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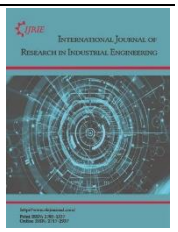

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The Impact of Digital Transformation on Sustainability: A Case of the Iranian Telecom Industry

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Abstract

The corporate landscape is highly affected by two market factors, namely digitalization and sustainability. These two driving forces have been the topic of several studies on how they change management methods, businesses, and society in general. However, the point that these two trends meet each other has been mostly neglected by research studies. Modern organizations and corporations are dealing with the adopting digital transformation issue as a new strategic paradigm. The present study attempts to elaborate on the relationship between digital transformation and sustainability. Therefore, through an in-depth review of the relevant literature, critical factors and their indicators were determined, and based on the proposed conceptual model, six hypotheses were developed. Then, a questionnaire was designed and distributed among 120 Iranian experts, managers, and consultants, and 97 complete questionnaires were returned. Reliability, Content Validity Ratio (CVR), and Content Validity Index (CVI) of the questionnaire were calculated, and the hypotheses were tested through Structural Equation Modeling (SEM) using SmartPLS Software. The results showed that digital transformation significantly affected an organization's sustainability aspects through operation, customer, business model, technology, workforce, and collaboration. Digital transformation and sustainability should constitute integral parts of organizational strategy. Considering that business practices affect the environment, society, and economy, digital transformation can influence the business sustainability. Digital technologies transform markets and create novel paradigms in the industry. In addition, they present new solutions to organizations to cope with sustainability issues. Due to this importance for organizations as consumers and other stakeholders, they are sensitive to the effects of business on brand value, revenues, and company valuation.

Keywords: Digital transformation, Sustainability, Corporate sustainability, Aligning.

1 | Introduction

Recently, sustainability has become an important criterion in research, development, and business. The increasing attraction to this critical point causes most pioneer societies and organizations to require the establishment of financial and environmental macro-strategies [1]. Meanwhile, organizations need to consider other challenging and contradictory factors which affect their operations. Constant capturing and employing the major changes can lead any pioneer organization to be prosperous [1].

On the other hand, the digitalization concept has become broadly pervasive in many layers of business and economy. This relevance motivates the organization to follow digital transformation as a critical process. The process has many levels of granularity and should be applicable in a broad range of organizations from a small one to nationwide. Moreover, the United Nations considers

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digitalization as its goal for sustainable development [2], [3]. Consequently, the organization and market leaders have attempted to explore the potential possibilities of digital transformation to overcome sustainability challenges and other related problems [1], [4].

New industry evolution is based on novel business models, and smart environments and services appeared through multi-dimensional digitalization in manufacturing [5]. In addition, rethinking best practices to achieve sustainability by leveraging digitalization has become a significant aim for many organizations and companies [6].

To survive in the complex and dynamic environment, organizations need new approaches to organizational strategy development. These can lead them to sustainability and balanced performance [7]. Nowadays, two major factors in the industrial world are digitalization and sustainability, and the way that these factors influence the practices of organizations or businesses and societies in general across the world has been extensively studied [7]–[9].

As a result, the present study attempts to provide a conceptual model for a better understanding of the digital evolution elements and its impact on sustainability in the Iranian context as a developing country. Therefore, in this research, the required analysis of digital transformation for retaining sustainability has been studied.

This paper is organized as follows: in the next section, the literature review on sustainability and digital transformation and related concepts is presented, and the research method and the results are provided in the upcoming sections. Finally, we present the conclusions in the last section.

2 | Literature Review

2.1 | Digital Transformation

Digital transformation is a dramatic change in the performance of an organization or a country centered on transformational technologies IT. Internet of Things (IoT), cloud computing, mobile applications, social media, virtual and augmented reality, data analytics, Artificial Intelligence (AI), and Blockchain are some of the most important types of transformational technologies [1], [11]–[13]. Consequently, productivity and revenue grow, and costs decrease [14].

