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The Impact of Integration of Industry 4.0 and Internal Organizational Forces on Sustaining Competitive Advantages and Achieving Strategic Objectives

Muawia Ramadan [1],*, Tariq Amer [1], Bashir Salah [2] and Mohammed Ruzayqat [3]

[1] Department of Industrial Engineering, Faculty of Engineering and Information Technology, An-Najah National University, P.O. Box 7, Nablus 97300, Palestine; tariqamer101@yahoo.com

[2] Industrial Engineering Department, College of Engineering, King Saud University, P.O. Box 800, Riyadh 11421, Saudi Arabia; bsalah@ksu.edu.sa

[3] Transport Systems and Logistics, Department of Mechanical and Process Engineering, Faculty of Engineering, University of Duisburg-Essen, 47058 Duisburg, Germany; mohammed.ruzayqat@uni-due.de

* Correspondence: mramadan@najah.edu

Abstract: Adopting and implementing the Industry 4.0 strategy to increase the overall performance of the organization became one of the main aims of organizations. However, ignoring the linkages between implementing strategic decisions and organizational internal factors/forces can endanger and shrink its performance, competitive advantages, and thus its strategic success. In this context, many companies failed to achieve the expected benefits of adopting the Industry 4.0 strategy. Therefore, the gained advantages of adopting the Industry 4.0 strategy should be sustained through perfect and comprehensive integration between Industry 4.0 concepts and the accompanying upgrades and changes in the organizational internal factors/forces. This will capitalize on organizations' internal strengths and avoid weaknesses or turn them into strengths. In this paper, a conceptual model is proposed to investigate the relation between Industry 4.0 and internal organizational forces and examine their impacts on the sustainable competitive advantages of the organization. In the hypothesized model, three innovation capabilities (i.e., technological, economic, and commercial innovation) have been used to mediate the relation between the internal forces and the sustainable competitive advantages in parallel with Industry 4.0 adoption. The model and the proposed hypotheses have been simulated and tested using partial least squares structural equations modeling software called SmartPLS. The sample size used is 125 responses from different manufacturing fields. The results demonstrate the significant role that the internal organizational forces play in maintaining and sustaining the organization's competitive advantages in combination with Industry 4.0.

Keywords: strategic management; internal organizational factors; Industry 4.0; sustainable competitive advantages

1. Introduction

In strategic management, organizations should continually strive to explore the best strategies that can be adopted to help them achieve their long-term strategic objectives and strengthen their competitive advantages [1,2]. In the strategy formulation stage, strategists analyze both external and internal organizational factors/forces using different tools such as SWOT analysis (i.e., strength, weakness, opportunities, and threads). The external opportunities and threads, as well as internal strengths and weaknesses, can be identified for establishing long-term objectives [3,4]. In fact, the external factors surrounding an organization's business are beyond its control, but since the internal factors/forces are executed within different internal functional areas within the organization, they can be considered, to a large extent, controllable factors [3]. In [3], the authors classified the

internal functional sectors into five areas, namely, management and production operations, finance and accounting, marketing, technology and information system (IT), and research and development. In this context, organizations strive to adopt strategies that maximize their strengths and avoid weaknesses or turn them into strengths in order to develop distinctive competencies that can support the organization's competitive advantages over their rival companies [3].

Recently, and based on the breakthroughs in information and communication technologies (ICT), [5] concluded that organizations desire to adopt strategies in the field of ICT to improve their ability in real-time data exchange to increase their control upon their manufacturing systems as well as enable real-time performance measurement. Furthermore, with its dynamic characteristics, the global markets can be considered one of the main causes of external factors that afflict the success of organizations [6]. Therefore, companies are pursuing to adopt and integrate ICT strategies in an effective way to ensure long-term competitive advantages to thrive and survive in turbulent markets [7–9]. In this context, after the emergence of Industry 4.0, which is characterized by powerful features in supporting industrial systems with the help of ICT, several manufacturing organizations rushed to adopt this promising strategy to digitize the production processes, improve real-time data exchangeability, improve performance, and thus enhance their competitive abilities [10–16]. The idea of Industry 4.0 revolves around converting organization's components into smart entities and building a highly advanced real-time smart IT system to facilitate the interactions between these entities in real time. Therefore, the overall production system becomes smart and self-reliant in order to smartly monitor, predict, control, and maintain its operational performance [17–20]. Moreover, Industry 4.0 is proposed to enable vertical and horizontal integration between all functional areas in organizations to optimize their operations through real-time data exchange [21,22]. So, the Industry 4.0 concept is in line with the idea of digital transformation of organizations in order to emphasize the organizational changes necessary to achieve the strategic objectives [23,24].

Although Industry 4.0 has powerful features in comparison with traditional manufacturing management paradigms and has become the most attractive strategy for companies that enable them to improve their performance measures, several companies failed to achieve and sustain long-term objectives through adopting such promising technology-based strategy [5,25–27]. In this regard, many researchers have attributed this failure to causes or barriers related to internal organizational factors/forces such as an unskilled workforce, financial issues, cyber security, work standardization, etc. [5,28–34]. For example, [31] identifies 15 barriers that lead to the failure of adopting Industry 4.0. Most of these barriers and failure causes can be classified as internal organizational forces such as ineffective change management, resistance to change, lack of internal digital culture and training, lack of digital skills, lack of standards, regulations, and forms of certification, and others. Almost similar barriers and failure causes have been identified by [25]. This indicates that there is an improper integration between Industry 4.0 and internal organizational forces to achieve the expected results.

In this regard, after ten years of emerging Industry 4.0, it is noticed that several recently published research papers are investigating the failure to fully achieve the expected benefits of Industry 4.0. This may refer to the improper and incomprehensive implementation process; for example, the majority of research papers that discuss the implementation of Industry 4.0 focus on the operational and technical aspects and ignore the strategical and managerial perspectives in their journey of adopting and implementing Industry 4.0 strategy [25,35,36].

In order for companies to be able to make radical changes and innovations, they need to secure all the supporting areas in their organization [4]. Therefore, adopting a breakthrough strategy such as Industry 4.0 should be accompanied by upgrading the internal organizational forces as a supporting agent for Industry 4.0 toward success; otherwise, the organization will fail to sustain the gains expected from adopting this strategy and

thus hinder them from achieving potential strategic goals. This is confirmed by [Lu Y., 2017], showing that several researchers focus on the technical-based implementation of Industry 4.0 in manufacturing systems, whereas a few studies investigate how the Industry 4.0 can be integrated with all internal organizational factors at the corporate level to guarantee a sustained strategic success [37].

