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Digital servitization and smart services for the new normal

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Abstract. The COVID-19 Pandemic has caused an economic breakdown, especially in the manufacturing industry. Manufacturing companies have used Digital service to stay in contact with their customers and as a source of revenue even during the general lockdown. An exploratory focus group has been carried out to understand the problems and opportunities manufacturing companies went and are going through and to suggest open research questions that both research and industry should explore further. To deeply analyse the content of the discussion, Latent Dirichlet Allocation (LDA) was used to identify the main research topics. 4 topics were identified as the most relevant to be investigated: digitalization and collaboration emerged as the most interesting trends that will characterize the new normal. For each of the topics, insights, critical points and research questions are presented and discussed, reporting the main evidence of the focus group discussion.

Keywords: Digital Servitization, Smart Service, COVID-19, Latent Dirichlet Allocation (LDA), focus group.

1 Introduction

The Covid-19 pandemic has caused vast economic breakdown across the world. In this period, business activity has collapsed. The manufacturing industry was one of the most severely affected sectors regarding the negative impact of product sales. In this context, servitization, the shift from a product-centric to a service-centric business model [1] [2], has played a key role as a countercyclical stabilizer and has helped manufacturers stabilize their businesses. Even if the (hard and soft) lockdowns deeply impacted both product and service businesses, the latter showed higher resilience [3]. In particular, advanced services [4] and smart product-service system [5, 6] have been less impacted than basic (reactive) maintenance, repair, and training services. Therefore, it is not surprising that, during the pandemic, innovation initiatives related to introducing new technologies and developing new smart services have been accelerated in manufacturing companies.

Smart Services are defined as "*digital-enabled business solution supplied within an ecosystem which provides economic and sustainable value to the customer by*

integrating into a unique offer intelligent products with data-enabled services allowed by physical and digital infrastructures" [6]. In this perspective, smart services make it possible to remoteise services traditionally delivered in the presence.

Digitalization and servitization, i.e. digital servitization [7], have been recognized as a "*proactive weapon for acceleration and implementation to respond to the crisis*" [3] since they can improve organizational resilience [8]. In this sense, it represents an excellent strategy to respond to the unthinkable changes that the COVID-19 pandemic requires the manufacturing company to face and support the definition of the so-called "new normal" [9].

Given the innovativeness of the topic and the scarce amount of literature regarding the holistic evolution of the unexpected changes in digital servitization research concerning the COVID-19 effects and the new normal definition, this study relies on the exploratory findings of an international focus group. The aim is to identify the main research topics that the scientific community will have to investigate to support companies in facing the new normal in the best possible way through the digital and smart service offering. To this end, problems and opportunities that both research and industry should explore further have been extracted from the discussion using topic modeling technique. The paper is structured as follow: section 2 explain the methodology adopted to identify the main topics, section 3 provides insight into the results, and section 4 deeply investigates each topic by reporting the main insights and open questions. Finally, section 5 concludes the paper.

2 Methodology

'A focus group is, at its simplest, an informal discussion among selected individuals about specific topics' [10]. In the literature, it has been used in multiple domains to explore a subject or a phenomenon. The reasons behind its selection lay in its main feature, which is the interaction of participants [10] to constitute a common understanding of a complex new phenomenon. The focus groups' scope is to provide insights about how experts perceive a new phenomenon [11].

The focus group is theoretically characterized by homogeneity of the participants, but it requires a sufficient variation among participants interest, knowledge and background to allow for contrasting opinions, the following selection criteria have been used to identify the experts:

- Research topics: All the participants selected are academic with a background in digital servitization with a different focus: strategical, tactical, and operational to guarantee homogeneity and variation among participants.
- Geographical distribution: For a global perspective on the topics, the experts must come from various countries.
- Experience in industry: To evaluate both theoretical and practical perspectives, experts deeply involved in industry-oriented projects are required.

The current study relied on the participation of 8 different experts, coordinated by two moderators to keep the discussion. The work was organized into a session group meeting anticipated by a preliminary individual evaluation of 4 statements the moderators have identified from the literature [3] and have used to stimulate the discussion. During the debate, the experts confronted each other starting from four statements but also diverging reporting their insights on the main topic. The discussion lasted half a day, and a detailed transcript created.

Since many different topics have been discussed in a divergent way, topic modelling has been applied to provide insights. Topic modelling refers to a set of machine learning algorithms providing insights into the 'latent' semantic topics in a collection of documents [12]. Latent Dirichlet Allocation (LDA) has been selected among all the algorithms available since it represents the simplest and most popular statistical topic modelling [13], where each sentence is a probability distribution of topics and each topic is a probability distribution of words representing the main ideas of the focus group participants. Then, the LDA algorithm aims to model a comprehensive representation of the text (namely corpus) by inferring topics from recurring patterns of word occurrence in the documents. Topics are heuristically located on an intermediate level between the corpus and the documents and can be imagined as content-related clusters. To carry out the analysis Text Analytics Toolbox of Matlab was used.

Grounded on the methodology proposed by [6, 14], the main steps to perform the analysis are represented in Fig. 1.