Digitalization facilitates innovation in business models and supports sustainable industry. The process of implementing digitalization is a challenging task and needs an ongoing commitment for realization of the complete capability and maturity of an organization. Doubtlessly, business model innovation brings critical benefits to the triple bottom line; therefore, establishing a sustainable industry is the objective and its success entails targeting the sustainable economic and social benefits in the long run. In general, industrial activists believe that creating value is realized optimally through incremental and radical digitalization advances that directly influence the economic performance of the company. Higher efficiency in the processes is realized by continuous analysis of operational data and facilitation of spotting and removing process-performance bottlenecks [16]. Systems with the capability of automatic self-correct can improve process efficiency and result in shorter downtime, optimized capacity, and decreased repair-time averages [16]. In addition, process optimization and observability of cost-efficient resources and operational costs reduction are some other aspects of digitalization. Through predictive approaches, it is easy to find quality and operational defects. Additionally, analytics facilitates finding the causes of defects (e.g., human, machine, or environment), which leads to achieving a decrease in scrap rate and lead time [17].

Regarding new digital technologies growth, it is easy to see that these technologies have the potential to change the game in each sector, significantly. Many industries and businesses have been empowered by applying advanced digital technologies.

2.2 | Sustainability

Sustainability means meeting the social, economic, and environmental needs of the present generation without compromising the social and environmental needs of future generations [18]. A modern definition of sustainability has broadened the scope recognizing the interconnectedness between environmental health, social prosperity, and economic well-being. Abdoli Bidhandi and Valmohammadi [19] and El Hilali et al. [20] raised the notion of triple bottom based on concept sustainability framework, encompassing an organization's impact on planet (environmental aspect), people (social aspect), and profit (economic aspect).

For decades, only current customer needs and shareholder profitability were important to organizations. But today, due to fierce competition, most of the stakeholders must be satisfied to ensure the growth and survival of the organization.

Balogun et al. [21] studied the role of digitalization in improving environmental sustainability by considering nine cases in different countries using big data and IoT to address issues related to environmental sustainability. In addition, Westerman et al. [22] examined the impact of digital workplaces on environmental sustainability.

Positive impacts of digital technologies, such as big data analytics, AI, IoT, mobile technologies, and social platforms on society and industry have been known. More specifically, companies now contribute to environmental sustainability and carbon emission reduction activities employing big data analytics, AI, and IoT [23], [24].

The main challenge is that sustainability is needed to make sure of a constant quality of life. The social aspect of sustainability is a main success factor for long-term future prosperity [25]. Businesses should not merely focus on the direct economic aspect of sustainability, such as minimizing energy consumption to cut costs and enjoy higher ROI and profit.

Therefore, the main hypothesis of the present study is proposed as follows:

H1: digital transformation affects organizational sustainability.

2.3 | Emerging Technologies of Digital Transformation

The role of digital technologies in the development of industrial platforms with efficient use of resources has been proven. These technologies reduce costs and promote the manufacturing systems flexibility and help to adapt sustainability goals [23].

Big data [12], [26]-[32], IoT [33]-[35], blockchain [36], [37], virtual reality [38], augmented reality [39], and AI [40] are the main categories of digital technologies analyzed broadly in this study. Thus, the first sub-hypothesis is put forth as follows:

H1a: digital technologies affect organizational sustainability.

Business model: undeniable characteristics of the modern age i.e., rapid industrial modernization [9] have internal and external environmental complexity that organizations and social institutes are faced with. As the business environment has experienced many changes, businesses attempt to increase their adaptability power accordingly. These changes are not avoidable; therefore, the excellence and sustainability of organizations is a function of the coordination level with environmental changes [10].

In addition, companies have accompanied the digital revolution emerged by cutting-edge startups and have tried to adapt their businesses to digital systems. Adopting the features of digital transformation

needs to accept radical changes concerning the creation and representation of relevant values. Therefore, the accordance of digital transformation with sustainability is an important issue needing further analysis [41]. The presence of digital technologies, such as cloud computing, blockchain, and big data analytics is growing so that it is becoming a main factor in the realization of business results and the success of management models [42].

The counterpoint of these two trends chooses digital transformation as a strategy to ensure the sustainability of organizations which has been neglected by researchers. Following the development of more efficient supply chains and efficiency of processes, we now witness a decrease in product lifecycles. Information and Communication Technology (ICT) has created new ways for global logistics and communication by managing the immense volume of data transferred with unprecedented speed. As a consequence, even large organizations can enjoy agility [19], which means the ability of an organization to thrive in a continuously changing, unpredictable business environment.

