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## Article

The influence of transformational leadership on organizational sustainability in the context of industry 4.0: Mediating role of innovative performance

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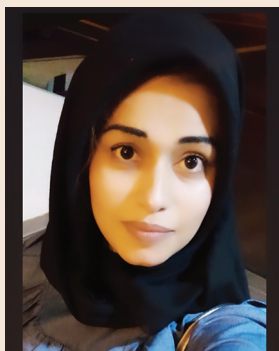
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## MANAGEMENT | RESEARCH ARTICLE

# The influence of transformational leadership on organizational sustainability in the context of industry 4.0: Mediating role of innovative performance

Aemin Nasir<sup>1</sup>, Nazlina Zakaria<sup>1\*</sup> and Rushami Zien Yusoff<sup>1</sup>

**Abstract:** The current study intends to ascertain the influence of organizational sustainability in the context of Industry 4.0 of textile industry of Pakistan. This study integrates the transformational leadership approach by aligning it with Industry 4.0 in order to manipulate the inequitable sustainability. The sustainability of businesses has dramatically been challenged due to digitalisation, smart manufacturing, and technological advancement issues, so therefore innovation has expanded magnitude in boosting the overall performance. The study determines the influence of transformational leadership, innovative performance on organizational sustainability, particularly in the perspective of Industry 4.0. The study is quantitatively analysed, and data collected from ISO textile firms of Pakistan through questionnaires. The collected data analysed on Smart-PLS through measurement model and structural equation modelling with second stage order. The results seem interesting as the association of Industry 4.0 influences the entire relationship significantly. Under the context of the fourth industrial revolution, the transformational leadership approach has uniquely boosted innovation performance and organizational



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Aemin Nasir is a full-time doctoral candidate in the School of Business Management at University Utara Malaysia. She holds MPhil in HRM. Her research interests are Total Quality Management, ISO, organizational sustainability and Industry 4.0. Dr. Nazlina Zakaria is a senior lecturer at School of Business management, University Utara Malaysia. She is serving as a postgraduate coordinator of Management. Her research expertise are organizational innovation, HRM, entrepreneur behaviour and PLS. Prof. Dr. Rushami Zien Yusoff is currently a Professor at School of Business Management and CEO of PACE at Universiti Utara Malaysia. He obtained his PhD from University of Bradford, UK. He is the Vice-Chairman of ISO/TC 176/SC 2 – Quality Systems, a Standard body responsible for development and establishment, of ISO 9001 for worldwide application. His consultancy work relates to ISO 9001 Quality Management System certification and the development of strategic Management Blueprint for more than 90 organizations in Malaysia.

### PUBLIC INTEREST STATEMENT

Fourth Industrial Revolution has abruptly taken over the traditional leadership approaches; the endless inventions of technologies are unfolding the challenges towards the sustainability of organizations. This study highlights the significance of alignment among innovativeness, transformational leadership and organizational sustainability to confront the digitization era. Hence, this study unpacks the effect of Industry 4.0 on leadership and organizational sustainability, and the mediating role of innovative performance on these relationships in the textile industry. The study demonstrates that a redefined transformational leadership has a positive effect on organizational sustainability. The outcome shows the innovative performance enhances organizational sustainability more after integration with smart technologies of Industry 4.0. The upshot of the research is a roadmap for Pakistan's Textile Industry to amplify the working ingeniously based on digitization of Industry 4.0.

sustainability simultaneously. The results depicted that innovative performance enhances organizational sustainability more after integration with smart technologies of Industry 4.0. Furthermore, the mediation reportedly confirmed in hypotheses found to be statistically significant. The results of the study are essential for the textile industry to develop strategies towards sustainability concerns while emerging the organization with Industry 4.0 to attain operational innovativeness. The outcomes of the research will work as a guideline for Pakistan's Textile Industry to increase the working efficiency and productivity effectively. The research's framework is a step forward to not only explore future empirical research but also it will help the other manufacturing sector to align the traditional approaches with high technological initiatives to uphold organisational sustainability.

**Subjects: Sustainable Development; Quality Management; Management of Technology & Innovation;; Management of Technology; Innovation Management; Critical Management Studies; Leadership; Human Resource Management; Organizational Change; Manufacturing Industries**

**Keywords: Transformational leadership; innovative performance; fourth industrial revolution; Industry 4.0; organizational sustainability**

## 1. Introduction

The sustainability of businesses is non-static phenomenon due to the number of grounds such as global climate conditions, scarce resources, and insecure, competitive global scenarios, an immediate increase in population, political instability, economic crisis and new innovative technologies worldwide (Demir et al., 2021). The primary issue for the companies is not only to attain a high level of performance but to sustain the position in the global market while competing with all upcoming unpredictable challenges. Correspondingly, in 2011 the fourth industrial revolution began by the German government, which boosted the precariousness of businesses (Oztemel & Gursev, 2020).

The literature depicted, the today's sustainability means to ensure a long-term success in the world market, and the companies were even investing in new business expansion strategies, employees, product design, processes, value chains, and culture to maintain the performance globally (ALNasser et al., 2013; Schaltegger & Wagner, 2011). Regrettably, the investment into the field of technology was understated by many of the companies, as they followed the conventional mode of operations. Consequently, the commencement of fourth industrial revolution (Industry 4.0) instigates the new challenges around the globe not only for manufacturing but almost in all the fields, such as education, banking, health, transportation and energy sector (Imran et al., 2019; Oztemel & Gursev, 2020). Hence, the field of sustainability is majorly contaminated as it deals with societal, environmental, and economic paradigms.

The globalisation has tightened the boundaries around the globe, which originate the leaders to achieve the long-term sustainability through reaching the competitive advantage by introducing technology reliance in production (Chaiprasit et al., 2011; Nasir & Rao, 2020). The involvement of technology has become a standard to differentiate among the firm's performance level and competitiveness in the world business market. Industry 4.0 has triggered the utilisation of the latest technologies in all the manufacturing industries. Many conventional businesses collapsed or lost their competitiveness as they did not innovate technically and digitally.

In a recent report, Kodak, Nokia, Xerox, BlockBuster, Yahoo, Segway, Sears, Macy, Hitachi, Polaroid, Toshiba, Circuit City, Hummer, Atari and Nortel telecom exposed as unsuccessful corporations due to their non-innovative strategies (Aaslaid, 2018). Furthermore, this report mentioned,

the successful corporations have managed to innovate their strategies digitally through taking timely decisions by foresighted leadership. Thus, leadership plays a fundamental role in gaining a competitive advantage in the business world. The survival of traditional businesses is getting complicated as the Industry 4.0 has begun the unpredictable competition for physical, digital and biological worlds (Schwab, 2017). The identification of new business models, principles and strategies are challenging for the experts, researchers and practitioners due to the complexity of numerous technologies of industry 4.0 (Maresova et al., 2018). According to Carvalho et al. (2018), only proactive and innovative businesses could deal with this competitive digitalisation. The organizations are still required to identify the new innovative approaches in order to deal with the digital transformation era.

Similarly, Shi et al. (2019), Schwab (2017), and Zakaria et al. (2019) pointed out a severe need to revise the traditional business models, leadership, and quality. Additionally, they mentioned the lack of compatibility between traditional leadership approaches and digital transformation in the fourth industrial revolution. The thought-provoking question is; who will lead this Industry 4.0 infinite, inexorable and indefinite digitalisation. With every passing minute, the new emerging technologies are boosting the challenges among companies worldwide (Zakaria et al., 2019).

Correspondingly, in a survey by Salimova et al. (2020), it is articulated the forty-eight per cent experts that the industry 4.0 trends have increased the challenges for company's leadership. The fifty leading managers revealed a severe need to upgrade business model and principles through digitalisation. The new business models require associated with the essential pillars of Industry 4.0 to keep them sheltered in this open-source era of technological advancement. Hence, this study is one of the initial investigations to determine the influence of a revised approach of leadership in the context of Industry 4.0.

In the same vein, some researchers strongly supported the revision of traditional leadership for competing with unpredictable challenges of Industry 4.0 (Lu, 2017; Zhou et al., 2015). Moreover, Schwab (2017) stated the four severe impacts of Industry 4.0; the highly involved customers, complicated design of products, rapid modification in innovation and removal of old business models. He mentioned the contemporary technological advancement would hit the sustainability of businesses. Besides, Shan et al. (2016) highlighted the presence of innovation in a business which helps to attain sustainability. Furthermore, the innovative performance emphasises the deployment of most up-to-date technologies which mitigate the negative consequences and maintain the performance level (Edgeman & Eskildsen, 2012).

