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The Role of Emerging Digital Technologies in the Apparel Industry of Pakistan

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ABSTRACT

Purpose: Current study examines the relationship of industry 4.0 on firm performance through process mediation of employee involvement and mass customization capabilities. The motivation to conduct the current study was driven by the decreasing trend of Pakistan apparel exports and the inconsistent findings in the literature on the relationship among variables.
Design/Methodology/Approach: Population of the study are the export members firms of HS code 61 and HS code 62 apparel manufacturing firms. From 1564 firms 10000 senior and middle management identified as a population. Structural equation modeling (SEM) was used to test the research model.
Findings: The results reveal that industry 4.0 technologies positively impacted firm performance. Study findings also show the process mediation of employee involvement and mass customization capability between big data and firm performance.
Implication/Originality/Value: To the best author's knowledge, this is the first attempt to examine the process mediation of employee involvement and mass customization capability on the relationship between industry 4.0 and Pakistan apparel firm performance.

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Introduction

Customers' demand for apparel is ever-changing (De Silva, Rupasinghe, & Apeagyei, 2019). In this rapidly growing business landscape, customers are demanding individually personalized products at a rational price in a speedy time creating immense pressure on the organization (e.g Narian & Ullah 2020; Zhang et al., 2019, Wiengarten et al., 2017). From last decades, mass customization (MC) is the dominant strategy for reacting to the customer's demand for goods variety that distingue businesses in the vastly competitive and segmented marketplace (Dimitris Mourtzis & Vlachou, 2018). Nowadays organizations are using mass customization capability as a considered approach to fulfill customers' requests and competitive advantage (Dou et al., 2020;

Ullah & Narain 2020a; Ullah & Narain 2020b). Prior studies report that industry 4.0 is beneficial for mass customization. Industry 4.0 technologies (I4 technologies) include "Cloud computing (CC)", "big data (BD)", "internet of things (IoT)", “additive manufacturing or 3D (AM)” (Ardito, Petruzzelli, Panniello, & Garavelli, 2019; Wijewardhana, Weerabahu, Nanayakkara, & Samaranayake, 2020). Pakistan is far behind in the adoption of industry 4.0.

Pakistan's apparel sector contribute 20 percent share in country textile exports (Javed & Atif, 2019) and provides a significant contribution to Pakistan's economy (Hamid et al., 2014; Javed & Atif, 2019). The clothing industry of Pakistan is the export-oriented and main source of foreign exchange income (Abbas, Hsieh, Techato, & Taweekun, 2020). It contributes 1.4 percent to world apparel export. According to the Pakistan Board of investment and trade in the 2017-2018 financial year, the apparel industry contributes 11.4 percent to Pakistan's export. Regardless of this, the clothing industry is facing a decrease in growth rate (Imran, 2018). WTO report (2019) shows a negative 11 percent annual change in exports of textiles and Pakistan was even not in the top ten clothing exporter countries list. Pakistan Bureau of Statistics released data that reported the textile and appeal exports declined 15 percent in June 2019 as compared to June 2018. In June 2018 Pakistan's textile export was $1.19 billion but in June 2019 it is $1.01 billion (Statistic, 2020). Textile Clothing and apparel export growth of Pakistan is not as much as other developing countries such as Bangladesh, Vietnam, etc. Pakistan's apparel industry export is still lagging as it contributes to only 1.10% of global export as compared to Bangladesh's 7.66 (Memon, Aziz, & Qayyum, 2020).

The current study has a few major contributions. This study has tried to establish the underpinning by introducing industry 4.0 as the mechanism to enhance MCC through which firm may enhance their overall performance because Pakistan has been facing challenges allied to technology. The current study is the first study that examined the process of mediation of IE and MCC. By investigating the impact of I4 technologies, this study can scientifically induce the apparel firms' leaders that introducing I4 technologies and EI is essential for the enhancement of MCC and FP.

