Digital transformation barriers and success factors: an Italian case study

Stefano Frecassetti [a)] and Alberto Portioli-Staudacher [a)]

a. *Department of Management, Economics, and Industrial Engineering, Politecnico di Milano, Via Raffaele Lambruschini, 20156 Milano, Italy*

Abstract: Nowadays, companies need to adapt to the huge changes that Digitalization is bringing to the environment in which they compete. Some studies have shown theoretical evidence of the fundamental role of Lean Management in driving and facilitating firms' journey in introducing Digital technologies. Nevertheless, practical and empirical contributions are still missing in the literature; thus, there is a strong need to fill this gap. This paper aims to fill this gap by showing the role and mechanism by which Lean Management can reduce the barriers to technology implementation and facilitate the success of digital transformation. Using the case study methodology, an Italian company will be analyzed, and its digital transformation path will be depicted. Further, the company's barriers and its relationship with Lean Management culture will be highlighted.

I. INTRODUCTION

After the concept of Industry 4.0 was born, several manufacturing companies started introducing digital technologies to their shop floors. In fact, given the increasing market pressure to deliver higher quality products with reduced delivery time and costs, companies were forced to find ways to improve their performance. In this sense, digital technologies are the case since they could improve operational, business, and sustainable performance [10, 14]. The benefits provided by digital technologies may vary depending on the type and maturity of the technology or sector of application. Nevertheless, several authors pointed out that if they are not implemented in a structured and precise way, these benefits in terms of performance could not be seen or not exploited [1]. In fact, there are several pitfalls behind a firm digital transformation. Firstly, companies can face several barriers which can harshly affect the implementation process by making it longer, inefficient, and costly [2].

Further, there is also a need to structure and plan the digital transformation path in a very robust and consistent way to avoid worthless investments and focus on the most relevant and fruitful technologies [1]. By doing this, firms will be easier to spot the hidden pitfalls and barriers and optimize the digital transformation. Also, technologies should be well integrated into the process to bring

actual performance improvement to firms [23]. In fact, several authors pointed out how the technology itself, without being integrated into the process, will not give the same benefits as the very well-integrated one [23]. This is particularly true where there is a strong presence of managerial tools and practices such as Lean Management. In fact, in companies with a strong awareness of Lean Management practices, several authors pointed out how introducing digital technologies can benefit traditional tools if integrated [13]. This integration has been called by some authors Lean 4.0 [6]. In addition, other studies showed how the same companies could benefit from an easier implementation of digital technologies thanks to a more streamlined process and a different managerial culture [16, 17, 24]. Knowing this makes it clear how these two paradigms are interrelated and beneficial to each other. However, there is still a scarcity of studies in the literature. Even though there is a mutually beneficial relationship, it is still unclear how the Lean Management culture inside a company can influence and facilitate the firm's digital transformation. Indeed, if, from an operative level, the benefits of the specific practices are roughly clear [7], from a more holistic perspective, there is still work to do. Particularly, some authors pointed out from a purely theoretical perspective that Lean Management practices can be beneficial for reducing barriers to Industry 4.0 technologies implementation. However, empirical confirmation

of these facts is still missing. This paper aims to fill this gap with an empirical study that wants to answer the following research question *"How can Lean Management reduce Industry 4.0 barriers?".* This paper will use the case study methodology to present the results gathered in an Italian company. Its digital transformation's barriers and success factors will be presented with its relationship with Lean Management. After this introduction, a literature review on the topic will be presented, followed by the methodology used to answer the research question. Afterwards, the findings will be presented, and then the conclusion will be, in which the study's results and limitations will be thoroughly discussed.

II. LITERATURE REVIEW

A. Lean Management

Lean Management is one of the most famous managerial paradigms in the manufacturing sector [15, 20]. Given the success and the benefits given to both operational and business performance [21], Lean Management practices have started to be implemented in other areas of manufacturing companies, for instance, in offices or warehouses[12]. Also, the growing interest has led companies from other sectors, such as service [22] or healthcare [11], to implement these practices to improve their performance. Over the years, Lean Management has also been combined with digital technologies to strengthen even more the power of its tools. This has become even more relevant in recent years with the spread of digital technologies after the Industry 4.0 paradigm was coined [3, 5]. In fact, the innovative digital technologies belonging to this paradigm can bring even more benefits to Lean Management practices [9]. On the other way around, Lean Management can facilitate the introduction of these technologies in firms' environments [3].