This can be considered an indicator for organizations to implement Industry 4.0 as a strategy to achieve long-term objectives and enhance competitive advantages rather than a tool used by individuals in some functional areas to achieve immediate goals.

As a result, the majority of research papers focus on the impact of adopting Industry 4.0 on the performance measures that show short-term benefits at the operational and technical level. The only article found in the literature that discusses the upgrading of internal forces in line with Industry 4.0 is written by [4]; the article analyzed differences among companies from five European countries in the context of readiness for Industry 4.0 in seven internal factors such as the internal system of education, knowledge management and development, corporate culture in relation to promoting innovation and knowledge development, and level of strategic alignment of development plans with existing resources.

Although several papers discussed Industry 4.0 from different sides, it is still obvious that a limited number of previous studies investigated and analyzed the impact of adopting Industry 4.0 from strategic perspectives supported by the organization's internal factors. This paper contributes to filling this gap by discussing the impact of the integration of Industry 4.0 and internal forces on the sustainable competitive advantages in the long term to achieve strategic objectives. The study analyses relationships between new internal forces and three innovative capabilities as a mediator to examine their impacts on competitive advantages.

In order to construct the conceptual model of this study, the internal forces/factors that may hinder the success of Industry 4.0, based on the literature, have been identified and classified under four internal force groups. After that, the subfactors have been used as measurable indicators in the conceptual model to numerically estimate how these factors impact the success of Industry 4.0 in enhancing and sustaining competitive advantages. The relationships between these factors have been represented using the path analysis technique. This method visually displays the relationships between measurable indicators and latent variables that are examined using partial least squares structural equation modeling (PLS-SEM). PLS-SEM is a multivariate statistical technique that allows researchers to indirectly examine and test unobservable latent variables using measurable indicators [38]. The constructed model has been simulated and tested using partial least squares structural equations modelling software (SmartPLS 3, SmartPLS GmbH, Boenningstedt, Germany). According to the results, the factors enhancing sustainable competitive advantages are considered strengths, whereas other factors are considered weaknesses that need to be turned into strengths, if possible; otherwise, they should be avoided.

The paper is organized as follows: An introduction with a summarized literature review has been provided in Section 1. In Section 2, the conceptual model and hypotheses have been introduced. Section 3 describes the research methodology starting with the design of the survey and data collection, and finally, the model analysis using SmartPLS software. In Section 4, the results obtained in Section 3 are presented and discussed. Section 5 discusses the limitations and future research directions, and finally, Section 6 presents the conclusion.

2. Research Conceptual Model and Hypotheses

2.1. Theoretical Model

The ability of an organization to make radical changes and adopt breakthrough innovations depends on its ability to pave the way for those changes by securing the supporting areas within its organization [4]. Therefore, the methodology followed in developing the conceptual model of this study focuses on the internal organizational factors. The internal organizational factors or forces that hinder the Industry 4.0 success have been investigated based on the literature, such as [25,26,31]. In our study, 22 barriers to Industry 4.0 success have been identified and considered as measurable variables. These barriers are used to measure the impact of the integration of Industry 4.0 with internal forces on sustainable competitive advantages through four types of organizational functions and three types of innovation. Therefore, the four first-order constructs, namely, technical virtuosity, economic and social environment, autonomous and decentralized system, and integration of production workplace, represent the basic functions and activities of the organization's internal forces, as depicted in Chapter three in [3]. More explanation about the relationship between each construct and its measurable variables is shown in Section 2.2.

The integration of Industry 4.0 pillars such as big data, augmented reality, and additive manufacturing can be considered an excellent supporter of innovation [39,40], which, in turn, leads to sustaining the competitive advantages of the organization [41–43]. In this context, the second-order constructs represent three types of innovation capabilities that mediate the relation between industry-based internal organizational forces and sustainable competitive advantages [44]. In this regard, Figure 1 represents the conceptual model of this research, which, in total, consisting of eight reflective constructs. The hypothesized relationships in the model will be tested to examine the overall impact on sustainable competitive advantages of the organization using SmartPLS software. In Table 1, indicators of the proposed constructs and their referents are listed.
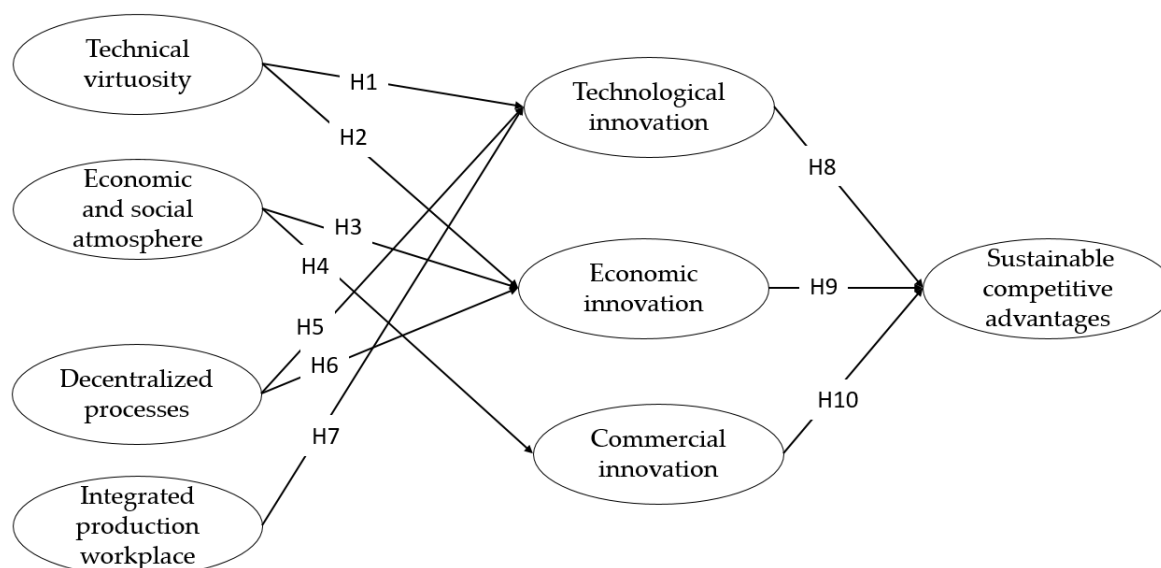
Figure 1. The proposed research model and hypotheses.

