal the employee can explain the idea to an ad hoc board that reunites once a month. If even the board refuses the proposal the employee can finally communicate the idea to the company management. Good and dynamic relationships are incentivized as, for example, the coffee break has been prolongated and made a free-phone zone. The program Technowrapp People embodies the firm's vision, every employee followed this program to improve their capabilities at listening to their colleagues and to the customer; in this perspective, a coach specialized in interpersonal relationships, once a month, helps training employees. Thanks to the internal listenability vision Technowrapp was able to identify the necessity to smooth the communication between departments; to solve the problem the firm developed "Improved Standard". It consists in creating cross-department groups that, meeting every two-weeks, favor discussion and problem solving.

Firm's vision deals also with the employees' welfare as the working shifts have been made more flexible, this, considering the business in which Tecnhowrapp operates, is not very common. Moreover, to improve the relationships between employees and to create a dynamic environment, the coffee-break has been prolongated by five minutes, those five minutes are a free-phone zone. Technowrapp values particularly continuous training and personal growth to enable a multi-channel communication strategy. This is also shown in the implementation of campaigns to stimulate knowledge and awareness about digitalization and 4.0 technologies, favoring discussion.

In 2012 Technowrapp implemented lean production solutions, this approach allowed the firm to face the increasing complexity of customers' requirements while also registering increased product demand. The adoption of new efficiency standards involved reorganizing processes with a continuous improvement vision extended to every firm's function. The optic of continuous improvement approach, during the years, evolved digitally; thanks to digitalization Technowrapp is able to clearly define and control internal processes such as production and assembly. To enable increased flexibility while

maintaining efficiency, Technowrapp implemented modularity in its production processes. Digitalization enables the firm to provide high value rapid solutions that respect agreed delivery time. Digitalization also affected the degree of machine connectivity and the magnitude of information available to be gathered and analysed. A data warehouse has been created to improve drastically control capabilities over processes, integrated software programs communicate on common basis allowing total data accessibility. Data warehouse is integrated with the sequent systems: ERP, PLM, MES, CRM, Ticketing, and BI; this integration allows to eventually substitute a software without the need of changing processes.

Combining the capabilities of understanding customers' characteristics and the efficient flexibility given by digitalization allows Technowrapp to customize its offering. Products and services are implemented collaborating with customers; through a relationship based on trust, R&D activities are completed with the customers' help in a cocreation logic. In this way Technowrapp is capable of meeting as closely as possible customers' requirements delivering high value for its clients through customization.

From 2008 the company's focus has been the service quality, for Technowrapp focusing on service quality means to deliver the right service at the right time, the service must be integrated into customers' processes, and it must be not discontinuous. Finally, the service's value must be perceived by customers, services that are not understood are not bought; therefore, the capability of communicating with the customer is crucial. For example, the maintenance service has the goal of guaranteeing business continuity at the global level, so, it must be prompt, excellent, and constant.

The services that Technowrapp found to be the most valued by customers until now are different:

- Teleassistance, 86% of customers' problems regarding Technowrapp's products are solved through teleassistance.
- If it is not possible to solve the problem remotely a Technowrapp expert will leave to reach the customer's location in 24 hours. The problem's solution is identified by a dedicated taskforce in the meantime.
- Preventive and predictive maintenance enabled by machines connectivity and IoT. The customer is reassured by the continuous monitoring activity that produces a proactive approach to possible business continuity problems.

- Data protection is ensured by the certification 27001 and by the intermediary role of Amazon Web Services. Data are presented in a way in which the customer is confident to share them. Data protection and customer awareness is also ensured by the anonymity of data packages and by specific contracts in which typologies of data are indicated, as well as how they will be used and why.
- Thanks to data gathering customer can benefit from monthly reports, sent via email, about their machines' performance and usage; constant updates are also available through the proprietary web application accessible from every device with an internet connection.
- Digital technologies adoption and 3D software development allow Technowrapp to accelerate the designing processes and to perform the FAT of entire plants virtually. This digital twist decrease delivery times, risks, and installation times. It was especially useful during the pandemic when physical presence was impossible.

Digitalization allows to improve the user experience for the installed base, in fact, thanks to a retrofitting process through QR codes integration into machines, the customer can easily obtain all the needed information about machines and their parts like relative manuals. The interface is designed collaborating with the customer to maximize usableness.

