

# Agility and Resilience of the French “Industrie du Futur” During the Covid-19 Pandemic: Insights from a Multi-dimensional Framework

## Agilité et résilience de l'« Industrie du futur » française pendant la pandémie de Covid-19 : aperçus d'un cadre multidimensionnel

Marcos Lima<sup>1</sup>, Patricia Baudier<sup>2</sup>, Marie Haikel Elsabeh<sup>3</sup>, Michel Dalmas<sup>4</sup>

<sup>1</sup> SKEMA Business School, Skema Center for Artificial Intelligence, France, marcos.lima@skema.edu

<sup>2</sup> EM Normandie Business School, Métis Lab, France, pbaudier@em-normandie.fr

<sup>3</sup> Institut Mines-Télécom Business School, France, marie.haikel-el-sabeh@imt-bs.eu

<sup>4</sup> ICD Business School, LARA Research Center, France, mdalmas@groupe-igs.fr

**ABSTRACT** This multi-case study analyzes the role of organizational factors influencing Industry 5.0 resilience during the early stages of the Covid-19 pandemic in France. McKinsey's 7S framework is used to understand how eight French Small and Medium Businesses belonging to the “Industrie du Futur” alliance adapted their strategy, structure, systems, skills, staff, shared values and management style while relying on their shared values to develop organizational agility and resilience. Our findings confirm that, even if technology systems were a key component of their response to the Covid-19 situation, human elements also played a central role in their ability to cope with the crisis. Our research also shed light on the importance of stakeholder networks in an organization's ability to adapt and prosper during crises. The resulting framework could help companies to develop a human-centric approach to agility and resilience.

**RÉSUMÉ** Cette étude multi-cas analyse le rôle des facteurs organisationnels influençant la résilience de l'industrie 5.0 au cours des premières phases de la pandémie de Covid-19 en France. Le cadre 7S de McKinsey est utilisé pour comprendre comment huit petites et moyennes entreprises françaises appartenant à l'alliance "Industrie du Futur" ont adapté leur stratégie, structure, systèmes, compétences, personnel, vision et style de management tout en s'appuyant sur leurs valeurs communes pour développer une forme d'agilité organisationnelle et résilience. Nos résultats confirment que, même si les systèmes technologiques ont été un élément clé de leur réponse à la situation de Covid-19, les éléments humains ont également joué un rôle central dans leur capacité à faire face à la crise. Nos recherches ont également mis en lumière l'importance des réseaux de parties prenantes dans la capacité d'une organisation à s'adapter et à prospérer pendant les crises. Le cadre qui en résulte pourrait aider les entreprises à développer une approche de l'agilité et de la résilience centrée sur l'humain.

**KEYWORDS** Agile Innovation, Human-centricity, Industry 5.0, McKinsey 7S Model, Resilience.

**MOTS CLÉS** Innovation agile, Humano-centré, Industrie 5.0, Modèle McKinsey 7S, Résilience.

## 1. Introduction

The development of so-called “smart technologies” has pushed the modernization of several industry sectors in what became known as the Industry 4.0 movement [RAL 20]. Under the label “Industry 4.0”, authors categorize a fourth industrial revolution, based on connected machines and sensors (“cloud-based devices”) which can dramatically improve productivity while reducing costs thanks to the use of real-time data to improve processes and adjust production. The three preceding revolutions coincide roughly with the waves of Kondratieff discussed by Joseph Schumpeter and neo-schumpeterian writers [FRE 01]: the age of steam and railways in the early XIX century, the age of steel and heavy industries in the second half of that century, and the age of oil, electricity, the automobile and mass production in the early XX century. The age of information technologies in general, and of connected devices, data-driven decision making and artificial intelligence which started in the late XX century is the basis for this fourth revolution.

According to Capgemini<sup>1</sup> reports, nearly half of industries in France, Germany, and the U.K have ongoing Industry 4.0 initiatives, and around 30% have formulated the need of implementing “smart factory” best practices. This report indicates performance, maintenance, production and inventory management as the main sectors affected by those technologies. Not all companies have the same degree of expertise in this domain, however: even if 55% of “digital masters” have achieved end-to-end business transformation through these technologies, only a minority of “beginners” have succeeded in the processes of infrastructure transformation (15%) and manufacturing process optimization (13%).

Smart factories use advanced digital technologies to produce goods or services (Ralston & Blackhurst, 2020). All industrial sectors are concerned, but leading examples are to be found in the aerospace, automotive, pharmaceutical, and biotech industries. Examples of these technologies include, non-exhaustively, the following solutions [JIM 21]:

- 3D Printing: using additive manufacturing processes to create faster, better prototypes or final products in small scale
- Distributed manufacturing: digital coordination of geographically disperse manufacturing assets for resource optimization
- Artificial intelligence for design & manufacturing: using machine learning to develop generative design solutions, predictive maintenance or process optimization.
- Collaborative tools: computer-aided design and manufacturing processes that facilitate face to face or distant collaboration.