Literature Review and Theoretical Framework

According to Newbert (2008), a resource-based review (RBV) argues that a firm can improve its performance if firm owns and exploits valuable and rare competencies. Maijoor and Witteloostuijn (1996) firms have two kind of resource tangible and intangible resources that bind semi-permanently to the organization. To finish the organization targets resources and capabilities needed, assets owned by the firm are known as resources, and the skill to utilize and unite resources are known as capabilities (Salam, 2019). In this research, I4 technologies are considered as the strength and the physical resource which is adopted as an enabler of MCC through the employee involvement According to Hitt, Xu, and Carnes (2016) presence of one resource must influence positively other resources.

Technologies and FP

AM and FP

According to Majeed et al. (2021), AM has huge potential in increasing the "material effectiveness", "reduce life cycle impacts" and allow enhanced "functionality". Researchers suggest that AM may reduce product development costs and it enhance firm innovation performance.

H1.1: AM has a significant positive effect on FP.

BD and FP

BD is characterized by 5Vs such as "high volume", "variety", "velocity (data renewed at very high speed)", "veracity" (veracity means data is associated with biased, inconsistency, and

incompleteness), and "value" (). By adopting BD, a firm can greatly improve its financial performance (Akter, Wamba, Gunasekaran, Dubey, & Childe, 2016; Chen, Mao, & Liu, 2014).
H1.2: BD has a significant positive effect on FP.

CC and FP
CC can provide improvement in the form of “operation”, “management”, and “strategic efficiency” (Vitari & Raguseo, 2020). CC influence positively on FP through better quality and innovation and provides time-saving as well as cost-saving (Ilmudeen, Bao, & Alharbi, 2019; Kathuria, Mann, Khuntia, Saldanha, & Kauffman, 2018; Ooi, Lee, Tan, Hew, & Hew, 2018).
H1.3: CC has a significant positive effect on FP.

Iot and FP
In Iot devices are interlinked with 'electronic', 'software', 'sensor', "network connectivity" and "actuators"' and these devices receive and communicate important information in real-time. Iots provides vigor change management in MC (Khayer, Bao, & Nguyen, 2020). According to Leong and Koshijima (2018), Iot has positive effects on a firm financial performance. Extant literature confirmed that Iot influences positively on FP (Tang, Huang, & Wang, 2018).
H1.4: Iot has a significant positive effect on FP.

AR and FP
By implementing AR, the organization can improve their productivity and efficiency and it also helps firms to provide training to their workers successfully (Khayer et al., 2020). Although AR influences positively on overall FP and it provides efficiency, enhanced productivity, and performance improvement (Lai, Tao, Leu, & Yin, 2020). It provides the opportunity of receiving information and shape an interaction of employees in a new way (Jetter, Eimecke, & Rese, 2018).
H1.5: AR has a significant positive effect on FP.

Technologies and EI
AM and EI
Adoption of AM in manufacturing processes, required employees with skills and knowledge of the latest technologies and materials, to have the capability to integrate and advance processes (Zigart & Schlund, 2020). Highly competent and empowered employees with adequate training to cope with problems when arise are important for AM implementation (Simpson, Williams, & Hripko, 2017).
H2.1: AM has a significant effect on EI.

BD and EI
Working with I4 technologies, employees gain autonomy and it enhances operational decision-making (Pérez-Pérez, Gómez, & Sebastián, 2018). I4 creates opportunities for employees to take better and more effective data-driven decisions (Rosin, Forget, Lamouri, & Pellerin, 2022; Wankhede & Vinodh, 2021).
H2.2: BD has a significant effect on EI.

CC and EI
CC is an effective technology that helps firms for monitoring and tracking the production sales and can improve the production decisions (Bousdekis, Lepenioti, Apostolou, & Mentzas, 2021). In the T&A, the adoption of CC are providing the benefits of value creation and enhanced competitiveness (Guo, Wong, & Guo, 2014; Mladenow, Fuchs, Dohmen, & Strauss, 2012).
H2.3: CC has a significant effect on EI.

