Role of Industry 4.0 Tools in Organizational Performance of the IT Sector

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Dedication

Dedicated to my exceptional parents adored siblings whose tremendous support and cooperation led me to this wonderful achievement.

Acknowledgment

Praise to Allah Almighty; I could have done nothing without His incredibly significant favors. I dedicate my thesis to my constant source of support and guidance, Muhammad Humza Nisar, with his efforts, I can achieve every milestone of my life. Furthermore, I dedicate my work to my maternal grandparents, who are no longer with me, but their prayers are constantly following my path. They will be missed until we meet again. I am grateful to my cherished parents for their tremendous and extraordinary support and belief in me and my adored siblings for all their support throughout my life.

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Abstract

In the contemporary period, numerous businesses undergo significant adjustments, such as evaluating critical components of their corporate operations and relying on technology to keep operations running while conforming to an ever-changing set of norms and new tactics. The present study aims to explore the relationship between Industry 4.0 (I4.0) tools and their impact on organizational performance, in addition to finding evidence supporting the moderating role of remote working and organizational agility in enhancing organizational performance. The study employed the quantitative research method and 377 questionnaires related to the I4.0 tools (Internet of Things (IoT), Big Data (B.D), Cloud Computing (CC) and Artificial Intelligence (AI)), remote work, organizational performance, and organizational agility, distributed online to the senior or executive-level individuals in IT firms. After data screening, the correlation, linear, and multiple regression analyses were carried out on 310 responses, and the results showed that I4.0 tools, remote work and organizational agility are positively impacted the organizational performance. These results supported the moderating role of organizational agility and remote working for increasing organizational performance through I4.0 tools. Moreover, the results indicated that the Internet of Things and Big Data significantly improve organizational performance. However, in presence of remote work and organizational agility as moderators, AI and Cloud Computing may significantly improve the performance of IT firms. The study also concluded that I4.0 tools are “better practices” for boosting organizational performance; hence, the findings benefit the firms working in the IT sector. This work contributes to existing literature knowledge, particularly in terms of maintaining the current condition and avoiding future work disturbance. This study is innovative as it investigates the relationship between Industry 4.0 tools and organizational performance in Pakistan's IT sector, with a focus on remote work and organizational agility, providing insights for IT organizations.

Key Words: Industry 4.0, Organizational Performance, Organizational Agility, Remote Work, IT Sector.

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List of Abbreviations

I4.0

Industry 4.0

AI

Artificial Intelligence

IoT

Internet of Things

BD

Big Data

SAAS

Software as a Service

IT

Information Technology

OA

Organizational Agility

OP

Organizational Performance

CHAPTER 1: INTRODUCTION

1.1 Background of Research

The recent era pushed several businesses to undergo significant transformation, including rethinking essential components of their company operations and using technology to maintain operations while adhering to a shifting environment of norms and new practices (Rajamanickam et al., 2023). Its goal is to examine the operation of Industry4.0 essential technologies while keeping data security, employee performance, and the organization's impact in mind. Industry 4.0 refers to the global industrial sector's move to digital production and digitalization. It is built on key technologies such as Internet of Things, Artificial Intelligence, big data analytics and cloud computing (Pagliosa et al., 2019).

Herczeg et al. (2023), stated that the availability of massive data, the development of advanced procedures, and the establishment of infrastructure, AI has grown into a top technology goal for enterprises. Businesses, however, face several obstacles that keep them from achieving performance improvements. Seven out of ten enterprises said that Industry 4.0 tools had a tremendous commercial impact on the performance and agility of the business; organizations must invest in IT resources to maximize their Industry 4.0 tools investments owing to adoption and restructuring delays (Mikalef & Gupta, 2021).

Although Industry 4.0 tools have quadrupled in the previous year and expanded by 270% over the past four years, enterprises still need help realizing performance improvements. AI has attracted much attention, and businesses are investing in it to obtain more commercial value. Above 80% of firms interpret AI as a strategic opportunity, and 85% see it as a means of gaining a competitive edge. Unfortunately, despite devoting time, energy, and money to adoption, many businesses find it difficult to reap the benefits of Industry4.0 tools (Hussain et al., 2021).

The Industry4.0 tools have been attempting to replicate intelligent behavior using computer programmers. Most of the literature regarding industry 4.0 tools as "imitating intelligent human behavior," which is already a far stronger term. Because a computer programmer must be capable of multitasking to be considered intelligent, this is a complex process (Wamba, 2022).

1.2 Industry Setting

Asia is a hub for developing and using rapidly advancing I4.0 technologies. Many countries in the region are spending money on R&D to increase their capabilities in areas such as AI, Big Data, IoT, and Cloud Computing. Problems must be overcome before these technologies can completely fulfill their benefits. Firms are worried about the digital divide, a labor shortage, and the privacy and security of personal data. The region's nation should invest in infrastructure, talent development, and policies encouraging innovation and growth to overcome these challenges (Lehman-Wilzig, 2021).

The IT sector can significantly impact the implementation of I4.0 tools, as businesses and IT professionals are well-positioned to understand the benefits and challenges of using these tools. They can also provide guidance and encourage teamwork to boost trust and buy-in. Due to Industry 4.0 tools that help companies increase efficiency and optimize operations, Asia's IT sector is changing. IoT sensors and devices can give real-time data that can be utilized to improve decision-making and resource allocation. At the same time, AI-powered automation and analytics tools can help to streamline operations and save human labor. A scalable and adaptable infrastructure for product development and testing is provided by cloud computing, while big data analytics can reveal insights into user behavior and preferences. However, adopting these solutions is difficult because of worries about data security and privacy and a lack of qualified people. To realize their full potential, businesses must make the necessary infrastructure, resources, and training investments (Walter, 2021).

1.3 Research Rationale

Remote work is now possible in many firms because of the emergence of Industry 4.0 solutions. Remote work can improve efficiency, cut costs, provide employers access to a bigger talent pool, boost employee satisfaction, and have a more negligible adverse environmental impact. It can help businesses reduce administrative expenses, access a wider talent pool, boost employee morale, and lessen environmental effects. Both businesses and employees may benefit from it. Work time flexibility will enable employees to continue with remote work practices at any time outside of regular business hours. Moreover, organizational agility and performance have also increased (Chatterjee et al., 2022).

The advancement of Industry4.0 tools and the enforcement of lockdown procedures in response to the COVID-19 have pushed the adoption of digital platforms for improving remote work. Companies had to work quickly to equip workers with the necessary equipment for full-time employment in a virtual world. Employees that work remotely must use the computer software provided by their company. The present research aims to highlight the significance of Industry4.0 tools on organizational performance in Asian countries. Moreover, the current research will explore how different flexible working factors such as workplace, time, and the availability of IT infrastructure help the employee become more productive and increase the performance and agility of the organization. It is worth noting that Asia is a diverse continent with various economies at different stages of development (Huang & Zhao, 2020).

Countries such as Japan, South Korea, and Singapore are leading the charge in adopting Industry 4.0 tools in the IT sector. These countries have a well-developed IT infrastructure, a skilled workforce, and supportive government policies, which have helped them become leaders in adopting Industry 4.0 technologies. Another challenge facing the adoption of Industry 4.0 tools in Asia is the digital divide. Although Asia is home to some of the world's largest economies, the digital divide is still prevalent in many parts of the continent. This divide is more pronounced in rural areas where internet access is limited, and adequate IT infrastructure must be provided (Saad et al., 2023).

Adopting Industry 4.0 tools in these areas could be faster, leading to a significant gap in adopting them in the IT sector. Moreover, the cost of adopting Industry 4.0 tools is also a substantial barrier for many companies in Asia. The desire to adopt organizational agility through Industry 4.0 tools is widespread, and research interest is considerable. The most popular and conflicting perspectives are of organizational Agility and I4.0 tools as either "paradigms" or 'capabilities' (Walter, 2021). The present research attempts to conceive agility as an "IT strategy" that can be achieved through an Industry 4.0 tool that positively influences organizational performance. Worker shifts to remote offices full-time due to the COVID-19 epidemic will account for around

37% of all work by April 2020; it is estimated that by the end of 2023, around 25% of all the work will be done through remote offices (Yang et al., 2021). These tools require a considerable investment in hardware, software, and training. This cost is prohibitive for many small and medium-sized enterprises (SMEs) in Asia, and they cannot make the necessary investments to adopt these technologies. This has created a significant gap between large and small companies adopting Industry 4.0 tools. This research, conducted from an IT and technological standpoint, gives a collective knowledge of many significant concerns and underlying difficulties plaguing businesses and society.

1.4 Research Objectives

Following are the research objectives of the current study.

Major Objectives

- To explore the role of remote offices in the association between I4.0 tools and organizational performance.

- To investigate the role of organizational agility in the association between I4.0 tools and organizational performance.

Minor Objectives

- To explore the impact of AI, Big Data, IoT, Cloud Computing, organizational agility, remote work on organizational performance.

- To explore the function of organizational agility in the correlation between AI, Big Data, IoT, Cloud Computing and organizational performance.

- To explore the function of remote working the relationship between AI, Big Data, IoT, Cloud Computing and organizational performance.

1.5 Problem Statement

While some countries have quickly adopted Industry 4.0 tools and technologies, others still need help. The picture is different for other Asian countries. For instance, countries such as Bangladesh, Pakistan, and Nepal have yet to make significant progress in adopting Industry 4.0 tools. Additionally, many corporations in these territories still rely on traditional and basic IT systems, making it challenging to adopt Industry 4.0 tools. The information technology sector is critical to Pakistan's economic growth and innovation. However, the country has a number of difficulties in properly adopting digital change. While there has been progress in some sectors, like as software development along with outsourcing, Pakistan keeps falling behind in terms of adopting industry4.0 technologies and utilizing their capability for organizational growth and competitiveness. Factors such as a lack of digital infrastructure and perception of professionals may inhibit the successful implementation of initiatives to transform digitally in the IT sector. The present study will discuss the gap in adopting Industry 4.0 tools in the IT sector of Pakistan countries (Hussain et al., 2021).

1.7 Definition of Terms

Given the rapid advances, definitions have also evolved throughout time.

I4.0 Tools: The Fourth Industrial Revolution, also known as I4.0 tools, is characterized by integrating advanced technologies such as artificial intelligence (AI), Internet of Things (IoT) ,cloud computing, and big data into the production and manufacturing processes. These technologies have significantly changed industries worldwide, including the information technology (IT) sector (Grabowska & Saniuk, 2022).

Artificial Intelligence: To understand the notion of AI, the phrases "artificial intelligence" and "intelligence" must first be comprehended independently. "Intelligence" may be defined as mental functions such as understanding, thinking, and learning. In contrast, "artificial" refers to something people manufacture instead of a phenomenon that occurs naturally. By combining the two terms, artificial intelligence may be described as developing technologies that can replicate human intelligence (Enholm et al., 2021).

Big Data: Big data is the term for collecting massive and complicated volumes of data that standard methods of data control are unable to analyze and store effectively. BGD examples include approximately one TB of data generated daily by Facebook, the US stock exchange, and Google (Bag et al., 2020).

IoT: IoT stands for automated machine-to-machine communication. The Internet of Things (IoT) is a collection of interconnected devices, each uniquely identified by the computer network to which it is linked. The system's linked gadgets may be accurately and effectively operated from a distance. In other words, the IoT makes everything smart, leading to the industry4.0 workplace and the industrial revolution (Gill et al., 2019).

Cloud Computing: A network access paradigm that enables immediate, practical access to a distributed pool of configurable computing resources (e.g., networks, storage devices, servers, apps, and services) that may be rapidly provided and released with minimum administrative labor or service provider involvement (Gill et al., 2019).

Organizational Performance: The performance of an organization is the extent to which a business, as a social system with specialized resources, can achieve its goals without depleting those resources and procedures or imposing an excessive strain on its personnel (Jenatabadi, 2015).

Remote Work: Remote work involves employees carrying out their duties away from a company's central office (Staples, 2001).

Organizational Agility: Organizational Agility (OA) is a term used to describe a company's capacity to thrive in a dynamic and unpredictable environment (Walter, 2021).

1.8 Thesis Structure

Following is the structure of the current study;

Chapter 1: This chapter introduces and defines the variables. Moreover, the problem statement and the objectives of the study are highlighted.

Chapter 2: Chapter 2 is concerned with providing a detailed overview, body of knowledge, and empirical evidence related to the variables of the present research. Moreover, the research gap and hypotheses are also presented in Chapter 2.