2.2. Research Hypotheses

2.2.1. Technical Virtuosity

In today's Industry 4.0 era, technological virtuosity is very important to improve the ability of organizations to quickly respond to the market's needs. Therefore, there is a need for new digital human skills and an associated digital strategy [31]. In this context, strategists need to recognize the main implications of Industry 4.0 on all organizational

aspects to create the most suitable decisions [45]. Therefore, recognizing the implication of Industry 4.0 will motivate employees at all functional levels to deal with this new strategy positively [46]. In addition to that, because of the necessity for a quick response to changes, organizations need to strengthen their internal research and development abilities to introduce new human-based technical practices and explorer the latest production-supportive techniques [47]. This will improve their ability to perform internal activities and tasks [48], digitalize intangible-based technical knowledge [49], and explore the best practices of Industry 4.0 to support technical virtuosity.

Finally, it is proposed that achieving all technical virtuosity aspects will pave the way for a strong technological and economic innovation. Consequently, the following hypotheses can be proposed:

Hypothesis 1 (H1). *Good technical virtuosity positively affects the firm's technological innovation.*

Hypothesis 2 (H2). *Good technical virtuosity positively affects the firm's economic innovation.*

2.2.2. Economic and Social Atmosphere

Companies are always hesitant to invest in new technologies since the economic gains of investing in new technologies are always questioned [47]. Therefore, strategists should make a clear assessment of the economic benefits gained by adopting Industry 4.0. The results can be used as corrective and guiding indicators [42]. Therefore, we need to conduct periodical cost–benefit assessments to evaluate how Industry 4.0 will influence the economies and the scale of the organization. Furthermore, the rapid advancements in technologies used in Industry 4.0 should be accompanied by the designed flexible employee reorganization standards. This means that an organization should prepare their employees to be ready for frequent reorganization practices since reorganization has become essential in adapting to the consequences of the latest technological advancements.

Industry 4.0 will not only have an impact on physical entities but the socioeconomic system of the organization as well [50]. Here the socioeconomic system describes the impact of Industry 4.0 on the work and employment environment from human perspectives. Therefore, a comprehensive update in socioeconomic systems in line with the developments of smart and digitalized manufacturing systems can be developed [19]. This will also pave the way for society 5.0 [51]. Furthermore, there is an interaction between economic innovation and social systems [52]. In a digitalized socioeconomic atmosphere, the internal digital culture of the organization will be enabled to integrate the team members with experts from different functional areas to enhance economic and commercial innovation [53]. Therefore, it is important to build a digital culture that describes how new Industry 4.0-based technologies will shape the way for employees to interact internally. Without a robust organizational culture, the human resources and work circumstances will be adversely impacted, and hence the economic and commercial innovation can hardly be developed or sustained as expected [46]. In other words, there is a need to build an organizational culture that is compatible with the new digitized working environment. Finally, adopting Industry 4.0 digitalization concepts at the economic and social levels will enable a company to distinguish itself from other competitors at the global standards level [51–53]. Consequently, the following hypotheses have been made:

Hypothesis 3 (H3). *The economic and social atmosphere positively affects the firm's economic innovation.*

Hypothesis 4 (H4). *The economic and social atmosphere positively affects the firm's commercial innovations.*

Table 1. Model operationalization.

Construct	Item No.	Indicator	References
Technical virtuosity (TV)	Q1	Industry 4.0 implications.	[45,46,54]
	Q2	Research & developments introducing new technical practices to support technical virtuosity.	[41–43]
	Q3	Explore the newest production supportive techniques.	[49,55–57]
	Q4	Digitalization of technical virtuosity.	[58,59]
Economic and Social Atmosphere (ESA)	Q5	Create a digital culture and work circumstances.	[31,46,58]
	Q6	Design flexible employee reorganization standards.	[30,60]
	Q7	Periodically conduct the cost–benefits assessment.	[31,47]
	Q8	Competencies for the digital economy.	[19,51,61,62]
	Q9	Global standards of socioeconomic position.	[54,55]
Decentralized processes (DP)	Q10	Decentralized organizational structure.	[63,64]
	Q11	Horizontal and vertical decentralization level.	[64–66]
Integrated production workplace (IPW)	Q12	Implementation of an integrated digital workplace.	[22,67,68]
	Q13	Degree of workforce productivity and innovation.	[67,68]
	Q14	Rate of knowledge and expertise exchange.	[67,68]
Technological innovation (TI)	Q15	Introduce new technology-based products.	[62,69–71]
	Q16	Introduce new technology-based processes.	[62,69,70]
Economic innovation (EI)	Q17	Change economic structure.	[52,72,73]
	Q18	Create new business models with the new economic activities.	[52,72,73]
Commercial innovation (CI)	Q19	Protect and exploit the intellectual property of intangible or tangible assets such as unique products difficult to imitate by competitors.	[42,53,62,69,71]
	Q20	Adopt innovativeness in promotion and marketing processes to adapt to recent trends and changes.	[42,53,62,69,71]
Sustainable competitive advantages (SCA)	Q21	Differentiation among other competitors.	[74,75]
	Q22	Continues improvements in economic indicators.	[74,75]

2.2.3. Decentralized Processes

The main goal of adopting the Industry 4.0 strategy is to create a fully smart, digitalized, and intelligent networked decentralized organization [65]. In the Industry 4.0 decentralized organizations, the huge amount of real-time data enable machines or products in the smart production system to make real-time decisions autonomously without human intervention [63]. Moreover, because of the high customization in the customer order, humans are still irreplaceable since coordination is required. Therefore, Industry 4.0 supports the self-controlling system that improves the workers' ability to make real-time decisions in unplanned events in real time, without turning to supervisors or problem solvers [66]. For strategical purposes, decentralization should include both horizontal and vertical integration of Industry 4.0, where nonmanagerial employees have the authority to make decisions without needing approval from low managers or the top management [76]. In the decentralization process, decisions can be classified based on the target strategic level, tactical level, operational, and real-time level [65]. Therefore, the Industry 4.0 smart system will foster both technical and economic innovation levels through quick response to the dynamic nature of manufacturing environments; for example, quick reaction to market dynamic behavior, fewer efforts on all levels, shorter production time, fewer quality problems, fewer machine breakdowns, etc. [57,64,67]. Therefore, building a decentralized system can support the compatibility of the Industry 4.0 and internal organization forces and thus enhance the innovation level [76,77]. Accordingly, the following two hypotheses have been made:

Hypothesis 5 (H5). *Decentralized Processes positively affect the firm's technological innovation;*

Hypothesis 6 (H6). *Decentralized Processes positively affect the firm's economic innovation.*

2.2.4. Integrated Production Workplace

To adapt to rapid changes in the markets and technological advancements, organizations tend to reshape the production workplace environment through the implementation of integrated smart and digital workplace [67,68]. The implementation of Industry 4.0 should be comprehensive and include all activities in the organization since the partial implementation will impact the performance in many ways, especially the employees and how they interact to perform their tasks [68]. Therefore, with the existence of Industry 4.0, the degree of workforce productivity and innovation will be changed directly to be reflected in the overall workplace production [78].

This construct focuses mainly on the role of an industry 4.0-based workplace environment in technological innovation. The smart and digitalized production workplace coordinates the work environment and facilitates expertise and knowledge exchange between talented professionals. This will improve the capability of organizations to continually generate new ideas and techniques and find new solutions [67,79,80].Furthermore, a digitalized workplace provides new features such as new ways of working, communicating, interacting, degree of employee engagement, and agility [68]. Accordingly, the following hypothesis has been made:

Hypothesis 7 (H7). *Integrated Production Workplace positively affects the firm's technological innovation.*

2.2.5. Technological Innovation

Innovation enables organizations to react faster to changes in highly competitive and dynamic markets [81]. Innovation is divided into several disciplines, one of these disciplines is technological innovation, and it focuses specifically on the technology and how it can be embodied effectively to improve new and existing products, services, and processes [82]. The technological innovation process in products and services is divided into three stages, namely, invention, realization, and implementation [83]. Therefore, in light of fast technological changes, technological innovation can be measured through, firstly, the rate at which the new innovative technological ideas are integrated within the newly released products [62,70] and secondly, the usage rate of the latest technologies to upgrade and improve the production system to support the sustainable competitive advantages of organization [71,82]. Technological innovation should fit with organizational structure since technological innovation influences organizational innovations, and this can be depicted through the compatibility between hardware and software parts [71]. Therefore, technological innovations are not linked to specific tangible products but are intellectual assets owned by the organization and they contribute to strengthening long-term competitive advantages [71]. The intellectual properties (IP) give the organization technological superiority over competitors and thus enhance sustainable competitive advantages [70]. Based on the literature, the following hypothesis has been made:

Hypothesis 8 (H8). *Technological Innovation can positively affect the firm's sustainable competitive advantage.*

2.2.6. Economic Innovation

Economic innovation is a new term that appeared recently after the emergence of Industry 4.0 and digital transformation. According to [73], economic innovation is a digital economic innovation that comprises different activities to maximize the benefits of an organization through enabling digital-based innovative changes. This will improve the interaction between all parties across the extended value chain, build new business paradigms to adapt to new market trends, and enable economic growth by combining with technological innovation. Accordingly, new economic competencies and skills are required to deal with such new developments and changes [55]. Based on the definition of

economic innovation, it is concluded that technological and economic innovation sectors are interconnected and influence each other [52,72] and that technological innovation will be accompanied by economic innovation. Therefore, the economic structure should be changed, as well as the way economic activities are performed [52].

Thus, economic innovation has a major role in achieving sustainable economic prosperity that enhances an organization's competitive advantages. Consequently, the following hypothesis has been made:

Hypothesis 9 (H9). *Economic Innovation positively affects the firm's sustainable competitive advantage.*

2.2.7. Commercial Innovations

As mentioned in Section 2.2.5, the third stage of innovation is the implementation which represents the ability of organizations to gain profit from the invented and realized products through continually adopting innovative tools in marketing and promotion to turn inventions into sellable products [62,70]. Several companies are strong at introducing inventions, but just a few of them are able to convert these inventions for commercial purposes in order to gain profit; this weakens the competitive advantages of organizations [71,84]. The invented and sellable products are represented as the intellectual properties of the company and considered an important factor for competitive advantages [43,46,71]. Therefore, the role of commercial innovation is to strengthen the competitive advantages by treating the invented and sellable products as intellectual properties unique and difficult to imitate by competitors since today's open innovation facilitates product imitation. In addition, it is important for the organization to adopt new and innovative marketing and promotion principles using the latest available methods and tools of the digitalized era rather than conventional tools to strengthen competitive advantages [42]. The following hypothesis has been made:

Hypothesis 10 (H10). *Commercial Innovations positively affect the firm's sustainable competitive advantage.*

2.2.8. Sustainable Competitive Advantage

Sustainable competitive advantages can be achieved through strengthening the ability of the organization to innovate at a faster rate to react against or adapt to changes faster than its competitors [85]. Therefore, differentiation in the market can be achieved through innovation [74]. From strategical perspectives, organizations either innovate or evaporate [3,65]. Thus, the innovation that leads to superiority in competitive advantages can be improved by utilizing a diversity of creative tools and techniques by individuals and groups [65]. Moreover, the ability of an organization to identify its internal strengths and weakness is essential in order to determine the innovation strategies on which the organization's overall competitive advantages rely [86]. The organization's competitive advantages can be measured through differentiation among other competitors using different tools; for example, a performance index can be used to indicate competitive advantage among other competitors [5,87]. Furthermore, economic indicators such as liquidity ratios, leverage ratios, growth ratios, and profitability ratios can also be used to measure the competitiveness of an organization [75,87]. Finally, in today's turbulent markets, the sustainable competitive advantages are not just about what assets (i.e., tangible or intangible) an organization has, as much as the rate at which an organization can acquire or develop new competitive factors in order to utilize them to support their economies of scale and success drivers [75].