Iot and EI

Iot has the potential for empowering employees and its helps employees to behave in empowered ways (Kushida & Pingali, 2014). Iot can make decision-making easier and helps employees to do their work efficiently with the minimization of errors (Leyer, Richter, & Steinhüser, 2018).

H2.4: Iot has a significant effect on EI.

AR and EI

According to Sievers, Reil, Rimbeck, Stumpf-Wollersheim, and Leyer (2021) results that I4 can influences employee commitment and EI and digital transformation due to I4 requiring the need for EI.

H2.5: AR has a significant effect on EI.

Technologies and MCC

AM and MCC

According to (Tortorella, Miorando, Caiado, Nascimento, & Portioli Staudacher, 2021) AM is an MC and personalization-enabling technology. AM provides features manufactured to produce several parts in an identical bunch (Mueller, 2012). AM provides significant cost-saving and benefits to buying customized low volumes of goods at mass production prices (Gibson, Rosen, & Stucker, 2010).

H3.1: AM has a significant positive effect on MCC

BD and MCC

BD provides MCC with a new idea of life. Big data can provide the organization with the ability to respond to the new customer according to his/her preferences and buying habit. It is widely used to enable mass customization (Delic, Eyers, & Mikulic, 2019). Tien (2012) reports the BDA as a key supporter of technology for the successful implementation of MC.

H3.2: BDA has a significant positive effect on MCC.

CC and MCC

CC technology helps firms to overcome these challenges related to the mass customization (Morabito, 2015). Adopting the CC organization enables it to respond the customer demands efficently (Kai et al., 2017; Lanza, Peukert, & Steier, 2022).

H3.3: CC has a significant positive effect on MCC.

Iot and MCC

Iot is one of the core technology to achieve MCC. Iot provides technical infrastructure for MC(Tieng, Chen, Cheng, & Yang, 2016). According to (Salvendy, 2001), Iot is the enabler of product development with higher mass customization.

H3.4: Iot has a significant positive effect on MCC.

AR and MCC

AR could fulfill customer and market demand by working combining with MC (Calegari, Avalone, & Fettermann, 2020). Implementation of MC needs the active involvement of customers and AR provides such an environment to involve all stakeholders in the product design process (D Mourtzis, Synodinos, Angelopoulos, & Panopoulos, 2020).

H3.5: AR has a significant positive effect on MCC.

EI and MCC

Successfully implantation of mass customization production in a firm requires highly trained designers and personnel so that they fulfilled customers' requirements timely and efficient and also for the firm's enhanced market competitiveness (Luh, Wang, Chang, Chang, & Chu, 2013).

According to Jain, Garg, and Kansal (2022), human resource plays an important role in achieving the firm MCC A study by Kakati (2002) founds that employees with a stock of knowledge and skills effectively improved the firm MCC.
H4: EI has a significant positive effect on MCC.

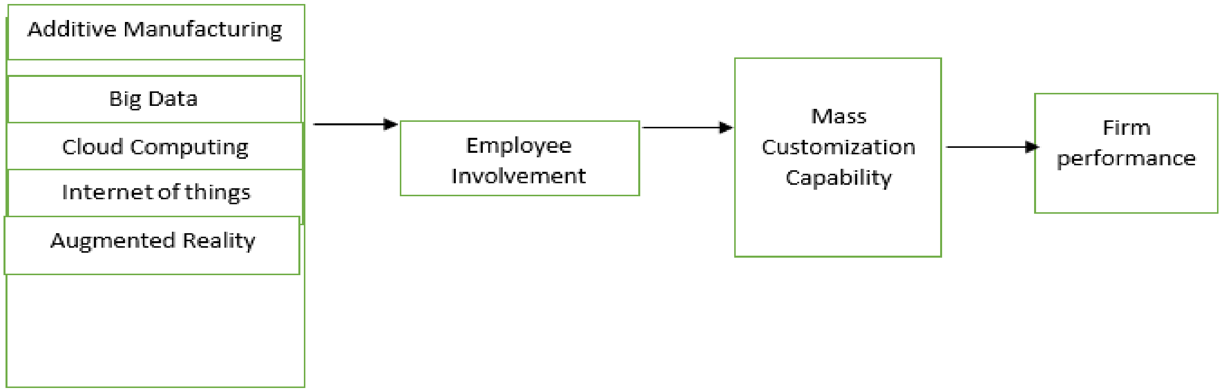
MCC and FP
MCC helps the manufacturer to provide customization of products by using innovative ways that result in an enhancement in the FP (Zhang, Qi, & Guo, 2017; Zhang, Qi, Zhao, & Duray, 2015) cited by (Jitpaiboon, Dobrzykowski, Ragu-Nathan, & Vonderembse, 2013). Few studies report that the complexity linked with MC operations may threaten the firm success and performance (Åhlström & Westbrook, 1999; Zhang, Guo, Huo, Zhao, & Huang, 2019).
H5: MCC has a significant positive effect on FP.