These innovations seek to enhance the management of production, inventory, quality, maintenance, and performance (both at a human and material level). Industry 4.0 (I4.0) advocates the automation of systems to ensure organizational agility and competitiveness [RAL 20]. Several researchers have explored the increase in productivity as one of the main benefits of I4.0 [BRE 14, LAS 14, HOF 17].

In spite of the progresses it may have brought in terms of productivity, critics of I4.0 have highlighted its overreliance on technology as a key driver of performance. These shortcomings led the European Commission to propose an Industry 5.0 paradigm (I5.0), emphasizing sustainability, renewable resources, human-centric work organization, and ethics [CAR 22, DEM 19b]. Indeed, the European Commission recently published a report called “*Industry 5.0: towards a sustainable, human-centric and resilient European industry*” [BRE 21]. In this policy brief, they highlight how

“Industry 5.0 recognizes the power of industry to achieve societal goals beyond jobs and growth, to become a resilient provider of prosperity by making production respect the boundaries of our planet and placing the wellbeing of the industry worker at the center of the production process. Industry 5.0 complements the existing Industry 4.0 paradigm by having research and innovation drive the transition to a sustainable, human-centric, and resilient European industry” [BRE 21, p. 14].

I5.0’s main goal is to leverage Human/Machine relations to build better manufacturing solutions. Applications and technological solutions are expected to support I5.0 to increase outputs and customized product deliveries. It requires greater expertise and adaptation from humans while relegating repetitive and/or dangerous tasks to robots or highly automated machines. Thus, human expertise and soft skills are at the center of I5.0, requiring highly skilled professionals with a focus on decision making where predictive analytics is used to support Human decisions. According to the

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<sup>1</sup> <https://www.capgemini.com/insights/research-library/smart-factories-and-the-modern-manufacturer/>

above-mentioned EU report, “*In order to ensure that both companies and workers benefit from the digital transition, rethinking and redesigning business models is necessary. Workers should be involved in every step of this transition process*” [BRE 21, p. 26).

Due to its novelty, there remains a literature gap on how I5.0 companies develop organizational agility and resilience [RAL 20], especially while facing a crisis such as the Covid-19 pandemic. This research aims to analyze, through a multiple case study method [STA 13, LEB 16], the interplay between technological and non-technological components in the response of French I5.0 companies to the pandemic and the role of these tangible and intangible variables in their response to the crisis.

The McKinsey 7S framework, proposed by Peters and Waterman [PET 80], was used to assess how I5.0 Small and middle-sized companies have developed such resilience mechanisms during the pandemic by considering the interactions between technology (Systems), strategic alignment (Strategy, Structure), and organizational culture (Staff, Skills and Style). We argue that this multi-dimensional model in general, and its three cultural “Soft S” elements in particular, may help us to better understand human-centric facets of the I5.0 resilience phenomenon [LIU 20]. Furthermore, we have enriched the 7S approach by adding an eighth “S” to consider the role of “stakeholders” of the innovation eco-system in the resilience process.

Our 8S framework is consistent with the French approach to the I5.0 movement, led by the “Alliance Industrie du Futur” (AIF) association. This approach goes beyond the technology-centric German model of Industry 5.0 to also consider “new approaches to human relations at work”, “organizational and managerial innovations” and the role of “new business model” strategies [AIF 18]. This article offers insights from eight case studies of French I5.0 companies that earned the “Alliance Industrie du Futur” label due to their extraordinary integration of technological and non-technological elements in their development. We aim to address the following research question: **How do these 8S factors contribute to organizational agility and resilience among Industry 5.0 companies in France?**

The article is structured in three parts. The first part, dedicated to the theoretical background, briefly discusses the sources of organizational resilience and agility, the origins and categories of the 8S model, as well as the I5.0 paradigm in Europe. This literature review shows how the 8S model is well adapted to the study of organizational resilience and agility among I5.0 companies. The second part presents the research design and data collection process. The results are presented and discussed here. Finally, in the conclusion, the managerial and theoretical contributions are presented, as well as the limitations of our study and future research perspectives.

## 2. Theoretical background

At the very core of the I5.0 approach suggested by the European Commission is the principle that a more human-centric digital revolution could render the economy in general and industrial players in particular more resilient to economic downturns such as the one experienced during Covid. This vision is based on the premise that humans, not machines, are ultimately the ones in charge of adapting agile strategies, structures and resources to face such crises, even if they are supported by digital tools. This section looks at organizational resilience and agility as the ultimate sources of competitiveness in a turbulent environment, and the eight organizational variables involved.