The solutions proposed by Technowrapp are designed to bring specific benefits to customers: continuous real-time monitoring of machines' performance and usage, risk reduction, promptness of intervention, increased awareness and data-driven decision making, increased efficiency thanks to data analysis, cost reduction thanks to improved performances.

Creating and maintaining a collaborating network is fundamental for Technowrapp to be able to innovate effectively in a time-efficient way. To digitalize its processes and to develop the right complete solutions Technowrapp collaborates with other firms as well as institutions such as Regione Veneto and universities. To shorten time of digitalization process along with reducing errors it has been crucial to benefit from the help of consultants.

Digitalization in the future will enable the implementation of a service that allows the customer to have complete information on the product's production and delivery time

benefiting the customer as his/her planning capabilities improve drastically. Another important future project is the one in collaboration with the university of Padova; it focuses on anomaly detection and predictive maintenance through machine learning. Technowrapp, by pursuing continuous improvement, plans to continue providing its customers with technology, assistance, and innovation; in this perspective listenability plays again a crucial role as evaluating every input, being internal, external, or machine-wise, can create new growth opportunities.

3.6 Findings

When analyzing and comparing the firms' peculiarities in respect to digital servitization adoption it can be formulated that innovating with this perspective is an ongoing continuous process. This is demonstrated by all the three firms analyzed; the fact that digitalization is a process that requires time is showed particularly by the experiences of Sariv and Technowrapp. Reengineering processes digitally necessitates of incremental improvements and actions, as the Sariv's CEO declared, digitalization is not a one-night innovation and might need a trial-and-error perspective along with retraining activities to improve employees' digital capabilities and 4.0 awareness. Galdi and Technowrapp exemplify the incremental approach to develop a true service strategy, both firms initiated early the transformation from manufacturer to solution provider (around ten years ago for Galdi, in 2008 for Technowrapp). The length of the implementation process is also shown when considering the fact that services increase both in quantity and complexity as time progresses. Galdi's service portfolio in around ten years proceeded from being composed by their E-Portal alone to comprise a much wider array of solutions (MASH, TYE, etc.). Firms underline how continuing in digitalization transformations and on the service perspective, permit them to constantly improve by undertaking increasingly high-value projects.

All the firms analyzed needed time to gather necessary knowledge to redesign their offerings and to effectively provide digital service solutions, human resource management is crucial to support digitalization and servitization strategies. The examples of Sariv and Galdi underlines the importance of digitally competent personnel to reach firm's goals; integrating new tech-savvy employees with firm's experts is fundamental to innovate while preserving know-how.

Another interesting aspect to be mentioned is one of the drivers behind the transformations underwent by firms. What firms have in common is that providing customers with solutions, whether digital or not, was a requirement from market sectors in which firms operate. For Sariv, for example, the economic crisis of 2008 and the fierce competition on prices from the far east combined with the simplicity of product's nature pushed the firm to develop a new differentiation strategy. Sariv focused on traceability of processes to reduce the risk perceived by customers and on developing solutions to meet customers' requirements through customization. A similar approach was embodied by Technowrapp that, being the market near-saturated, needed a sustainable competitive advantage to differentiate. Technowrapp found that providing tailor made plants and focusing on listening to the customer to understand his/her needs were effective differentiation factors. Lastly, Galdi's servitization approach originates from the role that the after-sale plays in its business, sectors specificities (e.g., raw materials' peculiarities) pushed Galdi in a new direction. The new direction allowed Galdi to acquire new bigger clients that value complete solutions the most.

As literature suggest, digital servitization is characterized by a high level of customer centricity as every firm analyzed declares that supporting its customers through products and services is a priority. More precisely, firms seem to focus particularly on relieving their customers from non-operational worries reducing also their non-current cost; by fully entrusting the provider customers can focus on their core businesses benefiting from the provider's support. To deliver services firms necessitate a deep understanding of customers' processes and business operations the implemented solutions must respond to their needs; in this sense, nearness to the customer is crucial. The strongest example of such approach is given by Technowrapp that has integrated listenability the firm's vision, the firm collaborates with customers that performs R&D activities, such as co-design, with Technowrapp. Employees are trained to effectively communicate with customers as interaction opportunities are diverse. Sariv is another fitting example as the goal of providing customized rivets is reflected by the collaboration with customers in the designing process.