B. Industry 4.0

Coined in 2011 at the Hannover fair, Industry 4.0 paradigms refer to technological changes in manufacturing to maintain global competitiveness. Within this paradigm is a wide range of technologies such as IoT, Simulation, Autonomous Robots, Cloud Computing, Augmented Reality, Cloud Computing and Integrated Planning and Control Systems [1, 26]. These technologies were first applied to the industrial sector, but recently, given the outstanding benefits they can give, they were also applied to other sectors [8]. Even though these technologies can bring substantial benefits to firms, if they are not well implemented, they can underperform, thus leading to investments and results not being fully exploited. In fact, companies face several barriers while implementing these technologies [2], which can hamper the digital transformation process or even discourage companies from further investments. The number of barriers companies can face is huge and may change with sector, company size and culture [2]. Knowing this, several companies tried to leverage existing managerial practices to facilitate the digital transformation process, and among the others, Lean Management seems to be one of the most compatible with Industry 4.0 [4, 19, 24].

C. Lean Management and Industry 4.0

Several authors pointed out the interconnection between Lean Management and Industry 4.0 [3, 4, 15, 24]. In the literature, it is possible to find different research lines characterizing this relationship. For instance, some authors stressed the facilitating effect of Lean Management toward digital technology implementation [16, 18]. Some studies show how having already implemented Lean Management practices facilitate both the implementation of the technologies and the operational performance [15, 24]. Others, instead, suggested that Industry 4.0 can magnify the power of traditional Lean Management practices and lead the companies to enhanced levels of performance [9]. Also, Industry 4.0 can ease the introduction of Lean Management in companies since these technologies can break down the barriers to the wider adoption of Lean Management [19]. Nevertheless, there is still a need to investigate both relationships, particularly the facilitating effect of Lean Management towards Industry 4.0. With this aim, this paper will focus on how Lean Management can help companies reduce barriers to Industry 4.0 technologies implementation.

III. METHODOLOGY

In this chapter, the methodology used for answering the highlighted research question will be presented.

A. Research Design

Given the qualitative dimension of the research question, the authors decided to use the case study methodology [25]. In particular, the decision was to perform a single exploratory case study [25] to investigate the possible relationship between Lean Management and Industry 4.0 barriers. This methodology has been widely used for addressing exploratory research on similar topics [8, 11, 12, 22]. Even if the outcome from a single case study approach cannot be considered extensive or extendable to other domains, it can provide useful insights regarding the topic under analysis and be considered a starting point for further research [25]. Thus, the authors decided to select on purpose an Italian company in which a case study was conducted using semi-structured interviews. This company's digital transformation presents a unique and interesting case study for exploring the challenges, opportunities, and success factors of digital transformation in the company's sector.

B. Company Description

The company under analysis is an Italian business-to-business (B2B) company specializing in designing and distributing do-it-yourself (DIY) products such as tools, plumbing arrangements, and hardware items. The company had the idea to transform digitally completely in 2017 and formed teams as a first step towards the organizational strategy and implemented the Digital Transformation in the subsequent year. Their first transformation was to change their Enterprise Resource Management (ERP) system. This made it possible to mine large amounts of field data and use it efficiently, and manual activities have been drastically reduced. They also brought a new forecasting system to the purchasing department and software to manage all the sales activities effectively in the Sales Department, which helped them forecast the demands with maximum accuracy and manage the customer orders. They also integrated these systems into the ERP to manage data effectively. Lastly, in 2021, the company introduced its new automated warehouse, consisting of 20 robots with 25,000 bins that store items. It has three picking stations and one inbound station, capable of handling up to six orders simultaneously with one operator/picker. The facility can perform up to 600 pickings per hour with a 0.1% picking error, utilizing lasers and weight check facilities on conveyors to tackle picking errors. The facility ensures a safer and more efficient work environment by reducing worker movement, eliminating vehicles, and enhancing ergonomics. All the processes are automated once the information has been entered into the system. To manage this automatic warehouse, they use software integrated with the company's newly developed Warehouse Management System (WMS) software to manage all the goods in the warehouse effectively. Like the demand forecasting software, this WMS software is also integrated with the Company's ERP system to give a complete overview of all the operations being carried out in the organization. In line with modern technological advancements, the company also launched a "Kaizen" program for continuous improvement which has been a key success factor in the firm's digital transformation. Initially started in the logistics department, the company expanded the program to include all organizational functions, improving operational and business performance.

