Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Lean 4.0 tools and technologies to improve companies' maturity level: the COVID-19 context

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Abstract

The global pandemic triggered by the new COVID-19 led to severe limitations in daily life, both private and professional. Almost all companies have been affected in one way or another. The COVID-19 crisis imposed new challenges for enterprises. As a result, many companies have been forced to rethink how to align many of their processes and practices with the new COVID-19 context, and fulfill their mission while maintaining a safe and secure management business operating environment for both employees and customers. This paper aims to bring empirical evidence, through a questionnaire survey, of the positive influence of using Lean Management tools and Industry 4.0 technologies on five organizational dimensions (strategy, leadership, culture, operations and products, and technology). Data from 98 Algerian and French companies of different sizes and representing various activity sectors was collected. Respondents were asked to answer 5 organizational dimensions (strategy, leadership, culture, operations and products, and technology) in the context COVID-19 crisis. Statistical analysis was performed through path coefficient using a Smart PLS. The results show that Industry 4.0 technologies tend to be strongly associated with Lean management tools, and that understanding the relationship between Lean management tools and Industry 4.0 technologies can improve the organizational dimensions: leadership, strategy, operation, and production. This research provides managerial implications that can help managers to understand the synergies and benefits of integrating and implementing Lean 4.0 tools and technologies in organizations in both crises and regular contexts.

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1. Introduction

On March 11, 2020, the World Health Organization (WHO) declared a pandemic of the highly contagious disease COVID-19 (coronavirus) [1]. As a result, the governments of several countries are taking actions that significantly affect the life of society, to reduce the spread and transmission of coronavirus. For example, on March 26, 2020, the French National Statistical Office estimated that the current economy is at about 65% of its normal state [2].

In this regard, governments imposed strict restrictions on companies in different sectors, set health and social protection distances, and in many countries locked out non-core companies [3]. Therefore, the COVID-19 crisis brought new challenges to companies. As a result, many companies have been forced to reconsider aligning their operations and processes with the COVID-19 context to maintain their business mission while providing a secure environment for their staff and clients. The Process Improvement Institute has undertaken research on how to adjust business processes and activities to accomplish the desired results cost-effectively and straightforwardly within a specified timeframe [4]. In addition, crisis outcome research focuses on various topics such as the impact of business adaptations and learning and adapting to survive in a crisis [5]. Such situations help boost innovation approaches and help to identify new opportunities. Furthermore, by enabling connectivity between products, machines, and customers, and using the increasing capabilities of systems to make decisions, organizations can enhance their agility (high-level variability at great speed) and cost-effectiveness [6].

This paper aims to bring empirical evidence of the maturity of companies through the measurement of five organizational dimensions and of the positive influence of using Lean management (LM) tools and Industry 4.0 technologies on four of the five organizational dimensions.

The remainder of this paper is structured as follows. Section 2 presents the situation overview and the theoretical background for this study. Section 3 describes the research methodology, with the results of its application presented in Section 4. Finally, Section 5 closes the paper by presenting conclusions and future research opportunities.

2. Background

COVID-19 has affected many communities, companies, businesses, and organizations all over the world. Uncoordinated government responses and blockages have resulted in supply chain disruption. Literature on crisis management in organizations has been moving in several different directions over the past few years. It has taken various perspectives of finance, accounting, management [7], and strategic management [8], which include unexpected changes in a particular system or its parts, a potential threat to the existence of structures [9]. Research on crisis outcomes focuses on different areas, such as the relationships with stakeholders after the crisis [10]. Crises can also be viewed positively and lead to a more open and responsive approach to management [11]. Literature highlights the possible positive impacts of crises and emergencies, contributing to stimulating innovation approaches and identifying new markets, and striving for perfection focuses on waste disposal and reduction of ancillary work.

Seven types of waste disposal have been established, supporting the following waste management principles as suggested by Kohler and Weisz [17]: overproduction, waiting, transportation, overprocessing, overstocking or unnecessary storage, task switching, and defects. The need to reconsider process improvement methods has become necessary due to the increasing complexity of processes [13]. New opportunities for efficiency improvement have emerged thanks to the capabilities of Industry 4.0 and the Lean management (LM) philosophy [14].