3. Research Methodology

3.1. Survey Design

In order to test the constructed conceptual research model, a web-based survey was designed to assess the study's conceptual model hypotheses. The designed survey is divided into two parts; the first part includes four general questions regarding the information about the organization's business area, size of the organization, type of manufacturing system, and level of automation. The second part is the questionnaire that contains 22 questions that represent the indicators in Table 1. The questions have been developed on the basis of the previous related literature. The questions are used to establish multi-item reflective measures for the eight constructs of our research model. All questions are rated by respondents on a five-point Likert scale from "1: strongly disagree" to "5: strongly agree". In total, the survey consists of 26 relevant questions. Based on [38], the minimum recommended sample size is 50, which is enough to make decisions about the hypothesized relationships. The total number of received responses is 125, which exceeds the minimum required sample size. This will increase the credibility of the model and ensure the stability and reliability of the results.

3.2. Data Collection and the Analysis Method

In order to test the research model and the proposed hypotheses, the questionnaire was sent to manufacturing companies that are familiar with the implementation of Industry 4.0. To increase the credibility of the study, the questionnaire targeted respondents from top management levels. For data analysis, statistical software called partial least squares structural equation modelling (PLS-SEM) was used to test the conceptual model and analyze the collected data to test the proposed hypotheses. PLS-SEM is a dynamic multivariate statistical tool. Its statistical properties (i.e., ordinary least squares (OLS) regression-based estimation technique) make it very useful for studies such as competitive advantage studies, complex social and market studies, and success driver studies [88]. The mathematical basis of PLS (i.e., nonparametric estimation procedure) enables it to analyze a small sample size [38]. However, PLS-SEM has some mathematical shortcomings and limitations, such as the unidimensionality assumption [89].

3.3. Analysis and Results

Using PLS-SEM, the analysis of the constructed model in Figure 1 will be divided into two steps. The first step will include the assessment of the reflective measurement model (i.e., the outer model). This step examines the reliability and validity of the model using different tests. The PLS model estimation is shown in Figure 2, where results such as path coefficients, outer loadings, and the R^2 values of endogenous constructs are shown. In the second step, the structural model (i.e., the inner model) will be examined. Parameters such as explained variance (R^2) and the size and statistical significance of the path coefficients will be estimated. The results of the PLS inner model estimation are shown in Figure 3. The explanations and the results of both steps are shown in the following two subsections.
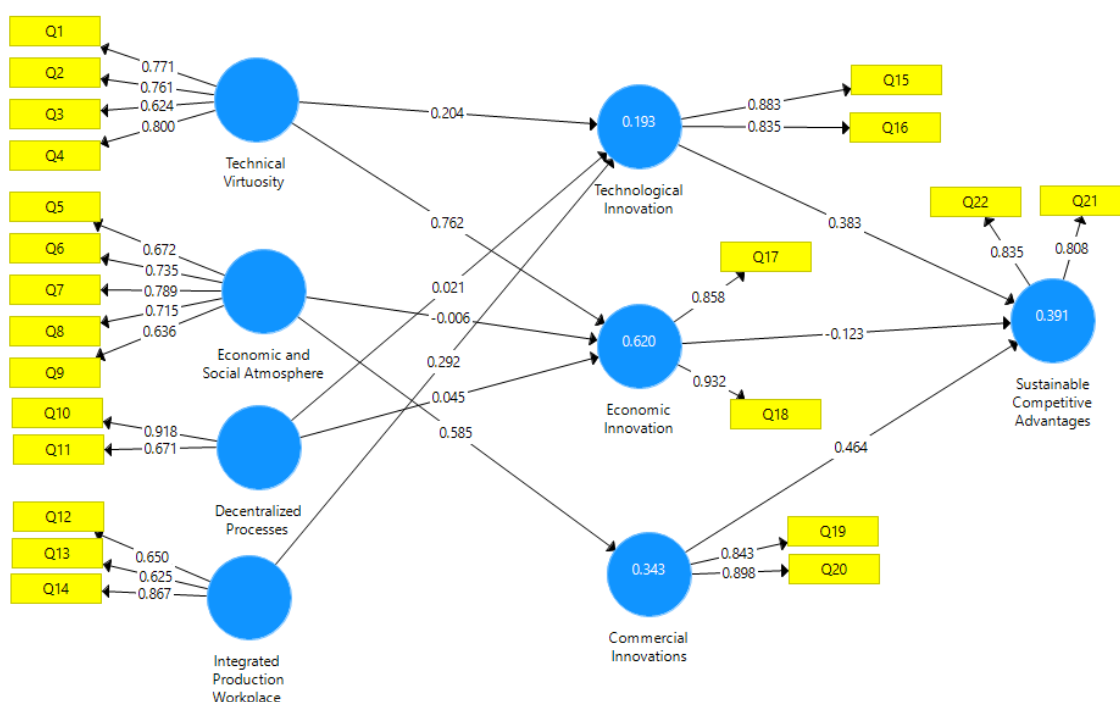
Figure 2. PLS path model estimation results of the proposed research model.
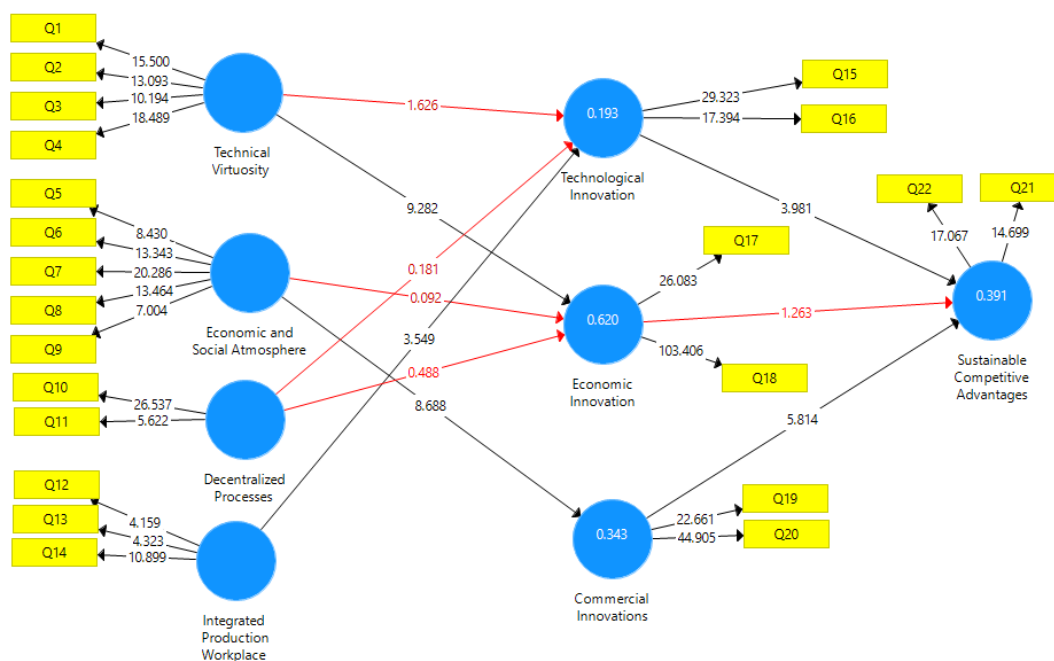