Mediating role of EI and MCC
Implementation of industry 4.0 is very risky because digitalization enhances the use of the digital system and also changes the demands placed on employees. Through EI firms may reduce such risks (Zhang, Qi, & Zhao, 2011). I4 technologies enabled manufacturing firms to manufacture with reduced time and provide the development of a value chain and also improved product quality with the enhancement in FP (Digmayer & Jakobs, 2018). A study by Kamble, Gunasekaran, and Gawankar (2018) finding shows that I4 technologies and FP have a positive and significant relationship in the context of the Pakistan retail industry. And through the implementation of I4, Pakistan's retail industry's overall performance would increase. Prior studies have highlighted that industry 4.0 and FP have a positive and significant direct relationship.

The following mediating hypotheses we proposed to be examined.
H6.1: EI mediate the relationship between AM and FP.
H6.2: EI mediate the relationship between BDA and FP.
H6.3: EI mediate the relationship between CC and FP.
H6.4: EI mediate the relationship between Iot and FP.
H6.5: EI mediate the relationship between AR and FP.
H7.1: MCC mediate the relationship between AM and FP.
H7.2: MCC mediate the relationship between BDA and FP.
H7.3: MCC mediate the relationship between CC and FP.
H7.4: MCC mediate the relationship between Iot and the FP.
H7.5: MCC mediate the relationship between AR and the FP.

The current study also focuses on the role of EI and MCC as a process mediation linking I4 technologies and FP. Based on the theoretical approach and previous findings in the literature we hypothesized the following:
H8.1: The relationship between AM and FP will be process mediated by EI and MCC.
H8.2: The relationship between BDA and FP will be process mediated by EI and MCC.
H8.3: The relationship between CC and FP will be process mediated by EI and MCC.
H8.4: The relationship between IoT and FP will be process mediated by EI and MCC.
H8.5: The relationship between AR and FP will be process mediated by EI and MCC.

Theoretical Framework



Methodology

Measures

Questionnaire is adopted from prior researches. Study variables were measured using 7 point likert scale, where 1 mean strongly agree and 7 means strongly disagree. FP measure adopted from Ali and Xie (2021) study. FP will measure by using two approaches such as "market effectiveness" and "firm profitability". Seven-point scale with -3 "much worse than competitor" to +3 "much better than competitor. AM items scale adopted from) study. To access the BD, we used four adopted items from the scale developed by N. A. Morgan, Vorhies, and Mason (2009). BDA measures through attitudinal and behavioral questions. To measure CC, we drew on the 5 items from (Niaki, Nonino, Palombi, & Torabi, 2019). To measure Iot, 5 items were adopted from Imran (2018) study. RA item scale was adopted from Oliveira, Thomas, and Espadanal (2014) study. Imran (2018) adapted these items from (Masood & Egger, 2019) and (Masood & Egger, 2019). EI item scale was adopted items from Shah & Ward (2007). Practices of EI are "problem-solving teams", "suggestion programs", "product/process improvement" and "cross-functional training". Six items were used from Tu, Vonderembse, and Ragu-Nathan's (2001) and Liu's (2006) instruments to measure MCC.

