Digitalization and servitization: opportunities and challenges for Italian SMES[1]

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Abstract

Purpose of the paper: *Servitization has presented a series of persistent shortcomings for manufacturing companies that have dramatically slowed down its adoption. Recently, digital transformation (digitalization) is posing a very similar challenge to manufacturing. Technologies like the Internet of Things (IOT) are forcing firms to create entirely new business models, migrating from product-centric approaches to (digitally-based) service-oriented ones. This paper aims at describing the impact of digital transformation on the adoption of service business models in manufacturing, with particular focus on problems, challenges and opportunities for Small- to Medium-sized Enterprises (SMEs).*

Methodology*: Given the exploratory aim of the research, a qualitative research method was adopted . The analysis is based upon six archetypal case-studies regarding different types of manufacturing companies involved in digital transformation, and 10 interviews with business and industrial experts.*

Findings and implications: *In our study, connected products offered by industrial machines, cooking appliances and home appliances manufacturers can trigger new service offerings. Predictive maintenance, accurate warranty modeling, consumption control, energy saving, and customer customized utilization of the products foster unprecedented relations with customers. In one case, the connected product is at the base of a machine-as-a-service (MAAS) model, with invoicing based on uptime and process efficiency. In all of the cases the importance of data analytics is deemed to be strategic for business model changes in the near future.*

Originality of the paper: *Digital disruption and transformation is a rather recent research stream, and at the best of our knowledge no research has been carried out with specific attention to its impact on service business models and servitization in SMEs. The paper contributes to this research stream by describing the main challenges and opportunities that await firms engaged in projects and experiments of digital transformation and service transition.*

Key words: digitalization; digital transformation; servitization; SMEs; Italy

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1. Introduction

Since its first steps in the '80s, the challenge of manufacturing servitization has consisted in leveraging on what happens after the product's sale, rather than just thinking of how to produce better products and sell them with a profit. As is well known, the reason for this strategic change lies in the fact that crafting an excellent product was (and still is) no longer enough to survive in many industries. Nevertheless, servitization processes have encountered a series of persistent shortcomings that have seriously hindered their potentially revolutionary importance (Gebauer *et al.*, 2005), and have dramatically slowed down the pace of digital transformation; as a result, only a small number of selected manufacturers have successfully transitioned to services.

Nowadays, technologies like IOT are posing a similar challenge to firms: this time however, the change is going to be disruptive and companies that don't acknowledge its importance are going to struggle to survive in the very near future. In fact, digital transformation is pushing innovative firms to leverage on services in order to create entirely new business models, finally migrating from product-centric approaches to (digital) service-oriented ones. 93% of manufacturing leaders are planning to use digital technologies to unleash the service model (Cisco, 2015), but without clear awareness of the various implications of digital transformation and a specific form of organizational operationalization digital initiatives will also be disappointing. In fact, the first experiences in digital transformation have clearly demonstrated that digital opportunities are accelerating at a dramatically faster pace than firms' ability to change.

The purpose of this study is to observe the technology-driven (digital) transformation of firms' business models towards services while paying special attention to small- to medium-sized companies. The research questions underlying such research have the intent of discovering the main impact on the servitization dilemma through the lens of digital transformation, and the main challenges and problems awaiting Small - and Medium - Enterprises (SMEs) in their transition to digitally-based service oriented business models.

The research project is in its first and exploratory phases. To date, we have encountered and directly interviewed many entrepreneurs and top managers whose companies are facing this transformation. A series of meetings with industry experts and knowledgeable technology consultants allowed us to identify a number of firms that are involved in the abovementioned transformation process: the analysis of the information that was gathered in preparing these case-studies is at the base of the empirical descriptions reported in section 3.

2. The changing landscape: digitalization, servitization and business models

Connected products are transforming both business and consumer markets landscapes, making space for brand new data-based service-oriented business models (Porter and Heppelmann, 2014 and 2015).