LM focused on continuous improvement and value-added activities while avoiding waste [15]. LM is based on the tools cited in Table 2.

A paradigm shift called Industry 4.0 has emerged in the manufacturing sector. Industry 4.0 has become a popular term, and there are many definitions. It was launched in 2011 in Germany as Industry 4.0 in the framework of the

national high technology strategy for 2020 to help secure their future leadership position in manufacturing [16]. Kohler and Weisz [17] describe Industry 4.0 as a powerful new approach to production control, enabling real-time workflow synchronization, as well as individual and flexible production. Among the several definitions, the most common terms are communication, real-time, and flexibility. Industry 4.0 is based on the technologies cited in Table 2. Rossini et al. [18] from a literature review argue a positive correlation between Lean management and Industry 4.0, but without testing them empirically.

Maturity is "the state of being complete, perfect or ready" [19]. In general, maturity assessment or maturity models can be applied efficiently to evaluate a process or organization [20]. The evolution towards maturity can be described in the form of a maturity model. These virtual models are characterized using a scale of increasing stages, i.e., maturity levels. Maturity allows the company to position itself by defining the stage that best describes its current situation. According to its objectives and needs, the company can evaluate a desired level of maturity and begin the process of reaching it. Therefore, the maturity models allow framing the capacities to be acquired to achieve the desired level. To the present day, numerous maturity models are being used in software development, management, engineering, and innovation [21]. The following section examines the dimensions used in maturity models to exploit them later in the questionnaire design used in this research. Table 1 summarizes the types of organizational maturity models concerning their dimensions and an example of existing models of LM and industry 4.0.

Table 1. Types of maturity models.

Maturity Model Types	Dimensions
Industry 4.0 maturity model **[22]**	Maturity Model as part of the 5-step process to implement Industry 4.0; 4-dimensional technology-focused evaluation: Factory of the future, Strategy, People, and Culture.
Industry 4.0 maturity model for manufacturing enterprise **[23]**	65 maturity elements grouped into 8 maturity Dimensions: technology, strategy, and leadership, products, employee, customer and partners, values creation processes, data and information, corporate standards.
Industry 4.0 / Digital Operations Self-Assessment **[24]**	Online assessment in 6 Dimensions; focusing on digital capability in 4 levels; application as a consultative instrument for an application fee in 3 out of the 6 dimensions.
Deriving essential components of Lean and industry 4.0 assessment model for manufacturing SMEs [19]	The authors presented the tools of Lean management and industry 4.0 of characteristics of manufacturing SMEs and their 09 perspective dimensions: strategy, products, employee's customers, operations, leadership, suppliers, culture, and technology.
A maturity model for industry assessment 4.0 readiness and maturity of manufacturing companies **[25]**	The Proposed model includes a total of 62 mature elements that are grouped into nine business dimensions: strategy, people, leadership, products, operation, culture, customers, governance, technology.

After analyzing the maturity models, we conclude that they focus on the company's dimensions at the company's general management level, such as: Strategy, Leadership, Culture, Employees, and Technology. Most models contain a "Technology" dimension, but its design differs from one model to another. In addition to information technology, it tends to contain the information technologies in the company, such as: digitization of products and processes, and digital management. In this context, the present research focuses on the evaluation of the companies' adaptability concerning the five dimensions (strategy, leadership, culture, operation and products, and technology), to ensure process improvement by eliminating waste, and the possibility of applying LM tools and Industry 4.0 technologies for improvement and innovation [26]. Therefore, this study aims to test the following four hypotheses:

- Hypothesis 1: Lean 4.0 tools and technologies directly influence the strategy dimension.
- Hypothesis 2: Lean 4.0 tools and technologies directly influence the leadership dimension.
- Hypothesis 3: Lean 4.0 tools and technologies directly influence the production and operations dimension.
- Hypothesis 4: Lean 4.0 tools and technologies directly influence the culture dimension.