3.2 Sample

Current cross sectional population was senior management (higher-level managers) and middle managers of apparel industry firms HS code 61 and HS code 62. HS code 61 export chapter refers to "knitwear and Hosiery" and HS code 62 export chapter refers to "readymade garment". The unit of the analysis of the study is the export HS CODE 61 and 62 firms. Zhu, Li, Wang, and Chen (2010) also used this unit of analysis in their study. More than 10,000 senior and middle management are working in these identified firms. According to Jia, Guo, and Barnes (2017), if the population is more than 10000 then a 370 sample size is recommended for the study. For the current study, 370 is the sample size.

The current study employed a systematic random sampling method for data collection. Due to the financial and time constraints, the selection systematic sampling approach was justified. Data collection was done from March 2021 to December 2021. Self-administrated survey was used. The researcher received a total of 250 usable questionnaires out of 370 questionnaires which translates into a reply rate of 67 %. Descriptive and inferential statistics SPSS and PLS-SEM were applied to the collected data. Of the 250 respondents, 76 % were male and 34 % were females. In terms of education, 24.3 % were graduates, 67% had a master's degree and 8.7 had other degrees. In terms of position, 36.2 % were middle managers and 63.8 % were senior managers. In terms of experience, 38.3 % had 1-3 years of job experience, 27.5 % had 3-6 years of job experience, 18.4 % had 6-9 years of job experience and 15.8 % had more than 9-year job experience. After receiving all responses, data were made suitable for further analysis by eliminating outliers and missing values.

Results and Discussion

Measurement Model

The measurement model includes checking the reliability of the data. It can be accessed through reliability and convergent validity.

Reliability and Convergent Reliability

According to Iqbal, Huq, and Bhutta (2018) composite reliability refer to the level to which items set shows that latent construct in a reliable manner. Table 1 presented the Cronbach alpha and composite reliability. This study used both tools to measure internal consistency. The results of table no.1 confirmed that all the study constructs are reliable and are in the acceptable range. Average variance extracted (AVE) was used for testing the convergent validity. The value of AVE more than 0.5 shows that convergent validity exists. However, to obtain the acceptable criteria of AVE few items were deleted based on less factor loading.

Table 1. Reliability

	Cronbach's Alpha	rho_A	CR	AVE
AM	0.941	0.943	0.955	0.809
BD	0.903	0.903	0.939	0.837
CC	0.933	0.935	0.952	0.834
Iot	0.948	0.95	0.96	0.829
AR	0.926	0.928	0.948	0.82
EI	0.972	0.972	0.976	0.835
FP	0.896	0.906	0.922	0.703
MCC	0.943	0.943	0.955	0.779

Table 2. Factor Loading (FL)

Items	FL	Items	FL	Items	FL
AM1	0.903	EI1	0.932	MCC1	0.874
AM2	0.905	EI2	0.934	MCC2	0.864
AM3	0.914	EI3	0.877	MCC3	0.907
AM4	0.895	EI4	0.876	MCC4	0.868
AM5	0.88	FP1	0.928	MCC5	0.897
AR1	0.916	FP2	0.917	MCC6	0.885
AR2	0.915	FP3	0.907	IT1	0.838
AR3	0.914	FP4	0.922	IT2	0.856
BD1	0.936	FP5	0.918	IT3	0.839
BD2	0.914	FP6	0.912	IT4	0.817
BD3	0.902	FP7	0.895	IT5	0.843
BD4	0.9	FP8	0.912	IT1	0.838
CC1	0.923	CC4	0.915	CC3	0.892
CC2	0.92	CC5	0.9		

Discriminant Validity:

It refers that items of a different construct are not overlapping. According to D. W. Morgan and Krejcie (1970),discriminant validity measures the share variance among each construct. The present study uses the Hair, Black, Babin, Anderson, and Tatham (2010) measure of discriminant validity. Table 3 results indicate that the square root of each AVE is larger than the off-diagonal elements in their conforming row and column.