Businesses use analytics to optimize resources deployment and control risks [43]. The increasing need, for instance, interaction and coordination and the emphasis on the necessity of lean manufacturing and minimized inventory [36], [44] fuel the need for business mobility solutions, first-class logistics, and broadband connectivity [45].

In addition, digital transformation brings business benefits by adopting an integrated approach to IT, supply chain, operation, and the rest of the functions that an organization performs. All these lead to sustainable values, lower costs, higher operational efficiencies, and expansion of a sense of urgency. Therefore, the second sub-hypothesis is suggested as follows:

H1b: business model affects organizational sustainability.

Customer: the aim of improving customers' experience needs a deeper perception of the customers, management, or digital presence of the organization, improving customer engagement, and more effective brand promotion, and realizing these factors requires a clear understanding of the customers and what can be expected from the organization [46].

The digital transformation of a business provides flexibility in the viability of its products and incorporates customers' feedback [28], leading to increased market share, revenues, and customer satisfaction. In addition, digitization enables customers to collaborate and compels industries to coordinate themselves with varying market conditions and to adapt themselves to consumer behavior. Growing technological advancements, enhanced consumer power, and fierce competition are symptoms showing commoditization threats [47]. The expansion of e-commerce and Internet shopping during the past couple of years dramatically reduces the costs for customers as well as enterprises from economic, social, and environmental aspects. Thus, the third sub-hypothesis is suggested as follows:

H1c: customer affects organizational sustainability.

Workforce: it is clear to organizational leaders that digital transformation and workforce transformation are interconnected; however, there are few insights to lead these interlinked efforts [48]. Businesses need to recruit and keep digital talents and promote a culture where employees, temporary workers, and robots cooperate, effectively. Lack of skillful talents is a challenge in the way of businesses to find and keep the right talents. Creating a digital workforce is not limited to recruiting and developing talents. On the hand, there is also a need to improve their workforce in other ways. Businesses can find skilled workers for temporary projects, which is also a shorter way of finding talent. Thus, the fourth sub-hypothesis is put forth as follows:

H1d: workforce affects organizational sustainability.

Operations: a key approach is to formulate a digital transformation strategy that functions as a key concept to integrate the whole process of coordinating, prioritizing, and implementing digital transformations in a company. Using and integrating digital technologies normally influences major parts of companies and sometimes extends beyond the organizational borders through products, business processes, sales channels, and supply chains. The potential advantages of digitalization include higher sales or productivity and innovations in value creation [49]. Thus, we suggest the fifth sub-hypothesis as follows:

H1e: digital transformation operations affect organizational sustainability.

Collaboration: the major part of this task is to improve industry collaboration with suppliers and partners in the value chain and develop a circular economy where the resources remain in use as long as feasible, the highest possible value is extracted from them and finally products and materials are recovered and regenerate at the end of their service life. Along with industry collaboration and new circular economy approaches, it is essential to examine each of the emerging and enabling technologies in terms of digital transformation initiatives and determine the way to leverage them and achieve notable improvements in sustainability. As a result, the seventh hypothesis is suggested as follows:

Corporations try to act in line with digital transformation to survive in the digital age. On the other hand, they are affected by complex activities related to digital transformation; therefore, different strategic alternatives should be analyzed via models and tools. Thus, the sixth sub-hypothesis is suggested as follows:

H1f: collaboration affects organizational sustainability.

3 | Research Methodology

In terms of objective, this study is an applied one. As far as the topics of the study are related to the telecom industry and based on the familiarity and the level of expertise of the Iranian ministry of communication, the sample of the study consisted of all top managers and experts of this ministry, such as the vice ministers in ICT industries, senior executive managers and chairman of the boards in telecom industries in public and private sectors, middle class manages, and consultants in the industry with minimum 10-years working experience in ICT management and operations. In addition, the opinion of academicians includes faculty members, post-doc, and senior researchers in the field of information technology management, computer engineering, and industrial engineering were explored. In this research and at the first phase of the methodology, based on an in-depth review of the relevant literature, the main constructs of digital transformation and their sub-construct were determined. Then, the indicators of the constructs and sub-constructs were identified by holding semi-structural interviews with ten experts of the Iranian Telecom ministry. It should be noted that due to the novelty of the topic in the country, the sample size was selected based on the purposive sampling method, and as a result, 112 respondents were selected. The demographics of the respondents are shown in *Table 5*. The study was carried out from July 2018 to May 2019. In terms of the method, the study was descriptive and the data was collected from the determined sample using a questionnaire. Therefore, the study is also a survey one. Based on the data analysis method, the study was correlational and used structural equations modeling in particular. Before distributing the designed questionnaire among respondents to assess its content validity, three academicians and two experts were asked to study the questionnaire. After applying a few modifications, the questionnaire was finalized. In addition, CVR and CVI coefficients were calculated. As the order of the questions can impact the response and to avoid such an impact, half of the questionnaires were distributed in one order and the other half in another one. In addition, to minimize self-report bias in the data, the respondents were informed to fill in the form even with their name or fill in anonymously [26], and the non-response bias test (wave analysis) was done. The responses of early and late waves of returned surveys were compared, and the results of the t-test indicated there were no statistically significant differences between early-wave and late-wave groups [11]. The obtained