3. Method

A questionnaire-based survey was used to collect data to study the influence of using LM tools and Industry 4.0 technologies on four of the five organizational dimensions (strategy, leadership, culture, operations and products) (see Table 2). Firstly, the researchers have developed a literature review in industry maturity models [19], [22], [23], [25], which were used in the questionnaire structure. The study aimed to collect data from 120 Algerian and French firms.

The criteria used to select respondents followed the probabilistic method. This type of sample was chosen based on the following criteria: accessibility, simplicity and availability of the respondents contacted [30]. Also, responses to the questionnaire were collected from companies that met the eligibility criteria via Google forms from June to September 2020. Data was collected from 98 Algerian and French companies from different sizes and activity sectors. Corresponding to a high response rate of (81.7%) compared with the average response rate (15%) for management studies [28].

In assessing the adaptability of Algerian and French companies concerning the five dimensions and ensuring the improvement of processes and the possibility of applying Lean management (LM) and Industry 4.0. Respondents were asked according to the five organizational dimensions (strategy, leadership, culture, operations and products, and technology) during the COVID-19 crisis. The questionnaire was structured in two parts. The first part was constructed to obtain information on the demographics and businesses of the respondents. The second part includes five dimensions to assess the adaptability of firms to the COVID-19 crisis, with each dimension being composed of several questions. The researchers drew on the work of Kolla et al. [19] and Schumacher et al. [25] to develop the questions for each dimension. The fifth dimension is the technology dimension, used to measure the application of Lean 4.0 tools and technologies within organizations. and measure the impact of Lean 4.0 tools and technologies from the technology dimension on the other dimensions. The items of each dimension are posed as a Likert scale, ranging from 1 to 5, where 1 is "not implemented/not present" and 5 "fully implemented/present".

The researchers used the SPSS and Smart PLS method [29] to analyze these four hypotheses, and implemented the measurement model to verify their reliability and validity.

Table 2. Questionnaire structure.

Organisational dimension (OD)	Description of OD	variables	Survey/item indicator
Strategy	Formally institutionalized in an organization by a carefully planned logic and cannot be left to chance [30]	Q.1.1.1	The 1st step of the business continuity plan in organizations « BCP »: the financial performance should be to identify the activities necessary to ensure the collective life of the work team.
		Q.1.1.2	The 2nd step of the business continuity plan in organizations: identify among employees, the key factors and their responsibility.
		Q.1.1.3	The 3rd step of business continuity planning in organizations: identify key functions and minimum staffing levels to maintain critical activities
		Q.1.1.4	The 4th step of the business continuity plan in organizations: identify subcontractors and external dependencies
		Q.1.1.5	The 5th step of the business continuity plan in organizations: identify the protection equipment (storage location, replenishment mode, etc.)
		Q.1.1.6	The 6th step of the business continuity plan in organizations: staff communication and training
		Q.1.1.7	The 7th step of the business continuity plan in organizations identify all the documents of your plan
		Q.1.2.1	The 1st type of waste: overproduction
		Q.1.2.2	The 2nd type of waste: unnecessary treatments
		Q.1.2.3	The 3rd type of waste: Waiting
		Q.1.2.4	The 4th type of waste: Transport
		Q.1.2.5	The 5th type of waste: overstock or unnecessary stock
		Q.1.2.6	The 6th type of waste: unnecessary movement
		Q.1.2.7	The 7th type of waste: Defect
Leadership	Develop a culture of improvement [30]	Q.2.1.1	The 1st teleworking challenges your company has faced: Ability of the manager to supervise virtual teams and work autonomously
		Q.2.1.2	The 2nd teleworking challenge your company has faced is that work processes and measures are not conducive to flexible working hours.
		Q.2.1.3	The 3rd teleworking challenges your company has faced: Employees experience mental health problems due to social isolation and economic anxiety
		Q.2.1.4	The 4th teleworking challenges your company has faced: Teams find it difficult to communicate and collaborate virtually
		Q.2.1.5	The 5th teleworking challenges your company has faced: Inability to translate cultural forces into the virtual environment
		Q.2.2.1	The training on the risks related to COVID-19
Technology	Provide a technology-independent	Q.3.1.1	Lean tool: 5S
		Q.3.1.2	Lean tool: Just in time
		Q.3.1.3	Lean tools: Visual management