Chapter 3: The third chapter provides a detailed overview of the data collection roadmap. It will provide information regarding the research philosophy, method, theory, and instrument used to collect data. Moreover, it will explain how the collected data will be analyzed.

Chapter 4: This chapter will provide the results obtained after collecting and analyzing the data. It will consist of tables, graphs, and a report on the analysis results.

Chapter 5: The fifth chapter of the study will discuss the results of the data analysis, the conclusions derived from the results, and how the objectives stated in Chapter 1 were achieved. Lastly, Chapter 5 will provide the implications and highlight the limitations that hinder generalizability.

CHAPTER 2: LITERATURE REVIEW

2.1 Digital Transformational Theory

The Digital Transformation Theory describes the process of using digital technology to fundamentally restructure organizational procedures, processes, and business models. It implies that digital transformation is required for organizations to stay competitive in the digital age of today, in which consumers, marketplaces, and technologies are continually altering (Wessel et al., 2021). According to the research by Tschang & Almirall (2021), digital transformation entails more than merely integrating new technologies. It entails a significant shift in how an organization runs, interacts with its consumers, and creates value. This may entail automating manual operations, implementing data-driven decision-making, improving the customer experience via digital channels, and developing new digital products and services. In the digital age, the notion emphasizes the significance of embracing digital technology to promote innovation, increase organizational performance, and build long-term competitive advantage cloud computing, big data, artificial intelligence (AI), and the Internet of Things (IoT) are examples of Industry 4.0 solutions that can improve organizational performance, agility, and support remote work (Johnson et al., 2021). The theory of digital transformation emphasizes the significance of harnessing Industry 4.0 technology to build a more agile, flexible, and efficient organization that can adapt to a fast-changing business landscape. Transformation to the digital age Companies can use Industry 4.0 tools to streamline processes, increase communication, and better analyze data in order to make more educated decisions. Furthermore, these solutions can enable remote work by giving employees access to the resources and data they need despite their physical location (Arshad et al., 2022).

2.2 Industry 4.0 Tools

The researchers Grabowska and Saniuk (2022) elaborated in their study that, Industry 4.0 has existed for some time, affecting not just business and industry but also other aspects of life and bringing up new opportunities for enterprises and consumers. Due to a constantly shifting environment, industrialization, increased competition, and the threats of crisis occurrences, continuous improvement systems must be created, improved, and integrated. To gain and maintain a competitive advantage, organizations must focus on implementing I4.0 tools to improve performance, efficiency, innovation, and competitiveness. The escalating economic crisis of recent times will significantly influence how firms operate, affecting both organizational agility and operational operations, such as creating remote offices

2.2.1 Internet of Things and Organizational Performance

The researchers Gao & Xu (2023), stated that the devices may communicate with one another over a vast network thanks to a brand-new technological paradigm dubbed the Internet of Things (IoT). The five most important IoT technologies—middleware, wireless sensing networks (WSN), cloud computing, radio frequency identification (RFID), and IoT application software are substantially included in IoT-based services and products. WSN is an IoT technology comprising independent sensors that monitor physical or environmental conditions. In contrast, RFID is an automated data collection system with a larger data storage capacity. Cloud computing is an innovation that makes it easier to combine inherited technologies with new ones. Middleware is an interrupted layer of software that sits between the application and technology layers (Lv & Li, 2021).

On-demand access to resources, including servers, networks, computers, storage, services, applications, and software, is made accessible through the Internet of Things (IoT), a computing paradigm. Several sectors use it significantly, including IT, manufacturing, healthcare, insurance and financial services, transportation, and materials. The logistics business dramatically benefits from IoT innovation, helping businesses run more efficiently. Although financial gains are essential for IoT adoption, many businesses are wary of the technology (Aceto et al., 2020).

In recent years, the Internet of Things (IoT) has proliferated more widely and significantly affected many parts of everyday life, including how we work. Using IoT technology, a network of interconnected devices can connect to and communicate with one another over the internet. Employees can access and manage numerous systems and procedures, including lighting, temperature control, and security systems, remotely from their home offices or other remote places using IoT-enabled devices(Gao & Xu, 2023). A study conducted in Malaysia, which included 3019 manufacturing enterprises in its sample, looks at the connections between the advantages and difficulties of IoT adoption and organizational performance. All seven hypotheses were evaluated using PLS-SEM (partial least square structural equation modeling), and the findings are consistent with six of the seven hypotheses. The study's limits and suggestions for more research as underlined; however, it may be used as a reference for IT industries when making decisions about the use of IoT (Lee et al., 2022).

2.2.2 Cloud Computing and Organizational Performance

The development of cloud computing is the most significant advancement since the creation and growth of the Internet. It was proposed by an MIT professor in 1960 and is the disruptive technology required for the sustainability of SMEs. In 1999, Salesforce released its first cloud-based CRM, and in 2002, Amazon became the first vendor. The term "cloud," which describes a group of water molecules, gave rise to cloud computing. The distributed servers, Client computers, and data centers are the three parts of cloud computing. End users utilize computers as cloud computing devices, and distributed servers are spread over several locations. Servers are gathered in the data center (Humayun, 2020).

With Cloud computing (CC), any user may access a data center on demand through the Internet. Obtain coherence and scale economies through resource sharing. CC provides four platforms: Services as a Service, Platform as a Service, Infrastructure as a Service and Software as a Service. Cloud computing is used to provide massive storage capacity on a remote server that is accessible from anywhere in the world (Kabugo et al., 2020).

According to Al-Azzawi & Kaya (2021), two architectures may be utilized to safeguard data: edge computing and cloud computing. Edge technology cannot offer real-time insights or rapid outcomes, yet cloud computing can analyze vast volumes of data. Cyber-attacks, malware, and other intrusions can infiltrate systems through edge devices. However, edge data centers are vulnerable to physical tampering, malicious software/hardware injection, and routing information attacks. By providing data centers' metrics such as power use, network traffic, SLA uptime and latency, quality edge data centers provide tools to defend networks in real-time. Unauthorized access to data centers caused by data stored in several places and with various providers might result in security problems.

Gopala & Sriram (2020), quoted that, with the help of a dependable cloud infrastructure called edge computing, businesses can integrate storing and data analytics onto smaller, closer-to-the-user devices. While Cloud Computing delivers scalability and dependability for managing macro data, it offers greater scalability, flexibility, and reliability for managing and processing microdata. Edge computing, however, remains in its infancy and has yet to establish complete apps that can store extensive quantities of data. To handle this, edge computing systems must enable various storage choices that can retain data for a more extended period. While cloud computing provides immediate, real-time findings and insights, edge devices are made to analyze smaller datasets.

The research by Humayun (2020), explored the role of AI, cloud computing, and IoT, three cutting-edge technologies, in HR analytics. HR professionals may examine employee performance, teamwork, and productivity using IoT data to pinpoint workplace improvement opportunities and enhance workforce planning and scheduling, increasing overall organizational performance. AI algorithms support HR workers by automating screening, finding the best candidates, and predicting employee retention and performance. HR professionals may store and manage vast volumes of HR data, access, and analyses data quickly and efficiently, and make data-driven choices regarding workforce planning and talent management with cloud-based HR analytics tools. The way HR professionals handle talent management, workforce planning, and employee engagement is changing due to these technologies.

Research by Picoto et al. (2021), sought to uncover the key elements that influence cloud computing adoption in enterprises and assess how it affects productivity. The findings revealed that perceived dangers, relative benefits, service quality, top management support, cloud providers' effect, enabling conditions, computer self-efficacy, server location, and opposition to alteration significantly impacted cloud computing adoption. The researchers employed a dual-stage analytical technique to assess their suggested prototypical, including artificial neural networks (ANN) and structural equation modeling (SEM). The study discovered, the use of cloud computing improves corporate effectiveness. According to the importance-performance map research, managerial initiatives should improve perceived risk, relative advantage, and top management support.

2.2.3 Big Data Analytics and Organizational Performance

Abiodun et al. (2021), stated in their study that big data analytics is a ground-breaking technical advancement in the academic and corporate realms, but there is continuous discussion over whether it can boost performance in a competitive environment. Although, there is some indication that big data analytics might provide worth, the researchers contend that further investigation is necessary before asserting that such expenditures can improve competitive performance. Six aspects related to big data and its relationship with organizational performance have been identified by the literature.

Big data analytics has the potential to significantly alter competitive performance in the IT industry. Customer-centricity allows organizations to gather and analyses enormous quantities of customer data, operational effectiveness can optimize operational procedures, innovation and novel possibilities can uncover new insights as well as opportunities, and it may encourage innovation, support the creation of new services and products, and capitalize on untapped markets (Herczeg et al., 2023). To fully realize the promise of big data analytics and increase competitive performance, organizations must invest not only in technological advances, but also in the capabilities, talent, and supporting an organizational culture that welcomes data-driven decision-making. Notwithstanding the enthusiasm for bigdata analytics investments, a study conducted by Fortune 1000 organizations revealed that outcomes differ significantly in performance (Rehman et al., 2019).

A study investigated the connection between a company's viable success and big data analytics capacity (BDAC). BDACs allow businesses to gather knowledge that might assist them in improving their dynamic capacities, improving marketing and technology capabilities. To evaluate the study's hypotheses, 202 IT managers and chief information officers who work for Norwegian businesses participated in a survey. Results from partial least squares structural equation modeling demonstrate how a strong BDAC may assist businesses in gaining a competitive edge. According to the findings, dynamic skills can help organizations gain a competitive edge. Researchers should concentrate on using a BDAC to support and empower organizational capabilities (Mikalef et al., 2019).

2.2.4 Artificial Intelligence and Organizational Performance

Wang et al. (2020), stated that a more specific definition of artificial intelligence only refers to artificially intelligent systems. Although there are various definitions, most of them fall into one of the following four categories: systems that behave like humans, systems that mimic human thought, and systems that behave rationally and reason are two different concepts. As a result of the emergence of various technologies in the digital age, business and consumer behavior has altered. The 4IR is driven by technologies like Industry 4.0, Artificial Intelligence(AI), Big Data, blockchain cloud databases, Internet of Things, and financial applications. Among today's most promising digital technologies, AI has significantly impacted various industries (Ranaldo, Dell'Atti, & Turco, 2021).

A blend of proactive and reactive Artificial intelligence (AI) has been lauded as an emerging foundation of economic value (Wang et al., 2020). Research by Enholm et al. (2022), examined the relationships between an AI capability and organizational innovation and performance and produced a tool to assess a firm's AI capability. It is based on contemporary research on AI in the organizational setting as well as the resource-based theory of the enterprise. Empirical research findings validate the suggested theoretical framework and related instrument by demonstrating the relationship between AI capability and enhanced organizational creativity and performance.

Research by Irfan et al. (2019), explored how AI skills affected organizational agility and supply chain efficiency. The results from the empirical research revealed that IT and AI architecture and assimilation impact supply chain capabilities and information integration indirectly affects organizational agility, according to survey data from 218 Pakistani businesses can be able to achieve efficiencies in their operations by implementing the I4.0 tools.

2.2.5 I4.0 Tools and Organizational Performance

Calış Duman & Akdemir (2021) determined the impact of Industry 4.0 technical features on the organization's operations. The province of Kayseri was investigated as part of Turkey's aim to digitize the industry. To acquire information from executives at firms using cutting-edge technology as well as those adjusting to the process, questionnaires, in-person interviews, and secondary information gathering methods were employed. According to the study, technology favors organizational performance measures such as production volume, profitability, revenue, production volume per person, production speed, product quality rate, and capacity utilization. It can also lead to considerable cost reductions for manufacturers. According to the findings, the function of remote offices in the link between I4.0 tools and performance should be examined in different industries.

Furthermore, Sivathanu and Pillai (2018) highlighted the importance of I4.0 tools and their role in the disruption process in the human resource sector, such as managing remote offices and employees. It aimed to utilize Credit Suisse as an example to demonstrate the benefits of Smart HR 4.0 in the HR field. Credit Suisse has made substantial use of people analytics to lower employee turnover. The study covered the function of I4.0 tools in human resources. The study's results showed that for enterprises to successfully navigate the obstacles of Industry 4.0 transformation and remote office management, they would need a Smart HR 4.0 strategy. New technologies like the Internet of Things, Cloud Computing, Big Data, and artificial intelligence would automate most jobs, creating leaner and more effective teams. To effectively implement Industry 4.0 would enable all sections to play a more tactical role in the overall organization's progress, organizational structure, and governance style adjustments would be necessary.