Figure 3. Bootstrapping results of inner model estimation.

3.3.1. The Measurement Model: Reliability and Validity Analyses

The reliability and validity analyses are considered the main statistical tests to assess the measurement model [38]. For example, reliability measures include indicator and construct reliability, internal consistency measures (i.e., Cronbach alpha and composite reliability), and composite reliability, considered a double-check test of the internal consistency of the constructs. The validity tests include construct validity (i.e., outer loading), convergent validity (i.e., average variance extracted (AVE)), and discriminant validity such as Fornell–Larcker criterion, cross-loading, and heterotrait–monotrait ratio (HTMT) of correlation criterion [38]. HTMT will be used as a double-check test for discriminant

validity since HTMT is more accurate than Fornell–Larcker criterion in assessing discriminant validity [90]. HTMT value ranges between 0 and 1, where values less than 1 indicate a good reliability level.

Based on [38], good reliability values of the internal consistency should be between 0.6 and 0.7, where Cronbach's alpha is considered as the lower bound, and composite reliability is the upper bound of internal consistency [38]. Table 2 shows the results of internal consistency. However, the results indicate that Cronbach's alpha values for two constructs, namely Decentralized Processes and Sustainable Competitive Advantages, are less than 0.6. In this case, and based on [38], Cronbach's alpha has some limitations, and it is not recommended by many researchers [90]. For example, it assumes that all indicators have the same reliability level, and it has the tendency to underestimate the internal consistency reliability. Therefore, technically, it is more appropriate to use a composite reliability test (CR). According to CR values shown in Table 2 that are greater than 0.7, it is considered that all constructs are reliable, and the internal consistency is confirmed.

Table 2. Results of reliability validity analysis.

Construct	R^2	Cranach's Alpha (α)	Composite Reliability (CR)	AVE
Technical Virtuosity		0.730	0.829	0.551
Economic and Social Atmosphere		0.760	0.836	0.506
Decentralized Processes		0.486	0.781	0.646
Integrated Production Workplace		0.676	0.762	0.522
Technological Innovation	0.193	0.748	0.849	0.738
Economic Innovation	0.620	0.786	0.890	0.802
Commercial Innovations	0.343	0.785	0.863	0.759
Sustainable Competitive Advantages	0.391	0.519	0.806	0.675

For outer model validity, the convergent validity test measures the level of correlation between the alternative indicators and their constructs in the model [38]. Convergent validity is estimated through average variance extracted (AVE). AVE can be estimated by the averages of the squared outer loadings values of indicators (i.e., the sum of squared outer loadings divided by the number of indicators). The validity of a construct can be confirmed if the AVE value is greater than 0.5. It is shown in Table 2 that all AVE values exceed the threshold value. Thus, the convergent validity is confirmed for our model.

The second validity test is the discriminant validity, which means that the used construct in the structural path is unique and cannot be replaced by another construct. Discriminant validity can be tested through two approaches, namely, cross-loading and the Fornell–Larcker criterion. In cross-loading, the outer loading of corresponding indicators of the specific construct (i.e., Correlation) should be higher than other cross-loadings of other constructs. Fornell–Larcker approach can be estimated by calculating the square root of AVE values of all constructs and comparing the resulting value of each construct with the values of other constructs [91]. To confirm the discriminant validity, the correlation value of each construct by itself should be higher than the correlation value with other constructs [92]. As shown in Table 3, the square root of AVE values on the diagonal in bold indicates that the discriminant validity has been established.

Table 3. Discriminant validity test using Fornell-Larcker criterion.

Nr.	Constructs	1	2	3	4	5	6	7	8
1	Commercial Innovations	**0.871**							
2	Decentralized Processes	0.466	**0.804**						
3	Economic and Social Atmosphere	0.500	0.520	**0.896**					
4	Economic Innovation	0.558	0.499	0.475	**0.711**				
5	Integrated Production Technologies	0.546	0.369	0.365	0.637	**0.722**			
6	Sustainable Competitive Advantages	0.517	0.228	0.253	0.565	0.541	**0.822**		
7	Technical Virtuosity	0.558	0.627	0.787	0.601	0.472	0.258	**0.742**	
8	Technological Innovation	0.300	0.257	0.377	0.586	0.396	0.475	0.355	**0.859**

However, the performance of the Fornell–Larcker criterion is still poor at detecting the discriminant validity [93]. Therefore, the discriminant validity can be double-checked through the heterotrait–monotrait ratio (HTMT) of correlations approach. Technically, HTMT estimates the true correlation between two constructs when they are perfectly measured and highly reliable. However, in case the correlation value between two constructs is closest to 1, it indicates a lack of discriminant validity, and it is called disattenuated correlation. Therefore, all HTMT values less than one indicate good reliability [90]. The discriminant validity is established on the basis of HTMT values shown in Table 4 below.

Table 4. Discriminant validity test using HTMT values.