Organisational dimension (OD)	Description of OD	variables	Survey/item indicator
	baseline for the future deployment Lean 4.0 within organizations [23]	Q.3.1.4	Lean tool: TPM
		Q.3.1.5	Lean tool: Kanban
		Q.3.1.6	Lean tool: SMED
		Q.3.1.7	Lean Tool: Poka-yoke
		Q.3.1.8	Lean tool: Setup Reduction
		Q.3.1.9	Lean tool: Jidoka
		Q.3.1.10	Lean tool: Quality control
		Q.3.1.11	Lean tool: Supplier development
		Q.3.1.12	Lean tool: Andon
		Q.3.1.13	Lean tool: Cellular manufacturing
		Q.3.1.14	Lean tool: WIP techniques
		Q.3.1.15	Lean tool: Heijunka
		Q.3.2.1	Industry 4.0 technology: IoT
		Q.3.2.2	Industry 4.0 technology: 3D printing
		Q.3.2.3	Industry 4.0 technology: Data analysis
		Q.3.2.4	Industry 4.0 technology: Simulation
		Q.3.2.5	Industry 4.0 technology: Robotics
		Q3.2.6	Industry 4.0 technology: Pattern
		Q.3.2.7	Industry 4.0 technology: Optimization Algorithms
		Q.3.2.8	Industry 4.0 technology: M2M
		Q.3.2.9	Industry 4.0 technology: Cloud
		Q.3.2.10	Industry 4.0 technology: Big data
		Q.3.2.11	Industry 4.0 technology: Sensors
		Q.3.2.12	Industry 4.0 technology: Cyber physics security CPS
		Q.3.2.13	Industry 4.0 technology: augmented reality (AR) and virtual reality (VR)
		Q.3.2.14	Industry 4.0 technology: Environmental excellence
		Q.3.2.15	Industry 4.0 technology: Human vaporization
Production and operation	Production and operations management knowledge is being consumed and applied to map the field's supply-side to its demand effectively side [31]	Q.4.1.1	The estimated impact of COVID-19 on your company's year-to-date labor productivity: Negative impact
		Q.4.1.2	The estimated impact of COVID-19 on your company's year-to-date labor productivity: Moderate impact
		Q.4.1.3	The estimated impact of COVID-19 on your company's year-to-date labor productivity: positive Impact
		Q.4.2.1	The prevention action was taken for the reception of the product/service: identify a clear area for receiving, loading and unloading products
		Q.4.2.2	The prevention action was taken for the reception of the product/service: sending to the supplier of the sanitary instructions to be respected before delivery
		Q.4.2.3	The prevention action taken for the reception of the product/service: the employee keeps a distance of 2 meters between himself/herself and the other person
		Q.4.2.4	The prevention action was taken for the reception of the product/service: there must be no physical contact the signature of the delivery is made with two pens
		Q.3	About the procurement lead times which increased due to an influx of demand or shortages of certain products
		Q 4.4	About a temporary out of stock on specific product references
Culture	Develop a basic understanding of organizational project management practices among all project stakeholders [32]	Q.5.1.1	About how the organization's infrastructure managed the culture and workplace shift to virtual working: Low impact, little or no problems related to the transition to virtual work
		Q.5.1.2	About how organization's infrastructure managed the culture and workplace shift to virtual working: Moderate impact
		Q.5.1.3	About how organization's infrastructure managed the culture and workplace shift to virtual working: Important and high-impact issues moving to virtual work

The sample presents a balanced number of firms for each background variable (see Table 3). Most respondents were from large companies (50); most companies were from France (83,7%); the majority (45,9 %) had more than 20 years of experience, in fact and we have two big groups at the extremes: either with high experience (40 respondents) or low experience (45 respondents), not many in between.

Table 3. descriptive analysis.