Nevertheless, Adams et al. (2016) mentioned the dealing with sustainability issue is impractical without implementing innovation at each level in the production. Considerably, this research establishes the innovation performance as a mediator to determine the influence Industry 4.0 prompt technologies on the sustainability performance. This study investigates the credence of transformational leadership through association of Industry 4.0. In this technological disruptive era, the reconsideration of the managerial principles and redesigning of business models are the primary requirement to hold the sustainability of an organization.

## **2. Literature review and hypothesis development**

### **2.1. Overview of the textile industry in Pakistan**

Fundamentally, Pakistan is an agriculture country with 22.1 million hectares cultivated land. The principal crops are rice, wheat, cotton, sugarcane, multiple fruits, and vegetables which collectively account for more than 75% of the worth of total crop production. In Asia, Pakistan's textile sector possesses the 8<sup>th</sup> position as an exporter (Abbas et al., 2020). This sector considers as a backbone of Pakistan's economy by contributing 62% in total exports, and 39% of the human force is engaged with textile. According to Shafiq (2012), in Pakistan, the quality of cotton is finer than Indian and

Chinese cotton. Contrast to this, Taneja (2011) and Arshad et al. (2020) mentioned the quality, design and price of textile products from China, India and Bangladesh are more substantial than Pakistan.

Correspondingly, the globalisation, digitalisation and prompt innovativeness are the inevitable phenomena around the world. The embryonic countries like Pakistan must rearrange the economy in order to pledge with worldwide crosscurrents (Fatima et al., 2021). The abrupt implementation of the industry 4.0 technologies around the globe has boosted the predicament and quandary in the manufacturing sectors (Küstters et al., 2017). It is no longer an option to uphold a secure position without upgrading the smart technologies, which innovates the product's design quality, consistency, and reliability. Therefore, textile companies require doing several integral transforms in managerial strategies if not; they cannot be able to acquire their market share in the era of smart manufacturing. A report issued by Pakistan's Textile Mills Association (APTMA, 2019) revealed a decline in the exports of textile sector value decreased PKR 266540 in 2019, the six per cent decline recorded in 2018. More practically, it is worth noting that the textile sector in Pakistan has been plagued by insufficient technology, as reported. As Dad and Karim (2019) stated, Pakistan's textile industry is incompatible with facing dynamic technological modification because the majority of companies uses outdated machines and software programs and low-cost technology. As a result, the other countries such as India, Vietnam, and China are fetching the export orders as they are updated and modified (Fatima et al., 2021; Siddique, 2021). The future sustainability of Pakistan's industry can only secure if the innovation techniques, production technology and managerial strategies must channelize with Industry 4.0.

## **2.2. Transformational leadership and organizational sustainability in the context of Industry 4.0**

The sustainability of an organization is a combination of three aspects such as economic, environmental and social (Vu et al., 2017). The economic element estimates the financial growth, market shares; the social aspect ensures the health, safety, human rights and client protection in society; the environmental factor covers the ecological issues of related to the organization's product, wastage in production and decrease in carbon impression (Hallstedt et al., 2013; Kang et al., 2010; Nasir & Pakistan, 2015; Spangenberg, 2005). Notably, from the economic, social and environmental, taking only one aspect is not considered as the real sustainability of an organization (Purvis et al., 2019). According to Purvis et al. (2019), the phenomenon of Industry 4.0 has done a severe hit to the economic, social and environmental factors of the organizations globally. He mentioned, in this open-source of era, customers are interconnected from the idea of the product until the delivery of it; the social media platforms are being used to discover and exchange the information.

Moreover, innovative technological software increases the transparency of manufacturing, such as marketing, sales, and distribution. Equally, the manufacturer gets the prior feedback regarding quality, design and price of the products which lessen the chances of loss. However, Purvis et al. (2019) stated that a petite transform in Industry 4.0 could depart an enormous positive or negative pressure on the sustainability of businesses. Noticeably, Oberer and Erkollar (2018) directed the organization to reconsider the leadership approach to adjust with unpredictable technological advancement.

### **2.2.1. Why leadership 4.0 is needed?**

Industry 4.0 is the mixture of multiple technologies which devalued the old techniques, business model, and conventional styles of leadership as well (Ivanov et al., 2019). According to Vlasov and Chromjaková (2018) mentioned the dysfunctionality of all traditional characteristics, they enforced to find new observations for Industry 4.0. Similarly, M. Xu, David and Kim, (2018a) declared the failure of preceding leadership in dealing with smart technologies, whereas the impact of Industry 4.0 is beyond individual levels. Therefore, the integration of leadership with pillars of Industry 4.0 is inevitable. In this scenario, the leaders lead the company by demolishing the traditional way of work, redesigning of products, and digitalisation of productions to restore the sustainability in the international market (Deloitte, 2015). The companies like Accenture, McKinsey Company and Boston Consulting Group have acquired the new business models by introducing smart leadership (Popova et al., 2018).



In this disruptive era, the thought leadership and knowledge-oriented leadership has been mentioned in a few pieces of research (Kowang et al., 2019; Zakaria et al., 2019). This study is associated transformational leadership with Industry 4.0 based on previous literature because it encouraged the new ideas and enhanced the creative channels in the business (Bass & Avolio, 1994; Pushpanathan et al., 2012; Runi et al., 2017; Zakaria et al., 2019). The four features of transformational leadership such as idealised influence, inspirational motivation, individualised consideration, and intellectual stimulation (Bass & Avolio, 1994). The idealized influence refers to a charismatic personality of leaders; they hold high moral and ethical values, sharpen and clear vision in the favour of organization performance. The inspirational motivation characteristic of a leader shows a positive and enthusiastic commitment to build a dynamic team to achieve organizational goals. The intellectual stimulation trait represents an encouraging leader to accept the change and creativity in the organization. Additionally the, individualized consideration characteristic of transformational leadership refers an empowerment of employees by providing time updated skills training which aligns them to attain not only the organizational but their personal targets as well. These characteristics encourage the researcher to adapt Industry 4.0 due to the clear vision of leader and readiness to take the risk at any time in the business. This study tag along with the definition of leadership 4.0 by Roux (2020) the digitally aligned ability and engaged with most up-to-date technologies to empowered the employee's capacity with ultimate clarity of purpose. Therefore, this study investigates the revised version through aligning the transformational leadership with Industry 4.0.

Moreover, they identified a leader with blurry vision, and a static tone encourages the failure of digitalisation. They further mentioned, the forty-nine per cent leaders confess they did not know where to begin with this digital transformation even though they invest yearly £500,000 for technological advancement. Thus, the immediate need is to revise, retrained and reorganises the principle force into the battle of digitalisation. Nevertheless, it has been reported that the incompetency of leadership has negatively influenced sustainability performance (Chiarini & Vagnoni, 2017; Ingelström & Jivenberg, 2018). The low quality, high costing, outdated designed of products and technology are the consequences of poor leadership on sustainability (Al-Nasser et al., 2016; Calabrese & Corbò, 2015; Dubey et al., 2015). Some empirical investigations have declared leadership as a positive factor to boost sustainability (Hooper et al., 2010; Mårtensson et al., 2019). Therefore, the following hypothesis is proposed:

**H1:** *Transformational leadership positively influences organizational sustainability.*

### **2.3. Innovative performance and organizational sustainability in the context of Industry 4.0**

Global competition, as well as the societal, cultural, technical, fiscal, human, and digital world advances that have accompanied it, has made it necessary for countries to establish cooperative relationships (Ahmed et al., 2021). Industry 4.0, which was first introduced to the agenda by Germany, seeks to adapt information technologies to conventional manufacturing systems, fundamentally transforming them. Businesses in technology-intensive next generation factories will build the technology they need through internal R&D studies as well as move it from outside the company (Yuksel & Sener, 2017). As of technical advances, the evolving cost relates to the principle of production and marketing focused on performance, speed, and creativity. On the one hand, it defines manufacturing processes that quickly respond to evolving customer demands, and on the other, it defines automation systems that are in constant contact and synchronization with each other. These dynamic stages of innovative technologies have challenged the organizational performance around the globe (Greve et al., 2021).