### 2.1. Resilience and Agility

According to [DUP 19], agility can be defined as the ability of an organization to rapidly adapt itself to the changes in its innovation ecosystem. To become agile, organizations must adapt their strategies, structures, processes, and culture to create products and services that better respond to the needs of its customers and other stakeholders.

Defined as such, agility is a necessary requirement for organizational resilience. Giannakis and Louis [GIA 16] define resilience as the capacity of an organization to survive environmental changes. In an increasingly complex and volatile world, organizations must constantly adapt their business models if they expect to become resilient to crises. Unless they have a clear map of the variables involved in organizational change, small and medium-sized CEOs can become daunted by the multiple facets of this problem. It is not enough to revisit the strategy, they must update their structure, the organizational knowledge (staff and skills), technology and culture. A framework of the key elements behind organizational agility (and subsequent resilience) could help these managers to better understand what dimensions need to be considered to increase their chances of success.

Few studies have analyzed I4.0 and I5.0 resilience from this perspective. In one such rare instance, Tortorella *et al.* [TOR 21] have shown that I4.0 technologies positively influence the resilience of companies. Yet, there is a remarkable lack of research concerning the human-centric aspects of I5.0 resilience.

## 2.2. The 8S model

Over the last decades, several organizational theories have been proposed to define how companies adapt to dynamic environments [LAW 67, ALI 21]. The literature suggests that the nature of organizational structure in industrial versus post-industrial firms could be synthesized by two different types of organizations: mechanistic versus organic structures [BUR 61]. The mechanistic paradigm is effective when environments have a high degree of certainty, in which technologies are stable and non-innovative. These mature organizations tend to treat employees as “human resources” that require little autonomy and offer few creative insights. Internal structures tend to be vertical, functional, and bureaucratic. These organizations tend to favor McGregor’s “X Theory” of human behavior and impose a rigid, controlling culture that assumes humans must be extrinsically motivated [MCG 60, CAR 05].

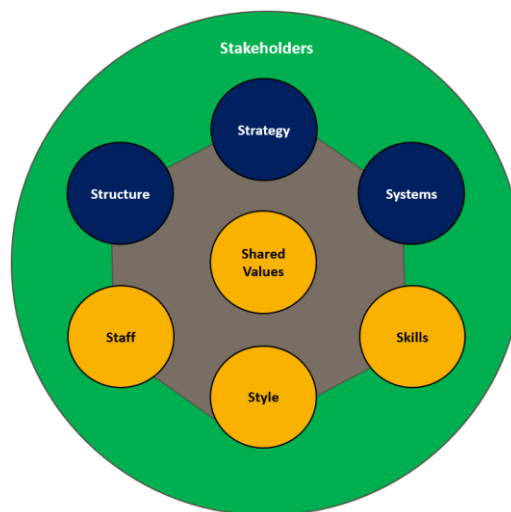
I5.0 organizations clearly belong to the organic paradigm, which recognizes the unstable, even chaotic nature of the external post-industrial environment. Technologies are typically non-routine, and organizations are based on teamwork, on face-to-face interactions and innovation through constant learning. Shared qualities with the I4.0 such as autonomy, empowerment, horizontal relationships, and consensus building become essential [BUR 61]. Management favors the “Y Theory” of human behavior, developing a culture of trust, empathy and self-driven / intrinsic motivation [MCG 60, CAR 05].

To better understand the internal dynamics of organic I5.0 companies, a multidimensional model capturing the structural, technological, strategic, and cultural dimensions of these complex organizations is needed. The McKinsey 7S model, proposed by Peters [PET 80], was a natural choice. It has become a key reference to analyze how a firm’s organizational design can be aligned to achieve effectiveness in a changing environment [RAV 15]. Even though a few previous works have relied on the 7S to evaluate the maturity level of I4.0 companies [e.g. DEM 19a, SAL 18], the recency of this paradigm makes such instances rare.

According to Ravanfar [RAV 15], this classic framework can be split in two dimensions: “hard Ss” (Strategy, Structure, Systems) and “soft Ss” (Staff, Style, Skills and Shared values). Hard Ss are tangible and explicit whereas the soft ones are human-related dimensions which are intangible and implicitly contribute to the formation of organizational culture. This differentiation seems essential to understand the role of human-centric factors in organizational resilience and agility. In our study, we decided to add an eighth “S” to account for the impact of the external environment and its “Stakeholders”. This extra dimension is necessary to capture the trends in the external environment, its key players, opportunities and threats that will shape the internal Ss [TER 01].