Scale of company	Frequency	%
Small	17	17,3
medium	32	32,7
Large	49	50,0
Total	98	100,0
Country	*Frequency*	*%*
France	82	83,7
Algeria	16	16,3
Total	98	100,0
Years of experience of company	*Frequency*	*%*
< 5 years	40	40,8
5-10 years	9	9,2
10-15 years	3	3,1
15-20 years	1	1,0
> 20 years	45	45,9
Total	98	100,0

4. Results and discussion

Cronbach's alpha was measured to test the reliability and determine the questionnaire items' internal consistency [33]. Results of Cronbach's alpha coefficient indicated a reliability coefficient of 0.704. According to Santos and Reynaldo [33], a Cronbach's alpha value greater than 0.7 implies that the instrument is acceptable.

Each dimension's Maturity Model level (MM) results from calculating the weighted average of all timelines (MDIi) in its related dimension. The weighting factor (gDIi) is equal to the average importance score of all 98 respondents for each item. The maturity level is calculated using the following formula:

$$M_D = \frac{\sum_{i=1}^{n} M_{DIi} * g_{DIi}}{\sum_{i=1}^{n} g_{DIi}}. \quad (1)$$

M: Maturity; D: Dimension; I: Item; g: Factor weight; N: Maturity item

First, the authors evaluated the five organizational dimensions within the companies in Algeria and France during COVID-19 by giving the value five to the percentage 100%. In this way, the authors were able to measure the percentage of each dimension and present the five dimensions together in the form of a radar chart to show which dimensions the organizations focused on during the COVID-19 crisis (Fig. 1).

One of the main advantages of organizations is to be able to produce customized products for customers. The radar shows an important concentration in companies on operations and production with a percentage of 47.2%. This dimension considers the logistics of products inside and outside the company environment, and it is the most critical component in a company.

The second dimension is the strategy with a percentage of 35.6%. This dimension could overwhelm companies, as they are more likely to focus on tactics and operations to manage their day-to-day business. According to the result of this dimension, researchers note that in Algeria and France, 64% of the companies have given importance to the identification of key functions and minimum staff to maintain the essential activities of their lives, which justifies the importance of the elimination of added value and all sources of waste, and the authors note that the other steps have not been applied in all companies, therefore, according to the answers to the second question of the same dimension that is related to the seven Mudas faced during the COVID-19 crisis, the authors notice that COVID-19 has generated the seven types of Muda within the companies and the expectation in the first place with a percentage of 47.2%, followed by the unnecessary movements with 44.9% of responses; which implies that French companies must implement the Business Continuity Plan by following all the steps recommended by the French Ministry of Labor, because it is a tool that can meet the challenges of employee safety and maintenance of activities, including in degraded

mode.

In the third position, the researchers found the cultural dimension linked to the management of change during crises or in the event of changes and risks with a percentage of 33.7%. And leadership position with 28.7%. Yue et al. [34], in their research on leadership in American companies, conclude that leadership and communication are the key factors in creating and strengthening employee confidence, which promotes their acceptance and even their collaboration in change processes.

In the last dimension, the researchers have the technologies, where they examined the application of Lean 4.0 tools with 18%, despite this percentage, they were able to apply Smart PLS tests to measure the correlation between the LM tools and Industry 4.0 technologies with the other dimension that they will present in the next section [28].

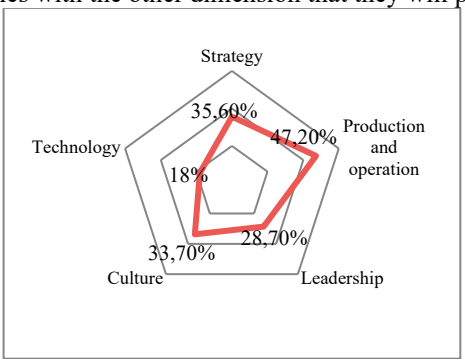

Fig.1. Evaluation of organizational dimensions application in companies in COVID-19 period.

To measure the application of Lean 4.0 tools and technologies within organizations, and to measure the impact of Lean 4.0 from the technology dimension on the other dimensions, the researchers continued to assess "discriminant validity" by calculating the values of Fornell and Larcker's criterion [35], and to prove the relevance of the structural model. The highest correlation was recorded between Culture-Culture (0.684), and the lowest correlation was recorded between Lean 4.0 tools and technologies-Culture (0.022).