results indicated that the opinions of late respondents were representative of the opinions of non-respondents. Therefore, non-response bias was not a concern [55].

The questionnaires were analyzed using the Partial Least Square-Structural Equation Modeling (PLS-SEM) method. The method is a multivariate analysis technique that has been widely used by researchers in recent years [50]. The PLS-SEM is known as a powerful tool that imposes minimum restrictions on measure scales. It is also used to model latent constructs that are not normally distributed [51]. Before using the method, the reliability and validity of the measurement model should be confirmed. Afterward, a non-iterative application of ordinary least squares regression was needed to achieve outer weights, loadings, and the relationships of the structure model for the latent and visible variables. Eventually, the bootstrap re-sampling procedure was used to determine if a structural path is significant. One hundred twelve questionnaires were returned.

The study was carried out based on the validation of documents and library studies; as a result, books, journals, and articles published in other countries on the theoretical foundation of theories on the subject matter were used. In terms of objective, the study was an applied one.

Fig. 1 illustrates the proposed conceptual model. As shown in *Fig. 1*, the considered basis for digital transformations includes Business model, customer, technology, workforce, operation, and collaboration. As described before, sustainability is also categorized into economic, environmental, and social elements.

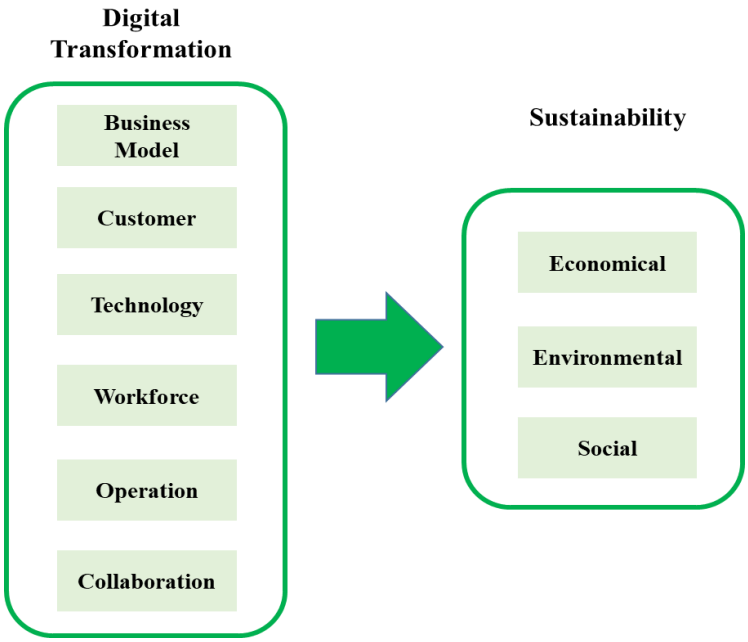

Fig. 1. Proposed conceptual model.

Hypothesis

H1: sustainability is affected by digital transformation technologies.

H2: organizational sustainability is affected by business models developed based on digital evolution.

H3: sustainability is affected by the customer.

H4: organizational sustainability is affected by the workforce in the field of digital evolution.

H5: organizational sustainability is affected by digital transformation operations.

H6: organizational sustainability is affected by collaborations in the field of digital evolution.

4 | Results

Table 1 shows the demographic information of the respondents.

Table 1. Demographic information of experts.