Communication with customers is an important aspect for considered firms when communicating the value of the offerings. Especially underlined by Galdi and Technowrapp communicating to customers the value of advanced/digital solutions is one of the main challenges. From Galdi's experience it emerges that customers are hesitant to

buy digital services for various reasons. First of all, as the Italian scenario depicts, there are still high percentages of digital unawareness and low diffusion of digital competences. Customers find it difficult to understand the value that some services can deliver, especially smaller realities are cautious in buying expensive services with which they have little confidence and knowledge. This concept is identified as a challenge also by the Technowrapp's CEO; as he said, if the customer is not able to comprehend the value that is being proposed, and the provider does not effectively communicate it, it is impossible to sell any solution. Moreover, as seen in the Galdi case, small customers still prefer to maintain a certain degree of self-sufficiency in their business processes to maintain production continuity, this is a trend that showed especially during the pandemic and the relative lockdown. The relevance of value communication is also mentioned in the Sariv analysis, showing the improvements in process control was one of the first step that the firm made when it started to implement a digitalization strategy.

Maintaining a close contact with customers is crucial for understanding their needs, in this perspective, services that allow a significant degree of information sharing between clients and providers are fundamental. Information and data exchange is achieved through different activities; as seen in the Galdi case, providing consultancy and different maintenance programs allows the firm to gain useful insights in customers' daily business and preferences. That information can be used to design better products and services. Data exchange on the other end is achieved thanks to the machine connectivity, Technowrapp, through IoT, gather machine-related data that helps the firm to improve knowledge about machines performances and usage.

Manufacturers taken into consideration in this research embody the vision of digital servitization, in fact, it is easily observable how firms position themselves as solution providers rather than products manufacturers. Solutions provided assume mainly two forms: maximized availability of products (all considered firms offer a certain degree of availability maximization) and performance optimization particularly through consultancy integrated with digitalization. Technowrapp ensures global business continuity as a crucial factor in the sector in which operates, through services integrated with digital technologies it can provide continuous monitoring to improve maintenance activities reducing and prevent downtimes. Sariv thanks to the total traceability of process and to the quality control, as well as to the automatic warehouse, it can offer minimized risk of errors guaranteeing product reliability. Moreover, it ensures product

adequateness through design and consultancy services. Galdi developing different kind of solutions for maintenance and spare parts provision services is able to meet different kind of customers' requirements, by offering the most complete solutions as possible it can relieve customers from many operations helping them in their daily business.

Observing the mentioned examples, it is possible to identify that consultancy is one, if not the most, widely offered service. Reasons for this are multiple, first of all, like the Galdi case study indicates, it is one of the services that can be easily paired with more advanced digitally ones. By combining data gathering and analysis with the interaction between a firm's expert and the customer, firms can improve their capability of supporting customers in their businesses. An example is the combination between Galdi's MASH platform with consultancy services or the monthly reports by Technowrapp from which clients benefit. Consultancy can be considered as one of the quintessential servitization solution as it allows providers to improve their knowledge about customers' needs as well as to maintain the required nearness to customers operations.

Traditional services are increasingly benefiting from a digital twist, as the already mentioned combination between consultancy and capabilities enabled by digital technologies, once purely physical services like spare part provision and maintenance can be refined by innovating some processes through digitalization. Spare part provision can benefit from the development of proprietary e-commerce platforms through which information about items' availability and/or the lead time can be given to customers. Those platforms also provide most of the information regarding machines' characteristics like 3-D manuals, wiring diagrams and settings. Maintenance on the other end, is the one service that assumes the most variety of forms; thanks to machine connectivity, firms can implement more and more refined maintenance services. The most diffused characteristic seems to be the transition to a programmed approach to a predictive one, this process requires a great quantity of data gathering and exploiting capacity, therefore in the service innovation process there seems to be intermediate steps. An example is the personalized maintenance implemented by Galdi, where thanks to the integration of digital technologies with experts' knowledge allows for an improved capability of responding to customers' requirements. traditional services, moreover, can benefit from the combination with more advanced digital services. This is because, as the Galdi case shows, digital services can be used as marketing tools to sell the traditional service.