To consolidate the assessment of the discriminant validity in variance-based structural equation modeling the authors used Heterotrait–Monotrait ratio (HTMT) (see Table 5), which is considered superior to previous indicators [36], as Fornell–Larcker criterion and (partial) cross-loadings (see Table 4).

Table 2. Fornell–Larcker criterion.

	Culture	Lean 4.0 tools and technologies	Leadership	Strategy	Production and operation
Culture	0.684				
Lean 4.0 tools and technologies	0.022	0.364			
Leadership	0.049	0.413	0.488		
Strategy	0.111	0.543	0.297	0.457	
production	0.031	0.423	0.127	0.453	0.439

Table 3. Heterotrait–Monotrait ratio (HTMT).

	Culture	LEAN 4.0 tools and technologies	Leadership	Strategy	Production
Culture					
Lean 4.0 tools and technologies	0.318				
Leadership	0.487	0.790			
Strategy	0.338	0.785	0.644		
production	0.424	0.665	0.676	0.661	

The results show that the HTMT values were less than 0.90, which means that this ratio meets the requirements of Henseler et al. [37]. In summary, the model evaluations provide good evidence of validity and reliability. Furthermore, the results prove that there is no collinearity problem interfering between Lean 4.0 tools and technologies with the other dimensions. The researchers evaluated the model by interpreting the coefficient of determination (R2), f2, and P-value. The coefficient of determination between 0.25 and 0.50 is considered good and above 0.50 is very well thought. Fig. 2 shows the values of r^2, the values range from 0.000 to 0.295.

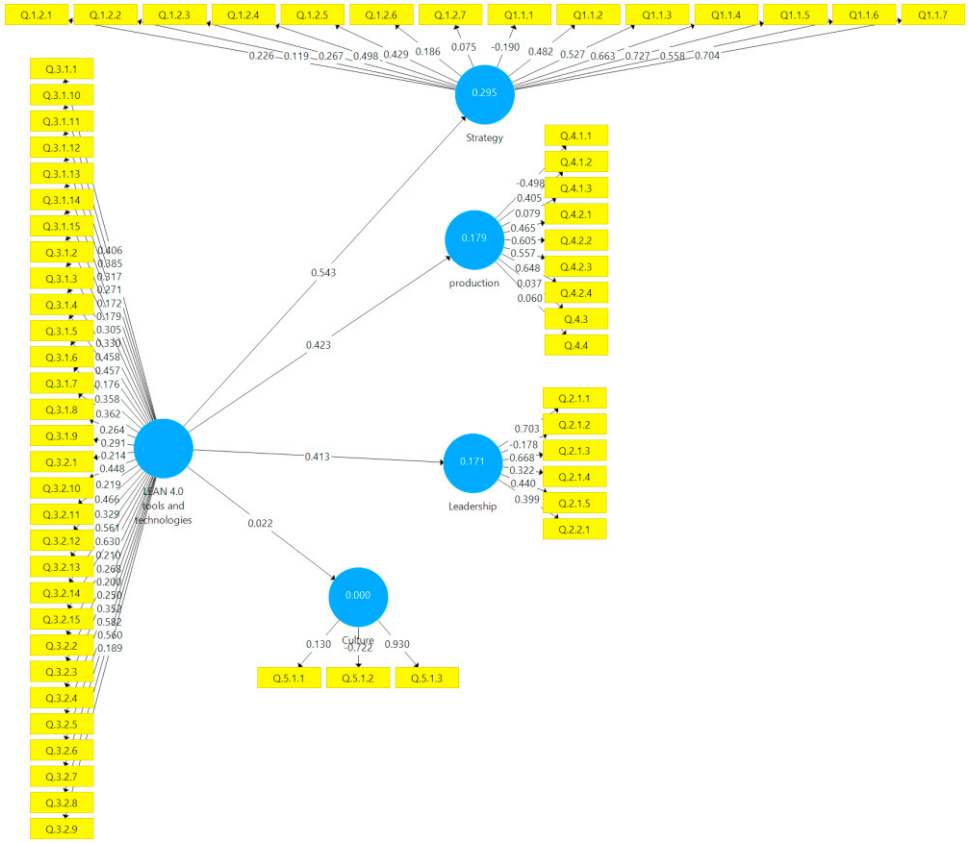

Fig. 2. Path coefficient results with Smart PLS.