Industry 4.0 technologies are becoming increasingly common, significantly impacting how well organizations perform. Internet of Things (IoT) Big Data, cloud computing and AI, are examples of I4.0 tools. These solutions automate and streamline various corporate activities, from supply chain management to production. Due to the time now available for employees to focus on higher-value tasks thanks to I4.0 tools, productivity growth has been one of the most significant ways this has affected organizational performance. Additionally, I4.0 tools have enhanced product quality because they allow for real-time product quality monitoring and early problem detection through sensors and advanced analytics. Another study explored the effect of I4.0 technologies and their interoperability on organizational performance (Rajamanickam et al., 2023).

Frederico et al. (2021), examined I4.0 technologies all the more pertinent since it may provide light on how SCs might employ digital technology to better prepare for unforeseen circumstances. An empirical survey research approach was used to accomplish this goal. One hundred fifteen valid replies were gathered during the first wave of the pandemic's peak data collection period. Afterward, multiple regression, correlation, and descriptive approaches were used to examine the data. According to the study, disruptive technologies substantially influenced organizational performance, including integration, cooperation, responsiveness, and transparency. Its integration also favored an organization's profitability.

I4.0 technologies enable collaboration, automate repetitive operations, and boost productivity and efficiency while providing real-time data and insights. These tools enable businesses to quickly respond to shifting market conditions and consumer demands, improve the customer experience, and spur development and profitability (Saad et al., 2023).

2.3 Organizational Performance

The effectiveness with which an organization attains its targets and objectives is indicated as organizational performance. Three critical characteristics of organizational performance are efficiency, quality, and operations. Efficiency is an organization's capacity to achieve its goals using the fewest resources possible. In other words, how effectively an organization uses its resources (time, money, and labor) to achieve its objectives. Increasing efficiency can result in cost savings, better production, and increased profitability (Tortorella et al., 2023).

Mirrazavi and Khoorasgani (2016), quoted in their research that businesses compete in a marketplace where indications of organizational success include consumers, inputs, and capital while also playing a significant role in logistics operations. The contribution of many corporate divisions, including marketing, logistics, human resources, and strategy, will be evaluated. Strategic management uses organizational performance to influence three dimensions of firm outcomes: financial success, market penetration of products, and returns on equity. Organizational performance may be evaluated using a scorecard, benchmarking, corporate process reengineering, and comprehensive quality management.

2.3.1 Organizational Performance and Organizational Agility

Growing more agile employees, groups, and businesses has been the focus of many theories, research, and practice in recent years. More research is needed to determine how agility interventions affect organizational performance, even though their primary goal was to help businesses compete more successfully in the contemporary hypercompetitive and constantly evolving workplace (Aguilar-Rodríguez et al., 2023). Researcher Pulakos et al. (2019), stated that Agility was a combination of proactive and reactive components, which essentially described resilience, based on data from 325 organizations and a sample of 114 enterprises with known financial performance measurements. Organizations with high agility-resilience had a 150% better ROI and a

500% higher shareholder return (ROE), demonstrating the strong correlation between the agility-resilience construct and indices of company financial success. Stability, appropriately sized cooperation, and continuous course correction were three organizational characteristics that significantly affected agility-resilience, which in turn assisted in mediating links to organizational financial performance.

2.3.2 Organizational Performance and Remote Work

Operations are the procedures and actions involved in manufacturing things or providing services. Effective operations management can offer improved efficiency, lower costs, and higher quality goods and services. Operations may be enhanced through streamlining procedures, efficiently managing resources, and incorporating new technology or innovations. The study examined how the Indian retail 4.0 environment affects the current supply chain performance metrics. The governance structure is used as a moderating variable. The findings of the study showed that the retail supply chain is helpful information for preparing I4.0 tools investments. The study also recommended that future research opportunities and implications for managers and top executives be discussed and further explored (Gawankar et al., 2020).

Management of the processes used to manufacture and deliver goods and services is a fundamental organizational job. With big data support companies, big data analytics and talent capabilities may be used to assist organization learning and operations management results. PLS-SEM was utilized in research that polled 520 valid responses from top management of the mining industry in South Africa's developing economy. The results demonstrate that big data analytics significantly impact product development and sustainable supply chain outcomes, and that big data analytics talent capability has a similar but less pronounced impact on staff development. Innovation and learning effectiveness impact organizational supply chain performance, and supply chain innovation has a significant moderating influence (Arshad et al., 2022).

Big data was initially used to define as a significant quantity of information, but over time it has evolved to refer to a collection of vast amounts of data. To make better decisions, innovative production models are required. The IoT is a significant advancement in current information technology that uses computer, identity, and identification technologies to connect everyday things to work and living. It provides a related intelligent management system platform, intelligent management software for heating meters, and real-time management assurance for the heat exposure bracketing intelligent management platform (El Alami et al., 2015).

The advancement and technology-driven markets create other issues that increase the focus on how cloud services and resource virtualization might enhance the maintainability and sustainability of products, production processes, logistics, and systems as part of the digitization promoted by Industry 4.0, which is also referred to by the phrase "Industry of the Future." That no longer required employees to be physically present at work. In order to create a broad digital platform for networked, intelligent production using AI, digital manufacturing—which is the digitalization of , production (with planning), supply and delivery operations of a networked company—requires the layout of advanced data centers, communication systems, and control systems with core technologies. This will enable a sustainable digital economy for corporate logistics to emerge adaptable to markets and customer focused (Gawankar et al., 2020).

Lv & Li (2021) conducted integrating IC card identification technology into intelligent management, which has significant research impact and value. The study revealed that AI and IoT technology, ground sensing technology, OPC/PLC, and other technologies could increase business efficiency by more than 30%.

The three most cutting-edge technologies in HR analytics are IoT, AI, and cloud computing. With IoT data, HR professionals may assess employee performance, collaboration, and productivity to identify areas for workplace development and improve workforce scheduling and planning. AI algorithms assist HR professionals by automating the screening, identifying the top candidates, and generating predictions about employee retention and performance (Csizmadia et al., 2023).

With cloud-based HR analytics solutions, HR professionals can store and manage enormous amounts of HR data, have instant access to it, analyze it quickly, and make decisions about talent management and workforce planning based on that data. The way HR professionals handle talent acquisition, employee engagement, and employee satisfaction is changing due to these technologies. Businesses should invest in these technologies to maintain their competitiveness and fulfill the evolving needs of the modern workplace. Hence, I4.0 tools help in establishing the remote offices and increasing the organizational performance (Ghanem & Alshahrani, 2021).

The efficiency and efficacy of the action-qualifying process are evaluated using performance metrics, which give decision-makers the data they want for management feedback. Because supply chain management indicates different factors to different individuals, it is difficult to quantify. The functioning of the supply chain must still be measured, though, because senior management has to be informed (Cudanov et al., 2011).

Because of IoT advancements, businesses and sectors may acquire a competitive edge. IoT can improve operating procedures while lowering costs and hazards significantly. There are still many difficulties to overcome, including social and technological ones. If such issues are resolved, IoT adoption and dispersion may be verified. Performance may be updated and progressed by determining the benefits and downsides of employing IoT in the supply chain. The growing use of IoT and digital technology will boost yearly profits by almost 110 billion euros (Nižetić et al., 2020).

Owing to the extensive use of sensors and IoT devices, big data creation is evident in the Internet of Things (IoT). Nevertheless, processing extensive data is complex owing to the need for computing, networking, and storage capabilities. In IoT systems, big data analytics (BDA) is anticipated to offer operational and client-level insight. The most modern BDA technologies, algorithms, and approaches were examined in the research, along with the framework and case studies of businesses profiting from BDA. It was determined that adopting IoT and BDA processes as key elements for value creation is the only way to realize the vision of Industry 4.0, which connects production systems with customers and suppliers, Furthermore, it helps in establishing the remote workplaces (El Alami et al., 2015).

Modern process surveillance and information analytics systems have been developed as a result of the increased worldwide rivalry in industrial production. Cloud computing AI, Internet of Things (IoT) technologies and big data availability provide platforms for implementing complex process data analytics. Some key participants are cloud service providers, distributors of business solutions, networking providers, and industrial engineering firms. Soft sensors are essential for gaining knowledge about the condition of process activity, mainly when it is impossible or unreliable to measure a critical process variable directly (Albelaihi & Khan, 2020).

AI, IoT, Cloud Computing and Big Data are developing as novel tools for addressing the complex problems researchers in Earth Sciences confront, both in computation and analysis. However, these technologies are considered necessary for the growth and performance of the organization. For the society that now count on specialized supercomputers, it provides a glimmer of optimism. Several new study topics, including quantum computing, , software engineering, software-defined networks, 5G networks, the bitcoin currency, and beyond, have evolved as a result of the ongoing growth of research in cloud computing. The emerging concept of Chat GPT (software based on AI) is considered a turn and enhances productivity and quality of work (Gill et al., 2019).

2.4 Organizational Agility

A study conducted by Wanasida et al. (2021), examined the critical significance of business analytics competence, quality of information, and innovation capacity in driving organizational agility and performance during the Covid-19. Data was gathered from 76 firms in Indonesia from diverse industries. SEM-PLS (Structural Equation Model-Partial Least Squares) analysis examined the connection between variables and evaluated several hypotheses. The results revealed that the Importance-Performance Matrix Analysis (IPMA) method analyzed an item's performance and importance. According to the findings, business analytics competence considerably influenced knowledge quality and creative capability, influencing organizational agility. Organizational agility influences organizational performance. As per the IPMA findings, organizational agility significantly influences organizational performance.

2.4.1. Organizational Agility and I4.0 Tools

Irfan et al. (2019), Organizational performance, agility, and I4.0 tools have intricated and interrelated relationships. Agility may increase an organization's capacity to acquire and use I4.0 technologies, just as deploying I4.0 tools can promote organizational agility. Eventually, increased organizational performance and long-term success can result from adopting and integrating I4.0 tools and organizational agility. Industry 4.0 tools are used increasingly by businesses to attain IT-dependent organizational agility, or capacity to react quickly to changes that frequently occur unexpectedly in the global setting. However, IT outsourcing may occasionally impede agility due to its high sunk costs and management requirements.

A study carried out by the authors to thoroughly evaluate the literature concerned the connection between organizational agility and digitalization. It investigates the facilitators, constraints, and advantages of procedures designed to provide organizations with the agility needed to address increasingly turbulent circumstances effectively. The bibliographic coupling strategy was applied to extract the research on I4.0 and its significance in improving the organizational agility 171 peer-reviewed papers published through 30 June 2021. Three subject clusters are identified and investigated, emphasizing big-data analysis skills as critical OA drivers. The study outcomes revealed current research gaps and offered 13 original research hypotheses for prospective upcoming research topics and innovative management techniques. Prior research has endeavored to connect IT subcontracting to IT-reliant organizational agility; nevertheless, bulk of these studies have focused on the hazards of erroneous outsourcing appropriation and the consequences of adverse outsourcing events on organizational agility (Ciampi et al., 2022).

By allowing quicker, more effective, and more responsive operations, using I4.0 tools may improve an organization's agility. For instance, using sophisticated analytics and predictive maintenance, businesses may spot possible issues before they arise and take preventative action to avoid interruptions. Similarly, by modifying production processes in real-time, automation technology may assist firms in reacting swiftly to changes in demand. Little empirical studies have explored how startups use digital tools to achieve this. However, they can facilitate them to increase their capacity for digital innovation (Munirathinam, 2020).

A study conducted by Gonçalves et al. (2022), employed a qualitative method constructed on 23 interviews with nine international automotive startups; they nearly entirely employ cloud services for their businesses. Thanks to SaaS providers' startup programmers, startups may stay concentrated on innovation projects without bothering about scaling. Uncertainty persists regarding the mechanisms underlying the effects of appropriation on organizational agility as well as how a corporation executes acceptable outsourcing appropriation to attain IT-dependent organizational agility. The firms' decision to employ SaaS-based digital technologies to boost their organizational agility and digital innovation projects was made public.

Reacting swiftly to shifting market conditions and Customers' requirements can increase an organization's success. Agile firms are better equipped to respond swiftly to competitive challenges, uncover new market possibilities, and adapt to new technology. Agile firms are better positioned to outperform their less agile competitors because they are more responsive to changes in the market(Khan et al., 2022).