Companies must adopt the "big data mindset" and think about their long-term strategy for data (Mayer-Schonberger and Cukier, 2013): none of the transformations that IOT is likely to bring about in the upcoming years would be possible without analyzing and understanding the potentially enormous flow of data that the Internet Of Things and the Industrial Internet Of Things (IOT and IIOT, briefly IOT) technologies are capable of generating.

Data gathering (via IOT) and data analysis are therefore growing in strategic importance, since they may offer fine-grained and complete information that can be capitalized in various areas: - enhancing the product and/or the system/solution; - developing new products and services; - optimizing customer segmentation, positioning and pricing strategies; - developing the capability of dynamically modifying business models' component configurations over time (SAS, 2015, 2016; Cisco, 2015).

For many manufacturers, this is definitely the time for Business Model (BM) experimentation, especially regarding BM that don't traditionally belong to the manufacturing culture like service-based ones. In this new landscape, companies that succeed in extending the service business are the ones that obtain comprehensive information on customer needs and use it to reshape their strategy. Traditional methods of obtaining such information (wide-ranging market research, workshops with selected customers, etc.) - that have always been important sources of ideas for developing new services (Gebauer *et al.*, 2005) - are now being transformed and amplified by the nature and the magnitude of new sources of business information like IOT.

This transformation will involve both service domains of Services Supporting the Product (SSP) and Services Supporting the Customer (SSC). If we consider that these are the basic means through which suppliers explore new relationships with customers and change their way of supporting customers' organizations (Mathieu, 2001), or even "move into the solution business" (Gebauer *et al.*, 2013; Davies *et al.*, 2007; Baines *et al.*, 2009), we can perceive the importance of the transformation underway.

Digitalization may actually introduce a new breed of SSP and SSC, as highlighted by recent field research (Noventum, 2016). As regards SSP, IOT-based preventive maintenance services and IOT-based availability services are catching on; on the SSC side, IOT-based process optimization services, IOT-based business optimization services and IOT-based business transformation services are gaining momentum. In strategic terms, IOTs are acting as service innovation engines, service profitability and growth boosters in the competitive environment, gradually performing new and important roles also in service innovation and in shaping firm evolution (Noventum, 2016; Noventum, 2015). In many industries, the use of data coming from sensors embedded in machines and products is enabling new forms of relations with key clients.

As regards SSP, starting from a comprehensive study that lists 55 traditional inter-sectorial BMs (Gassmann *et al.*, 2014), Fleisch *et al.*, (2014) selected the ones that are going to be influenced the most by

IOT technologies. They constructed an original business model pattern dedicated to IOT that they named "Digitally charged products" and highlighted BMs that we found useful in order to understand how products and services can change with digitalization.

But technology is only a part of the picture. In Chesbrough's (2010) words: "a mediocre technology pursued within a great business model may be more valuable that a great technology exploited via a mediocre business model". This means that the firm's BM has to be innovated in order for it to conform to new digital processes and services. As BM innovation is a very challenging activity, digitalization doesn't remove well-known difficulties in approaching servitization. Certainly, it poses a definite urgency on it. BM transformation poses serious challenges to firms: a strategic model has to take into account major impacts on value drivers such as efficiency, complementarities, lock-in effects, novelty, and the linkages among them (Amit and Zott, 2001).

Changes to business model design can be subtle, and even when they might not have the potential to disrupt an industry, they can still yield important benefits for the innovator (Amit and Zott, 2012). But this fascinating perspective often conflicts with current value chain configurations and the resistance to experimentations that numerous firms oppose in order to change. According to Christensen (1997, 2003) the disrupting force of new technology-based BMs lies in their conflict with established ones within the actual technological context. Corporate selection and valuation mechanisms (cognitive functions) applied to information about new BMs are based on the dominant logic of successful ones (Chesbroug, 2010). Following the established dominant logic, firms are led to miss potentially valuable uses of technologies that don't fit the current BM.