The sustainability is a dynamic state of business owing to numerous reasons such as globalisation, political instability, cultural issues and technological advancement. The existing literature has enforced organizations to deploy more innovative operations to sustain globally (Kagermann et al.,

2013; Kiel et al., 2017; Müller et al., 2018, 2018). Likewise, Venema and Anger Bergström (2018), argued the innovation is a booster to sustainability, but they doubt on the role of innovation as it becomes a dynamic worldwide. Consequently, Industry 4.0 hit up the sustainability of the business through a bunch of high tech technologies in the manufacturing sector (Greve et al., 2021; Julian Marius Müller et al., 2018).

Recent case studies identified the potential impact of innovation on social, environmental and economic states of an organization (Evans et al., 2017; Nasir & Rao, 2020; De Sousa Jabbour et al., 2018). An organization's ability to innovate enables diverse strategies and opportunities to be pursued to boost growth and survival (Abdo Alkhadher et al., 2016). In contrast, an investigation denied the influence of Industry 4.0 towards the ecological and social dimension of sustainability (Khan & Naeem, 2018). Furthermore, Kickul et al. (2010) stated if any organization is not getting any upshot over this digitalisation in the manufacturing sector, it illustrates that organization is not a growth-oriented business rather than wastage of the resources.

The cyber physical system, Internet of things, cloud computing, virtualisation, artificial intelligence, simulation, and big data are the main ingredient of Industry 4.0 even though with every second there are new innovative technologies are introduced under the umbrella of the fourth industrial revolution (Morrar et al., 2017). Furthermore, the impact of innovation is being challenged similar manner to the sustainability of an organization since literature creates an influential link between innovation and sustainability. Thus, this study investigates due to the involvement of Industry 4.0 whether the relationship of innovative performance and sustainability get influenced. Hence, following is the proposed hypothesis:

**H2:** *The innovative performance positively influences organizational sustainability.*

#### **2.4. Transformational leadership and innovative performance in the context of Industry 4.0**

One of the major principles among quality management practices is leadership; the decisive power and business dexterity inscribe the providence of the organization. The competency of leader attentively handles the loopholes of the entire system. Some previous researchers stated, the leadership is the uppermost influencing factor which keeps a positive impact on competitive advantage of business (Islam & Karim, 2011; Matzler et al., 2008; Mokhtar & Yusof, 2010). The transformational leadership, transactional leadership and laissez-faire leadership style are established but researchers are not clear over the compatibility of dimensions, whereas few studies managed to set up different styles of leaders through defining characteristics (Bass & Steidlmeier, 2006; Motwani, 2001; Prajogo & Sohal, 2003; Yusof & Aspinwall, 1999). The keen comparison of previous literature resulted to choose the transformational leadership as an influencer over the innovative performance (Bossink, 2004; Zainal Abidin et al., 2011; Zakaria, 2013).

The majority of businesses faced loss and some of them entirely vanished from the international market because leaders did not support the innovation in the products, process and organizational operations (Aaslaid, 2018). For instance, Xerox, Block Buster, Yahoo, Segway, Sears, Macy, Hitachi, Polaroid, Toshiba, Circuit City, Hummer, Atari and Nortel telecom were exposed as unsuccessful corporations due to their non innovative strategies (Aaslaid, 2018). The top management undermined the impact of innovativeness even in the era of massive digital disruption. Primarily, the concept of innovation is to adopt new idea, ways, and techniques, behaviours to make the system effective and efficient (Damanpour & Evan, 1984). This study considers the three most applicable dimensions of innovative performance in manufacturing, such as product, process and organizational innovation. The product innovation refers to an improved design and enhanced model of a product; a process innovation demotes a systematic and novel process through new tools and integrated finishing of an operation. In addition, the element of organizational innovation covers



the administrative empowerment and controlled by improving new procedures in the organization (Ling & Nasurdin, 2010).

Concurrently, the innovation is described as a dynamic process by implementing new methodologies and operational tools (Zainal Abidin et al., 2011; Zakaria et al., 2018). A leader with clear vision and charismatic attribute can accelerate the performance through implementing the innovation as a booster. The transformational leadership has a positive influence on the organizational performance through accepting the innovation in the operations (Herzallah et al., 2014; Hsien, 2016; Ismail et al., 2009). Correspondingly, traditional pattern of leadership is becoming obsolete due to explode of digitalisation that's challenged the innovative performance intensely (Park et al., 2017). Hence, this investigation reconfirms the influence of transformational leadership on innovative performance in the context of Industry 4.0. The study proposes the following hypothesis:

**H3:** *The transformational leadership positively influences innovative performance.*

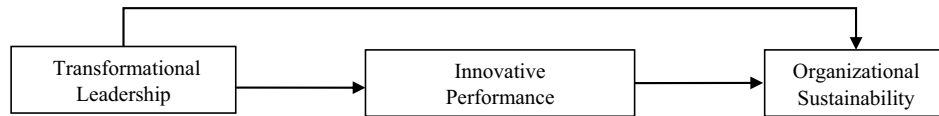
### **2.5. The mediating role of innovative performance with leadership 4.0 and organizational sustainability in the context of Industry 4.0**

Innovation denotes the trending and leading technological drivers over the decades in the manufacturing industry (Chen & Huang, 2009). The installation of smart technologies in the businesses increases the performance, social, environmental expectations of customers and enhances the value in the operationalization of business (Penalva, 2021). The innovative performance invests essential values in securing the sustainability of businesses (Walker et al., 2011). In addition, Eskildsen and Edgeman (2012) emphasised the presence of innovation would attain the level of sustainability. In contrast, a few researchers ignored the mediating impact of innovative performance on competitive advantages (Lori & Fallahnejad, 2015; Soreshjany & Dehkordi, 2014). On one side, the researchers agreed that implementation of the smart technologies prepares the businesses to sustain the level of performance (Ethe Raj.P and Sazali Abdul Wahab, 2018; Islam & Karim, 2011; Thuemmler & Bai, 2017).

Another contradictory view of scholars devalues the contribution of digitalisation if the innovative strategies are stagnant for long time (Morrar et al., 2017; Müller et al., 2018). Undoubtedly, business opportunities, performance, operations, supply chain practices, human resource management, quality management principles and sustainability are being challenged by the intervention of Industry 4.0 (Bansal & Song, 2017; Chaiprasit et al., 2011; Morrar et al., 2017; Schwab, 2017). Considerably, Adams et al. (2016) directed the companies innovation is required at all the levels of an organization to survive up the dynamic state of organizational sustainability. A smart utilisation of Industry 4.0 technologies to upgrade the innovativeness in the organization at product, process and administration ultimately leads to the sustainable development (Morrar et al., 2017; Penalva, 2021). Practically, the China is more forwarded in manufacturing and exporting the products as they frequent associate the smart technologies to enhance the innovativeness of the company (Lau, 2019).