A study conducted by Edu (2022) explored the connections between I4.0 tools use, IT capability growth, and monetary service agility. It discovered that unique I4.0 tool utilization founded on idea of an IT expertise perspective provided evidence that the agility of financial services might be improved. I4.0 tools and technologies to concentrate on financial information collection and market monitoring and using I4.0 tools to construct a deliberate transition plan for managing and transferability of data, and information discovery were examples of practical consequences.

2.5 Remote Work

Due to the global challenges, companies rely more on the internet for routine operations. Due to this, there is now a higher need for online services, including booking hotels, paying bills, getting medical advice, buying airline tickets, and more. The utility of cloud computing (CC) technologies has raised quantity, velocity, and diversity of data being created every single minute worldwide due to the growing rivalry between businesses to satisfy their consumers. Due to the volume and speed of the data flow, this information is stored in many forms and cannot be readily merged. Organizations must be prepared for the difficulties presented by big data to participate in the emerging digital economy (Khayer et al., 2021).

To serve the needs of an organization, essential structures, data sources, and architecture are identified, defined, and measured. Infrastructure is also defined. In order to assure privacy, accuracy, data security, quality, and control, new laws and rules must be created. Big data is assisting enterprises in making judgments established on the evaluation of vast quantities of information from multiple sources, including Internet of Things (IoT), to thrive in the new digital economy (Cudanov et al., 2011).

The concept of remote work consists of three sub-concepts that includes; Productivity, Infrastructure Flexibility, Workplace Flexibility and Work time Flexibility.

2.5.1 Productivity and I4.0 Tools

Cudanov et al. (2011), quoted in their study that by incorporating Big Data, IOT, and Artificial Intelligence, organizations are embracing technology breakthroughs and creating a unique tech culture. Internet of Things (IoT) is used by people analytics to enhance company choices around hiring, inspiring, using, and retaining skilled personnel. Wristbands supporting wearable IOT technology will be equipped with temperature, GPS, accelerometer and movement sensors to capture real-time data. These details may provide previously unknown information about an employee. Hence increases the productivity of the employees.

A research study sought to determine how the recent era and its accompanying work consequences influenced employee performance and whether I4.0 technologies moderated this connection. The poll included 106 employees from various service firms working remotely during the epidemic, and the data was evaluated using multivariate techniques. The findings revealed that work implications such as the home office workplace environment, virtual connection and job instability, did impact staff performance, but not as much as I4.0 base technologies. The research emphasizes the relevance of digitization in service businesses as a theoretical and practical way of boosting organizational performance (Arshad et al.,2022).

Research conducted by Gangwar (2017), examined the skills businesses seek in big data analytics jobs and big data programmers in the service sector. Three data sources were employed in a multi-method approach: executive interviews, internet job advertisements, and big data projects. Text mining analysis was utilized under a comprehensive competence theoretical framework to get insights into the necessary capabilities. The results demonstrated that companies are looking for individuals with solid cognitive and functional abilities in data analytics, computers, and business, as well as a variety of public proficiencies and certain behavioral qualities, as the management believes that employees who have the competencies related to AI, Big data analytics, Cloud Computing, and IoT, are considered as efficient, productive and effective.

2.5.2 Infrastructure Flexibility and I4.0 Tools

Chatterjee et al. (2022), stated in their study that the growth of AI and the speedy advancement of digital technologies are essential for remote employment. Employees benefit from having flexibility with their work and schedules, while businesses benefit from maintaining operations. However, the advantages of remote working can only be reaped if the necessary equipment is in place. For instance, online instruction can only be supplemented if kids have computers at home. Flexible infrastructure benefits workers, businesses, and instructors' and students' ability to work remotely.

The adoption and use of Big Data and Cloud Computing (BDCC) from a technology-organization-environment (TOE) perspective in organizations are examined in the research. Information from a representative group of 100 businesses was collected to assess the potential benefits and technical prowess of BDCC formally. Within the context of technologies, compatibility with existing infrastructure, data dependability and functioning, and security and confidentiality are substantially ranked. Organizational and environmental factors for adopting and using BDCC include managerial skills, financial expenditure capability, and government aid and regulation (Borangiu et al., 2019).

Ranaldo et al. (2021), quoted big data, AI, cloud computing, and IoT, to enormous amounts of digital information businesses and governments create. 90% of the data in the biosphere today was produced individually in the past two years, and approximately 2.5 quintillion bytes of data exist. The volume and availability of big data, such as the massive volumes of cloud infrastructure, the diversity of databases and layouts spilling data procurement situations, and the enormous capacity of inter-cloud movement, all add to the problems of security, safety, storage, methods, and processing.

The researchers Suler et al., (2021), stated in their study that with secure internet, distant data centers, hardware, and IaaS applications, cloud computing is gaining popularity in the IT sector and business. Many advantages include eliminating ownership expenses and allowing businesses to focus on their core competencies without worrying about infrastructure, operational effectiveness, or available resources. Mobile cloud apps, for instance, iCloud, Gmail, and Dropbox, have grown in popularity in recent years. Mobile cloud services enable distant system operators to outsource jobs. However, computing power and data storage have been limited due to wireless network and smartphone limitations.

Research by Lee et al. (2022), was aimed at investigating how resource limitations enforce businesses to become more susceptible to external environmental crises. Research has demonstrated how such instability has a disastrous impact on businesses. In Thailand in 2011, there were 557,637 impacted businesses and 2.5 million jobs lost. 13,000 Enterprises in Malaysia had significant effects in 2014. Companies attempt to handle the operations' disruption in the environment due to global issues with the use of cutting-edge technology.

Unfortunately, due to socio-material limitations, business players could not effectively employ novel technology in the operational environment. Big data technology facilitates data exploitation and adds value to several operational tasks. Moreover, it may support customizing the management of Customer and business partner relationships and contribute to resource efficiency (Abiodun et al., 2021).

2.5.3 Workplace Flexibility and I4.0 Tools

Every sector of the world economy has been significantly impacted by the recent era's economic issues, with severe ramifications for governmental and other institutions. Management of the interests of the workforce and their businesses is currently a challenge for leadership. The main impact of the pandemic on different HRM positions, how technologies are advancing and enhancing HRM, insightful estimates based on organizations' responses, and the path forward in the post-pandemic world (Persaud, 2021).

A study by Ranaldo et al. (2021), included an analysis of papers from 2019 that addressed the use of technology in HRM. These articles were classified into three categories: AI and information communication technology, cloud computing, and teleworking. The findings showed that the most significant major issues had been compiled and solutions offered. When things become authoritarian, genuine leadership emerges, and HR divisions prioritize employees' health and well-being. The results from the study suggested that cloud computing and other web-based technologies will also significantly improve resource allocation. Business innovation has been emphasized as crucial in numerous studies due to environmental changes, a variety of company hurdles, and legal requirements.

The research by Chatterjee et al. (2022), stated that businesses that enhance their research and development capabilities and increase their innovative technology capabilities will be better equipped to handle any unexpected crisis. These businesses could improve their customer relationship management (CRM) technical capability and offer flexibility in the working system may survive the recent diverse and technologically advanced dynamics.

According to the majority of studies, businesses may swiftly recover from such stormy situations if they implement the right strategies, such as big data analytics, cloud computing optimization technologies, IoT-enabled technology, and other tactics. No studies have examined how the organization's financial, technological, and inventive prowess could affect its operational capacity to influence its performance amid turbulence with the active help of Business technology leadership (Alashhab et al., 2021).

2.5.4 Work Time Flexibility and I4.0 Tools.

The four methods are AI, IoT, CC, and BGD. IoT serves as data provided by gathering a significant quantity of data from numerous linked IoT devices. At the same time, CC and BGD are responsible for processing this data to draw out meaningful information. If these four techniques are well-matched, they can enhance a variety of real-world applications. Increased return on investment for the business sector, a more intelligent healthcare sector, an increase in self-service analytics, and widespread use of edge computing are all advantages that may be reaped from integrating these four techniques (Aceto et al., 2020).

The research examined several connections suggested by the literature that would be important in a remote work setting. There is a substantial correlation between interpersonal trust between an employee and their boss and greater self-perceptions of performance, more work satisfaction, and reduced job stress. Industry 4.0 technologies significantly influence job satisfaction, performance, and employee productivity, indicating remote staff directors should prioritize tasks that exhibit competence, responsibility, and professionalism (Staples, 2001).

2.6 Research Gap

Table 1: Research Gap

Authors	1.4.0 Tool	Organizational Performance	Organizational Agility	Remote Work
(Ciampi et al., 2022).	✓		✓	
(Mirrazavi & Khoorasgani, 2016).	✓	✓		
(Gonçalves et al., 2022).	✓			
(Mikalef et al., 2019).	✓	✓		
Chatterjee et al., 2022).	✓			✓
(Arshad et al., 2022).	✓	✓		✓
Wanasida et al. (2021).		✓	✓	
This Research	✓	✓	✓	✓

The above table elaborates on how past researchers explained organizational performance. From the literature review, it was discovered that past research either discovered I4.0 tools associations with organizational performance, organizational agility, or remote work. None of the past literature employed all the variables in a single research work. Moreover, the literature lacks studies that investigate the moderating role of organizational agility and remote work in the relationship between I4.0 tools. Furthermore, the literature provided room to study the moderating role of organizational agility and remote work on AI, big data, cloud computing, and IoT.

2.7 Research Questions

RQ_1: What is the impact of Industry 4.0 tools on organizations' performance?

RQ_2: Does the organizational agility improve organizational performance?

RQ_3: Does the organizational performance improve through remote office?

RQ_4: How does the remote office affect the relationship between I4.0 tools and Organizational performance.

RQ5: How does the organizational agility affect the relationship between I4.0 tools and organizational performance?

2.8 Research Framework

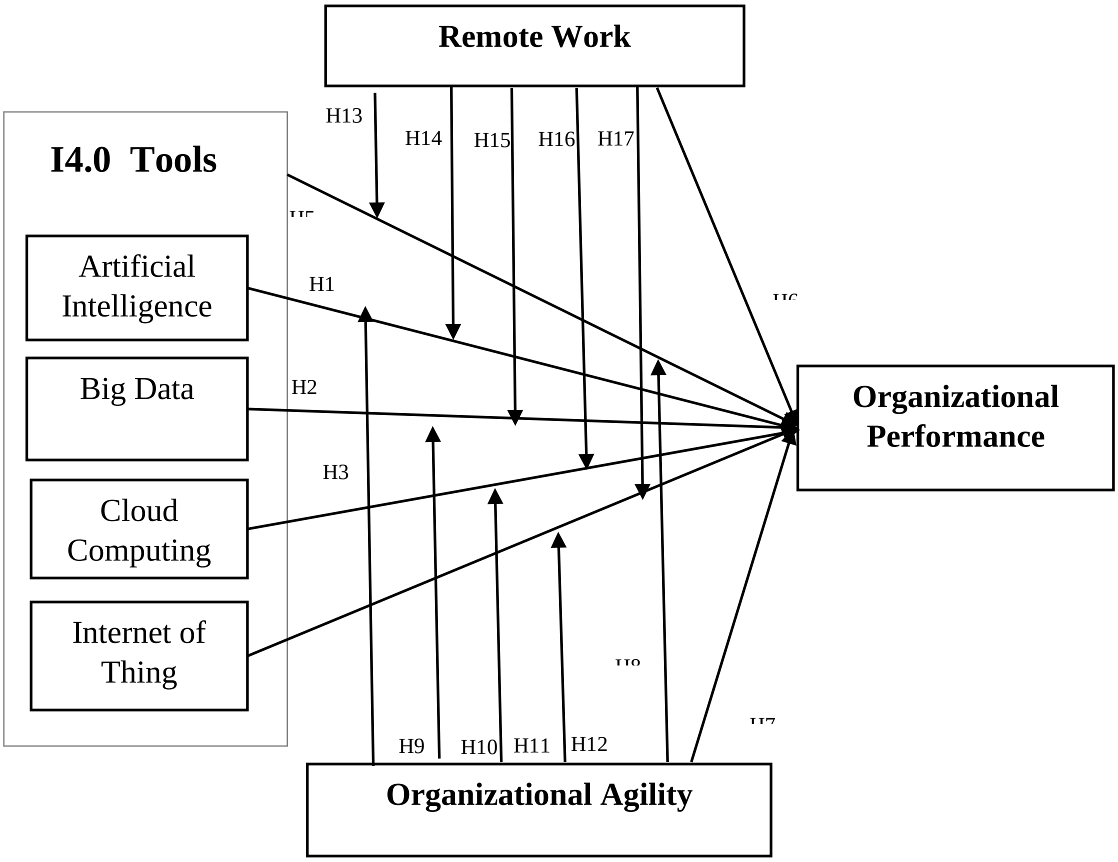

Figure 1: Research Framework

2.9 Hypotheses

H_1 A significant and positive relationship exists between IoT and organizational performance.