Table 3. Discriminant Validity

	AM	BD	CC	Iot	AR	EI	MCC
AM	0.899						
BD	0.527	0.913					
CC	0.619	0.909	0.91				
Iot	0.876	0.865	0.841	0.939			
AR	0.686	0.649	0.622	0.835	0.915		
IE	0.697	0.654	0.619	0.834	0.534	0.905	
MCC	0.669	0.618	0.606	0.826	0.716	0.72	0.883
FP	0.596	0.591	0.6	0.648	0.596	0.672	0.666

Structural Model

Testing the Direct Effect:

To determine the path coefficient statistical significance bootstrapping method was used. In this regard, each path coefficient T value was produced. Table 4 summarized the direct effects results. With regards to the results obtained for hypothesis testing relating to I4 technologies on FP. I4 technologies such as AM, BD, CC, and AR positively impacted FP with the following respective results; (β= 0.056, t=2.126) (β= 0.012, t=1.915) (β= 0.01, t=2.78) (β= 0.049, t=2.183,) indicating support for H1.1, H1.2, H1.3, and H1.5. Iot impact on FP is not significant (β= 0.056, t=1.382) resulting in a rejection of H1.4. With regards to the results obtained for hypothesis testing relating to industry 4.0 technologies on EI. I4 technologies such as AM, BD, CC, Iot, and AR positively impacted EI with the following respective results; (β= 0.077, t=1.918) (β= 0.013, t=3.42) (β= 0.057, t=2.362) (β= 0.067, t=3.328) (β= 0.04, t=18.981) indicating support for H2.1, H2.2, H2.3, H2.4, and H2.5.

Results show that industry 4.0 technologies other than CC are positive enablers of the MCC of the firm. As for the results of industry 4.0 technologies, results for AM, big data, Iot, and AR are (β= 0.011, t=1.9) (β= 0.069, t=2.799) (β= 0.065, t=4.356) (β= 0.068, t=5.43) are respectively and they positively enabler MCC of the firm indicating that H3.1, H3.2, H3.4, and H3.5 are supported. The result of industry 4.0 technology CC respectively (β= 0.071, t=0.363) indicates that CC is not the positive enabler of MCC of a firm, and H3.3 is rejected. EI impact on MCC is significant (β= 0.071, t=6.152) resulting in an acceptance of H4. Furthermore, MCC was found to be influenced positively on FP with (β= 0.052, t=1.841) and thus supporting H5.

Table 4. Summary of Direct Effect Model Testing

H		Original Sample	Mean	SD	T Statistics	P Values	Decision
H1.1	AM -> FP	0.119	0.121	0.056	2.126	0.017	Supported
H1.2	BD -> FP	0.023	0.021	0.012	1.915	0.028	Supported
H1.3	CC -> FP	0.028	0.031	0.01	2.78	0.035	Supported
H1.4	Iot -> FP	0.078	0.077	0.056	1.382	0.084	Not supported
H1.5	AR -> FP	0.106	0.104	0.049	2.183	0.015	Supported
H2.1	AM-> EI	0.147	0.151	0.077	1.918	0.028	Supported
H2.5	AR -> EI	0.76	0.76	0.04	18.981	0.00	Supported
H2.2	BD -> EI	0.045	0.044	0.013	3.42	0.00	Supported
H2.3	CC-> EI	0.135	0.139	0.057	2.362	0.009	Supported
H2.4	Iot-> EI	0.223	0.221	0.067	3.328	0.00	Supported
H3.1	AM-> MCC	0.021	0.024	0.011	1.9	0.029	Supported
H3.2	BD -> MCC	0.193	0.19	0.069	2.799	0.003	Supported
H3.3	CC -> MCC	0.026	0.026	0.071	0.363	0.359	Not supported
H3.4	Iot -> MCC	0.281	0.279	0.065	4.356	0.00	Supported
H3.5	AR -> MCC	0.37	0.376	0.068	5.43	0.00	Supported
H4	EI-> MCC	0.435	0.426	0.071	6.152	0.00	Supported
H5	MCC -> FP	0.095	0.096	0.052	1.841	0.033	Supported