According to Aguinis et al. (2017) the purpose to introduce mediation into a framework considers exploring the mechanism that transmits effect from one variable to dependent variable. Consequently, this study investigates the mechanism between transformational leadership and organizational sustainability through innovative performance as a mediator. Honarpour et al. (2018) pointed out the innovative performance mediates the relationship of quality management practices collectively, but the individual impact of leadership is undermined in the manufacturing sector. Moreover, Zakaria et al. (2018); Zakaria et al. (2017) found that organizational innovation is crucial to optimising entrepreneurial orientation's effect on firm performance. This research thus contributes to the EO-performance literature by adding OI as a missing link in the relationship review. More importantly, Firman and Thabrani (2018) declined the mediating role of innovation with economic sustainability of an organization but simultaneous influence of social and

**Figure 1. Theoretical framework.**



environmental is neglected. Hence, the contrary results provoked the study to reinvestigate the influences of innovative performance as mediator. Therefore, the study proposes the hypothesis:

**H4:** *Innovative performance mediates the influence of transformational leadership and organizational sustainability.*

**2.6. Theory of system management**

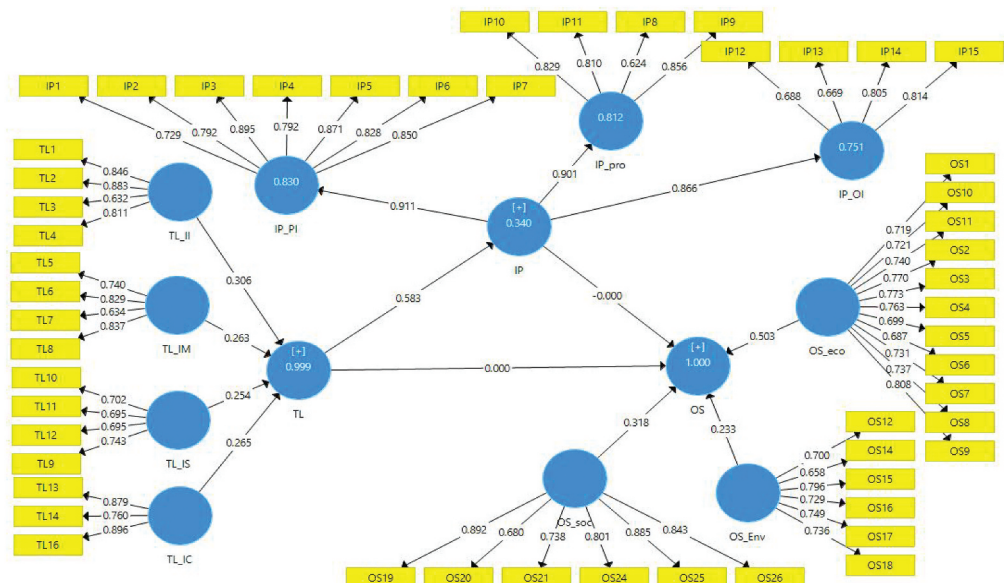
The research framework of this study is underpinned by the system theory; that consider organizations as purposeful and unified systems that are also interrelated in nature works as input, process and generate output (Robbins & Barnwell, 2006). Thus, the relationships between transformational leadership, innovative performance and organizational sustainability can be explicated by the system theory. Subsequently, the transformational leadership is aligned as input; innovativeness processes interpret as process to generate the sustainability in an organization. This study uniquely portrayed a revising approach of transformational leadership, reorganised the influence of innovative performance by associating it with smart technologies of Industry 4.0 and lastly, to retain the organizational sustainability which is magnificently challenged by digitalisation worldwide.

**3. Theoretical framework**

The detailed review of existing literature justified the conceptualisation of this theoretical framework. The following framework (see Figure 1) is formed for carrying out this research study through providing the graphical representation of three variables.

These constructs are not derived directly from any existing model because it involves the association of Industry 4.0 technologies that keeps a gap in literature with all the three latent of this study. The following hypothesis has been developed to determine the influences of fourth industrial revolution.

**Figure 2. Measurement model transformational leadership (TL), innovative performance (IP), organizational sustainability (OS).**



*H1: The transformational leadership positively influences organizational sustainability.*

*H2: The innovative performance positively influences organizational sustainability.*

*H3: The transformational leadership positively influences innovative performance.*

*H4: Innovative performance mediates the influence of transformational leadership and organizational sustainability.*

#### **4. Research methodology**

##### **4.1. Questionnaire design and data collection**

The current study is quantitative in nature and cross-sectional; hence data was collected at once. The data was collected from ISO 9000 textile companies, listed in Pakistan's stock exchange. The companies with ISO 9000 certification are intended to adopt the economical, environmental and social initiatives (Demir et al., 2021). Therefore, CEO and top managers of ISO companies were the most appropriate respondents for the data to be analysed as the study focused on organizational sustainability and transformational leadership. A self-customised questionnaire was designed to record the responses quantitatively by five point Likert scale. The questionnaire complied through an extensive modification from the literature. In order to confirm the face and content validity, a focused group discussion was conducted with four expert academicians and three industrialists from Pakistan's textile industry. The questionnaire was divided into two major parts; demographic section and items (see, Table 1). In the stock exchange of Karachi, Lahore and Islamabad 162 textile firms are listed, 129 are ISO 9000 certified (Pakistan Stock Exchange Limited, 2019). Therefore, the total population of this study is 129 textile firms. Thus, this study is associated with the operationalization of Industry 4.0 technologies so that, the collected data has revealed seventy two percent (72%) of textile industry in Pakistan has been triggered to install the different combination of Industry 4.0 technologies, such as cloud computing, cyber physical system, Internet of things, big data and artificial intelligence (Khan et al., 2021).

The researcher applied simple random sampling techniques. For fetching the appropriate sample size through G-Power tool that was utilised based on the predictors of the framework. The G-Power is recommended to be used in PLS-SEM analysis to determine the sample size of a given population. The required minimum sample size was determined as 92 based on the population of 129. Therefore, this study required minimum of 92 respondents to collect data as much closer to meet the analysis requirement for determining the relationship (Muhamad et al., 2014). The totals of 122 questionnaires were distributed specifically to all the ISO firms for maximum response. The data for this current study was collected in six month period (between November, 2019 to April, 2020). The firms located in Karachi could not manage to response due to the industrial strikes. It was tough to get responses from all the listed firms and to reach the respondents such as CEO or top managers were unpredictably time consuming, though researcher managed to received 109 useable responses.

##### **4.2. Measurement scale**

The study adapted existing scales to measure the key variables by using multiple items on five point Likert scale. The four dimensions of transformational leadership are measured using four reflective items each, adopted from (AlOwais, 2019; Devie et al., 2015; Sadeghi & Pihie, 2012) i.e., four items for idealised influence, example of the items "The leadership has a clear common vision to improve quality through IR 4.0 technologies", four items for inspirational motivation, example of the items "The leadership always encourages the employees to take necessary actions on their own to promote quality", four items for intellectual stimulation, example of the items, "The leadership re-examines critical assumptions to question whether they are reflecting the organization's policy on IR 4.0 technologies", four items for individualisation consideration, example of the items

**Table 1. Respondent's demographic profile with descriptive statistics**

<b>Position in the organization</b>	<b>Number</b>	<b>Percentage (%)</b>
CEO	34	31.1
General Manager	13	11.9
Quality Manager	21	19.2
Operational Manager	23	21.1
I.T Expert	18	16.5
Total	109	100
<b>Age of respondent</b>		
20-30	22	20.1
31-40	17	15.5
41-50	32	29.3
More than 50 years	38	34.8
Total	109	100.0
<b>Experience</b>		
Less than 5 years	18	16.5
5-10 years	22	20.1
11-20 years	18	16.5
21-30 years	20	18.3
31-40 years	12	11.0
More than 50 years	19	17.4
Total	109	100.0
<b>Organization Size (No. of Employees)</b>		
less than 50	15	13.7
51-100	22	20.1
101-500	41	37.6
501-1000	12	11.0
More than 1000	19	17.4
Total	109	100.0
<b>Organization Established Year</b>		
Less than 5 years	8	7.3
5-10 years	27	24.7
11-20 years	18	16.5
21-30 years	27	24.7
31-40 years	11	10.9
More than 50 years	18	16.5
Total	109	100.0
<b>Segment of Textile Industry</b>		
Textile Composite	31	28.4
Textile Spinning	35	32.1
Textile Weaving	43	39.4
Total	109	100.0

*“Leadership spends more time and put efforts to train employees in order to use IR 4.0 technologies”.*

The mediating innovative performance is measured with sixteen items representing three dimensions, adopted from (Gunday et al., 2011; Muhamad et al., 2014), i.e., seven items for product innovation, example of the items *“The implementation of IR 4.0 technologies increased the quality of the current product’s material”*, four items for process innovation, example of the items, *“The implementation of IR 4.0 technologies contributes to eliminate non-value-adding activities from the production processes”*, and five items of organizational innovation, example of the items, *“The implementation of IR 4.0 technologies contributes to making better knowledge management system”*.

The organizational sustainability is measured and adopted (Amrina & Yusof, 2011; Dos Santos et al., 2014; Hahn & Kühnen, 2013) with twenty-seven items reflecting three dimensions, i.e., eleven items for economical sustainability, example of the items, *“The implementation of IR 4.0 technologies increases the revenue growth of the organization”*, seven items of environmental sustainability, example of the items, *“The implementation of IR 4.0 technologies decreases the wastage from the operations”*, and nine items of social sustainability, example of the items, *“The implementation of IR 4.0 technologies contributes to the improvement in training and skills development”*.