H_2 A significant and positive relationship exists between cloud computing and organizational performance.

H_3 A significant and positive relationship exists between big data and organizational performance.

H_4 A significant and positive relationship exists between AI and organizational performance.

H_5 A significant and positive relationship exists between Industry 4.0 tools and organizational performance.

H_6 There is a positive and significant relationship between organizational agility and organizational performance.

H_7 A significant and positive relationship exists between organizational performance and remote offices.

H_8 Organizational agility has a moderating role in the relationship between I4.0 tools and organizational performance.

H_9 Organizational agility has a moderating role in the relationship between artificial intelligence and organizational performance.

H_{10} Organizational agility has a moderating role in the relationship between big data and organizational performance.

H_{11} Organizational agility has a moderating role in the relationship between cloud computing and organizational performance.

H_{12} Organizational agility has a moderating role in the relationship between internet of things and organizational performance.

H_{13} Remote working moderates the relationship between I4.0 tools and organizational performance.

H_{14} Remote working moderates the relationship between artificial intelligence and organizational performance.

H_{15} Remote working moderates the relationship between big data and organizational performance.

H_{16} Remote working moderates the relationship between cloud computing and organizational performance.

H_{17} Remote working moderates the relationship between internet of things and organizational performance.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Research Philosophy

The belief in critical and theoretical thinking based on the phenomena while gathering and evaluating data is known as research philosophy. Research philosophy refers to the complete presumptions and ideas guiding the research process. Research is a process of knowledge production. The assumptions and ideas that made up the research philosophy laid the foundation for the study design. Epistemology, Ontology, and Axiology are the three clusters that comprise the system of presumptions and beliefs. Whereas epistemology examines how we know what we know, ontology deals with reality and asks what its nature is. Based on these assumptions, there are five research philosophies: realism, positivism, interpretivism, pragmatism, and postmodernism. The axiology assumption highlighted the values and ethics in the study. Positivism depicts the autonomous existence of human conceptions and ideas. Contrarily, interpretivism denies that human perceptions and beliefs may exist independently. The "Positivism Research Philosophy", which gives factual information through observations, measurement, and specific beliefs and values, has been used in this study. Choosing the right research philosophy is critical for the investigation. Instead of interpretivism and realism, positivism is the research philosophy employed for the current study, which essentially exposes the theoretical and consistent attitude of the researcher based on objectivist presumptions (Walter & Andersen, 2016).

3.2 Research Approach

Research methods are created using logic, theory, the application of the concept, and generalizability. The three primary research methodologies are inductive, deductive, and abductive. The current study used a deductive method since its goal is to create hypotheses that may either be accepted or rejected depending on the data's findings (Timmermans & Tavory, 2012). Based on the quantitative research methodology, the current research employs the deductive approach, progressing from particular to general.

3.3 Research Strategy

The plan of action that directs a researcher's efforts and ideas is called a research strategy. A research strategy is a researcher's overarching plan or method to examine a particular research subject or issue. It entails using a methodical, coordinated approach to data collection and analysis to address a research issue or test a hypothesis. They consist of triangulation, quantitative, and qualitative approaches. The study uses a quantitative approach to address the problems raised by the current research (Abutabenjeh & Jaradat, 2018). The researcher gets help from the quantitative research methodology to gather the numerical data that gives scientific data that can either be accepted or not accepted by the study's hypotheses.

3.4 Research Method

The research's concept, methodology, design, and strategy are considered while choosing the research method. Choosing a study design, selecting a sample or population, identifying the research topic or problem, collecting data, interpreting the data, and making findings are all standard processes in a research plan. Identifying potential sources of bias, creating acceptable measurements, and choosing the best statistical techniques to apply are all possible components of the method. The research issue or problem, the available resources, and the researcher's experience and preferences will all influence the chosen research approach. The most common research methods include surveys, case studies, experiments, observational studies, and meta-analyses. These research approaches, which are developed from qualitative and quantitative research strategies, comprise a wide range of research procedures. (Chu & Ke, 2017). The primary research techniques used in the quantitative research strategy include gathering numerical data through surveys, questionnaires, and polls. This information was used in the current study using a questionnaire that consists of the variable of the present study, including AI, Big Data, cloud computing, IoT, organizational performance, remote work, and organizational agility.

3.5 Research Design

The next phase in research methodology known as research design, may be characterized as a thorough plan for data collecting that produces an outline for the investigation. Descriptive, Normative, and explorative research strategies are the three primary categories. Three principal research methodologies, including those employed in the social sciences, business, and engineering, are descriptive, normative, and exploratory. The purpose of a descriptive study is to outline the features of a specific population or phenomenon. It seeks to answer queries like "what is" or "how much" by gathering data and summarizing the findings. Survey research, observational studies, and case studies frequently employ descriptive research. Both qualitative and quantitative approaches are possible. Normative research determines the optimum course of action or assesses the efficacy of current practices or regulations. What should be or what is ideal are two concerns this kind of inquiry addresses. Exploratory research: When little is known about a given occurrence, and the researcher wishes to grasp the problem more thoroughly, exploratory research is utilized. This kind of study is employed to produce hypotheses and create fresh concepts. Case studies, interviews, and surveys are just a few examples of the qualitative and quantitative approaches that may be used in exploratory research. It is important to note that these research methods are not exclusive, and researchers frequently combine them to respond to their research questions. The type of research challenge, the data's accessibility, and the study's objectives all influence the research approach choice (Abutabenjeh & Jaradat, 2018).

The exploratory research strategy aims to assess the future and find prospective advancements. The stated description of the proposed measures serves as the foundation for this study. Hence, the descriptive research design approach is employed in this work.

3.6 Target Population and Sampling Technique

The target population is the group of people or things a researcher wishes to examine or analyze. The research results will be extrapolated to the bigger group (Omair, 2014). The present study's target population consisted of AI Engineer, Managers and Assistant Manager Network, Senior managers IT and Network, Junior Managers (IT, Software, Networks, AI) IT and Network Heads and Directors, Lab and Network Engineers, IT (Officers, Developers, System Specialists) and Cloud Specialist.

The term "sampling strategy" describes how a researcher chooses a sample or subset representative of the study's target population. Several sampling methods are available, depending on the study issue and the target population's characteristics. Typical sampling methods include Random sampling: There is an equal probability that each member of the target population was chosen for the sample. Stratified sampling: Based on specific criteria, the target population is separated into subgroups or strata, and samples are chosen from each stratum. Convenience sampling: Instead of choosing participants at random or systematically, participants are chosen based on their accessibility or availability. Recommendations from other participants in a snowball sampling process find participants. Researchers should carefully assess the sampling strategy they choose since it might affect the representativeness and generalizability of the study findings (Abutabenjeh & Jaradat, 2018). The present study employed a convenience sampling technique to obtain responses from the targeted population.

3.6.1 Data Collection

The procedure or method used to collect information or data for research purposes is the data-collecting method. It entails employing various techniques, such as surveys, interviews, observations, or experiments, to methodically collect data from diverse sources or subjects, such as people, organizations, or surroundings. The study objective, the type of data needed, the accessibility of resources, and ethical issues all play a role in deciding which data-gathering technique to choose. The technique for gathering data should be trustworthy and legitimate, which means that it should result in accurate, pertinent data that can be utilized to address the study questions. Data gathering is a vital component of research, and the quality and integrity of the data obtained depend on choosing the best data collection method (Chu & Ke, 2017).

According to a report by NASSCOM[1] , as of 2020, there were over 40,000 technology startups in Asia, with the majority of them located in India, China, and Southeast Asia (Ebert, 2020). Raosoft Population Calculator is an online tool that researchers and survey designers commonly used to calculate the appropriate sample size needed for a given population size and desired margin of error (Campbell, 2019).

The tool uses a formula that considers the population size, confidence level, margin of error, and response distribution to calculate the sample size. The results provided by Raosoft Population Calculator can help researchers determine the minimum number of participants needed for their study, which can save time and resources. Raosoft Population Calculator is a valuable tool for researchers who want to ensure that they have a sample size that is large enough to provide accurate and reliable results. However, it is essential to note that sample size is just one factor in ensuring the validity and reliability of research findings. Other factors such as sampling method, survey design, and data analysis techniques should also be considered. The calculator

[1] The National Association of Software and Service

suggested a sample size of n=377 for any population having more than 20,000 sizes (Raosoft, 2023).

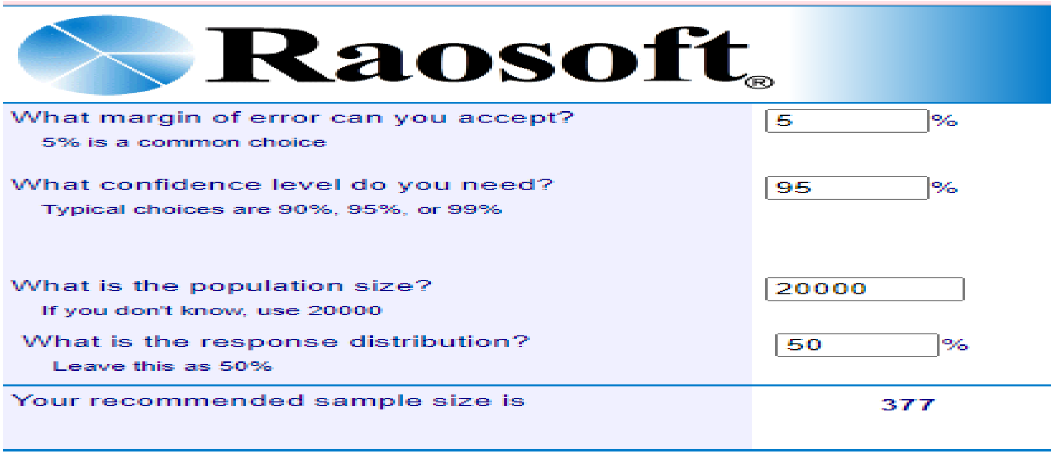

Figure 2:Calculation of Sample Size

The data from working in different Asian IT firms were collected online using online survey technologies such as Google Forms. The collected data was downloaded as an Excel file to pass the preliminary data screen checks. Data were examined using the SPSS v22 after the initial screening. The link between the variables in the current study was examined using linear, multiple linear regression, reliability, and correlation tests.

3.7 Instrument

The present study adapted the scale for Industry 4.0 tools from the studies that measured organizational performance and its relations with Industry 4.0 tools (Calış, Duman & Akdemir, 2021; Wamba, 2022; Imran et al., 2018). The scale related to the industry 4.0 tools consisted of 14 items, out of which two items were related to AI, three were related to Cloud computing, three were cornered with IoT, and the remaining four items were for measuring Big Data.

The scale that measured organizational performance was adapted from the study of Calış, Duman & Akdemir (2021), consisting of 8 items. Furthermore, the instrument for organizational agility was adapted from the study of Wamba (2022), and it has eight items. Lastly, the instrument that measured remote work was adapted from the research work of Chatterjee et al. (2022). The scale consisted of 19 items related to the employee's productivity, workplace flexibility, work time flexibility and infrastructure flexibility.

3.8 Reliability and Validity

The 50 respondents were given the instrument to determine whether it was valid and reliable for attaining the research goals. Using the tests for validity (Correlation Analysis) and Test for reliability (Cronbach Alpha Value), SPSS was used to assess the data collected from the 50 IT engineers, IT managers, IT and Network directors, IT heads, AI specialists, and officers. The 50 survey responses were used to determine if the questionnaire was valid and reliable for the research. The results from the pilot study suggested the instrument of the present study was reliable and valid as the results indicated a correlation moderate to the high-level correlation between all of the variables of the present study.