Testing the Mediating Role of EI:

Smart PLS 3.0 was used for examine the mediating role of EI. The table 5 result indicates that employee involvement mediate the relationship of AM and FP with (β= 0.032, t=2.014) thus, supporting H6.1. EI did not mediate the relationship BD-MCC with (β= 0.027, t=0.72) thus, rejecting H6.2. Table 6 results indicates that IE mediates the relationship of CC and FP with (β= 0.027, t=2.215) thus, supporting H6.3. Based on the table Results, indicate EI fully mediates the relationship of Iot-MCC with (β= 0.033, t=2.946) thus, supporting H6.4. The results obtained show that EI mediates the relationship of AR and FP with (β= 0.057, t=5.785) thus, supporting H6.5.

Testing the Mediating Role of MCC:

Mediating results are displayed in table 5. The table 5 shows that MCC mediate the relationship of AM and FP with (β= 0.009, t=0.227) thus, rejecting H7.1. MCC did not mediate the relationship BD-FP with (β= 0.012, t=1.532) thus, rejecting H7.2. The table 5 results shows that of MCC did not mediate the relationship of CC and FP with (β= 0.008, t=0.324) thus, rejecting H7.3. Table 5 results indicate that MCC fully mediates the relationship Iot-FP with (β= 0.016, t=1.7) thus, supporting H7.4. The table 5 results show that MCC mediates the relationship of AR and FP with (β= 0.021, t=1.646) thus, supporting H7.5.

Table 5. Summary of the Testing Mediating Role of EI and MCC

H		Original Sample	Sample Mean	SD	T Statistics	P Values	Decision
H6.1	AM-> EI-> MCC	0.064	0.063	0.032	2.014	0.022	Supported
H6.2	BD-> EI-> MCC	0.02	0.018	0.027	0.72	0.236	Not supported
H6.3	CC-> EI-> MCC	0.059	0.059	0.027	2.215	0.014	Supported
H6.4	Iot-> EI-> MCC	0.097	0.094	0.033	2.946	0.002	Supported
H6.5	AR-> EI-> MCC	0.331	0.324	0.057	5.785	0	Supported
H7.1	AM-> MCC-> FP	0.002	0.003	0.009	0.227	0.41	Supported
H7.2	BD-> MCC-> FP	0.018	0.018	0.012	1.532	0.063	Not supported
H7.3	CC-> MCC-> FP	0.002	0.002	0.008	0.324	0.373	Not supported
H7.4	Iot-> MCC-> FP	0.027	0.027	0.016	1.7	0.045	Supported
H7.5	AR-> MCC-> FP	0.035	0.036	0.021	1.646	0.05	Supported

Testing the Process Mediation of EI and MCC:

The study proposes the process mediating of IE and MCC between industry 4.0 technologies and FP (fig1). The Process Mediation role of EI and MCC was examined with the help of Smart PLS 3.0. Mediating results are displayed in table 7. As for the process mediating role of EI and MCC on the AM-FP relationship, the results obtained show that IE and MCC did not process mediate the mentioned relationship with (β= 0.005, t=1.313) thus, rejecting H8.1. Furthermore, we did find support for H8.2 because the process mediation effect of IE and MCC on BDA-FP was significant (β= 0.003, t=0.628). The 8.3 hypothesis was rejected as the process mediation of EI and MCC between CC-FP is not significant (β= 0.004, t=1.389). Finally, we did not find support for H8.4 because the process mediation effect of IE and MCC on Iot-FP was not significant (β= 0.006, t=1.497). Furthermore, we did find support for H8.5 because the process mediation effect of IE and MCC on BD-FP was significant (β= 0.017, t=1.801).