C. Data Collection

Given the exploratory dimension of this study, data regarding the two different topics under analysis were collected by interviewing key company people. Open-ended semi-structured interviews were carried out with some of the key users who are directly affected by the digitalization process. The questions were framed based on the overarching research objective: to know the barriers and success factors of the digital transformation process and how they are related to Lean Management. The main themes of the semi-structured interviews were roughly structured as follows:

- How was the digital transformation of the company? (Which technologies were implemented, when they started, etc.)

- How is your company using Lean Management practices and tools?

- What are the barriers that your company faced during the digital transformation?

- What success factors have your company experienced during the digital transformation?

- Did your company follow Lean Management during the digital transformation process?

With this main question scheme, different one-to-one interviews were conducted with seven key company members involved in digital transformation. The interviews were recorded and then transcribed to allow the analysis of them.

D. Data Analysis

After the interviews were carried out and transcribed, the authors decided to analyze them using a mix of deductive and inductive coding. Each interviewee's responses were coded in different rounds for a better and standardized overview of the topics under analysis. In particular, the interviews were coded until the third order to extract and cluster information related to barriers they face, the factors which contributed to the successful digital transformation, and the possible role of Lean Management in this. Afterwards, the researchers furtherly analyzed what was obtained and connected all the information by referring to the existing literature. The following chapter will present all the results from this part.

IV. FINDINGS

This section will present the results obtained from the data analysis. In particular, the company's barriers and success factors during the digital transformation and its relationship with Lean Management will be presented.

A. Barriers to Industry 4.0 Technologies Implementation

- Difficulties in selecting the right partner: this barrier emerged from the interviews as one of the most prominent. Several company members stated the importance of working closely with the technology provider. In this sense, companies with high levels of Lean maturity usually work closely with their supplier; thus, Lean Management could reduce these barriers.

- Lack of proper change management: one of the most difficult things to manage while implementing new technologies is managing the change which the company faces. Usually, Lean Management companies have a mindset oriented to continuous change; thus, they could be facilitated in this sense.

- Resistance to change: this barrier is prominent, especially without clear communication of the change and its goals, together with peculiar support from the management. Companies with a high willingness to continuously change are more willing to have a low prominence of this barrier.

- Lack of employee skills: new technologies require new competencies, which require more company effort, especially if the employees have high seniority. Thus, this barrier can be faced through appropriate training before and during the transformation.

- Lack of top-management support: top managers must put effort into and support the transformation and the employees during the process. In this sense, usually, projects in Lean companies are guided by top managers who are the sponsors and directly provide support to these transformations.

- Technical issues: the company faced several issues, such as complexity management, lack of standardization and integration of the systems. These issues can be partly addressed through specific practices or by standardizing the environment before Digitalization.

- Lack of dedicated teams: without the right culture and the dedication of a specific team to drive the change brought by the digital transformation, there is the risk of failure of the whole project. The most important factors are creating a supportive environment, building the right habits among colleagues, and having the right

team structure. This is another traditional characteristic of a company with a high degree of Lean Management maturity.

As can be seen, all those barriers could be faced by extensive use of Lean Management practices and by creating a continuous improvement culture [15, 20]. Some of the barriers will be impacted most, while others only partially, but in companies where the Lean Management maturity is higher, these barriers could be overcome more linearly.

B. *Digital transformation success factors*

- Involving key stakeholders: one of the most important factors that can guarantee the success of digital transformation involves the key stakeholders of each relevant area. Inform and involve all the people touched by the transformation is fundamental and could help reduce the resistance to change and foster commitment at any level.