Figure 1 presents our adaptation of the 7S model for the purposes of this research. The soft Ss (yellow) refer to behavioral / human aspects of organizational resilience, such as learning, knowledge sharing and commitment [BEC 09]. Indeed, Weick and Sutcliffe [WEI 07] emphasize how quality staff and relevant skills are required to develop effective resilience. Best practices in this domain include the reduction of the number of hierarchical levels and the autonomy of teams to encourage employee engagement and creativity. The other Soft Ss (Style and Shared Values) also play a key role in this process. Shared values are common beliefs (such as vision, mission and social impact) that help employees identify with corporate vision and social mission [MCD 91]. Management Style refers to how the organizational culture is translated into HR policies to improve overall performance and well-being.

The hard Ss (Strategy, Structure, Systems and Shareholders) are strongly influenced by the Soft Ss. On the one hand, a coherent strategy and a flexible structure using competitive systems are the key to agility, as long as they are capable of leveraging the ability to learn with stakeholders in the external environment, such as customers, competitors, suppliers, partners, universities, research centers and government agencies. On the other hand, without the talent of a highly qualified staff, developing the right skills to cope with change and motivated by an appropriate management style, even the best strategies are doomed to fail [TER 01].



**Figure 1.** 8S Framework (adapted from Peters, Waterman and Philips [PET 80])

### 2.3. From I4.0 to I5.0

The executive chairman of the World Economic Forum, Klaus Schwab was one of the leaders of the I4.0, defending the customization of products through flexible mass production methods based on the use of “smart” (cloud-based, data-driven) devices for self-diagnosis, self-configuration, and self-optimization of manufacturing lines [LAS 14]. According to Frank *et al.* [FRA 19], nine technologies are at the core of I4.0 processes: Augmented Reality, Internet of Things (IoT), simulation, autonomous robots, cloud computing, cybersecurity, additive manufacturing, vertical and horizontal system integration, big data and consumer analytics. To help rank the degree of maturity of I4.0 companies, Lizarralde Dorronsoron *et al.* [LIZ 20] created a scale with the following dimensions: overall information technology strategy, smart products and digital twins, adaptive and learning capabilities, product tracking, smart operations, data-driven services, smart factory systems.

Industry 5.0 emphasizes human expertise and a better collaboration with robots, smart machinery, and AI [MAD 21]. The focus of I5.0 is on the optimization of human work through technology. Machines can drive speed and accuracy of operations, while humans bring empathetic decision-

making, creativity and expertise to the equation. This increases the responsibility but also the flexibility of humans as they interact to increase product adaptation to each client, combining both economies of scale and scope [CAR 22]. In I5.0, humans will typically engage in missions requiring adaptation and thinking, while machines will be used for repeated, dangerous or unhealthy tasks. Human expertise is at the center of I5.0 compared to I4.0 because the process of production needs highly skilled professionals. Combining the best of both worlds, machines produce real-time data that is processed by artificial intelligence (AI) and humans monitor the activity and make decisions. Thus, predictive analytics and artificial intelligence are used as support tools for human decisions. In this paradigm, robots and machines become collaborative tools, “cobots” [MAD 21]. I5.0 typically involves technologies such as Edge Computing, AI, Cobots, Digital Twins, Blockchain, Internet of Everything, and Big data analytics [JAV 20].

In Europe, Germany and France are leaders in I5.0. The German Industry 4.0 movement, also known as “*Industrie 4.0*”, is a national strategic initiative launched by the German government through the Ministry of Education and Research (BMBF) and the Ministry for Economic Affairs and Energy (BMWi) in 2011<sup>2</sup>. The term was coined by German research politicians to explicitly circumvent cumbersome headlines such as “Cyber-Physical Systems” (CPS). The initiative aims to drive digital manufacturing forward by increasing digitization and interconnection of products, value chains, and business models, and to support research, networking of industry partners, and standardization<sup>1</sup>. It is pursued over a 10-15 year period and is based on the German government’s High Tech 2020 Strategy.

To follow up on Germany’s example, France created the “*Industrie du Futur*” alliance (AIF) to showcase best practices in this domain. Inaugurated in 2015 by eleven key stakeholders in the French Innovation system, the AIF’s main goal is to support French companies, particularly SMBs, in their industrial transformation by developing business models based on digital technologies while at the same time emphasizing non-technological dimensions of organizational competitiveness. This approach of industrial “production as a system” considers not only technology but also organizational, economic, human and social dimensions [AIF 18]. It aims to make companies more attractive for new talents by involving employees in projects such as collaborative engineering and open innovation solutions. The development of employee training and well-being is a key aspect of the French approach [AIF 20].

Thus, the AIF framework differs from the German Industry 4.0 model [BMB 11] in the way it emphasizes not only the hard-S components of organizational resilience and agility but also the human-centric soft-S dimensions. In that sense, the AIF approach is closer to the Industry 5.0 vision. The principles of this French movement [AIF 18] were designed to foster agility and resilience not just through advanced technologies, but also through the development of an innovative organizational culture, built on a skilled staff and appropriate business strategies.