Table 2:Summary of Present Study's Instrument

Scale			
Variable	Number of Items	Authors	Reliability
Industry 4.0 Tools	13	Calış Duman & Akdemir, 2021; Fosso Wamba, 2022; Imran et al., 2018	0.911
Remote Work	19	Chatterjee et al., 2022	0.981
Organizational Agility	8	Fosso Wamba, 2022	0.947
Organizational performance	8	(alış Duman & Akdemir, 2021	0.976
Artificial Intelligence	2	Fosso Wamba, 2022	0.527
Big Data	4	Imran et al., 2018	0.896
Cloud Computing	3	Calış Duman & Akdemir, 2021	0.757
Internet of Things	3	Imran et al., 2018	0.843

3.9 Ethical Standards

Researchers are expected to adhere to ethical standards and guidelines when collecting data from study participants. The researcher is responsible for ensuring that participants' data are kept secure and only used for the study. The researcher must also ensure that participants' data is not shared with third parties or distorted after completing the research. This study aims to follow all ethical standards and guidelines for data collection. The researcher maintained the confidentiality of participants' data and did not share it with third parties. Respondents were not coerced into participating and provided their consent freely.

CHAPTER 4: RESULTS AND ANALYSIS

With 310 responses, this chapter tested the study's hypotheses by demonstrating descriptive, correlational, and reliability analyses. The current study's sample size was 377, and to get their perspectives on the study's variables, the 377 IT professionals were given access to an online survey. Three hundred ten responses were deemed useful following the initial screening step. Hence, results with an 82.22% response rate are presented in this chapter.

4.1 Demographic Analysis

Table 3:Summary of Demographic Analysis of N=310

Demographic Analysis		
Gender		
	Frequency	Percent
Male	202	65.1
Female	108	34.8
Total	310	100.0
Age		
20-30	113	36.5
30-40	120	38.7
40-50	58	18.7
50-60	19	6.1
Total	310	100.0
Qualification		
Bachelors	107	34.5
Masters	140	45.2
Ph.D.	57	18.4
Others	6	1.9
Total	310	100.0
Sector		
Private	145	46.8
Semi Govt.	82	26.5
Public	83	26.8
Total	310	100.0

Designation		
AI Engineer	2	.6
Assistant Manager Network	14	4.5
Lab and Network Engineer	41	13.2
IT and Network Head and Directors	41	13.2
Managers, Seniors Mangers IT and Network	74	23.9
Junior Managers (IT, Software's, Network, AI)	16	5.2
IT(Officers, Developers, System Specialists)	37	11.9
Cloud Specialist	37	11.9
Others	48	15.5
Total	310	100.0

The data in the above table represents a sample of 310 respondents categorized based on their gender, age, qualification, sector, and designation.

Gender: The data shows that 65.1% (202) of the sample were male, 34.8% (108) were female.

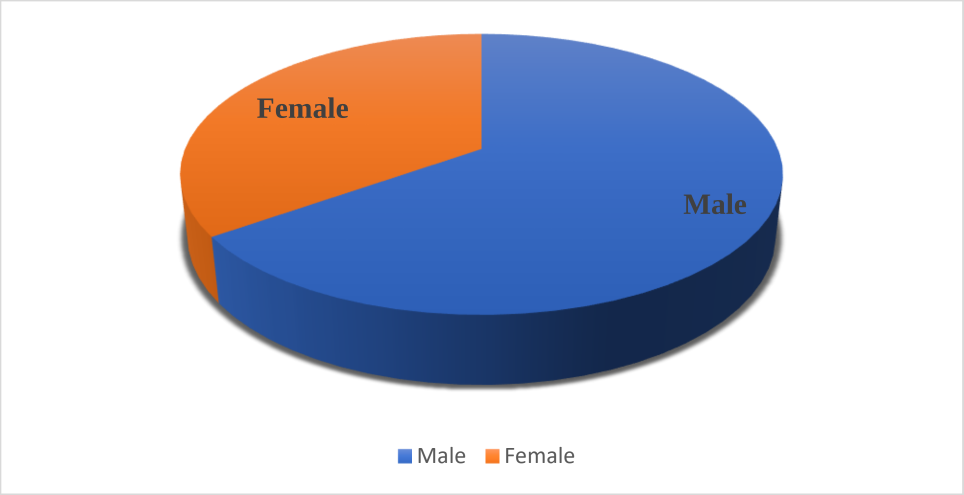

Figure 3:Gender of Sample (N=310)

Age: The age distribution of the sample is as follows: 36.5% (113) were between 20-30 years old, 38.7% (120) were between 30-40 years old, 18.7% (58) were between 40-50 years old, and 6.1% (19) were between 50-60 years old.

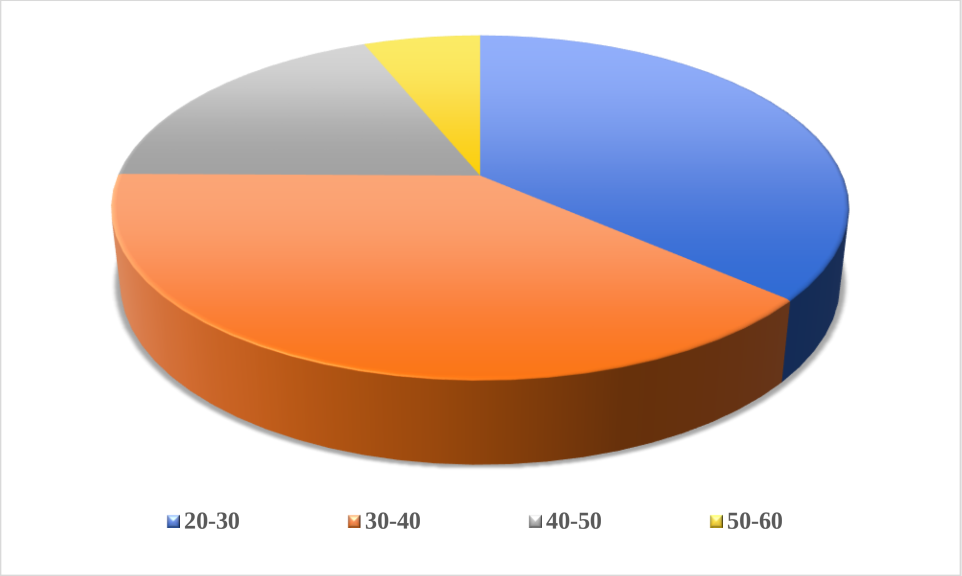

Figure 4:Age of Sample (N=310)

Qualification: 34.5% (107) of the sample had a bachelor's degree, 45.2% (140) had a Master's degree, 18.4% (57) had a Ph.D., and 1.9% (6) had other qualifications.

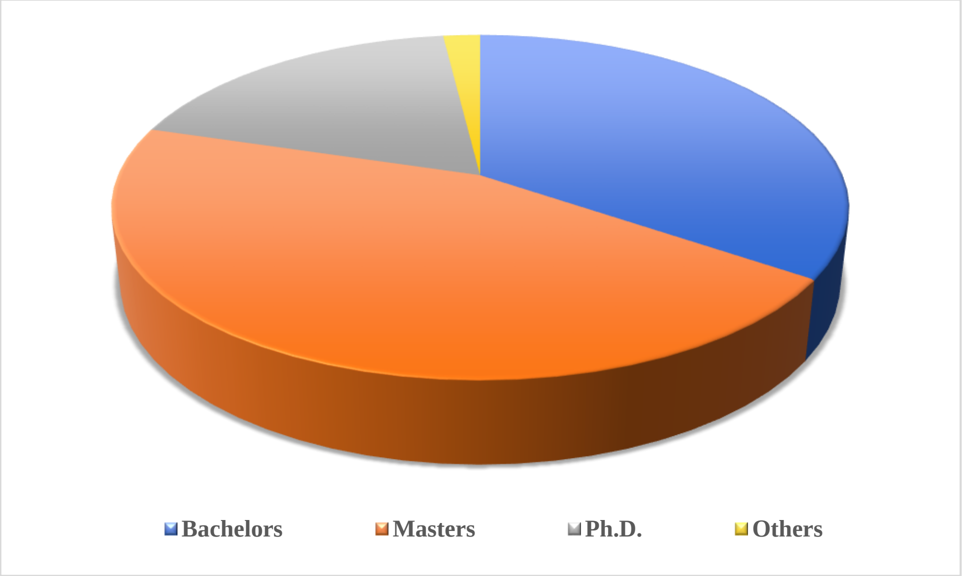

Figure 5: Education of Sample (N=310)

Sector: 46.8% (145) of the sample worked in the private sector, 26.5% (82) worked in the semi-government sector, and 26.8% (83) worked in the public sector.

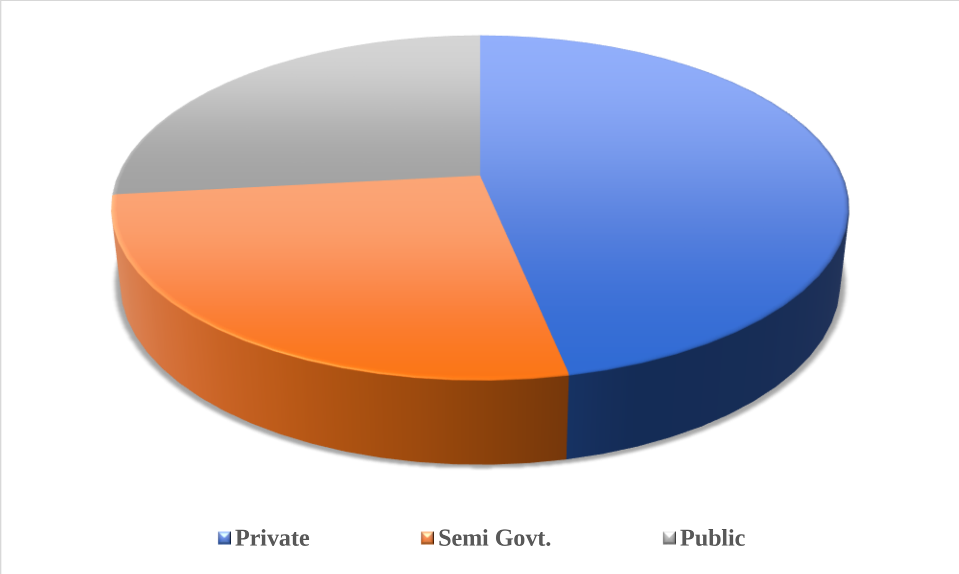

Figure 6: Sector of Sample (N=310)

Designation: The distribution of the sample based on their designation is as follows: 0.6% (2) were AI Engineers, 4.5% (14) were Assistant Manager Network, 13.2% (41) were Lab and Network Engineers, 13.2% (41) were IT and Network Heads and Directors, 23.9% (74) were Managers and Senior Managers IT and Network, 5.2% (16) were Junior Managers (IT, Software, Network, AI), 11.9% (37) were IT (Officers, Developers, System Specialists), 11.9% (37) were Cloud Specialists and the reaming 15.5% (48) were belonging to some other senior designations.

