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The Impact of Digital Transformation on Business Performance: A Study of Small & Medium Enterprises

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Abstract: Companies must constantly change in order to be relevant in the fiercely competitive business world of today. There is no time for theoretical debate or pilot projects at this moment in Industry 4.0 and digital transformation. The findings of this study on the impact of Industry 4.0 technology on Pakistani SMEs' output are discussed. Pakistan's major cities (Karachi, Lahore, Peshawar, Islamabad, Gujrat, and Sialkot) were randomly selected to participate in a survey that included a pertinent questionnaire. Big data, cyber-physical systems, and interoperability were found to significantly improve business outcomes using SPSS multiple regression approaches. The internet of things, on the other hand, had a minimal impact. This study not only gives useful insights into the domains of digital transformation and Industry 4.0, but it also presents new directions and a framework for future studies. Because there has been little research in this area, the findings will help managers justify expenditures in technology infrastructure within their firms. Furthermore, policymakers can utilize the current research to develop appropriate strategies for developing human capital and improving absorption capabilities in an ever-changing digital context. Overall, this study adds to our understanding of how firms might use Industry 4.0 technology to achieve long-term growth and competitiveness. Companies in Pakistan can stay ahead of the competition by embracing these innovations.

Keywords: Industry 4.0, Pakistani SMEs, Business success, and Digital transformation.

1. Introduction

Businesses are being forced to reassess their management structures as a result of digital disruption. Traditional hierarchical and closed organizational structures, according to Imran, Hameed, and Haque (2018), are unable to keep up with the speed of digital disruption. Traditional companies need to think like digital disruptors, be adaptable to change, and rethink their organizational structures if they want to be competitive (Bharadwaj, Sawy, Pavlou, & Venkatraman, 2013). This transformation is a once-in-a-generation opportunity to address basic concerns in areas such as health care, education, and the environment (Chen, Preston, & Swink, 2015).

The goals of Industry 4.0, according to Slusarczyk (2018) and Thames & Schaefer (2016), include increased automation as well as increased operational effectiveness and productivity. Imran, Hameed, and Haque (2018) and Posada et al. (2015) report that integration with the web and advanced algorithms provide better information management and higher value production. However, more study is required to completely comprehend Industry 4.0's outcomes (Xu, Xu, & Li, 2018). As a result, this study presents a

paradigm and explores how the Industry 4.0 revolution has affected SMEs. The study's goal is to shed light on the variables that affect how well certain industries perform.

2. Review of Literature & Theory

2.1 Pakistani SMEs

Pakistan's economy relies heavily on its small and medium-sized businesses (SMEs) (Qureshi & Herani, 2011) because SMEs account for roughly 90% of all businesses, employ 80% of the non-agricultural labor force, and produce over 40% of the country's annual GDP. Lack of strategic planning, insufficient business information systems, and a deficiency in the human capital required by modern businesses are just a few of the obstacles that make it difficult for small and medium-sized enterprises (SMEs) in Pakistan to run smoothly. According to Zhang, Peng, and Li (2008), the current era, also known as Industry 4.0, is the fourth industrial revolution and is characterized by the convergence of data, knowledge, and Cyber-Physical System (CPS) production. The idea of "Industry 4.0," which built on the successes of prior industrial revolutions that used steam and water power in the 18th century and electrical energy for mass manufacturing in the 20th century, was adopted by Germany's developing economic system in 2011 (Van Holten & Hess, 2016).

Big data (BD), the Internet of Things (IoT), interoperability, and cyber-physical systems are the four essential facets of Industry 4.0 that are the focus of this study. The importance of these elements for better performance is evident, and their adoption can address technology concerns of SMEs and significantly impact both production and services (Imran, Hameed, & Haque, 2018; Nawanir, 2016; Shahbaz, Kazi, Othman, Javaid, Hussain, & Rasi, 2019). Past studies have demonstrated the positive correlation between technology adoption and company success (Brynjolfsson & Hitt, 2000; Ghobakhloo & Hong, 2014), as well as how IT deployment affects an organization's structure and procedures (Heracleous & Barrett, 2001). For SMEs to achieve long-term financial success, the adoption and implementation of big data, IoT, and smart factory technology should be supported by appropriate organizational structures and procedures (Nawanir, 2016).Overall, understanding the impact of Industry 4.0 on SMEs is crucial for leveraging digital innovation to drive business success and foster economic growth in Pakistan and beyond.