Table 6. Summary of Testing Process Mediation of EI and MCC

H		Original Sample	Sample Mean	SD	T Statistics	P Values	Decision
H8.1	AM->EI->MCC->FP	0.006	0.006	0.005	1.313	0.095	Not supported
H8.2	BD->EI->MCC->FP	0.002	0.002	0.003	0.628	0.026	Supported
H8.3	CC-> EI-> MCC->FP	0.006	0.006	0.004	1.389	0.083	Not supported
H8.4	Iot->EI->MCC->FP	0.009	0.009	0.006	1.497	0.068	Not supported
H8.5	AR->EI-> MCC-> FP	0.031	0.031	0.017	1.801	0.036	Supported

Predictive Relevance:

Table 4 indicate the cross redundancy for employee involvement, mass customization capability and firm performance to be 0.716, 0.68 and 0.767 correspondingly and thus the predictive validity of the value is proven.

Table 7. Predictive Relevance

	SSO	SSE	Q^2 (=1-SSE/SSO)
AM	1195	1195	
BD	717	717	
CC	956	956	
Iot	1195	1195	
AR	956	271.201	
EI	1912	445.426	0.716
FP	1195	1195	0.767
MCC	1434	458.381	0.68

Conclusion

Study results indicate the importance of I4 technologies for apparel firm MCC. It is evident that through successful implementation of I4 technologies in operations Pakistan apparel firm would be able to respond to the customer ever-changing demands, capability to make customize products quickly on a larger market scale and at a lower cost comparable to mass production, respond to global competitions easily and innovation challenge, through these technologies firms can predict the future trend and patterns that help firm in achieving competitive advantages, produce good with low cost, low wastages with reducing time lead production cycle. Global challenges encourage manufacturers to produce with efficiency competitive to mass production. The positive relationship between I4 and MCC is reported by many studies (Compeau, Higgins, & Huff, 1999; Fornell & Larcker, 1981).

For advancing manufacturing, industry 4.0 was proposed, so that firms realize shorter product life cycles and offer highly customized products in a cost-efficient way (Shi et al., 2020). This industrial revolution has an extremely favorable effect on mass customization, improvement in production completion time, lower waiting time, high utilization of equipment and higher customer satisfaction, continuous improvement in firm performance, and competitive advantage. Pakistan's apparel industry should enhance the adoption of I4 in its operations. Pakistan apparel export is facing negative growth that why I4 technology is the need of the hour. Without the latest technology transformation, this industry can't compete in the global market competitions. Customer demand for tailored and unique products is also increasing, for fulling the customers' demands quickly, with quality products and with low cost, the apparel industry needs technological advancement. Without this advancement, this industry cannot survive in this global competitive market.

Practical Implication:

From the industry practitioners' perspective, the current study evidence suggests that industry 4.0 technologies adopted by firms play an important role in MCC that can play a significant and contributing part towards the FP of the apparel industry. Current research also provides input to the Government of Pakistan to formulate and implement industry 4.0 technologies toward the enhancement and sustainability of the apparel industry exports, especially given global competition from both developed and developing economies countries.

Theoretical Implication:

Current study attempt to contribute to the understanding of the I4, EI, MCC, and FP relationship. Current study contributes to the literature by shedding light on the importance of I4 in the apparel industry, especially the Pakistan apparel industry. The bulk of literature regarding this topic is limited to developed countries and such as the current study extends literature dedicated to I4, IE, MCC, and FP to the apparel industry of Pakistan, which is a developing county. Lastly, testing this process model also attempts to find the solution for the issues of decreasing trend of Pakistan apparel exports and better FP.

Limitation and Recommendation:

1. The first limitation concerns the cross-sectional research design for the inspection of the hypothesis's relationships. It is highly recommended that longitudinal studies are conducted to investigate the impact of industry 4.0 on MCC on FP.
2. The current study used a single respondent from a firm may introduce biases. It is recommended that future studies adopt various informers from a single firm for the minimization of biasness of results from an individual response from a firm.
3. Future studies may be conducted in collaboration with government export agencies to generate better survey responses.
4. The current study focused on Pakistan, a developing country with a semi-industrial economy. This study can be replicated in further countries with the same stage of economic development for comparative analysis. (Shi et al., 2020).

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