In fact, the digital transformation is driving a "two-front war" in manufacturing (Cisco, 2015): firstly, firms are to maintain a legacy business while moving to a new territory populated by services. Moreover, digital disruption is increasingly requiring manufacturers to be technology companies, since companies that make the best use of data will becous the most successful. Consequently, companies have an urgent need of digital capabilities that are necessary for managing a greater volume and variety of data, and leveraging on analytics to create new business insights (Noventum, 2015). However, it has been noticed that IOT-enabled service portions of the BM are always digital in nature (Gassmann *et al.*, 2014). This means that companies have to manage additional service orientation: also, in this context, extending the service business requires a new service-development process that is similar to the one used in service companies (Gebauer *et al.*, 2005).

The literature also highlights a list of other challenges awaiting minor manufacturers approaching digital service BMs. Competence requirements will probably affect the value chain, since the most successful manufacturers orchestrate ecosystems of partners in order to fill capability gaps, create new experiences and insights, and add value to end customers (Gebauer *et al.*, 2013, Gebauer *et al.*, 2012; Paiola *et al.*, 2012; Paiola *et al.*, 2013). Unfortunately, this can be far outside of the comfort zone of

many manufacturers. Contracting and pricing are other relevant issues: the pricing of new services must be carried out on the basis of equipment availability, leading the service provider to assume the equipment's operating risk and requesting the establishment of an ongoing relationship with the customer (Gebauer *et al.*, 2005). Contractual agreements are subsequently to be modified in order to accommodate a new breed of supply relations.

Finally, various problems are also pointing to firms' dimensions and the matter of SMEs (for a review see Gebauer *et al.*, 2010). Unlike large corporations, SMEs are less certain about what their business is going to become and what their position will be in these new scenarios. In fact, the need to continue to perform well in the current business environment while conducting the experimentation of new BMs is particularly challenging for smaller firms. In addition, the earnings coming from the new experimental models are far less than those coming from established ones, and that is an additional reason that calls for caution. Also, professional competences inherent in activities like big data analysis highlight a critical competence gap for SMEs. As previous studies have pinpointed, other relevant critical points may arise in relation to the distance from the end-customers, the type and nature of distribution channels and the articulation of the value chain, in which SMEs frequently have limited bargaining power.

Service business development in SMEs depend on the value chain position and the business environment, and in particular on sales models, where suppliers and OEMs selling through distributors do not primarily extend the offered services, but rather reconsider their service process configuration together with distributors (Gebauer *et al.*, 2010).

3. The empirical research

3.1 Methodology

As digitally-based BMs are still in their introductory phase in Italy, we managed to design an exploratory research based on a cross-analysis of a multiple-case study. Consequently, in order to consistently arrange selection criteria for such a cross-case analysis, we gathered and used information from 10 expert interviews: the indications and suggestions deriving from this phase have proven precious in selecting firms that had already implemented IOT-based solutions in Northern Italy.

The aim of the field study was to get detailed information on decision-making processes related to BM changes due to the introduction of IOT in the firms: between the end of 2016 and the beginning of 2017, we collected data from several in-depth face-to-face semi-structured interviews (lasting between 1 and 2 hours each) with the firms' key-informants like CEOs or top managers in charge of IOT-related activities. In almost every case 2 or more people were involved in the interview. These interviews represent the initial part of a more complex and articulated investigation program that will lead to subsequent meetings in the forthcoming months. The research methodology is in line with established specific literature on case-study research (Eisenhardt, 1989; Yin, 1994).

The involved firms are all Italian manufacturing BtoB or BtoC firms that operate in industries that have been seriously affected by technological developments related to digital transformation and in particular IOT and IIoT-based solutions. We deliberately excluded large MNEs since their extended resource-base and market position allow them to deal with IoT-based innovation in a very different way compared to SMEs (Laudien and Daxbock, 2016). See table 1 for an overall representation of firms' basic features. Given the aim of the study and its exploratory nature, our empirical setting followed conceptual considerations: instead of building a statistically representative sample we aimed at depicting the variety of situations and challenges posed to SMEs by the transformation described above (Miles and Huberman, 1994). As may be noticed (Table 1), the interviewed firms are different in size, industry, value chain position and sales model.