As previously stated, the objective of this paper is to investigate the role of these multiple dimensions in the resilience of I5.0 companies, particularly those involved in the “Vitrine Industrie du Futur (VIF)” AIF initiative<sup>3</sup>. The following sections detail how we used the 8S framework as a basis for understanding how hard and soft elements of organizational design contributed to agility and ultimately to their resilience during the Covid-19 crisis. To reiterate our purpose, the research question driving the study was “how do the 8S factors contribute to organizational agility and resilience among Industry 5.0 companies in France?”.

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<sup>2</sup> [https://ati.ec.europa.eu/sites/default/files/2020-06/DTM\\_Industrie%204.0\\_DE.pdf](https://ati.ec.europa.eu/sites/default/files/2020-06/DTM_Industrie%204.0_DE.pdf)

<sup>3</sup> See full list of participants here: <https://vitrinesindustriedufutur.org/>

### 3. Methodology

We conducted our study during the first months of the Covid-19 pandemic in 2020. The sample consisted of eight companies labeled as “Vitrines Industries du Futur” (VIF) for their operational excellence according to the French I4.0 and I5.0 criteria described above. A multi-case approach was applied (Stake, 2006; Le Blanc, 2016; Yin, 2003). This method is suitable for exploratory research with little theoretical evidence to support a hypothetical-deductive approach (Saunders *et al.*, 2009). Semi-structured interviews were conducted from May to June 2020 with CEOs and top managers of the eight VIFs from different sectors of activity (Table 1). As the data was collected during the Covid-19 lockdown in France, all interviews were done using Microsoft Teams as a videoconferencing platform. The questions guiding the semi-structured interview were derived from each of the 8S model categories as related to resilience and agility. Typical questions included probes such as “how did you adapt your [8S DIMENSION] to face the Covid crisis” and “how did those measures increase your ability to adapt (agility) and cope (resilience) with the crisis”. Interviews were transcribed and analyzed using a manual coding method based on the dimensions of the 8S model.

Cases were chosen on the basis of a selection of made by our partners in this research project, Bpifrance (a large investment bank who finances innovation projects in France) and the AIF. These partners were most familiar with the cases of companies that best fit the profile of human-centric management practices that resulted in agile solutions to the Covid crisis and thus created opportunities to improve organizational resilience.

#### 3.1. *Hard-S-driven resilience*

We decided to start with the dimension of stakeholders, as it involves external players such as suppliers, customers, institutions, competitors, and market trends that impact an organization’s strategy, structure and culture [ALI 21]. For most of the respondents, the pandemic has increased the need to have close partnerships with third parties. It has also emphasized the importance of using local suppliers to increase resilience against the crisis. E5, for example (who saw demand for their products actually increase during the pandemic), negotiated additional stocks with their suppliers to secure higher production levels and thus avoid shortages. Exchanging best practices through virtual communities with key partners and competitors also proved very useful (E1, E5, E6, E8). AIF encouraged this practice by creating “web coffee seminars” for their members to exchange ideas on how to face the crisis. The CEO of E3 stressed the importance of mutual trust with partners and customers in this period of crisis. He encouraged his salesforce to multiply “virtual visits” to their key customers to reassure them about their ability to maintain production despite the lockdown. He also increased collaboration with other research labs to discuss how to continue their innovation efforts at a distance and enhance telework productivity.

	<b>Founded</b>	<b>Activity</b>	<b>Interviewee's position</b>	<b>Date of interview</b>
<b>Enterprise 1 (E1)</b>	2010	Manufacturing lines for building materials & intralogistics	CEO	14/05/2020
<b>Enterprise 2 (E2)</b>	1947	Machining of mechanical parts	CEO	03/06/2020
<b>Enterprise 3 (E3)</b>	1992	Manufacturing of hearing protection	CEO	10/06/2020
<b>Enterprise 4 (E4)</b>	1993	Lock-wireless Anti-Rotational Devices	CEO	25/05/2020
<b>Enterprise 5 (E5)</b>	1991	Pet-food	Managing Director	04/06/2020
<b>Enterprise 6 (E6)</b>	1986	Malnutrition solutions	Operations Director	12/06/2020
<b>Enterprise 7 (E7)</b>	1973	Landscaping machines /equipment	CEO	09/06/2020
<b>Enterprise 8 (E8)</b>	1995	Semiconductors	Exec. VP Operations	29/05/2020

**Table 1.** *Sample Characteristics*

Results can be divided according to our model in two sub-sets: Hard S-driven resilience factors and Soft S ones, as displayed on Table 2