2.2 The Factors Affecting Digital Transformation

Modernizing an organization and embracing digital transformation demand superior human capital. Every aspect of a business is anticipated to be impacted by such technological breakthroughs. According to Lasi et al., (2014), the phrase "Industry 4.0" refers to a wide range of innovative concepts and techniques that are being used to radically transform traditional business operations. Big Data, Cyber-Physical Systems, IoT, and Interoperability are all aspects of digital transformation that were considered in this analysis. This phenomenon, which has the potential to alter how organizations conduct their operations, can be explained as a technical push (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014; Shahbaz, Sohu, Khaskhelly, Bano, & Soomro, 2019).

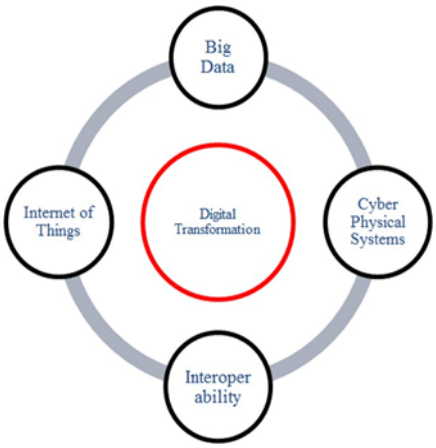

Figure 1. Digital Transformation

3. Big Data

Big data is a phrase that refers to a broad range of techniques used to analyse enormous amounts of data, knowledge, or information, including data that is both organised and unstructured, and that are used for collection, transmission, storage, analysis, search, and confidentiality (Xu, Xu, & Li, 2018). The handling of enormous volumes of data typically involves the usage of big data (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). Big data's nature includes several methods for locating and interpreting the data to provide fresh concepts. Big data, as described by the author in (Manyika et al., 2011), is a systematic visualization where the volume of data is just too great for technology to effectively store, manage, and analysis. By volume, diversity, and velocity, authors in (Zikopoulos et al., 2011) have categorized big data. The expression and the uptake of technology are closely related (Gunasekaran et al., 2017). There are several technological obstacles that can be addressed by using big data. Better technology is made available by it, and this aids in the discovery of more effective data storage methods (Erevelles, Fukawa, & Swayne, 2016). The following is our hypothesis on how big data influences the success of businesses:

Hypothesis 1: The use of big data improves company performance

3.1 Cyber-Physical Systems (CPS)

Cyber-physical systems (CPS) combine physical and computational capabilities to interact with humans in unique ways (Nawanir, 2016). The ability to use computation, communication, and control to interact with and enhance the capabilities of the physical world will significantly aid future technological advancement.

Hypothesis 2: CPS improves company performance.

3.2 Interoperability

The aforementioned components come together to form interoperability. It is the two-way exchange of information among cyber-physical systems, people, and intelligent manufacturing. This makes it possible for manufacturing partners to exchange a variety of data in an efficient and accurate manner. Interoperability is defined as the ability of systems to translate and transmit data without error. In the modern era, this is an essential part of any cutting-edge technology setup (Homburg, Wielgos, & Kuhnl, 2019). Therefore, more interoperability should lead to greater efficiency.

Hypothesis 3: Interoperability improves corporate performance.

3.3 IoT

Interest in the IoT has grown in recent years across a wide range of businesses. The Internet of Things (IoT) is more than a trendy term; it is a burgeoning movement, a tried-and-true commercial strategy, and a game-changing technological innovation. The author (Ashton, 2009) established and defined IoT as only acknowledged, standardized devices with knowledge of RFID, which has the ability to change the course of history. IoT is defined by the authors of (Li, Chen, Tang, & Yan, 2018) as "network-connected tools." The commercialization of IoT applications has now moved to the consumer market and the autonomous business sector, having begun in the healthcare and transportation industries (Thames & Schaefer, 2016). The foundations of Industry 4.0 are RFID, cloud computing, middleware, and numerous software applications (Belli, Davoli, Medioli, Marchini, and Ferrari, 2019). Organizations of various sizes make use of IoT technologies. The Internet of Things (IoT) could improve supply chain and logistics efficiency, for example, by giving more specific data (Gunasekaran et al., 2017). According to Chen, Preston, and Swink (2015), by 2020, there will be 26 billion internet-connected gadgets in use, up from 0.9 billion in 2009. As a result, we can better understand the persuasive potential of IoT technology. Numerous studies have been undertaken on the advancement of IoT technology and its uses, but few have looked at how IoT adoption affects the success of Pakistan's small and medium-sized organizations (SMEs).

Hypothesis 4: IoT has a favorable effect on corporate performance.