Based on the LDA modelling results, four clusters were obtained and represented through word clouds for a preliminary interpretation. The sentences belonging to the four clusters were analyzed and the insights achieved are discussed in the following.

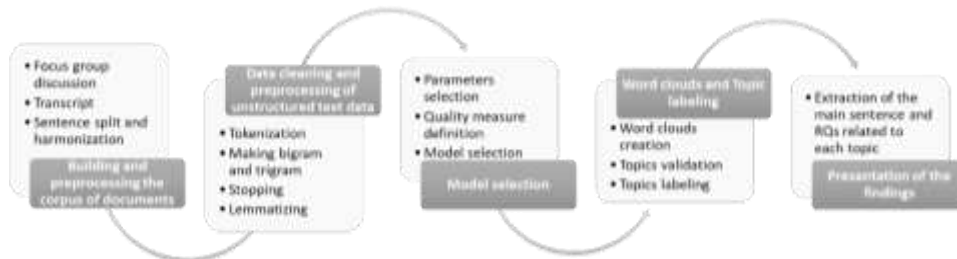


Fig. 1. Research Methodology

3 Definition of the main topics

3.1 General statements and agreement level

Four statements, based on [3], were used to support the discussion during the roundtable:

- Statement #1: The provision of digital and remote services has helped (and will help) the manufacturing value chain to be more resilient

- Statement #2: The adoption of digital technologies to provide services has been enormously accelerated due to the pandemic
- Statement #3: Use and outcome-based services are suffering due to the risk perceived during the pandemic
- Statement #4: Customer acceptance of digital services, their willingness to pay and share data have accelerated

An instant poll, results reported in Fig. 2, among the panellists assessed the level of agreement about the statements on a 1 (strongly disagree) - 4 (strongly agree) scale. The panel had a high agreement on statements 1 and 2, a moderate agreement on statement 4. At the same time, we found conflicting opinions on statement 3. The discussion started with the four topics, but the panellists discussed several aspects of digital servitization and pandemic in a divergent way. Some topics were touched upon multiple times in support of the different statements. As previously mentioned, to really extract the main topics characterizing the impact of the pandemic on the digital servitization and the new normal trends, LDA analysis on the transcript was performed. A summary of the main findings is described in the following.



Fig. 2. Statement instant poll results

3.2 Word cloud on the general discussion

A word cloud of the transcript text was created to highlight the most used terms in the discussion. Wordcloud creates a chart from the unique elements of the text with sizes corresponding to their frequency counts.



Fig. 3. General wordcloud

Some of the most used words are directly linked to the 4 statements under discussion, while other words show additional themes that emerged during the discussion: customer, platform, IoT, remote, chain, risk, and AI. This underlines how digitalization and collaboration are the most interesting topics and will characterize the new research trends.

3.3 LDA Topics identification

LDA analysis aims to extract and cluster the main themes discussed. We identified 4 LDA Topics that maximize the coherence of the groups, and their main content is summarised in the word cloud reported in Fig. 4.

In particular, the moderators punctually analyzed the sentences allocated to each group by the LDA algorithm to investigate and provide an in-depth interpretation of the topics covered. The word cloud allows a synthetic representation of the most repeated words and thus facilitated the interpretation and characterization of each group. The aim was to understand the contents and insights of each topic. In addition, several critical points and research questions that both research and industry should explore were extracted from the discussion.



Fig. 4. LDA topics word cloud

The four topics obtained from the LDA are:

- TOPIC 1: Provision of new forms of value through remote services in a B2B environment, involving different value chain actors
- TOPIC 2: Platform, IoT, and Artificial Intelligence as new technologies to answer customer needs
- TOPIC 3: Digital servitization emerged during the pandemic as a new strategy to provide smart service thanks to collaborations
- TOPIC 4: Understand and measure business and financial risk and the impact of new business models (pay-per-x, outcome-based...)

4 Results and Discussion

In the following, each topic is explained. Then, starting from the insights and the critical points that emerged along with the focus group, open research questions to be addressed by future research and discussions within the managerial and scientific communities are reported.

TOPIC 1: Provision of new forms of value through remote services in a B2B environment, involving different value chain actors

During the pandemic and general lockdowns worldwide, digital and remote services helped all the value chain actors be more resilient [8]. In fact, due to the already well-known and strong convergence of digitalization and servitization [15], the growth of digital services accelerated due to customer demands that occurred during the pandemic. To date, it remains unclear whether the adoption of these technologies will also drive value chain actors to servitize their business in the future, and to what extent their role in the supply chain will favour or obstacle their servitization path (e.g., technology

provider, component manufacturer, OEM, ...). However, this rapid transition highlighted the risk of having a concentration of profits in the hands of a few value chain orchestrators and the inability of other players to achieve the expected benefits and margins.

Along with this transformation, it emerged the disruptive and relevant role of "pure" software players. This role has been seen often as a threat, but who in most cases have complementary capabilities and need to team up with manufacturers and vice versa.