Tab. 1: Outline of firms

Case	Size (€Mio 2016)	Position	Distribution	Activity
A	50-100	OEM BtoC, national	Indirect	Heating devices
B	100-200	OEM BtoB, international	Direct	Packaging machines
C	50-100	OEM BtoB, international	Mixed	Professional cooking appliances
D	100-200	Ist tier supplier, international	Indirect	Technological control systems
E	0-50	Ist tier supplier, national	Indirect	Technological control systems
F	0-50	KIBS, (sub-) systems integrator, local	Direct	Innovation consultancy and solutions

Source: Author's elaboration of primary research data

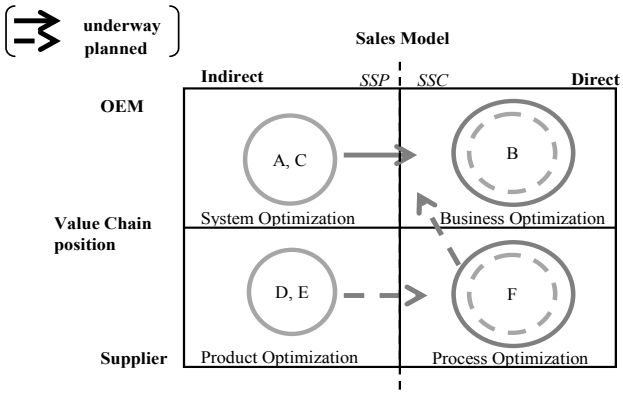
3.2 Findings and discussion

During our research we observed some of the transformations described in the preceding literature (see table 2 for a summary). Home appliances manufacturers, industrial machine builders, and specialized sub-systems producers offer services that can become the base for new value-added offerings: predictive maintenance, warranty modelling, consumption control, energy savings, and customized use of the product. In some cases, SAAS, PAAS and MAAS concepts (Software-, Product- and Machine-As-A-Service) may be introduced with a completely new billing system based on the equipment's efficiency (better uptime and improved process efficiency) or actual rate of utilization. In these cases, the service BMs' experimentation led to a completely new (and deeper) relation with key clients.

Nevertheless, the transition poses different challenges to SMEs. A first mention goes to the financial challenge: unfortunately, a full-scale adoption of the service revenue model is such a radical transformation for which not even the most innovative of the investigated firms are ready. Substituting the service revenue model for the product's one poses big financial problems for a medium-sized company even if lock-in effects

on consumables may help. Financial pressures may contribute to forcing firms to build an ecosystem with partners and other manufacturers in order to enlarge the installed base. Collaborative relations with customers are mandatory in any case, also because of the inherent complexity of new IOT-based services contractual agreements. Lack of experience make contracts very difficult to draw up, leaving them incomplete and therefore subject to adjustments and upgrades over time; these circumstances are all very unlikely to happen without a long-lasting mutually beneficial collaboration with the customer. Positive experimentations can lead to a certain degree of standardization and replication for other customers and business opportunities.

Fig. 1: A matrix of business model changes



Source: Author's elaboration of primary research data

According to our research, two main factors may condition firms' adoption of IOT-based service BMs: its position in the value chain and its distance from end-customers, that is the type and nature of distribution channels, i.e. the sales model (see figure 1). Companies can play different roles in often very articulated BtoB production chains: OEMs producing complex solutions or product-service sub-systems may compete with system integrators and sellers for the attention of manufacturing end-users. On the other hand, specialized components producers may have to compare and integrate their operations with those of the former category: when the product is a stand-alone part or a sub-system within a more complex offering, large key (intermediate) clients with substantial bargaining power can control the business, dictating specific requisites for products and functions that are not necessarily in favor of the best technological solutions: preferences can be frequently driven by mere cost considerations where very little space is left for upgraded features that allow new or augmented digitally-driven functions. On the whole, the value chain can count on the presence of multiple intermediate subjects that take charge of various tasks - such as system design, technological integration, installation and maintenance. In such a complex and articulated picture, SMEs that craft specialized components normally cannot boast a direct relation with the end user and any connection with the end user's needs and wishes.