Education Level	Reference
MA	65
Ph.D. student	20
Ph.D.	27
Frequency	**Field of study**
38	Information technology
32	Management
42	Industrial engineering

As the independent variable (digital transformation) and dependent variable (organizational sustainability) are informative and reflective constructs [32] according to PLS-SEM analysis, the one-dimensionality of each component in the model needs to be checked. Based on the smart-PLS 3 algorithms, the result of the analysis is shown in *Fig. 2*.

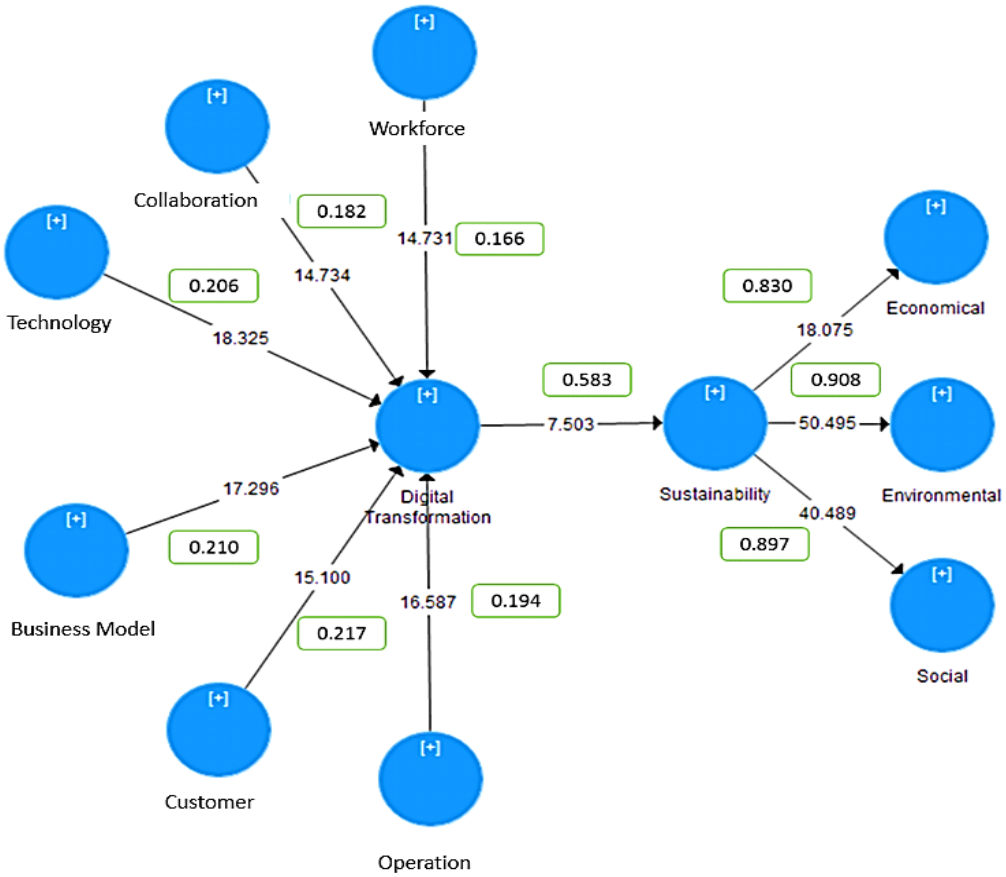

Fig. 2. Smart PLS 3 – PLS algorithm, bootstrapping.

By definition, a component is unidimensional when Cronbach's alpha and Composite Reliability (CR) are higher than 0.7. As listed in *Table 2* Cronbach's alpha ranges from 0.70 to 0.94, while CR values range from 0.92 to 0.96 -i.e., exceeding the threshold value (0.7). In addition, the table shows the estimation by the model, including the outer weights, outer loadings, and Average Variance Extracted (AVE) measures.

Table 2. Coronbach's Alpha, Rho_A, CR, AVE.