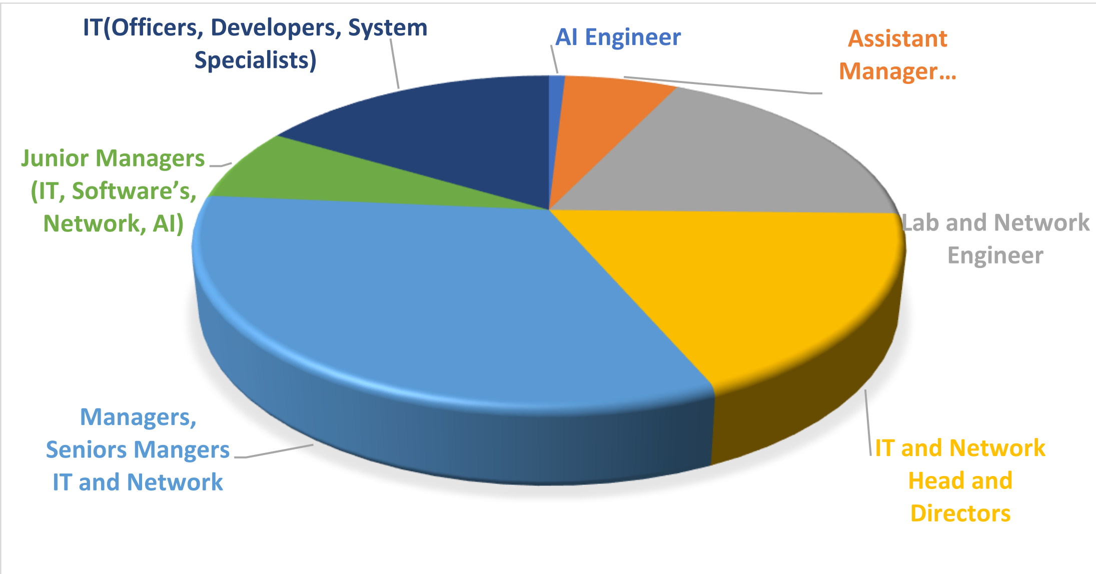

Figure 7: Designation of Sample (N=310)

4.2 Descriptive Statistics

Table 4: Descriptive Statistics of Sample (N=310)

Descriptive Statistics							
Variables	N	Mean	Minimum	Maximum	Range	Std. Deviation	Kurtosis
Internet of Things,	310	4.1484	1	5	4	0.72619	7.573
Cloud Computing	310	4.0581	1	5	4	0.78794	3.543
Big Data	310	3.9073	1	5	4	0.75126	4.855
Artificial Intelligence	310	4.0065	1	5	4	0.74713	2.924
I_4.0_Tools	310	4.0218	1	5	4	0.66328	6.727
Organizational Performance	310	4.0895	1	5	4	0.62968	10.32
Organizational Agility	310	4.0051	1	5	4	0.66256	7.117
Remote Works	310	4.0812	1	5	4	0.69284	9.126

The above table illustrates the descriptive statistics for eight variables: IoT, CC, BD, AI, I_4.0_Tools, OP, OA, and RW. Where N represents the number of observations (in this case, 310), Mean refers to the average value of the variable across all observations, Minimum: is the smallest value observed for the variable, Maximum: is the most significant value observed for the variable, range: the difference between the maximum and minimum values, Std. Deviation: a measure of how much the data is spread out around the Mean; specifically, it is the square root of the variance; Kurtosis: a measure of how "peaked" the data distribution is compared to a normal distribution. Positive Kurtosis shows more peaked distribution, while negative Kurtosis indicates flatter distribution.

Based on these statistics, it can be interpreted that for each variable, all minimum and maximum values are the same (1 and 5, respectively), indicating that the variables are measured on a 1-5 scale. Moreover, the mean values range from 3.9073 (BD) to 4.1484 (IoT). The ranges are all 4, indicating that the variables have the same amount of variability across their range. Furthermore, the standard deviations range from 0.62968 (for OP) to 0.78794 (for CC). Lastly, the kurtosis values range from 2.924 (for AI) to 10.32 (for OP), indicating that some variables have more peaked distributions than others.

Lastly, for normality the value of kurtosis ranging from +7 to -7 is considered good and the data falls into this range is considered as normal (Sovey et al., 2022). The results from the above table indicated that the data of the present study was normally distributed. However, a bit of issue regarding the normality was revealed for the remote work and organizational performance.

4.3 Reliability Analysis

Table 5: Results from the Reliability Analysis

Reliability Statistics		
Variables	Cronbach's Alpha	N of Items
Internet of Things	.836	3
Cloud Computing	.838	3
Big Data	.826	4
Artificial Intelligence	.794	2
I4.0 Tools	.877	12
Remote Work	.891	19
Organizational Agility	.883	8
Organizational Performance	.873	8

This table shows the reliability statistics for eight variables: IoT, Cloud Computing, Big Data, AI, I. 4.0 Tools, Remote Working, Organizational Agility, and Organizational Performance. Here is what each column means:

A Cronbach's alpha, which quantifies the internal consistency or stability of a group of survey questions, is frequently used to assess reliability. Higher numbers denote more dependability, with the alpha coefficient ranging from 0 to 1. A Cronbach's alpha of 0.7 or above is adequate for most research purposes. Reliability statistics, in the context of survey research, refer to measures of the internal consistency or stability of a set of survey items intended to measure the same construct or concept. Cronbach's alpha is a commonly used measure of internal consistency reliability, which ranges from 0 to 1, with higher values indicating greater reliability (Sürücü & Maslakçi, 2020). The reliability table reveals the statistics related to the present survey that includes items related to various topics related to technology, work, and organizations. The table shows Cronbach's alpha values and the number of items for each topic area.

For example, the table indicates that all Industry 4.0 tools (AI, Big Data, Cloud Computing, IoT) have a Cronbach Alpha value of .877. For IoT, the α was reported as .836; Cloud Computing have α value of .838; Big Data having α= 826; AI, α= 794; The "Remote Working" topic has the highest level of internal consistency, with a Cronbach's alpha of.891. Concerning Organizational agility and performance, the α was reported as .883 and .873, respectively.

The number of items varies across the variables, as three items (IoT and Cloud Computing) and 19 items (Remote Working). The number of items can affect the reliability of a variable, with more items generally leading to greater reliability. However, a larger number of items can also make a variable more cumbersome to administer, so researchers must balance the need for reliability with practical considerations. In conclusion, based on these statistics, all eight variables had Cronbach's alpha values above the acceptable threshold of 0.7. This suggests that the items in each variable consistently measure the same underlying construct and that the variables are likely reliable measures of those constructs.

4.4 Correlation Analysis

Table 6:Results from the Correlation Analysis

Correlations								
	IoT	CC	BD	AI	I_4.0_Tools	OP	OA	RW
IoT	1							
CC	.67**	1						
BD	.67**	.74**	1					
AI	.57**	.69**	.75**	1				
I_4.0_Tools	.83**	.89**	.92**	.83**	1			
OP	.74**	.60**	.67**	.61**	.75**	1		
OA	.70**	.66**	.75**	.63**	.79**	.78**	1	

RW	$.65^{**}$	$.58^{**}$	$.58^{**}$	$.56^{**}$	$.67^{**}$	$.68^{**}$	$.70^{**}$	1

$*p<.05$. $**p<.01$

IoT: Internet of Things, BD: Big Data, AI: Artificial Intelligence, CC: Cloud Computing, OP: Organizational Performance, OA: Organizational Agility, RW: Remote Working.

This table shows the correlations between eight variables: IoT, CC, BD, AI, I_4.0_Tools, OP, OA, and RW. The correlations range from -1 to 1, with values closer to -1 or 1 indicating a stronger relationship between the variables and values closer to 0 indicating a weaker relationship (Sürücü & Maslakçi, 2020). Based on these correlation results, it can be stated that all of the correlations between the variables are positive, indicating that as one variable increases, the other tends to increase as well. Furthermore, the strongest correlations are between I_4.0_Tools and each of the other variables, with correlations ranging from .836 to .925. This suggests that I_4.0_Tools is strongly related to other measures of digital transformation. Concerning the correlations between IoT and each of the other variables, it was discovered that the correlation coefficient ranged from .577 to .740, indicating a strong relationship with the other variables. The correlations between CC, BD, and AI and each of the other variables are also generally moderate to strong, with values ranging from .60 to .753. Lastly, RW and the other variables exhibit the weakest correlations, with values ranging from 0.561 to 0.701. This shows that compared to the other factors, remote working may have a weaker correlation with other metrics of digital transformation and organizational performance than the other variables.

4.5 Regression Analysis

A statistical method called regression analysis is employed to look at the connection between one or more independent variables and a dependent variable. It is a widely used data analysis and forecasting technique in various industries, including engineering, finance, and the social sciences. Regression analysis aims to determine the type and degree of the link between the independent and dependent variables. The present study used regression analysis to test the relationship between the variables.

4.5.1 Linear Regression with Organizational Performance as Dependent Variable

Table 7:Linear Regression Results for Hypotheses 1-7

Regression Table								
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Durbin-Watson**	**Unstandardized β Coefficient**	**Sig**	**t**	**Sig**
Internet of Things	0.54	372.6	0	1.943	0.642	0	19.30	0
Cloud Computing	0.36	173.1	0	1.824	0.479	0	13.15	0
Big Data	0.45	254.5	0	1.795	0.564	0	15.95	0
Artificial Intelligence	0.38	190.6	0	1.944	0.521	0	13.80	0
I4.0 Tools	0.56	397.7	0	1.796	0.713	0	19.94	0
Remote Work	0.46	266.6	0	1.986	0.619	0	16.32	0
Organizational Agility	0.61	494.1	0	1.786	0.746	0	22.22	0

A linear regression analysis was conducted to test the relationship between IoT and Organizational performance. The above table indicated an R^2 of .548, indicating that IoT explained 54.8% of the variance in organizational performance. Moreover, the table further revealed a ΔF=372.688.611, p<.000, indicating that the model is reliable for further analysis. Durbin Watson's (D-value) of 1.943 also lies in the acceptable limit of 1.5-2.5, indicating that the present research's data follows the normal distribution. Lastly, the unstandardized beta slope, β= .642, p<0.05, indicates IoT is a significant predictor of organizational performance. Hence, the H_1 of the present study is accepted.

The table further explains the results from linear regression analysis conducted to explore the relationship between Cloud Computing and Organizational performance. The results revealed an R^2 of .360, indicating that Cloud Computing explained 36% of the variance in organizational performance. Moreover, the table further revealed a ΔF=173.168, p<.000, and DW value of 1.824, indicating that the model is reliable for further analysis and following the normal distribution. Lastly, the unstandardized beta slope, β=0.479, $p<0.05$, indicates Cloud Computing is a significant predictor of organizational performance. Hence, the H_2 of the present study is accepted.

The results from the linear Regression analysis that carried out the relationship between Big Data and Organizational performance showed an R^2 of .452, indicating that Big Data explained 45.2% of the variance in organizational performance. Moreover, the table further revealed a ΔF=254.52, p<.000, and DW value of 1.795, indicating that the model is reliable for further analysis and following the normal distribution, the unstandardized beta slope, β=0.564, $p<0.05$, indicating Big Data as a significant predictor of the organizational performance. Hence, the H3 of the present study is accepted.

Moreover, the above table also shows the results from the linear regression analysis conducted to explore the relationship between AI and Organizational performance. The results revealed an R^2 of .382, indicating that AI explained 38.2% of the variance in organizational performance. Moreover, the table further revealed a ΔF=190.62, p<.000, and DW value of 1.944, indicating that the model is reliable for further analysis and following the normal distribution. Further, the unstandardized beta slope, β=0.521, $p<0.05$, indicates AI positively influences and has a significant relationship with organizational performance. Hence, the H_4 of the present study is accepted.

The above table shows the results from linear regression analysis conducted to explore the relationship between Industry 4.0 Tools (IoT, Big Data, Cloud Computing and AI) and Organizational performance. The results revealed an R^2 of .564, indicating that Industry 4.0 Tools explained 56.4% of the variance in organizational performance. Moreover, the table further revealed a ΔF=397.64, p<.000, and DW value of 1.796, indicating that the model is reliable for further analysis and following the normal distribution. Further, the unstandardized beta slope, β=0.713, $p<0.05$, indicating Industry 4.0 Tools positively influenced and has a significant relationship with organizational performance. Hence, the H_5 of the present study is accepted.

The above table illustrates the results from linear regression analysis conducted to explore the relationship between Organizational Performance and Remote Working. The results revealed an R^2 =.464% indicating 46.4% of the variance in Remote Working was due to Organizational Performance. Moreover, the table further revealed a

$\Delta F=266.629$, $p<.000$, and DW value of 1.986, indicating that the model is reliable for further analysis and following the normal distribution. Further, the unstandardized beta slope, $\beta=0.619$, $p<0.05$, indicates that Remote Working positively influences organizational performance. Hence, the H_6 of the present study is accepted.

Lastly, the results of linear regression analysis conducted to explore the relationship between Organizational Agility and Organizational Performance. The results revealed an R^2 =.616%, which means 61.6% of the variance in Organizational performance is explained by Organizational Agility. Moreover, the table further revealed a $\Delta F=494.138$ $p<.000$ and a DW value of 1.786, indicating that the model is reliable for further analysis and following the normal distribution. Further, the unstandardized beta slope, $\beta=0.746$, $p<0.05$, indicates Organizational Agility is positively influenced and has a significant relationship with Organizational Performance. Hence, the H_7 of the present study is accepted.

4.5.3 Moderating Effect of Organizational Agility Relationship between I4.0 Tools and Organizational Performance

Table 8: Multiple Regression Result of Moderating Role Organizational Agility in Relationship Between I4.0 Tools and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	t	Sig
I4.0 Tools	.66	297.89	0	0.486	0	9.32	0
Organizational Agility				0.327	0	6.29	0

I4.0 Tools (IoT: Internet of Things, BD: Big Data, AI: Artificial Intelligence, CC: Cloud Computing), OA: Organizational Agility.