<b>8S Model</b>	<b>AIF axes</b>	<b>Cases</b>
<b>Hard S</b>	<b>1. Shareholders-driven resilience</b> - Network development, regional ecosystem integration, shared resources	E1, E5, E6, E8
	<b>2. Strategy-driven resilience</b> - Business model change, customer-centric development, differentiation; reinforcing R&D teams; use of intelligence systems to monitor the environment	E1, E2, E3, E4, E6
	<b>3. Structure-driven resilience</b> - Organizational innovation, agility, change management, cost-cutting reorganizations	E2, E3, E6, E7, E8
	<b>4. Systems-driven resilience</b> - Real-time process monitoring, IoT, collaborative platforms, cloud-based services, traceability	E1, E2, E3, E4, E5
<b>Soft S</b>	<b>5. Staff-driven resilience</b> - Talent attractiveness	E4, E5, E6, E7
	<b>6. Skills-driven resilience</b> – Internal competency development	E4, E5, E6, E7
	<b>7. Management Style-driven resilience</b> - Human-centered management	E5, E6
	<b>8. Shared-values-driven resilience</b> - Corporate Social / Ecological Responsibility	E2, E5, E6

**Table 2.** *Companies of the AIF axes of I5.0 development*

The crisis has led two companies (E4 and E5) to make plans to repatriate the production of certain products back to France to reduce decentralization and foreign dependency during the early stages of the pandemic. E3 stated that the crisis created opportunities for growth through the acquisition of weakened competitors. According to E4's CEO, "*the crisis made it easier to advance our R&D*



*strategy by hiring top talent from struggling industries*". For several of the interviewees, this is a time to revisit their business model strategies and customer-centric tactics and to reinforce their core competencies to create differentiation (E1, E2, E3, E4, E6, E7). As expressed by E7's CEO, *"the crisis forces you to rethink priorities"*. E3 will reinforce its intelligence systems to better monitor post-pandemic opportunities and threats.

Several companies understood that the crisis required rethinking their structure. E4 decided to use the downtime to develop new product lines. Most companies had to put in place telework solutions overnight; this transition was greatly facilitated by the fact that their information systems and records were already cloud-based and easily accessible from a distance. For E8, this transition to distance collaboration came even more naturally as they already had a multinational, multi-campus structure. The key to maintaining (or even increasing) productivity during telework was constant communication and structural agility (E2, E5, E8). Indeed, most companies mentioned that their pre-Covid employees were used to shifting jobs according to changing demands (E3, E6). Of course, manufacturing jobs could not be done from a distance. As a key to maintaining operations during the lockdown E5 and E6 mentioned a spirit of solidarity among "blue-collar" workers and the professional pride in being part of an "upside-down pyramid", where manual labor is highly regarded and valued. Flexible production systems allowed rotation of people with partial unemployment status (E2). Adoption of legally imposed measures such as determining who was "essential personnel" and who could/should work from home eventually came down to a line of fracture between the people operating the machines on the factory floor and the managerial staff who could work behind a computer screen from home. But there were several examples of solidarity from white-collar managers coming to the factories in spite of their entitlement to work remotely.

Highly automated production lines using robots facilitated the adaptation of most interviewed companies. Indeed, to cope with stronger demand during the lockdown, E5 activated their robots at night and at the weekends to increase production while compensating for fewer human operators. E4 also intensified digitalization by acquiring new tools such as a 3D scanner, Computer-Aided Design software, and 3D printers. E6 similarly developed its 3D printing capability to overcome maintenance problems with spare parts. E8 and E6 intensified the automation of support functions (finance, HR) during the pandemic. *"The key to driving this automation process without losing employee morale is to find a balance between varied human tasks and automation"*, stated the CEO of E2. Most companies benefited from pervasive digital tools and automation to scale production up and down according to the shifts in demand during the pandemic (E5, E2, E4, E1, E3).

### **3.2. Soft-S-driven Resilience**

E5, E4 and E6 all emphasized the importance of reassuring their workforce by multiplying communication channels during the crisis. E3 increased the frequency of transversal meetings to discuss not only strategic changes to adapt to the crisis, but also to give feedback and reassure the staff about the security of their jobs despite the uncertain times. They managed to keep morale high by reminding employees of the company's core competencies (adaptability, resourcefulness, innovation) and how these same values would see them through the crisis. The fact that most companies in our sample had a culture of empowerment and engagement led to several employee-driven solutions to adapt to distance project management, establishing hybrid workplace routines (with a blend of face-to-face and distance communications). According to E4 and E7, the ability to attract top talent while also developing internal competencies was the key to building a resilient workforce.