Nr.	Construct	1	2	3	4	5	6	7	8
1	Commercial Innovations								
2	Decentralized Processes	0.649							
3	Economic and Social Atmosphere	0.691	0.814						
4	Economic Innovation	0.747	0.806	0.629					
5	Integrated Production Technologies	0.811	0.830	0.492	0.437				
6	Sustainable Competitive Advantages	0.789	0.494	0.378	0.523	0.675			
7	Technical Virtuosity	0.704	0.621	0.870	0.802	0.723	0.420		
8	Technological Innovation	0.448	0.429	0.561	0.541	0.571	0.789	0.513	

The PLS estimation of the outer loading factors of reflective indicators for the measurement model is shown in Table 5. A common rule of thumb is that the acceptable indicators' outer loadings values should be between 0.6 and 0.7 or higher [94]. However, according to [81,82], if the value of outer loadings of the reflective indicator varies between 0.4 and 0.7, it is accepted if the indicator is recently established and the research is exploratory. Accordingly, the results shown in Table 5 still indicate that the factor loadings values are higher than 0.4, and this implies that the outer model is reliable. In addition, the outer model can be checked by the t-statistics, where the values should be higher than 1.96 [95]. According to the shown t-statistics values in Table 5, the outer model indicators are significant.

Table 5. Estimation of the outer model (outer loading and T-statistics).

Constructs	Indicators	Outer Loading	T-Values
Technical Virtuosity	Q1	0.771	17.311
	Q2	0.761	13.074
	Q3	0.624	8.748
	Q4	0.800	18.056
Economic and Social Atmosphere	Q5	0.672	8.601
	Q6	0.735	13.021
	Q7	0.789	19.369
	Q8	0.715	13.489
	Q9	0.636	6.691
Decentralized Processes	Q10	0.918	26.206
	Q11	0.671	5.224
Integrated production workplace	Q12	0.650	4.627
	Q13	0.625	4.265
	Q14	0.867	11.562
Technological Innovation	Q15	0.883	31.883
	Q16	0.835	17.288
Economic Innovation	Q17	0.858	28.245
	Q18	0.932	98.256
Commercial Innovations	Q19	0.843	22.091
	Q20	0.898	42.479
Sustainable competitive advantages	Q21	0.808	13.215
	Q22	0.835	17.089

3.3.2. Structural Model

In this section, the path coefficients and other inner model parameters will be estimated in order to explain the variance among latent variables' relationships (i.e., constructs) in the structural model and evaluate the hypothesized path. As shown in Figure 2, the coefficient of determination (R^2) is a standard statistical coefficient that represents the variance amount in an endogenous construct explained by the predecessor exogenous construct(s), where the acceptable coefficient values range between zero and one [96]. For example, the R^2 value for sustainable competitive advantages is ($R^2 = 0.391$), which means that (39.1%) of the variance in this endogenous construct is explained by the three preceding constructs, namely, technological, economic, and commercial innovation, where the economic innovation has the highest impact on sustainable competitive advantages, with a value of (0.620), followed by commercial innovation (0.343), and finally, technological innovation with the value of (0.193). The R^2 values are shown in Figure 2 and Table 2.

In addition, in order to evaluate the hypothesized path model relationships, it is important to verify the path coefficient sizes and statistical significance that represents the strength of relationships between latent variables (i.e., constructs) in the structural model. In order to be verified, the standardized path coefficient (B-values) should be equal to or greater than 0.1 [97], while the statistical significance values (t-value) should be above +1.96 and below −1.96 (i.e., two-tailed test with a level of significance 5%); level of significance is represented by *p*-value. These values have been obtained using the bootstrapping procedure in PLS-SEM. The results of the standard path coefficient (B-value), standard deviation (STDEV), and statistical significance (T-value and *p*-value) are shown in Figure 3 and summarized in Table 6.

Based on the results, the research model confirms that the competitive advantages can be sustained through several Industry 4.0-based improvements to strengthen the internal organizational factors in order to achieve strategic objectives. It is confirmed that

both technological innovation with values (B = 0.383 and T = 3.799) and commercial innovation with values (B = 0.464 and T = 5.455) have a significant positive impact on the sustainable competitive advantages of the organization. However, economic innovation with values (B = −0.123 and T = 1.188) has a negative impact on sustainable competitive advantages, but it is insignificant since T-values within the interval (+1.96, −1.96) are not significant constructs. Moreover, the Decentralized Processes construct with values (B = 0.045 and T = 0.630) has a small positive impact on Economic Innovations. Similarly, with values (B = 0.021 and T = 0.860) Decentralized Processes has a small positive impact on Technological Innovation. However, both impacts are not significant since, in both, relation T-values fall within (+1.96, −1.96). Finally, the Technical Virtuosity construct has a good positive impact on Technological Innovation but is not significant with values (B = 0.204 and T = 1.547). The rest of the relationships between constructs are summarized in Table 6. As shown, it is confirmed that H2, H4, H7, H8, and H10 are supported, whereas H1, H3, H5, H6, and H9 are not supported. Therefore, it can be concluded that Technological and Commercial Innovation is strongly predicting Sustainable Competitive Advantages, while Economic Innovation is not. The Decentralized Processes construct is not a good predictor for both Technological and Commercial Innovation. Similarly, Technical Virtuosity is not a predictor of Technological Innovation. The analysis and interpretations of these findings will be discussed in the following section.

Table 6. The bootstrapping procedure results for the inner model.

Hypotheses: Relationship	B-Value	STDEV	T-Value	*p*-Value	Conclusion
H1: Technical Virtuosity → Technological Innovation	0.204	0.132	1.547	0.123	H1 is not supported
H2: Technical Virtuosity → Economic Innovation	0.762	0.084	9.107	0.000	H2 is supported
H3: Economic and Social Atmosphere → Economic Innovation	−0.006	0.065	0.095	0.924	H3 is not supported
H4: Economic and Social Atmosphere → Commercial Innovations	0.585	0.0.67	8.784	0.000	H4 is supported
H5: Decentralized Processes → Technological Innovation	0.021	0.119	0.177	0.860	H5 is not supported
H6: Decentralized Processes → Economic Innovations	0.045	0.094	0.482	0.630	H6 is not supported
H7: Integrated Production Workplace → Technological Innovation	0.292	0.084	3.490	0.001	H7 is supported
H8: Technological Innovation → Sustainable Competitive Advantages	0.383	0.101	3.799	0.000	H8 is supported
H9: Economic Innovation → Sustainable Competitive Advantages	−0.123	0.104	1.188	0.235	H9 is not supported
H10: Commercial Innovations → Sustainable Competitive Advantages	0.464	0.085	5.455	0.000	H10 is supported