3.4 Theoretical Foundations

The Resource-Based View (RBV)'s theoretical foundations are sufficiently covered in this work. In parallel, the RBV of IT suggests that the firm's IT resources might serve as a competitive advantage (Nwankpa & Roumani, 2016) and (Shahbaz, Chandio, Oad, Ahmed, & Ullah, 2018). Further emphasis is placed on the firm's unique resources, which include its IT infrastructure, IT configurability, and human IT capabilities (Nwankpa & Roumani, 2016). Each IT resource is unique and tough to obtain. The integration of a company's technical resources results in higher organizational competency (Nwankpa & Roumani, 2016) and (Mubarik, Govindaraju, & Devadason, 2016). The impact of big data, IoT, interoperability,

and CPS, among other industry 4.0 technologies, on the financial success of small and medium-sized enterprises (SMEs) is the primary focus of this research (see Figure 2).

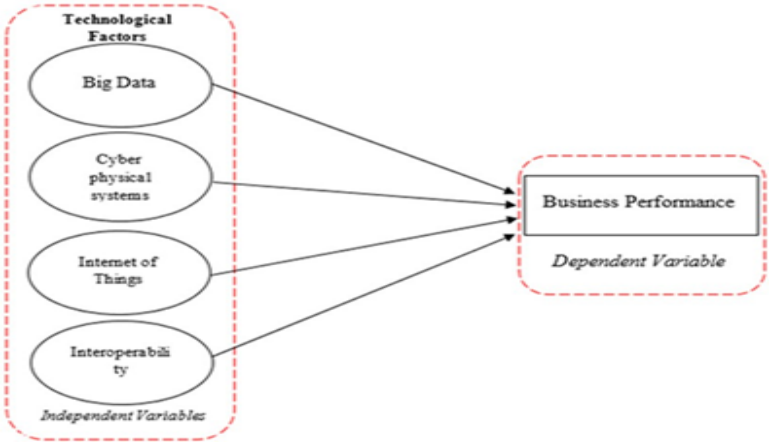

Figure 2. Theoretical framework

4. Methodology

The Big data, IoT, interoperability, and CPS were the four main digitalization elements that were taken into account in order to determine how industry 4.0-related corporate digitalization affected enhanced business performance in Pakistani SMEs. The questionnaire was physically and electronically distributed to a number of SMEs in Gujarat, Lahore, Islamabad, Peshawar, and Karachi. In the order listed in the sample table of (Kenpro, 1970), 390 surveys were distributed. All managers and professionals with knowledge of industry 4.0 and the digital revolution participated in this poll. A random selection procedure was used to choose the participants. The information was compiled using a 5-point Likert scale that ranged from "strongly disagree" to "strongly agree." The questionnaire has two significant sections. In the first half of the study, variables like age, gender, marital status, and income were covered; in the second, the main research determinants of big data, interoperability, CPS, and the Internet of Things were the focus. Modifications were made to the survey based on (Nawanir, 2016) and (Imran, Hameed, & Haque, 2018). In this study, data were analyzed using multiple regression methods using SPSS.

5. Outcomes & Data Analysis

239 of the 400 questionnaires that were distributed were chosen because they included honest responses. 38 responses were ruled invalid as a result of not answering more than 61% of the survey's questions. Out of the questionnaires chosen, 45 come from the manufacturing of pharmaceuticals, 80 from the textile sector, 23 from the cutlery business, 65 from beverages, 35 from fans, and 24 from the manufacturing of surgical equipment. Table I includes the respondents' demographic information. Figure 3 displays the intended SMEs' demographic information.

Table 1. Participants Demographic

Designation	Number of respondents	(%)
Entrepreneurs	35	14
Managers	129	55
Administrators	75	31
Total	239	100
Experience (years)		
1-5	77	32
6-10	46	19
11-15	82	36
16-20	18	7
21 and more	16	6
Total	239	100

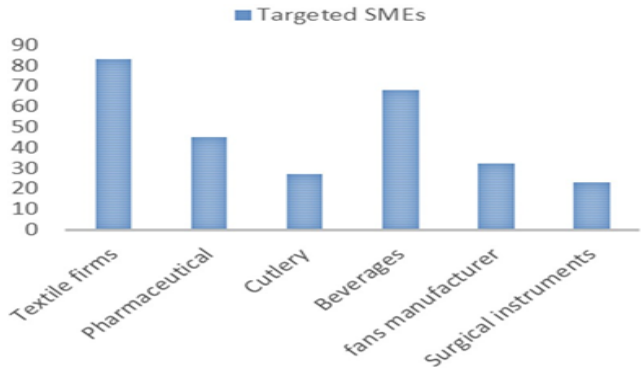

Figure 3. Targeted SMEs

There were two phases of data analysis. In the first round, 280 responses were kept after those with a higher absence value or that were otherwise outliers were removed. Cronbach's alpha was used to determine the data's consistency. Table II displays the mean, standard deviation, and Cronbach's alpha for the sample sizes used. Cronbach's alpha for each item is greater than or equal to 0.80, putting them in the suitable range (Sarstedt, Ringle, & Hair, 2017; Creswell). Independent mean values for big data (3.37), CPS (3.35), Internet of Things (2.97), and interoperability (3.28).