Tab. 2: Description of firms' business models, main problems and envisioned solutions

Case	Current BM	Experimental BM	Problems encountered	Envisioned solutions and BM developments
A	Produces and sells durable goods for final users via indirect distribution system; being the distribution channel the "real" customer, it defines itself a BtoB business: no services are provided by A, since the distribution channel is in charge of them.	Physical freemium: the product is sold along with a dedicated app. Connected products are envisioning the creation of big data regarding customers' use of selected product-lines.	Data analysis in its first steps, reveals typical defensive (reactive) services and solutions, such as warranty control and products-use optimization. Unprecedented relation with end users causes an "identity crisis" in the firm, but also envisions new and unexpected opportunities.	First attempts in redesigning strategy and BM in order to exploit direct relation with customer, for example by approaching the Business of consumables (Razor and Blade).
B	Traditional equipment manufacturer specialized in a niche segment, selling directly to end users. Traditional SSP like maintenance and spare parts selling. Long lasting relationships with customers.	Performance-based contracting experimentation with one key-client, with remote equipment management and remarkable productivity gains that are granted and honored.	Approaching the service revenue model poses significant financial problems: MAAS's annual revenue is a little share of the equipment's market value. Contractual agreements are very difficult to set and frequently incomplete, asking for recurrent adjustments that are impossible without a collaborative relationship. In some cases MAAS is not requested, but the customer is willing to pay to learn how to improve OEE from B.	B aims at engineering the experimental solution and replicate it for other customers, in order to exploit its international installed base. Locked-in auxiliary consumables is a complementary business that will have a role in establishing financial equilibrium. Crafting an ecosystem of partners is imperative in building the installed base.
C	Professional appliances are sold via direct and indirect channels to end users (BtoB) with different services being provided in pre- and post- sale situations.	Experimental digitization via connected machines, IOT has led to the offer of new services enabled by data analysis in order to improve customers' OEE.	IOT-based strategies are in stand-by due to the weak reaction of the market, while data gathering is under way. MAAS business model is prevented by products' low rate of utilization and by the current structure of distribution channels.	Building a direct distribution structure, also in view of the international markets' expansion. Extend the line downwards from cooking to food conservation.
D	Differentiated digital control systems for refrigeration and conditioning industry with a varied customer base and articulated distribution channel.	Small machines are being equipped with TCP/IP protocol and WIFI gateways in order to access cloud services. At the moment maintenance ticketing and management support are in place.	Due to value chain structure and costs importance, direct customers have little interest in advanced service extensions. This is a transition phase in which the firm "hasn't found what the future's business model is yet".	A new product-service solution based on amazon cloud is in its pre-launch phase. A couple of additional experimentations are underway.

E	Multi-purpose digital control systems for heating, refrigeration and conditioning industry are sold to a highly-differentiated customer base through an articulated and variable distribution structure.	Specific projects linked to customers' needs are being put in place; regulations in some industries have shaped sophisticated information needs that are the base of the ongoing transformation.	Hindering role of the distribution systems and general contractors due to cultural factors and contractual power. In some cases, key end customers are also still not ready for a service-based BM. E's strategic vision is partial, not having decided what role to play in the value system.	Technological solutions for plug and play also using cloud technology are ready; critical agreements and partnerships with OEMs are under way. The company's fundamental activity is deemed to be data management and analysis, in which some lock-in positions may be developed.
F	Local specialized technological supplier and systems integrator with direct contact with customers. Software competences are complemented with hardware ones.	Currently F is transferring from selling software to SAAS and cloud services, along with smart plug-in products that standardize specific services and allow pay-per-use contracting. BM is evolving from selling a project to selling a customizable modular solution, PAAS plus consulting.	Technology is ready to be used, unlike customers (manufacturing SMEs, both suppliers and OEMs). Some solutions regarding predictive maintenance are being implemented.	IOT are a strategic touch point. Apps and other products can act as introductory initiatives. In F's opinion, it is necessary to combine different BMs in this transition phase.