	Cronbach's Alpha	Rho_A	CR	AVE
Technology	0.855	0.856	0.933	0.874
Customer	0.838	0.838	0.925	0.860
Operation	0.725	0.725	0.879	0.784
Workforce	0.811	0.821	0.913	0.841
Sustainability	0.939	0.941	0.947	0.599
Collaboration	0.823	0.824	0.919	0.850
Business model	0.801	0.814	0.909	0.833
Economical	0.724	0.726	0.879	0.784
Environmental	0.841	0.841	0.926	0.862
Social	0.826	0.828	0.920	0.851
Digital transformation	0.894	0.898	0.919	0.655

The loading of the reflective-visible variables and the respective latent values are depicted by outer loadings. The loadings can be used to examine the reliability of each item. When the loading is bigger than 0.7, the item is considered reliable [61], and all outer loadings (0.80-0.95) were greater than 0.7. In addition, the AVE measures were used to examine the convergent validity of the constructs. Here, the AVE measures ranged from 0.55 to 0.80, which was greater than the threshold of 0.5. In addition, the square root of AVE on each construct was higher than the correlations of the intended construct with other constructs. By validating the measurement model, the structural model can be estimated that determined the relationships of latent variables.

According to [52], divergent validity is acceptable only when AVE values are greater than the common variance between the intended construct and other constructs. Therefore, the acceptable divergent validity of a measurement model shows that a construct in the model has more interactions with its sub-constructs rather than with other constructs [26]. In the PLS method, this is obtained by a matrix whose values are the correlation coefficients between the constructs and the main diameter of the root matrix of AVE for each construct.

The latent variable correlation section of the output file was applied by Smart PLS. In addition, the original diameter used the AVE squared (*Table 3*).

Table 3. Fornall locker.

	Technology	Customer	Operations	Workforce	Sustainability	Collaboration	Business Model	Economic	Environmental	Social	Digital Transformation
Technology	0.93										
Customer	0.71	0.92									
Operation	0.70	0.73	0.88								
Workforce	0.61	0.58	0.51	0.91							
Sustainability	0.88	0.88	0.83	0.79	0.77						
Collaboration	0.26	0.35	0.38	0.32	0.38	0.92					
Business model	0.46	0.57	0.56	0.41	0.56	0.62	0.91				
Economical	0.61	0.59	0.54	0.81	0.59	0.24	0.36	0.88			
Environmental	0.45	0.59	0.57	0.40	0.57	0.59	0.75	0.35	0.92		
Social	0.80	0.79	0.70	0.59	0.49	0.36	0.48	0.58	0.49	0.92	
Digital transformation	0.45	0.58	0.58	0.43	0.58	0.83	0.80	0.37	0.797	0.51	0.8

Structural model: at this point, the structural model of the study was evaluated. In this study, in contrast to the measurement model, the structural model was not related to the questions (observed variables), and the latent variables, and their relationships were tested. To examine the fitness of the structural model, one of the most famous criteria, i.e., t-value was utilized (*Table 4*). Based on the bootstrap command, smart

PLS measures these coefficients. Measuring the fitness of the structural model by obtaining coefficients is according to the presumption that the obtained values must be greater than 1.96 at the confidence level of 95%. Based on the analysis done by the software, these values for all the items were greater than 1.96.

Table 4. Outer loading-T statistic.

	Outer Loading	P value	T
Technology	18.325	0	0.206
Customer	15.1	0	0.217
Operation	16.58	0	0.194
Workforce	14.73	0	0.182
Sustainability	7.5	0	0.583
Collaboration	14.73	0	0.166
Business model	17.29	0	0.210
Economical	18.07	0	0.830
Environmental	50.49	0	0.908
Social	40.48	0	0.897

As it can be seen, the t-value of the environmental and social components was the maximum t-value, which are equal to 50.49 and 40.48, respectively. Moreover, the t-values for the Technology and economic components were 18.325 and 18.07, respectively; however, the other components had the lowest t-values in comparison with the other indices (Sustainability = 7.5, Collaboration = 14.73, Workforce = 14.73).

The obtained data through the surveys and literature review was examined and analyzed to find the common themes between digital parameters and sustainability. Digital transformation is the main area of focus, not on the inter-relationship between traditional ITs, like enterprise applications and business processes. Therefore, data analyses were mainly concentrated on the effects of digital transformation elements, including technology, customer, operation, workforce, business model, collaboration, on business processes. Therefore, the impact types were examined, if needed, in terms of sustainability.

The result is shown in *Table 8*. T-value of Environmental and Social domains had the maximum t-value along with other domains and the values were equal to 50.49 and 40.48, respectively. Furthermore, technology and economical had the t-value of 18.325 and 18.07, respectively. The other domains have the lowest t-values in comparison to the other indices (TSustainability = 7.5, TCollaboration = 14.73, TWorkforce = 14.73).