Table 2. Cronbach's Alpha, Mean, & Standard Deviation

Variable	Number of items	Cronbach's alpha	Mean	S.D.
Big data	4	0.816	3.37	0.673
CPS	4	0.834	3.35	0.570
IoT	5	0.851	3.39	0.569
Interoperability	3	0.880	2.97	0.681
Business performance	10	0.827	3.36	0.522

In the second stage, multiple regression was used to determine the strength and direction of the linear relationship between the study's variables (Shukla, 2016). Table III shows the correlations between the independent and dependent variables found in the regression analysis. Small and medium-sized enterprises (SMEs) in Pakistan can benefit from investing 36.6% in big data, 34.6% in CPS, 32.2% in IoT, and 33.8% in interoperability, according to a regression analysis of these factors against business performance and variation. Table III demonstrates the positive effect of large data on performance at the 0.05 level of significance. At the same P-value threshold, CPS and interoperability are found to have a substantial effect on business results. At a significance level of 0.634, it is determined that the impact of IoT on corporate performance is marginal at best. Big data has a beta of 0.307, CPS of 0.314, IoT of 0.170, and interoperability of 0.227. These results suggest that a 1% boost in big data can boost company performance by 30.7%. Furthermore, performance increased by 31.4% for every 1% increase in CPS. When 1% extra money is spent on the Internet of Things (IoT) and interoperability, SMB performance increases by 17% and 28.3%, respectively. The evidence suggests that hypotheses H1–H4 are true, but H3 is false.

Table 3. Regression Analysis Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sign.
	B Std Error	Beta		
(Constant)	0.884	0.124	4.683	0.000

1	Big data	0.307	0.513	0.309	5.406	0.000
	CPS	0.314	4.972	0.314	4.629	0.001
	IoT	0.170	0.806	0.190	-0.477	0.634
	Interoperability	0.283	4.904	0.280	4.722	0.000
			Dependent variable: Business performance			

6. Discussion

Strategic leadership's top priority right now is the advancement of firms using industry 4.0 methods. In fact, most policymakers in affluent nations believe that ecosystems will have a large strategic impact [2, 7]. These results are consistent with those in (Waschneck, Altenmuller, Bauernhansl, & Kyek, 2016), (Nawanir, 2016) and (Imran, Hameed, & Haque, 2018), where it was noted that these parameters had favourable effects on the performance of SMEs in Thailand and Indonesia. In contrast to the findings of (Imran, Hameed, & Haque, 2018) on the SMEs of Thailand, the current study found that the effect of IoT on performance was negligible. The contrasting technology and commercial environments in Pakistan and Thailand might be the possible causes of these conflicting outcomes. Reports state that Thailand, a popular tourist destination, adopted cutting-edge technology before Pakistan, which has marginally boosted the capacity of that country's SME sector to absorb new technology. The rate of growth and development of small and medium-sized firms in Pakistan is moderate, notwithstanding their creation and expansion. Now is the time to implement them in order to obtain a competitive advantage and survive in a highly competitive market, as opposed to reading innovation discourses in the past to confirm the existence of such technologies (Keawphang, 2014; Shahbaz, Kazi, Bhatti, Abbasi, and Rasi, 2019). To attain agility, a prerequisite for modernizing corporate environments, managers must strike a balance between exploring and exploiting their organizations (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). Therefore, to address this issue, improve performance and efficiency, and gain a competitive edge, Industry 4.0 technologies like big data, CPS, and interoperability are needed.

7. Conclusion

Small and medium-sized enterprises (SMEs) in Pakistan were analyzed to see how they were utilizing industry 4.0 technologies including big data, CPS, IoT, and interoperability. It was found that small and medium-sized enterprises (SMEs) might benefit greatly from adopting big data, CPS, and interoperability. Companies feel the effects of innovation and work hard to adopt and use new technologies. As a result of technological advancements, traditional corporate structures are becoming obsolete. The government of Pakistan should aid and encourage SMEs to fully use these technologies into their processes. They will be able to accomplish goals that are currently out of reach for Pakistani SMEs, such as lowering costs, increasing output, and increasing product value. Industry 4.0 places rigorous demands on businesses, and these can only be met with the proper kind of human capital equipped with cutting-edge skills.

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