Source: Author's elaboration of primary research data.

IOT-based service BMs emerging in this initial phase heavily depend on the position of the supplier in the value chain and the distribution's organization. For OEMs and suppliers with no or occasional contact with end users, the manufacturers' novelty merely regards some SSP applications affecting products or systems optimization such as: IOT-based warranty optimization, preventive maintenance services or projected forms of IOT-based availability services (see the left side of figure 1). For OEMs and suppliers with direct contact with end customers, a more advanced and complex experimentation is in place due to the different opportunities of changing and upgrading the relation with customers (and therefore relating to SSC). In this case, IOT-based process optimization services or initial IOT-based business optimization services are in place in some restricted, albeit lengthy, experimentation. Overall, those experimentations are blurring some categories in the value chain and slightly changing the BMs of the firms in the sample, as shown in figure 1. OEMs with indirect sale models are showing a clear shift towards SSC, partially bypassing the distributor for some services, while suppliers have a hard time taking a similar step. Firms with direct sale models, in particular OEMs, are in a privileged position in order to unleash the potential of BMs based on a reinterpreted relationship with the end customer.

In such a context , a particular role is being played by distribution channels, thus affecting companies that have exclusive or prevalently indirect contact with end users. Some firms report that their interest in the new digital service BM conflicts with their distributors' aims and is

complicated by the fact that distributors change a lot depending on the actual market. In this environment, services that are added to the product (e.g. maintenance and warranty) are frequently outsourced to third parties, since as says an interviewed manager "OEMs are used to selling machines and not to supply services". The same happens when staying in contact with the customer, a situation that IOT are likely going to change, since the firms in our sample are reconsidering the overall service approach of the distributor by designing initiatives that enhance its customer services and, under the surface, making steps downstream.

Finally, interviews with specialized Knowledge Intensive Business Services (KIBS) companies have also permitted us to depict a parallel change regarding the specialized services players involved in the value chains we observed. Small and medium consulting firms and system integrators that possess specific knowledge on applications technology and customer needs now seem capable of competing with international consulting MNEs. In some cases OEMs supplying industrial equipment are requested to act as KIBS: even if MAAS is not requested, the customer is willing to pay to learn how to improve Overall Equipment Efficiency (OEE) from the supplier.

4. Conclusions and future research

The data deriving from IOT devices and regarding the use of products are opening an entire new world of possibilities and sparking interest and experimentation in companies of all dimensions. But unlike large corporations that have started to take over IOT-related firms and incorporate precious capabilities, SMEs are striving to understand the change and its possible consequences for their businesses.

The study presented in this paper is still in its initial phases. Therefore, the limited number of collected cases and examples seriously discourage a consistent generalization of the results achieved so far, which will have to be confirmed by further investigation. Nevertheless, we believe that our research has a valuable potential impact both on theory and practice. We outlined the various problems that firms face during their transformation: even if these problems are not completely new to the servitization literature, their weight and intensity are being redefined within the new technological landscape, where value chains' actors and roles are reshaping themselves. In particular, in this study the company's position in the value chain and sales model have demonstrated being critical variables for manufacturing SMEs in the course of the adoption of new IOT-enabled service-based BMs. This has a profound impact on managerial considerations regarding the future shape of the business of every SME involved in the transformation, since the ability to govern such change instead of being disrupted by it will depend on how firms use products, services and data to influence (and even change) its own and other players' position in the ecosystem.

As one interviewed CEO said: "it all depends on the customer: if he hasn't changed his business model, no appreciation of innovation efforts will be encountered by suppliers". In this context, the pace and extent of

the evolution is driven by end customers' and end user manufacturers' needs and sensitivity, and intermediate actors like distributors will follow accordingly.

Future research may therefore focus on the roles of different parties (installers, system integrators, OEMs, maintenance companies, component suppliers) in the process of BM transition in the ecosystem. Which subject is more capable of and interested in using the data coming from the customer? What role in the value chain can act as a change-enabler? Who is going to take advantage of the change? These should be some of the questions to answer in the future development of this research.

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