5 | Discussion

Ensuring the alignment of adopted strategies with sustainability is one of the requirements of modern and leading organizations. Having a suitable business strategy in place for transportation and shipping routes, production and maintenance plans means avoiding wasting time, products, and resources which affect the sustainability performance of the organization. Digital transformation is a dramatic change in the performance of an organization or a country centered on transformational technologies [53]. Pointed out that the use of technological advances is one of the prerequisites for sustainability. Additionally, some researchers considered digital transformation technologies to be a powerful tool for promoting sustainability [24], [54] and believed that the effects of digital transformation and sustainability are intertwined. In addition, Blockchain and other uses of IoT help organizations to utilize more sustainable solutions than traditional information-sharing strategies [36] for controlling their supply chain and improving the efficiency of their operations. This leads us to the second important point in which the most dominant feature of digital transformation is mobility.

Dehbasteh et al. [23] findings indicated the sustainable consequences of the digitalization of production processes. Moreover, they found out that if the expected benefits are achieved through digital technologies, they can affect sustainability. One of the important benefits of digital transformation is

the reduction of using paper books, records, magazines, and contracts by digital communications and digital file management. Through cloud storage, we could eliminate paper waste and overhead costs of traditional storage and secure crushing, and it also provides constant access to documents from any place. In addition, Blockchain and other uses of IoT help organizations to utilize more sustainable solutions than traditional information-sharing strategies [36] for controlling their supply chain and improving the efficiency of their operations.

Some companies have been able to attract customers who are concerned about the environment by offering green products to them [10].

The functionalities that support sustainability cover a wide range from better product design to predictive maintenance and product tracking [55]. Moreover, sustainability is achievable by improving the efficiency of operations where the environmental footprint decreases compared to conventional manufacturing processes. For instance, monitoring operations data is a way to decrease scrap rates and equipment wear and tear [55]. There are many social benefits in digitalization, such as higher safety that is achieved by increased autonomy of processes and decreasing the rate of human errors and accidents. For instance, a sensor shuts down an operation when it detects a worker entering a restricted area [55]. In addition, using automatic machines that can be controlled remotely eliminates risky jobs in the mining industry.

In addition, the rapid advancement in the domain of digitalization has accelerated the creation of new business models leading to value creation in the digital age and creating new revenue streams compatible with new technologies [56]. According to [57] customer orientation, taking advantage of opportunities through digital and innovation capabilities, could impact various aspects of organizational sustainability. This sort of value that is usually created indirectly is rooted in digitalization, and societies can enjoy its benefits. Therefore, it can easily attract the attention of policymakers.

6 | Conclusion

Management is required to ensure that the strategy adopted by the company is perfectly aligned with the sustainability efforts. However, divergence is a usual issue, and it adds to the fragility of sustainability effects due to the lack of genuine commitment and prioritization.

Digital technologies could transform markets and create novel paradigms in business. In addition, they could bring new solutions to organizations to deal with sustainability issues. Digital transformation and sustainability complement each other.

By placing documents on the cloud and increasing the availability of such services, employees can use different work-related software and files from almost anywhere. As a result, the move towards telecommuting is increasing and the waste created by modern workplaces (overhead costs, energy consumption, commute-time emission, and the like) decreases. Indeed, unified communication providers have created that much mobile collaboration that commuting is not the only thing in which employees can skip. Nowadays, there is even no need to fly to company field offices or vendor quality inspections.

Blockchain and other IoT technologies could help us control the supply chain or automatically monitor the quality of the vendors, suppliers, and end products all without stepping outside the office. Therefore, it will be possible to have more efficient plans for shipping and transport routes, production programs, and maintenance schedules that means avoiding wasted time, product, and resources.

Through developing wider profit margins and improving energy efficiency, smart buildings and the IoT enable businesses to cut their costs mostly in terms of energy consumption. By using smart sensors and monitoring devices, it is possible to adjust electricity, heating, and cooling use for each room. In addition, in order to save resources, digital transformation can save a great volume of money.