Open questions for further research are:

- What about pre-sales services? Remote has been extensively used also in this perspective. How to consider remote services along the lifecycle of the solution?
- Remote has great potential, but why should customers pay the service as much as before when done remotely? Remote service must be packaged in a way that can keep the margins. How to deal with co-creation issues, value for the customer and pricing for remote services or "assisted self-service" by the customers?
- How to increase the capabilities of different actors and roles in the value chain? For instance, technicians should become "data-savvy" technicians, and SMEs should grow their digital capabilities to be part of such value chains

TOPIC 2: Platform, IoT, and Artificial Intelligence as new technologies to answer customer needs

Digital technologies played a key role in service delivery during the pandemic. In particular, IoT, Platforms, and AI emerged as the most widely adopted technologies[16].

As previously mentioned, the pandemic fostered the growth of remote services. Also, it enabled manufacturing companies to deliver solutions with a high level of personalization obtained from insights based on data collected via the platform. However, to ensure a high level of personalization, this data's processing turns out to be "human-based". The role of humans is still critical to add value for the customer during data processing. This is not the only direction taken by manufacturing companies, in fact in many are also trying to mass-customize their services through the adoption of AI, which can support standardization and automation of some activities of the service delivery process [17].

It must be emphasized that although it emerged how the role of digital technologies is undisputed to provide both customized and standard services, the technology-push approach adopted by many companies during the pandemic is limiting. Therefore, rather than focusing on the best "technologies", it is essential to identify the digital functionalities to enhance customer involvement, which can be enabled by (one or more) technologies.

Open questions for further research emerged are:

- Companies need to focus on the functionalities the technologies can provide more than on the technologies themselves. So how to change their approach from technology-push to solution-driven?
- The notion of "platform economy" is more and more agreed upon. How to support companies, especially SMEs, in this transition?

- How will Artificial Intelligence support companies to achieve mass customization within the provision of services? Through which paths and mechanisms?

TOPIC 3: Digital servitization emerged during the pandemic as a new strategy to provide smart service thanks to collaboration

Everyone agrees that the accelerated adoption of digital services experienced during the pandemic can also be successful in the new normal. A critical success factor is collaboration to develop and deliver services among different value chain partners, which is even more relevant than in the "traditional" servitized value chain [18]. However, how to improve this close collaboration between all actors is still an open question. Indeed, data sharing is an issue that involves trust, technical capabilities, system interoperability, etc. These aspects are particularly critical in complex systems, where different parts (e.g. of a production line) are produced by various OEMs collaborating with different IT providers: data belonging to one part of the systems may not be disclosed to suppliers of other parts of the same system. In this context, creating close collaboration means moving from a single-actor perspective to a multi-stakeholder perspective, involving manufacturing companies and IT providers from the early definition of servitization business models [15].

Open questions for further research are:

- Are value chain actors collaborating to provide digital services to build up a common business model for their servitized offerings?
- Close collaboration between manufacturing and IT players is needed to develop valuable digital services. How can such collaboration be defined, supported and measured?
- It is hard for a company to have all the competence and skills regarding digital servitization. How to identify proper competence and collaboration mechanisms to answer customer needs? How to orchestrate all the actors in the value chain?

TOPIC 4: Understand and measure business and financial risk and the impact of "new" business models (i.e. pay-per-x, outcome-based...)

The panel discussed the role of restrictions, the evolution of risk perception, and the phenomenon of digital transformation related to offering and adopting pay-per-x and outcomes-based business models. In this period, these business models are seen as an opportunity by customers to reduce their risk [19]. Currently, many manufacturing companies are hesitating to invest in Capex, in this perspective Opex based business models can help a lot. On the other hand, the producers/suppliers of these business models may perceive that they bear too much risk [20]. This will make them withdraw from offering these business models or reduce their scope. This issue is very contextual, with significant differences between B2C and B2B and across industries, so a contextual approach to studying these business models should be taken.

Open questions for further research emerged are:

- How has the pandemic impacted the customer's and supplier's perception and adoption of these "new" business models (their willingness to adopt these new business models, risk perception)?
- How to forecast and measure the risk of these services?

- How can we improve/facilitate the measurement of performance indicators? How can we measure the margins and support companies to improve the margins?

5 Conclusions

In an environment of high uncertainty and uneven impacts, it remains too early to talk of a real recovery. However, research and industry should understand the problems and opportunities of the effects of COVID-19 and explore further the impact on the ongoing and future business. Smart services have been used by manufacturers to stabilize their businesses. A focus group with experts and the use of the topic modelling Latent Dirichlet Allocation (LDA) allowed identifying four main topics that research and industry should focus on. Providing new forms of value, collaborating with the value chain actors, developing digital technologies, and answering customer needs are some of the main concepts that characterise the main four topics.

However, this work presents some limitations, in particular linked to the methodology adopted. Although the composition of the focus group reflects the topic under investigation in terms of skills, knowledge and number of experts involved, the final contribution is undoubtedly influenced by the specific interest of each expert and the impact of COVID in individual countries. Moreover, the reported perspective is exclusively academic, in order to address the issue, future research should consider refining the results obtained by enlarging the focus group by involving experts from the industrial world.

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