About the challenges arising from digital servitization strategies integration, it is interesting to notice how a factor that can inhibit digital servitization opportunities for firms is the fact that there is still resistance in sharing production data for the development of advanced remote services that use Big Data technologies. Such data are often sensible, and customers might be diffident in giving up the control of the information flow to other parties maintaining complete autonomy over private data management. Therefore, developing more advanced services outside the remote monitoring/maintenance paradigm could obstructed by such tendency. Technowrapp, for example, to ensure customers about data utilization must stipulate specific contracts where are indicated the typology of data that will be gathered as well as how and why they will be used. To ensure customers, moreover, it delegates cloud activities to Amazon Web Services as are generally well trusted. Data gathering and data protection challenges are also to be evaluated when considering the cybersecurity aspect; digitalization increases cybercrimes opportunities especially during the pandemic where remote working and cloud adoption augmented. Ensuring protection for customers' data against cyberattacks is crucial if digital services are offered if their delivery and value relies on constant data exchange. In Sariv, cybersecurity is one of the main investment factors as it possesses sensible data from their clients and cyberattacks could procure substantial economic damages. Data protection can be considered and provided as a part of the service offering to help customers protect their intellectual property.

It is interesting to notice also how servitization and digitalization interacts in each firm. Literature shows how they are two phenomena that build each other up; for Galdi the implementation of digital solutions was a consequence of the servitization approach previously embodied. However, for Sariv, the capability of offering guarantees of performances and customization derived directly from the digitalization process initiated earlier. For Technowrapp, the boundaries between the two trends are more blurred, it is more difficult to identify which transformation led to the other. From the analysis it is not possible to deduct clearly what approach is the precursor of another; what can be identified is the fact that the differences in implementing a digital servitization strategy come also from industries' specificities, such as the type of customers, products, and dynamics. For firms (like Galdi) in less technology intensive environments where the after-sale is already important, servitization strategies might be executed before digitalization. Moreover, dealing with an industry less propense to digitalization and with

smaller sized customers, it is more difficult to deliver and communicate the value of digital solutions. While more technology intensive sectors might require a first digitalization that will enable the offering of service solutions.

For analyzed firms, integrating digital servitization strategies requires a significant business model innovation. The most stressed element in the innovation is the change in mindset from manufacturers to solution providers as selling services is a completely different process than selling products. Servitizing could mean to perform activities once considered to be outside of what required to a manufacturing firm, for example, Galdi provides customers consultancy services in microbiology. Firms increasingly take on responsibilities once outside their boundaries undertaking activities to support customers' processes, an example is the Technowrapp vision of ensuring business continuity to their clients. Finally, it can be observed how the change in vision is a radical action that can be also identified in specific periods, it is the case of Technowrapp and Galdi that identifies the change in mindset towards a service focus in 2008 and around ten years ago respectively.

Creating and maintaining a dynamic network of collaborations with business partners, universities and other institutions are crucial activities to catalyze the innovation process. Through collaborations firms can acquire the necessary knowledge and capabilities redesign their processes and offerings. All the three analyzed firms stressed the importance of relationships with other realities to effectively implement a digital servitization strategy. Sariv collaborated with its suppliers, to the point where they could be defined as partners, to effectively digitalize its processes and reach complete traceability. Technowrapp underlines the importance of collaborating with consultant and universities to speed up the transformation and reduce errors in the progression.

SMEs analyzed integrate more than one digital technology at the time, as literature suggests, IoT, Big Data, and Cloud Computing are technologies that often enable each other, and their functionalities are closely related. Sariv thanks to the data gathered by IoT technologies can improve its decision making with Big Data technologies. Integrating more than one digital technology allows firms to develop wider arrays of offerings by designing new services. Moreover, it is interesting to mention the fact that all the three considered firms, thanks to digital servitization, compete internationally while maintaining complete control over their processes. An important percentage of Sariv's

and Technowrapp's business is conducted abroad, nonetheless their SME nature, to servitize digitally permits firms to compete in broader markets.

3.6.1 Case study analysis' integration with the general vision

Once the peculiarities of the experiences of the analyzed firms have been described, it is interesting to continue the research by benefiting from a more generalized approach of the digital servitization trend. Some aspects that arose from the case studies analysis are reflected in literature contributions that identify trend characteristics; this allows to give clearer representation of the trend, its implications as well as the vision that it embodies. The findings from the case studies analysis have been integrated with the features, drivers, implications, and vision of digital servitization identified by Roberto Siagri in its latest book "La Servitizzazione. Dal prodotto al servizio. Per un future sostenibile senza limiti alla crescita". Integrating such contribution helps framing the digital servitization trend while still conserving a more practical analysis approach.