Environment

The development of the Internet of Everything (connected objects and people) creates an immense volume of data that could be used by analytics and visualization techniques to learn the way to interact with others, businesses, and the planet. Achieving such insight gives us the ability to uncover patterns for more sustainable behavior like:

- *More reliable forecasts of natural events or disasters.*
- *Optimized agricultural production and food supply at the global scale.*
- *Predicting traffic congestion and creating zones with low emission.*
- *Adding limitations on energy production based on the exact need of consumers.*
- *Finding defects in or imminent failure of specific product components to enable preventive maintenance and avoiding expensive repair or replacement.*

Social

In this field, the digital revolution causes actual change in the game and makes it possible to introduce a new model of society through sharing that is one of the main principles of sustainability thinking.

Doubtlessly, creating such a connected world and harnessing the obtained data can create an environmental load. Using the "Green IT" techniques, such as virtualization entails efficient hardware components, free air-cooled data centers, and so on to ensure minimum impact.

Economy

In many cases, the tangible positive economic benefits created by sustainable approaches to business are quite evident, such as a decrease in waste production, lower energy consumption, and faster operations that save time.

In the case of large companies, active involvement brings more effects as follows:

- *They can attract more consumers who are concerned about environmental issues.*
- *They can reduce the "bottom-line" effect of the growing energy prices and environmental taxes.*

Thanks to the cloud approach to IT services, there is no need for prohibitive investment in new technologies and sustainable business processes. In addition, the solutions could be brought to the market using commercial approaches based on consumer mentality about time/place-free access and "only pay for what you use".

Digitization forces companies that want to remain sustainably successful in the market to adapt their existing business models to the new market environments and conditions. Indeed, when existing business models become obsolete through technological changes, companies have developed new business models [58].

This paper represents qualitative and exploratory research on the relationship between digital transformation and sustainability. Such papers stated that the use of technological advances is one of the major prerequisites for sustainability [53]. Some scholars argued that digital transformation through the use of digital technologies can be a powerful tool for promoting sustainability [24], [59] and supporting SDGs [60].

Digital transformation is reinventing business by creating new revenue streams in new ways [56]. New and adapted business models were crafted by companies to be able to capture value in the digital age. Becoming a customer-centric company, outdoing the competition, exploiting the tremendous

opportunities that digital capabilities offer, and possessing innovation capabilities are what firms look during a digital transformation [61].

The findings showed some impressive results concerning the sustainable implications of the digitalization of manufacturing processes. If the predicted benefits are achieved through digital technologies, they could massively impact sustainability [23]. The effects of digital transformation on sustainability are mixed [61].

6.1 | Recommendations and Limitations

A key requirement of organizational sustainability efforts is digital transformation. Internal and external dynamics among organizations could lead us to deeper insights into integration points between digital transformation, sustainability elements, and business processes. It also highlights the effects of the selection of technology platforms. The major results for businesses are business efficiencies, agility and innovation, cost reductions, and customer experience enhancements. The framework was examined deeper, and a few recommendations were made; therefore, there is a need to recognize digital transformation and sustainability as strategic imperatives by organizational leadership. Moreover, there is a need for organizations to find long-term partnerships with ICT companies active in digital technology fields. Through this, the long-term results of sustainability could be linked to digital transformation. There is also a need to find an individual or committee with adequate influence on the strategy of the organization to stay in charge of the digital transformation of the organization. Such a person might be the Chief Financial Officer (CFO), Chief Information Officer (CIO), Chief Technology Officer (CTO), or chief digital officer, and the internal structure of the organization decides which one is the best choice. Furthermore, there is a need for a specific person in charge of digital transformation in an organization. In addition, there is a need to create an alignment between the digital strategy and the sustainability strategy of the organization. Thus, the directors of sustainability, strategy, and digital works need to cooperate and define the strategic initiatives and projects.

It has been more than a decade since we have faced with the challenges of sustainability. The end of economic stagnation is not near, and we are moving towards a period of low growth when financial resources for sustainability are going to be scarce. On the other hand, ecological problems in the world emphasize the need for such investment. Technological development and fast digitalization are opportunities for businesses and organizations to achieve higher productivity, innovations, and chances to adapt to the rapidly changing world. These changes also bring the risk of changes in employment patterns, more income inequality, privacy concerns, higher dependence on the cyber world, and disruptive-business models. The ability of organizations to control sustainability challenges depends on creating and controlling technology and finding new solutions.

Conflicts of interest

All co-authors have seen and agreed with the contents of the manuscript, and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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