E4 and E7 put forward their employees' capacity to adapt to different tasks using e-learning to increase their agility to deal with changing scenarios. Having a high level of digital literacy also helped them to mobilize different tools and platforms to maintain production despite partial lockdown constraints. According to E8, the crisis showed the importance of relying on a high-performing staff to leverage innovation and adaptability to become more resilient.

Overall, the Covid-19 crisis demonstrated the importance of a strong culture with commonly shared values. To strengthen the sense of community and belonging, E3's CEO created weekly videos with personal messages to all employees and organized virtual meetings to update the employees on how the situation evolved. E6 emphasized its social mission (producing and delivering malnutrition solutions across the globe) to inspire not only employees but also volunteers who wished to work on a part-time basis to double their efforts to increase production, knowing that the pandemic would certainly make their products more relevant than ever.

#### 4. Results and discussion

The Covid-19 crisis presented an unprecedented challenge in terms of strategic adaptation and resilience across the Globe [SPI 21]. While some recent publications have covered the topic of the resilience of Industry 4.0 [BEL 21, DEM 19b], and Industry 5.0, few studies have addressed the impact of Covid-19 on the organizational resilience of I5.0 companies. The aim of this research project was to use the 8S framework to better understand the impact of hard and soft organizational variables on I5.0 SMEs resilience during the crisis. This framework facilitated the assessment of how a few I5.0 SMEs in France created resilience by adapting their strategy, structure, technology and ecosystem (tangible, hard-S variables) thanks to their flexible, agile, and motivated staff, their skills, and their shared values (intangible, soft-Ss).

Our findings confirmed that the resilience of I5.0 companies was directly linked to their strategic ability to quickly adapt their strategies to minimize the impact of the crisis both on management and production [JAV 20]. Like the results by Ramirez-Peña *et al.*, [RAM 20] and Belhadi *et al.* [BEL 21], we also found the importance of digitalization strategies in assuring continuity of activities during the pandemic. However, we realized it was not the “Cyber Physical Systems” that saved the day but human centric elements such as strategic flexibility and resourcefulness that allowed these companies to survive (and even thrive) during the crisis. Tools are important for developing agile strategies or resilience, but the other people-centric elements of the model (staff, skills, shared values) seem to be even more important.

Regarding the related structural changes, most interviewed companies displayed surprising agility to adapt to remote or hybrid working, reducing the risks of Covid-19 contagion while still maintaining production (E1, E3, E5, E7 for instance). Incentive measures had to be put in place to substitute contaminated personnel. Last-minute calls to participate in off-shift tours of duty were not uncommon. A spirit of voluntary participation in exceptional efforts emerged in cases where inverted pyramid structures were already the norm. Historically, most VIF companies already had very horizontal or bottom-up organizations, with autonomous production units and agile, empowered employees [AIF 18]. That flexibility and autonomy apparently helped their staff acquire the new skills they needed to shift the mode of production practically overnight. These results are aligned with Lepore, Micozzi, and Spigarelli [LEP 21], showing the strategic role of employee empowerment during the pandemic in Industry 5.0 companies. Belhadi *et al.* [BEL 21] also found a similar correlation between well-trained staff, structural agility and organizational resilience as key characteristics of companies that coped well with the Covid-19 emergency.

As was to be expected, technology and automation, in general, and communication systems, in particular, played an important role in this process. Most companies were quick to develop virtual seminars, e-learning and distance project management tools to work in hybrid mode. Their level of familiarity with technology was a major differentiator. With regards to the production processes, some companies took the downturn as an opportunity to invest in R&D to improve automatization by upgrading their systems or reincorporating external activities. Other companies had to adapt their strategies and consequently re-design their structure to adjust production capacity according to the demand. This was greatly facilitated by their advanced technologies [RAI 21, BEN 21, NAR 21].

With regards to stakeholders, we saw how companies established deeper connections with their clients and partners as well as companies of the same sector as a way of coping with the crisis and finding common solutions. Some companies used the downturn to intensify cooperation with suppliers to co-develop new products. The AIF ecosystem played an important role by animating communities of practice and “virtual coffee” sessions to share insights and resources. Several CEOs acknowledged this as an important source of their resilience. Our results are aligned with those of Kumar *et al.* [KUM 20], who show that I5.0 companies were less challenged by the crisis and could maintain relations with key stakeholders (such as customers and suppliers).

However, our study also highlighted the importance of “soft-S” variables, such as the ability to coordinate dispersed staff to adapt their skills or to develop a different management style more adapted to the strategic imperatives of the crisis. Some of the interviewed managers had to face a paradox as they had to maintain employee motivation while reducing production capacity, thus increasing productivity. The French government’s partial-unemployment benefits helped avoid firing unused labor. Rather than losing this talent, most managers embraced this opportunity to upgrade their skills through training.