The development of 4.0 technologies that leads to the progressive digitalization of the world has great implication for businesses. In particular, the features of digitalization and its consequences have great innovation potential for firms, in fact they can now rethink their business models in a non-product-centered perspective. In some cases, as analyzed, digital technologies are exploited to support and refine already-existing service-oriented strategies developed by manufacturer. However, digitalization is to be considered more as an enabler as it lays down the technological foundations that will boost product, service, and business model innovation. The characteristics of servitization to be fully implemented require especially for a development of sufficiently mature technologic substrate both in terms of capability and of economic feasibility of such solutions. For these reasons it is useful to specify the relevant aspects of digitalization combining the findings from the case studies analysis and the identified trend characteristics.

Innovation brought by digitalization leads to a progressive dematerialization of the physical good; the product gets smaller and more compressed while the information content dilatates and increasingly acquires importance. The physical aspects of a good are becoming less valuable in favor of the digital component, moreover, as information becomes an intrinsic component of goods and their production innovation opportunities to utilize less material, time, space, and energy arise. It is useful to give an example of the

progressive dematerialization of value; when considering the videoconference, it can be noticed how presence is provided even in absence of physical presence.

When considering the more particular case of machines it is important to notice how the software is becoming the main component; while the mechanical part has been significantly reduced, the electronical part increasingly extends, this and important effects on the machine nature. Machine, thanks to IoT integration, are connected to each other and can exchange huge quantities of data. To give a more comprehensive picture of the magnitude of that kind of innovation it is enough to mention that machine-generated data, today, amounts, on an annual basis, for the 40% of the data present on the internet.

IoT connects machines functioning as a social network of the things, through connection and communication it is possible to collect contextualized information. These types of data are rich in context but agnostic in respect to the application, this means that the same set of contextualized information can lead to different kinds of knowledge depending on the type of application used to conduct a specific analysis. This means that data can be considered the primary material from which transformations can occur as new information and knowledge is created, and new possible business models imagined. Therefore, in the data economy the value relies on what can be extracted from data abundance. Understanding the value of data helps also comprehend the method behind the process' architecture design; as seen in the case studies the architecture is designed to be modular with loosely coupled layers, meaning that the same instrument gathers, distributes, and memorizes data while the elaboration role is left to the applicative layer. With digitalization, the concept of data silos is substituted with the one of data lake; every application is equal in accessing data as they are no more disposed in a hierarchical manner, but they are disposed around data lakes alimented by the IoT. This demonstrates how data prevails in respect to the application, thus, multiplying the possibilities of use.

Thanks to the IoT capabilities and to the more efficient system architecture it is possible to develop digital twins of the objects. The digital twin is the exact digital replica of the physical thing, it is created in real time by the IoT, and it is one of the enabling factors for the transformation of business models.

To better understand the potential value of data it is useful to mention how, disposing of historic data and real time data can lead to saving a lot of maintenance costs in every sector. It could be saved up to the 12% on programmed reparations, 30% on maintenance

costs and the downtimes can be reduced by the 70%. Moreover, thanks to machines digitalization, compilation and interpretation errors regarding related modules and tables are reduced.

Once the importance of data is understood it is easy to comprehend that some of the most relevant inhibiting factors for business model innovation are the incapability to generate value from gathered data and the potential risks relating to cybersecurity. The latter can be provided also as a service by digitalized firms that can ensure customers the safe transportation of data and the continuous software updating.

There are many still well-functioning products that have been manufactured before the industry 4.0 wave. However, they can still benefit from technology integration through the retrofit operation. Retrofitting is a make-up operation that allows to revitalize already installed plants and machineries, it enables machines to operate in a 4.0 perspective even if creating an accurate digital twin is not always possible.

As already mentioned, digitalization intersects the trend of servitization by enabling the innovation of the business model in a way in which everything becomes service, even the product itself. Servitization principles shift consumers' attention from a possession of goods dimension to a more intangible one where the benefits from goods consumption are independent from goods ownership. Therefore, value creation, in servitization, focuses on satisfying customers' intangible needs.