The demographic characteristics of the respondents are presented in Table 1, the number of responses from the respondent’s position in the organization; the highest response rate was from CEO’s (31.1%) whereas general manager’s response was lowest (11.9%). With regards to age of the respondents, with more than 50 years of age represented (34.8%), those between the age of 31–40 participated lowest (15.5%). Further, the respondents with 5–10 years showed highest participation (20.1%) whilst with 31–40 year of experience were (11.0%) represented lowest. Table 1 also shows the size of organization based on the number of employees, the highest representation were (37.6%) from those organization which have number of employees 101–500 and the low representation were from the organization with 501–1000 employees (11.0%). The organizations which established in less than 5 years were (7.3%) as lowest, the organizations with 5–10 years and 21–30 years of establishment responded highest (24.7%). The responses from the textile segments, weaving represented highest (39.4%), the less response was represented by textile composite (28.4%) see, Table 1.

#### **4.3. Pilot study**

In the current study, 32 textile companies were selected from Punjab state which was not the part of the main study. The 50 questionnaires were sent and 37 respondents returned the questionnaires whereas only 13 were not received. Therefore, based on 32 usable questionnaires, SPSS and Smart-PLS 3 were used to test their reliability (see, Table 2). The Cronbach’s alpha is extensively used index of reliability in organizational research. Furthermore, there are diverse proposition on the minimum acceptable values of Cronbach’s alpha, ranging from 0.70 to 0.95 (Bonett & Wright, 2015; Cui & Li, 2012).

As Table 2 shows the Cronbach’s alpha of all the instruments in this study ranged between 0.709 to 0.921, consequently, Cronbach’s alpha values did not show that any of the items needs to be deleted in the pilot testing and therefore all the items were maintained.

### **5. Analysis and result**

This section of the study entails analysis of collected data; analysis was conducted through utilisation of Smart-PLS by PLS-algorithm and bootstrapping method. The first section of analysis consists of measurement model to assess the reliability and validity of constructs, first phase also assessed the convergent validity. Considerably, the structural equation model (SEM) in this study follows the two-stage approach through latent variable score in order to run the bootstrapping.

#### **5.1. Measurement model**

This section of study assessed the reliability and validity of constructs based on factor loading, composite reliability and average variance extract (AVE). The factor loading must be retained if it is higher than 0.40,

**Table 2. Items reliability analysis**

Constructs		No. of Items	Cronbach's alpha
<b>Transformational Leadership</b>	Ideal_ Influence (II)	04	0.862
	Inspirational_ Motivation (IM)	04	0.802
	Intellectual_ Stimulation (IS)	04	0.734
	Individual_ Consideration (IC)	04	0.811
<b>Innovative Performance</b>	IP_ Product	07	0.921
	IP_ Process	04	0.798
	IP_ Org	05	0.709
<b>Organizational Sustainability</b>	Os_ Economical	11	0.901
	Os_ Environmental	07	0.857
	Os_ Social	09	0.891

the value to composite reliability must remain higher than 0.70 for acceptability, higher than 0.80 shows good reliability and higher than 0.90 demonstrate excellent reliable construct. The value for AVE must remain higher than 0.50 for acceptability of construct reliability and validity (Hair et al., 2014). The Table 3 and Figure 2 presents factor loading, composite reliability, AVE and VIF.

The Table 3 demonstrated the construct reliability, validity and average variance extract (AVE); the values for internal consistency are measured by outer loading of each item. The items are retained with higher outer loading as lower than 0.40 were deleted. The items OS 13, OS 22, OS23 and OS 27 from organizational sustainability (OS) were deleted due to lower outer loading. The item IP 16 from innovative performance (IP) was deleted, and from transformational leadership (TL) 15 was deleted due to lower outer loading. In nutshell, there were 59 items in total and 06 items were eliminated and remaining 53 items were used for data analysis that satisfied the construct reliability and validity. The value for Variance Inflation Factor (VIF) should not be higher than 5 (Henseler et al., 2014). The measurement model of current study also reported that all the items had VIF less than 5; this is acceptable to assess the multicollinearity. Table 3 shows that composite reliability has been reported for each dimension of every construct such as the endogenous construct organizational sustainability consist of three dimensions namely economical, environmental and social perspective. The Cronbach alpha for economical sustainability found to be 0.918, environmental sustainability observed as 0.826 and social sustainability found to be 0.893; similarly three dimensions for innovative performance namely product innovation, process innovation and organization innovation observed Cronbach alpha as 0.920, 0.786, and 0.732 respectively. The transformational leadership also observed for Cronbach alpha and reported 0.803, 0.757, 0.701 and 0.801 respectively. The composite reliability was also assessed for each dimension of all constructs, first of all the organizational sustainability was assessed for composite reliability for economical sustainability found to be 0.931, environmental sustainability observed as 0.872 and social sustainability found to be 0.919; similarly three dimensions for innovative performance namely product innovation, process innovation and organization innovation observed composite reliability as 0.936, 0.864, and 0.834 respectively. The transformational leadership also observed for composite reliability and reported 0.874, 0.847, 0.801 and 0.884 respectively. The average variance extract (AVE) was also assessed for each dimension such as economical sustainability found to be 0.550, environmental sustainability observed as 0.532 and social sustainability found to be 0.657; similarly three dimensions for innovative performance namely product innovation, process innovation and organization innovation observed AVE as 0.679, 0.617, and 0.558 respectively. The transformational leadership also observed for AVE and reported 0.638, 0.584, 0.502 and 0.718 respectively. All VIF values reported as lower than threshold values so therefore no multicollinearity detected.



**Table 3. Construct validity and reliability**

First order Constructs	Second order Constructs	Scale Type	Indicators	Loadings	CR	Alpha	AVE
Os_ Eco		Reflective	OS 1	0.719	0.931	0.918	0.550
			OS 2	0.770			
			OS 3	0.773			
			OS 4	0.763			
			OS 5	0.699			
			OS 6	0.687			
			OS 7	0.731			
			OS 8	0.737			
			OS 9	0.808			
			OS 10	0.721			
			OS 11	0.740			
Os_ Env		Reflective	OS 12	0.700	0.872	0.826	0.532
			OS 14	0.658			
			OS 15	0.796			
			OS 16	0.729			
			OS 17	0.749			
			OS 18	0.736			
Os_ Soc		Reflective	OS 19	0.892	0.919	0.893	0.657
			OS 20	0.680			
			OS 21	0.738			
			OS 24	0.801			
			OS 25	0.885			
			OS 26	0.843			

(Continued)

**Table 3. (Continued)**

First order Constructs	Second order Constructs	Scale Type	Indicators	Loadings	CR	Alpha	AVE
	<b>Organizational Sustainability (OS)</b>	Formative	<b>Items</b>	<b>Weight</b>	<b>VIF</b>	<b>t-value</b>	
			Os_ Eco	0.510	4.982	8.597	
			Os_ Env	0.680	3.002	19.703	
			Os_ Soc	-0.159	4.881	2.801	
<b>First order Constructs</b>	<b>Second order Constructs</b>	<b>Scale Type</b>	<b>Indicators</b>	<b>Loadings</b>	<b>CR</b>	<b>Alpha</b>	<b>AVE</b>
IP_Product		Reflective	IP 1	0.729	0.936	0.920	0.679
			IP 2	0.792			
			IP 3	0.895			
			IP 4	0.792			
			IP 5	0.871			
			IP 6	0.828			
			IP 7	0.850			
IP_Process		Reflective	IP 8	0.624	0.864	0.786	0.617
			IP 9	0.856			
			IP 10	0.829			
			IP 11	0.810			
			IP 12	0.688			
IP_Org		Reflective	IP 13	0.669	0.834	0.732	0.558
			IP 14	0.805			
			IP 15	0.814			

(Continued)