Some of our interviewees created resilience by refocusing on long-term projects, attracting new profiles for R&D. Most companies reaped the benefits of a pre-Covid culture of trust, relying on the goodwill of their employees to adapt. These results are consistent with the study of McKinsey [AGRA 21] on how companies of Industry 4.0 were able to continue and even accelerate their transformation during the crisis.

Concerning the dimension of shared values, the crisis was “*a test of how much of the corporate discourse could really be put in practice*”, as the CEO of E7 stated. The lockdown period was an opportunity for companies to reassert their core values with their employees. Belief in their vision and trust in their leadership proved crucial to overcome the crisis. In order to maintain this social bond in spite of telework distance, top management understood the need to multiply channels of virtual interaction [CRA 20].

## 5. Conclusions

The Covid-19 crisis presented an unprecedented challenge in terms of strategic adaptation and resilience across the Globe [FON 18]. While some recent publications have covered the topic on the resilience of Industry 4.0 supply chain during this period [SPI 21, BEL 21, DEM 19b, SIN 22], few studies have addressed the combined role of human-centricity and agile best practices in organizational resilience among I5.0 companies. The aim of this research project was to use the 8S framework to better understand how these eight components were combined to help companies cope with the crisis. Our findings suggest that the competitiveness of I5.0 companies in our sample is directly linked to how they combined technology (systems) with talent management (staff, skills, style) to promote a long-term vision (shared values) and achieve their strategies with the help of stakeholders in the surrounding ecosystem.

### 5.1. Theoretical contributions

Our research provides novel insights into how Industry 5.0 companies adapted to the Covid-19 crisis. The 8S approach helped us understand how I5.0 companies can: (1) analyze the opportunities and threats in the external environment from the perspective of their relationship with key stakeholders; (2) adapt their strategies according to these trends; (3) adjust their structure thanks to their organic nature; (4) make use of their advanced technologies and communication systems to adapt their processes.

Other studies have indicated similar findings, as shown above. However, unlike those, we have emphasized the importance of “soft” / human elements as enablers of this resilience, such as (1) developing a trust-based management style, empowering employees to co-construct the transition; (2) focusing on the skills development to facilitate the adoption of new tools and technologies, (3) acquiring new talent to address the unmet needs of the post-pandemic phase. All of these soft elements were enabled by a strong corporate culture (shared values) that favors self-development, autonomy and teamwork.

## **5.2. Managerial contributions**

Beyond the illustration of the intricate relationships of the original 7S variables, this study contributed the 8<sup>th</sup> dimension to the classic McKinsey framework, thus emphasizing the role of the external environment in shaping corporate resilience. Our study provides a unique insight into how I5.0 companies managed the crisis. A great part of their resilience was derived from tangible and intangible assets developed prior to the first lockdown, such as their affinity with robotization and automation technologies. Yet, the crisis seems to have accelerated their transition to the Industry 5.0 paradigm.

The 8S framework can be a valuable guide for managers looking for how to align the hard and soft variables in their organizational environment. By adding the 8<sup>th</sup> S to the classic McKinsey framework, we remind these managers of the importance of understanding the external environment before re-designing their strategy, structure and systems. Most importantly, we emphasized the role of non-technological, human-centered elements in this resilience project. The 8S framework can be used as a self-diagnosis tool to evaluate companies on a resilience scale similar to the maturity model of Lizarralde *et al.* (2020). These contributions may thus contribute to consolidating the European Commission guidelines on how to develop a healthier, more resilient and agile I5.0 ecosystem.

## **5.3. Limitations and future research**

This study focused on a limited number of companies and in a very specific context, the crisis of the Covid-19 and located in France. A longitudinal study focusing on the resilience of several companies within the Industry 5.0 movement would enable us to discover if these companies adapted differently to different crises and a wider research within other European countries is needed. Our future research could focus on the impact of the crisis on the evolution of the business models of Industry 5.0 companies. Indeed, we could complement Müller, Buliga, and Voigt’s recent study (2018) by applying the 8S framework in order to understand how I5.0 companies have adapted their business models to the crisis.

Furthermore, the enlarged 8S model we proposed could be further validated by using a quantitative approach based on a larger sample of European I5.0 companies. By developing a consistent measurement instrument and testing it with a representative sample, we can gain a better understanding of the categories of the model relating to each other and its overall explanatory power using advanced statistical techniques. Cross-country and cross-industry comparisons could help better understand how different managerial styles correlate with agility and resilience throughout the continent.

Finally, it is worth pointing out that these findings were drawn from interviews with high level managers (CEOs and executives). As the main purpose of the paper was to understand agility and resilience from eight different managerial perspectives, we neglected to hear the perspective of non-managers about this crisis and how it was survived.

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