- Process standardization consists of breaking down the main goal into phases and continuously changing and improving these phases as the project progresses. This approach allows for continuous analysis and adaptation to change as unforeseen problems may arise during the project that requires direction change.

- Effective communication: a successful digital transformation requires effective communication and collaboration among employees at all levels of the organization. Engaging people in improvement by actively communicating and collaborating with colleagues is fundamental to achieving the goals. It is also fundamental to seek feedback from those in lower positions who may have a fresh perspective on the process and can improve the final results.

- Employee training: One of the key aspects of change management is providing adequate training programs to employees to ensure that they are proficient in using new processes and technologies. Therefore, companies must invest in employee training and support when transitioning to new processes and technologies.

- Supportive organizational culture: It is essential to have a team that can identify potential issues and errors in the process and address conflicts between different processes during implementation. In this sense, a good culture among colleagues and a stronger commitment from management are essential. These factors ensure that the project is completed successfully and efficiently.

- Top-management involvement: To successfully achieve digital transformation, there is a need to have someone who provides clear directions to everyone involved in the project. Having a clear goal and a timeline, along with a well-developed plan, is crucial for achieving the goal of the project, and a top manager has the role of aligning the goal of the project with that of the key users.

- Continuous improvement: the continuous improvement culture has been considered one of the most important success factors in the company's digital transformation project. Continuous improvement was key in the digital transformation, for instance, improving productivity before introducing the automatic warehouse. Furtherly, it was fundamental to prioritize areas of intervention to identify waste and activities to be performed. Also, it has created an optimal environment where the impact on other departments when implementing something new was considered to avoid creating problems elsewhere.

From these success factors, it is clear how fundamental it is to have a structured strategy and particularly a strong culture along the whole company to ensure digital transformation success. In this sense, Lean Management plays a fundamental role. In fact, it is possible to see how continuous improvement is fundamental to spot areas of improvement before Digitalization and prioritize activities. However, if we look at the other factors, they are usually considered typical traits of a Lean organization [20].

V. CONCLUSION

This paper has highlighted the main barriers and the success factors an Italian company faced during its digital transformation. As pointed out in the findings section, the potential role of Lean

Management in reducing barriers is clear. Most barriers relate to the change a company needs to undertake during the digital transformation. Usually, companies with a high degree of Lean Management culture are used to face changes, given the continuous improvement mindset embedded in them [15, 20]. Also, the other barriers can be easily addressed by using Lean Management practices to achieve a more streamlined and waste-free process before Digitalization [20]. If we also consider the success factors, it is clear how continuous improvement was fundamental for the company under analysis and others, such as having an adequate strategy and a culture inclined to change [20]. Also, in this case, all the success factors underlined in the interviews can be directly linked to the most common traits of the Lean Management culture, which usually leverages people contribution, group problem-solving, training and top-management support [15, 20]. By knowing this, it is possible to state that Lean Management has a fundamental role in driving and facilitating digital transformation and can impact reducing barriers and fostering a successful digital transformation. The implications of this are both theoretical and practical. From the theoretical perspective, the literature is enriched by a case study adding other knowledge on digital transformation barriers and success factors. Also, it adds knowledge on how Lean Management can reduce barriers to digital transformation and can be considered a first step that could be a basis for further and deeper research regarding this topic.

On the other hand, from a more practical perspective, managers and firms can use this study to gather knowledge and try to address in a better way their digital transformation path by leveraging Lean Management practices and culture. Even though this paper can enrich the existing body of literature and can help managers and practitioners, it has its own limitations. First of all, this study is based on a single case study design. Thus, the results are poorly extendable and generalizable to other domains. Secondly, it has considered only a purely qualitative dimension without using any quantitative tool to enrich and validate what was obtained from the interviews. Lastly, the company under analysis has contextual factors (such as dimension, culture, and geographical location) that may have influenced the results of this study. Thus, as further research, the authors suggest enlarging the companies under analysis, for instance, using a multiple case study approach and maybe including

companies from different countries and sectors, each having different dimensions. Also, further studies should consider using other techniques, such as surveys, to give a quantitative perspective to the results.

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