**Table 3. (Continued)**

First order Constructs	Second order Constructs	Scale Type	Indicators	Loadings	CR	Alpha	AVE					
								Items	Loadings	CR	AVE	
	Innovative Performance (IP)	Reflective	IP_Product	0.911	0.922		0.797					
			IP_Process	0.901								
			IP_Org	0.866								
First order Constructs	Second order Constructs	Scale Type	Indicators	Loadings	CR	Alpha	AVE					
								TL 1	0.846	0.874	0.803	0.638
								TL 2	0.883			
								TL 3	0.632			
								TL 4	0.811			
								TL 5	0.740			
								TL 6	0.829			
								TL 7	0.634			
TL 8	0.837											
Inspirational_Motivation (IM)		Reflective			0.847	0.757	0.584					
								TL 9	0.743			
								TL 10	0.702			
								TL 11	0.695			
Intellectual_Stimulation (IS)		Reflective			0.801	0.701	0.502					
								TL 12	0.743			
								TL 13	0.879			
Individual_Consideration (IC)		Reflective			0.884	0.801	0.718					
								TL 14	0.760			
								TL 16	0.896			

(Continued)

**Table 3. (Continued)**

First order Constructs	Second order Constructs	Scale Type	Indicators	Loadings	CR	Alpha	AVE
	Transformational Leadership (TL)	Formative	<b>Items</b>	<b>Weight</b>	<b>VIF</b>		<b>t-value</b>
			II	0.341	4.021		1.688
			IM	0.055	4.785		0.222
			IS	0.406	4.771		1.978
			IC	0.287	3.273		1.133

Note: TL\_II—leadership idealized influences; TL\_IM—inspirational motivation; TL\_IS—intellectual stimulation; TL\_IC—individualization consideration; IP\_PI—innovation performance—product innovation; IP\_Pro—process innovation; IP\_OI—organizational innovation; OS\_Eco—organizational sustainability economic sustainability; OS\_env—environmental sustainability; OS\_soc—social sustainability;  $p < 0.05$  ( $t > 1.645$ );  $p < 0.01$  ( $t > 1.96$ )

### 5.2. Heterotrait-monotrait ratio (HTMT)

Discriminant validity for the measurement model was assessed through the Heterotrait-Monotrait ratio (HTMT) and presented in Table 4. The HTMT is an estimate of the correlation among constructs, parallel to the correlated construct score. If the value of the HTMT is higher than this threshold, there is a lack of discriminant validity. Some authors suggest a threshold of 0.85 (Kline 2011), whereas others propose a value of 0.90 (Teo et al. 2008). The threshold value for accepted HTMT is suggested as 0.90 (Henseler et al., 2014; Al Mamun et al., 2018). Table 4 presents the values for HTMT that confirms discriminant validity.

### 5.3. The establishment of higher order constructs

This study establishes the higher order construct to curtail the number of relationships in the research framework. The higher order construct reduces the complexity of the research frame and keep the theoretical parsimony to make the best understanding. Moreover, this approach avoids multicollinearity due to multiple dimensional structure of the research framework (Hair et al., 2012). Table 3 illustrates the path coefficient from dimensions of organizational sustainability to second-order organizational sustainability are significant at  $p < 0.01$  (see, Table 3). The weight values are given as second order construct that found to be 0.510 (OS\_eco), 0.680 (OS\_env) and  $-0.159$  (Os\_soc) were reported significant at  $p < 0.01$  (see, Table 3). Moreover, the VIF 4.982 (OS\_eco), 3.002 (OS\_env) and 4.881 (Os\_soc) denotes the dimensions of organizational sustainability. The t-values are 8.597, 19.703, 2.801 mentioned for economical, environmental and social sustainability.

The Table 3 illustrated all first-order constructs for innovative performance with reflective indicators and second-order constructs with reflective indicators are also presented. The correlation among these dimensions is also presented in Table 3 and close correlation among dimensions indicate presence of second-order construct (Byrne, 2013). The constructs having reflective dimensions and reflective indicators known as type 1 reflective-reflective model. Similarly, the independent variable transformational leadership was measured on the base of four dimensions including idealised influences, inspirational motivation, intellectual stimulation, and individualisation consideration with reflective indicators. Table 3 illustrated all dimensions with indicators of all constructs. The Byrne (2013) construct is modelled with reflective indicators of four first-order constructs and formative second-order construct base on four first order dimensions. The model is known as type II reflective-formative construct and measured on the base of first order indicators (Wetzels et al., 2009). The Table 3 also illustrates the transformational leadership as first-order construct with reflective indicators to explain the second-order construct as formative construct. The path coefficient found to be significant as shown in table. The four dimensions of transformational leadership explained by the weight found as 0.341 (TL\_II), 0.055 (TL\_IM), 0.406 (TL\_IS) and 0.287 (TL\_IC) with significant at  $p < 0.01$  (see, Table 3). Nevertheless, Table 3 presents the VIF of transformational leadership's dimensions resulted as 4.021 (TL\_II), 4.785 (TL\_IM), 4.771 (TL\_IS) and 3.273 (TL\_IC) which is less than 5; this is satisfactory to assess the multicollinearity. Moreover, the Table 3 depicted the t-values of all the dimensions of transformational leadership 1.688 (TL\_II), 0.222 (TL\_IM), 1.978 (TL\_IS) and 1.133 (TL\_IC) which should be greater than 1.645 at 5% and 1.96 at 1%. Hence, the TL\_IM 0.222 and TL\_IC 1.133 are not found to be significant. In this case, the study checked the outer loading which are greater than 0.5. Therefore, the study has retained the dimensions as suggested by Sarstedt et al. (2019) the insignificant outer weights does not interpret the low quality of the model whereas the significant outer loadings higher than 0.5 propose the usability of the dimensions in the higher order construct measurement model.

### 5.4. Structural equation model (SEM)

This section of study investigates the relationship between constructs of the framework through utilisation of bootstrapping method of PLS. At first  $f^2$ ,  $R^2$  and  $Q^2$  are assessed and secondly hypothesised relationships between constructs were investigated. The Table 4 presented the effect size of Cohen  $f^2$  that shows the influence of exogenous variables on endogenous variables (Cohen, 2013). If the value of  $f^2$  observed as 0.35 it is large effect size, if the value is observed as 0.15 that show medium effect size, whereas 0.02 presents small effect size according to Cohen (2013). The Table 5 shows the effect size  $f^2$  of transformational leadership and Innovative performance had relatively higher to medium effect.

**Table 4. HTMT (heterotrait-monotrait)**

	TL_II	TL_IM	TL_IS	TL_IC	IP_PI	IP_pro	IP_OI	OS_eco	OS_env	OS_soc
TL_II	----									
TL_IM	0.610	----								
TL_IS	0.551	0.634	----							
TL_IC	0.761	0.511	0.801	----						
IP_PI	0.761	0.612	0.792	0.692	----					
IP_pro	0.542	0.571	0.517	0.677	0.803	----				
IP_OI	0.491	0.529	0.412	0.741	0.625	0.801	----			
OS_eco	0.631	0.613	0.791	0.681	0.767	0.589	0.701	----		
OS_env	0.581	0.511	0.691	0.635	0.548	0.787	0.678	0.510	----	
OS_soc	0.782	0.565	0.671	0.614	0.443	0.671	0.547	0.423	0.618	----

Note: TL\_II—leadership idealized influences; TL\_IM—inspirational motivation; TL\_IS—inspirational motivation; TL\_IC—intellectual stimulation; IP\_PI—individualization consideration; IP\_pro—process innovation; IP\_OI—process innovation; OS\_eco—organizational innovation; OS\_env—organizational sustainability economic sustainability; OS\_soc—social sustainability



The study reported  $R^2$  in the table above that explain the variance in dependent variable, the rule of thumb for  $R^2$  is considered as higher if observed as 0.26, the moderate value is suggested as 0.13 and 0.02 considered as weak (Cohen, 2013). The value for  $R^2$  in current study found to be 0.349 that is substantial and explain the variance by 34% in dependent variable. The  $R^2$  of dependent variable with three or more independent constructs should be at least substantial (Henseler et al., 2009). The study also reported predictive relevance  $Q^2$  as suggested by Hair et al. (2012) through blindfolding method of PLS, it presents the quality of overall model. It has been suggested that  $Q^2$  must remain higher than zero that reflects the predictive relevance of the model (Henseler & Chin, 2010). The result of blindfolding presented  $Q^2$  in Table 5 as endogenous constructs (TL, 0.289; OS, 0.471) that is higher than threshold value, hence  $Q^2$  is accepted.