The principles of digitalization integrated with the ones of servitization are the concepts at the basis of the differences between the previous product manufacturer perspective that focused on managing certainty and the new digital production model that is oriented towards uncertainty management. The digital servitization model is more dynamic, more pervasive, and more dematerialized thank the traditional manufacturing production model, this is because providing services requires continuous actions and real time measures.

The technological progress is leading towards a scenario where machines have increasingly less maintenance needs, in this way the provider's revenues from the after-sale activities (such as spare part provision) decrease significantly. This is one of the reasons for which many firms' business models are turning to a service-oriented one in a pay-per-use paradigm. In many cases, for the customer is more convenient to buy the use of a product (for example an automobile) rather than its ownership. What it is interesting

to notice is that also to the provider will be more convenient to sell the use of the product. This is because digitalization has the capability to transform inefficiencies in value for providers, customers, and society. To better understand this concept, it is useful to consider the example of an automobile. With customers buying the use of the service only for the needed trip-time, product usage is maximized as the need to park the vehicle is eliminated and, most importantly, the vehicle is readily available for other customers. Moreover, the sale of services allows the producer to be more competitive as offering the use of the product consent to the customer to avoid an important upfront investment. It is clear, however, that the economic model proposed by digital servitization needs subjects that are willing to privilege product access rather than product ownership; the change in mindset is not an overnight process.

Another transformation brought to the economy by digital servitization is that the new perspective will lead from a competitive economy to an economy based on collaboration and competition at the same time. Relationships among market players will be shaped by cocreation logics; for example, the diffusion of open-source software is a digital innovation that goes in that direction. By digitalizing processes, it will be the demand that will define production; firms interpreting digital production models utilize pull techniques to manufacture more and more personalized products that will satisfy specific customer's requirements. These opportunities are made possible by two main reasons: the capability of firms to predict the effective demand will improve and the customer will participate in the creation and production processes. Once digitalized, every activity can potentially assume the similar pull physiognomy. It is important to underline that the change to a pull approach is natural as digitalization is intrinsically relational and favors listenability.

As digital servitization progresses the business models will gravitate around the service thought as use first, and then it will develop to a service intended as outcome/performance. The last implementation level will be achieved once the production will be completely autonomous thanks to digitalization.

As anticipated, the last digital servitization implementation level will be achieved once, other than activating new business models focused on providing outcomes/performances, the production will be completely autonomous. The automation of production pushed by factories will free employees from repetitive work, in doing so the employees' attention can be placed on human activities such as the creative resolution

of problems and collaboration. This prospect due to its long-term nature could be labeled as unattainable and futuristic, however, as seen in the case studies analysis, some manufacturing firms are benefiting from some automation degrees to relieve employees from repetitive activities and to attain some working hours flexibility.

The new mentality that accompanies digital servitization opens opportunities to transform the current economic system into a service-oriented economy supported/enabled by digitalization. Such new mindset can support a more sustainable economy that benefit the firm, the customer, and society. The potentialities of the service economy, although it can be considered well defined and established, are yet to be largely extended and exploited to production activities. The economic system, with the digital servitization model generally implemented, can renovate itself separating material use from GDP production.

CONCLUSIONS

Digital servitization is gaining attention among researchers and firms especially as a differentiation factor. Through this research it was possible to obtain useful deep insights about the practical implications of digital servitization innovation for Italian manufacturing SMEs. Although it is not possible to generalize the findings it was possible to identify a common pattern that characterizes the analyzed case studies also meeting the more general theoretical trend's framework.

The major drive to innovate the business model in a digital servitization perspective is the need to differentiate offerings and exit the price competition avoiding the commodity-trap.
Digitalization and servitization intersect each other in this context, digital technologies adoption enables the design of advanced services facilitating the transition towards a servitization approach. Digitalization is not an inevitable prerequisite for servitization as the analysis suggests that, in some cases, servitization is a strategy that SMEs considered and started implementing it well before the 4.0 wave. However, digitalization generally plays a crucial role in servitization as it lays down the technological foundations for business model innovation.

Business model innovation for digital servitization deals firstly with the value creation aspect, in fact, SMEs analyzed transition from a pure manufacturer approach to a vision where the firms are solutions providers. Providing service and solutions requires a change in mindset all along the organization; the whole organization must interpret a different vision as internal processes and offering design must be aligned to allow a sustainable and effective digital servitization strategy adoption.