4. Discussion

The main concern of this paper is to investigate how the integration between internal organizational factors and Industry 4.0 impacts the sustainable competitive advantages of an organization to achieve its strategic objectives. In other words, from a strategical perspective, Industry 4.0 will be integrated with internal organizational factors, but this integration should be accompanied by upgrading these internal forces to be compatible with new strategy requirements to act as a supportive success agent for Industry 4.0. This will create an integrated smart real-time organization or Industry 4.0-based internal organizational factors to achieve the organization's strategic objectives. In this regard, the results

confirm the significant impacts of several internal factors on sustainable competitive advantages. For example, technical virtuosity and economic and social atmosphere have a significant impact on economic innovation; however, in its turn, economic innovation has a negative impact on sustainable competitive advantages. The potential justification for the negative impact is that the economic innovation may lead to an increase in the expenses paid by the organization, and this will weaken its price-based competitiveness. However, the company should recognize these expenses as an initial investment cost, and there is no high running cost in the new system. Integrated production workplace construct has a significant impact on technological innovation and, in its turn, also has a significant impact on the sustainable competitive advantages. In this regard, technical virtuosity has a positive but insignificant impact on technological innovation. This is because technical virtuosity is related to the execution of technical activities in a very skillful manner, and this will improve the learning curve of labor without creating a significant impact on technological innovation. Moreover, this may weaken the ability of workers to innovate. As mentioned above, technical virtuosity positively impacts economic innovation since it contributes to improving economies of scale.

Industry 4.0-based decentralized processes construct has an insignificant negative impact on both technological innovation and economic innovation. This result may refer to disadvantages of decentralization found by respondents in the long term. It is true that decentralization has a big impact on production performance in the short term (i.e., operational level), but in the long term, it may diminish the ability of the organization to improve its technological innovation ability.

The smart and digitalized production workplace positively impacts technological innovation through a coordinated work environment and facilitates expertise and knowledge exchange between talented professionals. This will improve the capability of organizations to continually generate new ideas and techniques and find new innovative solutions. Finally, the results show that technological and commercial innovations have a significant impact on improving the ability of companies to sustain and maintain their competitive advantages, while economic innovation has a negative impact.

In light of the obtained results, it is obvious that internal organizational factors play major role in enhancing the ability of an organization to improve and sustain its competitive advantages in the long term and strive to secure steady growth and achieve strategic objectives. Therefore, organizations should pay more attention to several internal forces that will enhance their competitiveness ability in the long term

5. Limitations and Future Research Directions

This study highlights the importance of internal organizational forces for the success rate of Industry 4.0 and how the integration between these forces and Industry 4.0 pillars will sustain the competitive advantages of the organizations and achieve their long-term objectives. However, this study has some limitations or weaknesses that open the door for future research opportunities in this area. For example, the study focuses on the manufacturing sector in general and does not focus on a specific manufacturing field. Therefore, the differentiation between different manufacturing fields needs further analysis. Furthermore, the study does not focus on the service sector; therefore, the finding of this study cannot be generalized to the service sector. This is because adopting Industry 4.0 concepts in the service sector has different measuring variables, and therefore using the same research questions is incorrect.

At the analytical level, this study used the SmartPLS software, which uses PLS-SEM. However, PLS-SEM has some mathematical restrictions and limitations. For example, one of the main limitations is unidimensionality, where PLS-PM assumes that each group of variables/indicators can be described with a single construct [89]. In our study, some groups of variables/indicators may be explained by other latent variables. Therefore, here, multidimensionality exists. Multidimensionality is defined as the relationships between

measuring variables/indicators in a single group explained through multiple constructs/latent variables. Therefore, other methods, such as the Process PLS method, which is developed by [89], or NetPCA developed by [98], can be used to measure the multidimensionality in the model.

6. Conclusions

In this paper, a research model has been proposed to study the relationship between the adoption of the Industry 4.0 strategy and the accompanying or subsequent changes in internal organizational factors and examine the impact of these relationships on sustainable competitive advantages. The methodology used to construct the model begins by examining the causes of Industry 4.0 failure in several organizations where the intended objectives have not been achieved. Based on the literature, almost all Industry 4.0 failure causes are classified as internal causes. After that, four main internal factors have been proposed as an umbrella (i.e., first-order constructs) for almost all failure causes (i.e., indicators). The SmartPLS has been used to test and simulate the proposed model. In general, the findings confirm that the Industry 4.0 strategy should be implemented through the integration of internal organizational factors. This will help to root the concepts of the fourth industrial revolution in all organizational aspects and boost the organization's ability to achieve its long-term strategic objectives as well as sustain its competitive advantage [33,99,100].

From a strategical perspective, and based on the results, the internal factors can be classified as either internal strength or internal weakness. The internal factors with positive impacts can be considered internal strengths, and they significantly contribute to sustaining the competitive advantages of the organization. The internal factors with negative or insignificant impacts can be considered internal weakness factors and should be investigated in order to either avoid their adverse impacts on the Industry 4.0 adoption or, if possible, turn them into strengths to support Industry 4.0 adoption.

The theoretical implications of this study, which may add value to the literature, can be summarized as follows: The study focuses on the challenges facing the implementation of the Industry 4.0 in order to obtain the desired benefits; the study indicates that the implementation of Industry 4.0 needs internal organizational supportive factors to achieve the expected benefits. The study addresses the Industry 4.0 implementation from strategic perspectives to achieve long-term rather than short-term objectives. Finally, the study quantifies the impact of some internal forces that act as an incubator for Industry 4.0 to enhance and sustain the competitive advantages of organizations. The results demonstrate the importance of some internal organizational forces for the success of Industry 4.0 implementation.

From practical perspectives, organizations can develop new methodologies or roadmaps to implement technology-based strategies such as Industry 4.0 to fully gain the potential benefits and avoid failure in the short term. In light of the results, organizations can determine which internal forces should be upgraded and improved to be compatible with new concepts of Industry 4.0. These changes may include, for example, new forecasting tools that use big data, developing new policies, updating job specifications, changing the span of control, adding new communication channels, upgrading the training and upscaling methods using virtual and augmented reality, adding new manufacturing technologies based on additive manufacturing concepts, modern employee financial control tools, designing real-time monitoring, etc. Doing so will significantly contribute to the long-term success of Industry 4.0 in enhancing and sustaining the competitive advantages of organizations.

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