### 5.5. Findings

The current section of analysis investigated the relationship between constructs as direct hypotheses H1, H2, H3 and a mediating hypothesis H4. The relationship between constructs are measured on the basis of  $\beta$  value as it shows the direction of relationship, the t-value must remain higher than 1.96 with 5% error margin and p-value must remain lower than 0.05 for acceptable significant relationship (Hair et al., 2014). The Table 6 below demonstrates the result of hypotheses of proposed framework and Figure 3 below shows the structure equation model.

Table 6 and Figure 3 show the result of hypotheses of proposed framework, the first hypothesis H1 demonstrates result as ( $\beta = 0.060$ , t-value = 2.087, p-value<0.05), based on t-value the first hypothesis is statistically accepted, as cut off point for t-value is 1.96 with 5% error margin, so therefore H1 is accepted statistically. The second hypothesis H2 demonstrate results as ( $\beta = 0.927$ , t-value = 43.266, p-value<0.01), based on t-value the hypothesis is statistically accepted, as cut off point for t-value is 1.96 with 5% error margin, so therefore H2 is accepted statistically. The third hypothesis H3 demonstrates result as ( $\beta = 0.595$ , t-value = 9.438, p-value<0.05), based on t-value the third hypothesis is statistically accepted, as cut off point for t-value is 1.96 with 5% error margin, so therefore H3 is accepted statistically. The fourth hypothesis H4 investigated the mediating role of IP between exogenous and endogenous constructs of proposed framework. The results of mediating hypothesis shows that ( $\beta = 0.551$ , t-value = 9.236, p-value< 0.01), based on t-value the hypothesis is statistically accepted, as cut off point for t-value is 1.96 with 5% error margin, so therefore H4 is accepted statistically. In nutshell, the direct and mediating hypotheses of the study found to be statistically significant.

### 6. Summary of hypotheses results

S#	Hypotheses	Results
1	The transformational leadership positively influences organizational sustainability	Sig
2	The innovative performance positively influences organizational sustainability	Sig
3	The transformational leadership positively influences innovative performance	Sig
4	Innovative performance mediates the influence of transformational leadership and organizational sustainability	Sig

**Table 5. Effect size of Cohen  $f^2$ ,  $R^2$  and  $Q^2$  of TL, IP and OS constructs**

Relation	$f^2$	$R^2$	$Q^2$
Organizational sustainability (OS)	----	0.930	0.471
Transformational leadership (TL)	0.430	----	----
Innovative Performance (IP)	0.547	0.354	0.289

## 7. Discussion and conclusion

The findings of this research correlated with past studies' result that verified a positive relationship between transformational leadership and organizational sustainability (Mårtensson et al., 2019; Oberer & Erkollar, 2018; Penalva, 2021). Consequently, this study confirmed the interference of IR 4.0 technologies enhance the role of leadership in the sustainability of an organization. Similarly, some prior studies demonstrated the positive influence of innovative performance to enhance the organizational sustainability (Evans et al., 2017; Müller et al., 2018). It shows the involvement of latest IR 4.0 technologies into the process of innovation influence the sustainability of an organization (Honarpour et al., 2018). This study suggests the leadership of an organization has to adopt and promote the IR 4.0 technologies to achieve the desired sustainability through integration of innovation performance. This paper has significantly determined the influence of revised conceptualised leadership associating with industry 4.0. The transformational leadership is considered as suitable for the textile companies of Pakistan to be implemented. The grand challenge of upcoming smart era can be catered if the leadership capability improves and adopt the best technologies for operationalization (Ali et al., 2021). The organizational sustainability has positively influenced through transformational approach of leadership particularly for coping up the issues of Industry 4.0. Furthermore, the textile firms require implementing smart technologies as the innovative performance enhanced the line of sustainability. The aligned leadership with inventive approach helps the manufacturing industry to upgrade the products and processes. The fourth industrial revolution has given a huge set back to the businesses of underdeveloped countries (Abbas et al., 2020; Greve et al., 2021; Siddique, 2021). The contribution of innovation would retain the existence of the business in the global market. Overall, the sustainability of a business relies on the integration of Industry 4.0 smart technologies. The manufacturing in Industry 4.0 is more automated, flexible, innovative, and robotically monitored but it also lessens the demand of human resource which accelerates the unemployment worldwide. The future researcher may investigate the influences of human resource practices and quality management as the Industry 4.0 requires more empirical exploring in numerous perspectives.

This research is focused on the challenges faced by the textile industry in Pakistan due to the digitalization; mostly organizations are not aligned with Industry 4.0 technologies. The technological infrastructure is not up to the mark for developing countries like Pakistan where organizations must be able to manage IoT, cyber physical system, artificial intelligence, big data and cloud computing. Besides, elements of Industry 4.0 such as big data, IoT and smart factory concepts are shaping the future of manufacturing industries. According to Muktadir et al. (2019) and Siddique (2021) the technology-related barriers are significant barriers to big Human factors related challenges to sustainability of manufacturing industries. In addition, Ali et al. (2021) reported that the lack of technological infrastructure is the most considerable challenge to employ Industry 4.0 technologies in the textile industries of Pakistan.

### 7.1. Theoretical implication

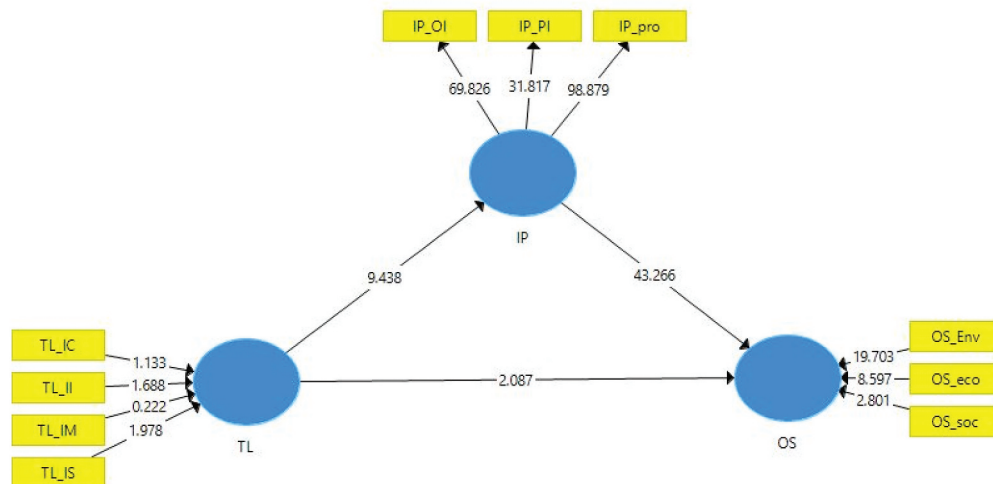
In due course, this paper leads to numerous contributions to the quality management principles, innovative performance and organizational sustainability, incorporating the Industry 4.0 technologies and ISO organization's body of knowledge. Initially, leadership the well-recognized principle of quality management has been redefined in the perspective of Industry 4.0. Specifically, the

**Table 6. Result of research hypotheses**

S#	Relationship	Std Beta	Std. Error	t-values	p-values	LLCI	ULCI	Decision
H1	TL -> OS	0.060	0.029	2.087	0.019	0.017	0.110	Supported
H2	IP -> OS	0.927	0.021	43.266	0.000	0.885	0.958	Supported
H3	TL -> IP	0.595	0.063	9.438	0.000	0.473	0.683	Supported
H4	TL -> IP -> OS	0.551	0.060	9.236	0.000	0.417	0.653	Supported

TL—Transformational Leadership; IP—Innovation performance; OS—organizational sustainability  
 p < 0.01(t > 1.96); p < 0.05(t > 1.645)

**Figure 3. Structural equation model transformational leadership (TL), innovative performance (IP), organizational sustainability (OS).**



transformational approach of leadership segregated with its four dimensions from the digitization lens of the current perspective fourth industrial revolution. This showed a novel direction to uphold organizational sustainability, by a quantitative organizational assessment tool to guide the top management towards the implementation of industry 4.0 technologies.