Value creation is innovated by designing new high value services to be paired with the original products, moreover, digital technologies' capabilities are exploited to develop smart connected products that, exchanging great quantities of data, enable advanced operations. SMEs create value by offering performance guarantees, for example in the form of maximized availability, and proprietary know-how that can help customers in their daily business.

Business model innovation deals also with customer relationships management, implementing product-service solutions asks SMEs to have deep knowledge about customers' needs. In this sense taking actions to maintain a sufficient level customer

nearness (such as consultancy activities) becomes crucial as customer centricity characterizes value delivery strategies approach. Customer relationships evolve into relational ones with a collaborative approach and co-creation logics. Another important aspect is the significant role digital technologies play in reducing the distances between clients and providers. Digitalization supports firms in designing solutions that satisfy customers' needs and help firms increase their customization capabilities.

Once service solutions have been designed in a way in which are able to satisfy customers' requirements, they become one of the most important contributors for firms' revenues. The value created by the digital servitization approach is significantly different from the value of simpler product provision, so, the value capture aspect is interpreted with a different vision. Offerings are structured by designing offering packages that comprise different services like different degrees of maintenance support and/or spare parts provision to meet diverse customers' requirements. Digital servitization unlocks new possibilities to consider new sales approaches such as pay-per-use contracts and performance-based contracts.

Business model innovation for digital servitization presents numerous challenges for SMEs. The most relevant ones are human resource, communication of value to customers, and cybersecurity. Regarding human resource, it is noticeable how SMEs need to perform retraining activities in communication with customers and in digital awareness and competences. Moreover, introducing new figures with expertise in digital technologies might be necessary. Italian SMEs need to face the difficulties brought by the need of communicating effectively to hesitant customers the value that is being proposed, the low diffusion of digital capabilities and awareness inhibit digital solution proliferation. The challenge that is increasingly gaining importance is ensuring cybersecurity, both for preventing economic damages from cyberattacks and for guaranteeing customers' data protection, SMEs analyzed need to invest in cybersecurity solutions to remain competitive in an increasingly digitalized environment. Ensuring data protection is a prerequisite for the provision of digital services based on data exchange.

SMEs, thanks to digital servitization, can compete internationally while maintaining control over their processes and products; moreover, by providing complete solutions, they are able to attract bigger and more important clients. The process, however, is continuous and requires trial-and-error and incremental improvements. To support the transformation, firms are required to build and maintain a dynamic network of

collaborations with business partners, universities, and other institutions. A network of relationships can reduce the time required to innovate as well as reducing errors in the processes.

Finally, digital servitization is a pervasive strategy that affects many aspects of firms' business models, the potential of a service-oriented economy is yet to be fully expressed. As the integration of digital technologies enables to innovate established business practices, digital servitization strategies will increase in adoption and advancement. Digital servitization has the potential to reshape the current economic environment as the immaterial components of products is becoming more important than the material ones.

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Appendix – Interview

1. Quali sono state le necessità che hanno portato un'azienda come la vostra ad intraprendere un percorso di innovazione del proprio business model in una prospettiva di servitizzazione digitale?
2. Qual è stata la prospettiva adottata per prima tra servitizzazione e digitalizzazione?
3. Come sono cambiate le relazioni con i clienti?
   a) Che ruolo assumono le tecnologie digitali in questo aspetto?
4. Quali sono e sono state le maggiori difficoltà che un'azienda come Galdi incontra nello sviluppare e distribuire soluzioni e servizi avanzati?
   a) Come sono state affrontate tali sfide?
5. Qual è il ruolo dei servizi nei guadagni dell'azienda?
   a) Qual è il ruolo dei servizi avanzati nello sviluppo di offerte avanzate?
   b) Come sono integrati i servizi avanzati con i prodotti e gli altri servizi tradizionali?
   c) Qual è il ruolo dei servizi nell'acquisire nuovi clienti?
6. Nell'esperienza di Galdi, quali sono le tempistiche del processo di servitizzazione digitale?
   a) Quali sono stati i miglioramenti e le trasformazioni attuate nei vari step del processo?
7. Qual è stato l'impatto della pandemia nelle performance aziendali?
   a) I servizi si sono dimostrati più resilienti rispetto ai prodotti?
8. Un'azienda come Galdi come può innovare ulteriormente il proprio approccio vis-a-vis la servitizzazione digitale?
   a) Quali sono i progetti futuri di Galdi?