In conclusion, regarding the model's predictive power, the authors have concluded that all Lean and Industry 4.0 tools and technologies are valid and reliable. The researchers tested their hypothesis with the coefficient parameter and the significant value generated from the 82% bias-corrected confidence intervals. The path coefficients give a significant value (at the p 0.05 level), with only the relation Lean 4.0 tools and technologies ➔Culture unsupported. Thus, the coefficient (T) value to the relation Lean 4.0 tools and technologies ➔ Culture is 0.022. In conclusion, all the hypotheses are supported, except the first hypothesis.

Akdil et al. [38] showed that Lean 4.0 transformation needs a comprehensive perspective on the company's strategy, leadership, operations, and products, which makes the maturity models (MM) suitable.

As Lean 4.0 is related to process improvement, it is easier to achieve sustainable supply chain and strategy capabilities [39]. Thus, Lean 4.0 can improve the company's leadership skills by decentralizing the decision-making process and providing autonomy to the company's modules. The researchers argue that to achieve and maintain the highest standards of Industry 4.0, it is important for Lean 4.0 is to successfully develop the leadership capabilities, skills, and competencies to achieve organizational excellence [40].

In this landscape, Lean 4.0 is a trendy manufacturing initiative that aims to innovate production processes, and operations toward sustainable practices by using enhanced digital technologies in the assembly line [41]. Each of the technologies suggested in the Lean 4.0 tools and technologies improves several aspects of production [6]. Lean 4.0 is

a toolbox for identifying and eliminating waste. By reducing waste, the production quality is enhanced; and production time and cost are reduced [39].

The particularities of this research due to the pandemic crisis do not enable us to assert that these results support previous studies, as there are few existing studies on Lean 4.0 tools and technologies with the organizational dimensions that have been developed during a crisis.

5. Conclusion

This research presents important theoretical contributions by showing the relationship between Lean management tools and Industry 4.0 technologies, and their impact on the organizational dimensions: leadership, strategy, operation, and production. It also provides managerial implications that can help managers and practitioners to measure companies' adaptability and understand the synergies and benefits of integrating Industry 4.0 technologies in LM in organizations during periods of crisis.

The researchers propose a new approach to identify the adaptability of firms in crisis management, such as the present COVID-19 pandemic. The five organizational dimensions: strategy, leadership, production and operation, technologies, also based on the integration of Industry 4.0 technologies and Lean tools, which corroborate the improvement of operational performance. The Smart PLS was used to verify the impact of 15 LM tools and 15 Industry 4.0 technologies on the other four organizational dimensions.

This research offers new perspectives on the organizational literature during the COVID-19 period, as it can be used to understand the relevance of the organizational mechanism in different types of companies, and how it can use Lean 4.0 technologies, to achieve a competitive advantage.

In analyzing the application of Lean 4.0 in the maturity models, there was a barrier in limited access to complete information on maturity models. Therefore, the analysis of the maturity model is based on the impact of Lean 4.0 on the other organizational dimensions: strategy, leadership, production and operation, and culture. The importance of this study consists of an analysis of the evaluation of the adaptability of Algerian and French companies about five organizational dimensions (strategy, leadership, culture, operation and products, and technology). This is important because there have been few studies of the adaptability of companies during the COVID-19 period and measuring the correlation between Lean tools and Industry 4.0 technologies, most of which are based on deductive or inductive analysis in regular contexts. The researchers have developed a maturity model for evaluating the adaptability of companies during COVID-19. This conceptual model allows us to collect data on the state of progress of manufacturing companies from different sectors and countries to identify additional success factors for an efficient industry, based on Lean 4.0 tools and technologies.

Business owners increasingly implement lean 4.0 because they are beginning to understand their potential. As a result, the role of these factor methods as process improvement and business performance practices will be reinforced by a new perspective that emphasizes the importance of their mechanisms on the financial performance of organizations, especially in crises.

The main limitation of the research is that the researchers only used organizations of two countries in their sample (Algeria, France). Another limitation is to measure the maturity of organizations with only five organizational dimensions.

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