**7.2. Methodological implication**

This empirical study is one of the pioneer studies to the highly supportive role of leadership principle of management which drives organizational sustainability through unfolding the elements of industry 4.0. This research contains a novelty in terms of the extensive modification of all the indicators in the main framework. It’s empirically originating the agenda of coalition with technology under the existence in ISO 9000 to maintain the sustainability. Additionally, this research shows that leadership and innovation at all organizational levels are critical to the effective and full execution of sustainability at the social, economical, and environmental levels.

**7.3. Practical implication**

The results of the study are essential for the textile industry to develop strategies towards sustainability concerns while emerging the organization with Industry 4.0 to attain operational innovativeness. The outcomes of the research will work as guidelines for Pakistan’s Textile Industry to increase working efficiency and productivity effectively. Manufacturers in developing countries should use the conceptual structure built in this study as a road map to introduce a new strategy that integrates sustainability into their strategic prioritization with maximum trust based on their current conditions. The Policymakers should use the study’s results to define and prioritize which of the sustainable manufacturing activities currently being adopted by Pakistan manufacturers needs help in the form of legislation, laws, facilities, as well as financial and technical assistance. Notably, as reported by Fatima et al. (2021) the Pakistani textile companies are not encouraged in international markets due to the use of behind the clock technology, consequently, this study will work as roadmap for that particular industry to persuade the top management to reason with Industry 4.0. To conclude, the contributions of this study may help textile top management to plan and implement managerial and operational strategies that align with the digitization challenges.

**7.4. Limitation to the study**

The research’s framework is a step forward to not only explore future empirical research but also it will help the other manufacturing sector to align the traditional approaches with high technological initiatives to uphold organisational sustainability. The top management was the respondent to this study from textile ISO companies. For the generalization of the concept, a cross-organizational and cross-country study can be conducted in the future.

### 7.5. Recommendations to the future study

This empirical research was conducted with textile ISO companies; it can be replicated at different types of manufacturing organizations in the future. It is therefore important to do a comparative review of the challenging areas of manufacturing, to better investigate their relationships and connections, interviews with a larger spectrum of stakeholders and top managers may be undertaken in the future to expand this study and achieve a broader perspective.

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**Appendix**  
**Questionnaire**  
**Section A: Respondent & organization profile**

**State your position in the organization:** \_\_\_\_\_  
**CEO, General Manager, Quality Manager, Operational Manager, I.T expert.**

Please tick at the relevant box for the questions below.

Age	20-30 31-40 41-50 More than 50 years
Experience	Less than 5 years 5-10 years 11-20 years 21-30 years 31-40 years More than 50 years
Organization Size (No. of employees)	Less than 50 51-100 101-500 501-1000 More than 1000
How long the organization has been established?	Less than 5 years 5-10 years 11-20 years 21-30 years 31-40 years More than 50 years
Choose your Segment of Textile	Textile Composite Textile Spinning Textile Weaving

**Section B: Please encircle the appropriate**

**Transformational Leadership**

<i>Idealized Influence</i>	The leadership has a clear common vision to improve quality through IR 4.0 technologies.
	The leadership has the ability to anticipate changes and make plans to accommodate it through IR 4.0 technology.
	The leadership encourages employees to utilize up to date IR 4.0 technologies to improve the quality of products and processes.
	The leadership gets employees suggestions while planning and conducting work for quality based on IR 4.0 technologies.
<i>Inspirational Motivation</i>	The leadership always encourages the employees to take necessary actions on their own to promote quality.
	The leadership encourages the employees to use IR 4.0 technologies to complete their task and assignments.
	The leadership emphasize on IR 4.0 technologies to enhance the quality than cost.
	The leadership expresses confidence that goals will be achieved if they are aligned with IR 4.0 technologies.
<i>Intellectual Stimulation</i>	The leadership re-examines critical assumptions to question whether they are reflecting the organization's policy on IR 4.0 technologies.
	The leadership seeks different perspectives through IR 4.0 technologies to solve quality problems.
	Leadership strives to use IR. 4.0 technologies to attain new business ideas.
<i>Individual Consideration</i>	Leadership puts more endeavours to use IR. 4.0 technologies to sustain quality.
	Leadership spends more time and put efforts to train employees in order to use IR 4.0 technologies.

(Continued)

<b>Transformational Leadership</b>	
	The leadership believes in IR 4.0 technologies to improve organizational working quality.
	The leadership encourages employees to integrate quality measures with IR 4.0 technologies to achieve organizational goals.
	The leadership advocates that the employees' individual goals and organizational goals should be integrated while embracing IR 4.0 technologies to achieve better quality.
<b>Innovative performance</b>	
<i>Product Innovation</i>	The implementation of IR 4.0 technologies increased the quality of the current product's material.
	The implementation of IR 4.0 technologies has reduced the manufacturing cost of the current product.
	The implementation of IR 4.0 technologies has high customer satisfaction due to the developing newness of the current products.
	The implementation of IR 4.0 technologies updates the technology for new product development.
	The implementation of IR 4.0 technologies has increased the number of new products introduced to the market.
	The implementation of IR 4.0 technologies contributes to increasing the speed of new product development.
	The implementation of IR 4.0 technologies contributes to decreasing the cost of new product development.
<i>Process Innovation</i>	The implementation of IR 4.0 technologies contributes to eliminate non-value-adding activities from the production processes.
	The implementation of IR 4.0 technologies contributes to increasing the quality of machinery and software.
	The implementation of IR 4.0 technologies contributes to improvements in the logistic processing speed.
	In order to reflect the notion of IR 4.0 technologies, we use up-to-date technology in manufacturing processes.
<i>Organizational Innovation</i>	The implementation of IR 4.0 technologies contributes to making better knowledge management system.
	The implementation of IR 4.0 technologies has increased organizational flexibility.
	The implementation of IR 4.0 technologies contributes to develop stronger external relations.
	The implementation of IR 4.0 technologies contributes to building up a strong image against new competitors.
	The implementation of IR 4.0 technologies contributes to getting a higher success rate in new product launch as compared to competitors.
<b>Organizational Sustainability</b>	
<i>Economical Sustainability</i>	The implementation of IR 4.0 technologies increases the revenue growth of the organization.
	The implementation of IR 4.0 technologies increases high profitability growth.
	The implementation of IR 4.0 technologies increases the improvement in terms of sales.
	The implementation of IR 4.0 technologies increases in the reputation of the organization.
	The implementation of IR 4.0 technologies increases in the number of customers.
	The implementation of IR 4.0 technologies increases the improvement in product quality.

(Continued)



(Continued)	
<b>Transformational Leadership</b>	
	The implementation of IR 4.0 technologies decreases the customers complain.
	The implementation of IR 4.0 technologies decreases the inventory cost.
	The implementation of IR 4.0 technologies increases improvement in the production percentage.
	The implementation of IR 4.0 technologies decreases the delivery lead time.
	The implementation of IR 4.0 technologies increases in new product development.
<i>Environmental Sustainability</i>	The implementation of IR 4.0 technologies decreases the wastage from the operations.
	The implementation of IR 4.0 technologies increases the improvement in the usage of materials.
	The implementation of IR 4.0 technologies contributes to reducing energy consumption in performing organizational operations.
	The implementation of IR 4.0 technologies contributes to reducing the noise level inside and outside the workplace.
	The implementation of IR 4.0 technologies is aligned with the organizational policies that control the air, water and land emission.
	The implementation of IR 4.0 technologies increases public health and safety.
	The implementation of IR 4.0 technologies contributes to reducing hazardous waste from production.
<i>Social Sustainability</i>	
	The implementation of IR 4.0 technologies contributes to the improvement in training and skills development.
	The implementation of IR 4.0 technologies contributes to the improvement of corporate social investment.
	The implementation of IR 4.0 technologies contributes to improving the product image.
	The implementation of IR 4.0 technologies increases in the number of permanent employees.
	The implementation of IR 4.0 technologies increases in employee satisfaction.
	The implementation of IR 4.0 technologies increases in the occupational health and safety of employees.
	The implementation of IR 4.0 technologies increases the number of certified suppliers.
	The implementation of IR 4.0 technologies increases the customer satisfaction.
	The implementation of IR 4.0 technologies has improved the image of the organization as a model of good practices among people in the community.

1 = Extremely Disagree, 2 = Quite Disagree, 3 = Slightly Agree, 4 = Quite Agree, 5 = Extremely Agree



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