The results from the Multiple Regression Analysis revealed that organizational agility has a moderating role in the relationship between I4.0 Tools and organizational performance. The model reported an R^2 =.66, indicating a 66% variance in organizational performances explained by organizational agility and I. 4.0 tools. Hence H_8 of the present study is accepted.

4.5.4 Moderating Effect of Organizational Agility Relationship between Artificial Intelligence and Organizational Performance

Table 9: Multiple Regression Result of Moderating Role Organizational Agility in Relationship Between AI Tools and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	T	Sig
Artificial Intelligence	.64	274.65	0	0.173	0	4.66	0
Organizational Agility				0.623	0	14.89	0

The results from the multiple regression analysis revealed that organizational agility has a moderating role in the relationship between artificial intelligence and organizational performance. The model reported an R^2 =.64, indicating a 64% variance in organizational performances explained by organizational agility and artificial intelligence. Hence H_9 of the present study is accepted.

4.5.5 Moderating Effect of Organizational Agility Relationship between Big Data and Organizational Performance

Table 10:Multiple Regression Result of Moderating Role Organizational Agility in Relationship Between and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	T	Sig
Big Data	.63	261.69	0	0.153	0	3.44	0
Organizational Agility				0.614	0	12.152	0

The results from the multiple regression analysis revealed that organizational agility has a moderating role in the relationship between big data and organizational performance. The model reported an R^2 =.63, indicating a 63% variance in organizational performances explained by organizational agility and big data. Hence H_{10} of the present study is accepted.

4.5.6 Moderating Effect of Organizational Agility Relationship between Cloud Computing and Organizational Performance

Table 11:Multiple Regression Result of Moderating Role Organizational Agility in Relationship Between Cloud Computing Tools and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	T	Sig
Cloud Computing	.62	258.69	0	0.115	0	3.089	0
Organizational Agility				0.656	0	14.856	0

The results from the multiple regression analysis revealed that organizational agility has a moderating role in the relationship between cloud computing and organizational performance. The model reported an R^2 =.62, indicating a 62% variance in organizational performances explained by organizational agility and cloud computing. Hence H_{11} of the present study is accepted.

4.5.7 Moderating Effect of Organizational Agility Relationship between IoT and Organizational Performance

The results from the multiple regression analysis revealed that organizational agility has a moderating role in the relationship between internet of things and organizational performance. The model reported an R^2 =.68, indicating a 68% variance in organizational performances explained by organizational agility and internet of things Hence H_{12} of the present study is accepted.

Table 12:Multiple Regression Result of Moderating Role Organizational Agility in Relationship IoT and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
Internet of Things	.68	258.69	0	0.321	0	8.163	0
Organizational Agility				0.497	0	11.546	0

4.5.9 Moderating Effect of Remote Working in Relationship between I4.0 Tools and Organizational Performance

The results from the multiple regression analysis revealed that remote working has a moderating role in the relationship between I4.0 Tools and Organizational Performance. The model reported an R^2 =.619, indicating a 61.9% variance in organizational performances explained by the remote working and I4.0 tools. Hence H_{13} of the present study is accepted.

Table 13: Multiple Regression Result of Moderating Role Remote Work in Relationship BwtweenI4.0 Tools and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
I4.0 Tools	.619	190.62	0	0.521	0	11.15	0
Remote Work				0.713	0	6.657	0

I4.0 Tools (IoT: Internet of Things, BD: Big Data, AI: Artificial Intelligence, CC: Cloud Computing), RW: Remote Working.

4.5.10 Moderating Effect of Remote Working in Relationship between Artificial Intelligence and Organizational Performance

Table 14: Multiple Regression Result of Moderating Role Remote Work in Relationship Between AI and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
Artificial Intelligence	.54	184.23	0	0.291	0	7.42	0
Remote Work				0.443	0	10.49	0

The results from the multiple regression analysis revealed that remote working has a moderating role in the relationship between artificial Intelligence and organizational performance. The model reported an R^2 =.54, indicating a 54% variance in organizational performances explained by the remote working and artificial intelligence. Hence H_{14} of the present study is accepted.

4.5.11 Moderating Effect of Remote Working in Relationship between Big Data and Organizational Performance

Table 15: Multiple Regression Result of Moderating Role Remote Work in Relationship Between Big Data s and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
Big Data	.579	210.90	0	0.350	0	9.146	0
Remote Work				0.398	0	9.594	0

The results from the multiple regression analysis revealed that remote working has a moderating role in the relationship between big data and organizational performance. The model reported an R^2 =.579, indicating a 57.9% variance in organizational performances explained by the remote working and big data. Hence H_{15} of the present study is accepted.

4.5.12 Moderating Effect of Remote Working in Relationship between Cloud Computing and Organizational Performance

Table 16: Multiple Regression Result of Moderating Role Remote Work in Relationship Between Cloud Computing and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
Cloud Computing	.526	170.56	0	0.246	0	6.356	0
Remote Work				0.456	0	10.38	0

The results from the multiple regression analysis revealed that remote working has a moderating role in the relationship between cloud computing and organizational performance. The model reported an R^2 =.526, indicating a 52.6% variance in organizational performances explained by the remote working and cloud computing Hence H_{16} of the present study is accepted.

4.5.13 Moderating Effect of Remote Working in Relationship between Internet of Things and Organizational Performance

Table 17: Multiple Regression Result of Moderating Role Remote Work in Relationship Between IoT and Organizational performance

Regression Table							
Variables	**R^2**	**ΔF**	**Sig. ΔF**	**Unstandardized β Coefficient**	**Sig**	**T**	**Sig**
Internet of Things	.616	246.06	0	0.446	0	11.01	0
Remote Work				0.314	0	7.389	0

The results from the multiple regression analysis revealed that remote working has a moderating role in the relationship between internet of things and organizational performance. The model reported an R^2 =.616, indicating a 61.6% variance in organizational performances explained by the remote working and internet of things Hence H_{17} of the present study is accepted.

4.6 Discussion

By April 2020, 37% of work was be done remotely as a result of the COVID-19 pandemic. Globally, several sectors have changed as a result of the Fourth Industrial Revolution, which is defined by cutting-edge technology like AI and IoT. Nevertheless, several Asian nations, like Bangladesh, Pakistan, and Nepal, are finding it challenging to implement Industry 4.0 tools because of things like a lack of backing from the government, a weak IT infrastructure, and a lack of qualified people. This makes it difficult for these nations to abandon conventional manufacturing and production techniques. The present study aimed to present the perspective IT industry on the adoption of I4.0 tools enhancing organizational performance and organizational agility and how the remote office can be stained and increase organizational performance through I4.0 Tools. The results from the demographic analysis revealed that most responders (75.2%) were male and between the ages of 20 and 40. All responders represented Asia. 45.2% of respondents held a master's degree, and the private sector employed 46.8%.

Regarding designation, managers and senior managers in IT and networks comprised the majority (23.9%). Overall, these reliability statistics provide some evidence that the survey items used to measure these topics are reliable and consistent, which can increase our confidence in the results obtained from the survey. However, it is essential to note that reliability is just one aspect of validity. It refers to the overall accuracy and appropriateness of the survey items for measuring the intended constructs.

The present study investigated the relationship and influence of I4.0 tools (AI, IoT Cloud Computing, and Big Data) on organizational performance. The results from the correlation analysis revealed that all the I4.0 Tools had moderate to high correlation with organizational performance, indicating a strong relationship between I4.0 tools (AI, IoT, Cloud Computing, and Big Data) on organizational performance. I4.0 tools reported the strongest relation (r=.751), and the highest correlation is reported for the IoT (r=.740), indicating that I4.0 tools are necessary for organizational performance. The relationship between I4.0 Tools and organizational performance was further retested through the linear regression analysis to identify which tool creates more variance in organizational performance. It was found that I4.0 tools can explain a 56.4% variance in organizational performance. The present study findings are persistence with the results of previous research where researchers emphasized based on empirical evidence that organizational performance can be boosted by I4.0 tools (Al-Azzawi & Kaya, 2021; Borangiu et al., 2019; Ciampi et al., 2022; Ghanem & Alshahrani, 2021; Humayun, 2020; Ranaldo et al., 2021).

One study conducted by McKinsey & Company in 2020 found that companies that had already adopted digital technologies before the COVID-19 pandemic were more resilient during the crisis than those that had not. The study also found that remote work and collaboration tools helped companies improve their efficiency and performance during the pandemic. In particular, companies that had invested in cloud computing, data analytics, and automation could adapt more quickly to the sudden changes brought on by the pandemic (Dan et al., 2022).

Another objective of the present study was to investigate the potential of Tools for Industry 4.0 to increase agility. The correlation study results demonstrated that all of the I. 4.0 Tools had a positive relationship with organizational agility. , which shows a strong relation between I4.0 tools (AI, IoT, Big Data, and Cloud Computing) with organizational agility. Collectively, I4.0 tools reported the strongest relation (r=.794) with organizational agility. Moreover, the highest correlation is reported for Big Data (r=.758), Indicating that I4.0 tools are necessary for organizational agility. Moreover, it was also found that organizational performance and organization agility have the strongest relationship (r=.7885). Regarding the connection between organizational performance and organizational agility, it was shown that effective organizational performance might account for 63.1% of the variance in organizational agility. Moreover, the present study’s findings supported the moderating role of Organizational Agility and Remote Office. The results from the multiple regression analysis revealed that approximately 10% variance increased between I4.0 Tools and organizational performance. However, it was noted that Organizational Agility and Remote Office as individual moderators have greater influence on the relationship between I4.0 tools and organizational performance. This implies that the I4.0 tools help establish and manage the remote office, increasing organizational agility that ultimately leads to an increase in the performance of organizations. Furthermore, the results from the multiple regression analysis revealed a strong moderating role for organizational agility in the relationship between AI, big data, cloud computing, IoT, and organizational performance. The statistics revealed that in the presence of organizational agility as a moderator, the relationship between AI and organizational performance was 64%

stronger than previously (34%). Likewise, the relationship between big data and organizational performance and the presence of organizational agility as a moderator were explained by 63%, which previously was 45%, concerning the relationship between cloud computing and organizational Performance results indicated an increase in performance by 26% in the presence of organizational agility as a moderator. Lastly, the variance between IoT and organizational performance increased by 14% in the presence of organizational agility as a moderator. The findings of present study are consistent with those of other studies, which stressed that I4.0 tools and efficient operational reformatting might increase organizational agility based on empirical data (Eickemeyer et al., 2021; Frederico et al., 2021; Grabowska & Saniuk, 2022; Kumar et al., 2021; Narayanamurthy & Tortorella, 2021; Pagliosa et al., 2019; Sivathanu & Pillai, 2018).

This indicates that the I4.0 technologies may improve performance in various ways, notably by enhancing organizational agility. The ability of an organization to adapt swiftly to shifting market conditions and consumer demands can improve performance. In order to increase their performance, more agile businesses may be better equipped to use I4.0 tools' advantages. Real-time data collecting and analysis, automated repetitive tasks, collaboration, and quick market demand adaptation are all features offered by these technologies. Moreover, I4.0 technologies could make remote work more accessible, which improves organizational performance and helps it stay flexible over time. The performance and agility of a business may be impacted by the use of AI, big data, IoT, and cloud computing technologies individually. Companies that make I4.0 technology investments are better positioned to thrive in the rapidly changing business environment. Investigating the effects of these technologies on organizational performance, agility, and remote work may provide information on how firms may make the most of these resources (Narayanamurthy & Tortorella, 2021).

Investigating the potential of I4.0 tools to improve organizational performance and agility through remote offices was another goal of the current study. The findings of the correlation study showed that all of the I4.0 tools (AI, Cloud Computing, Big Data, and IoT) had a high correlation with remote working, demonstrating a significant relationship between the I4.0 technologies and remote working. I4.0 tools found the strongest correlation ($r = .677$) between remote work and productivity. Moreover, the IoT is said to have the highest correlation. This demonstrated the need for I4.0 tools for remote working. Also, it was shown that remote work positively correlated with organizational performance and agility. The findings of the present study are in line with those of earlier research that emphasized the potential for I4.0 tools and effective operational reformatting to promote organizational agility in light of empirical evidence (Calış Duman & Akdemir, 2021; Dan et al., 2022; Gadekar et al., 2022; Gill et al., 2019; Hussain et al., 2021; Jenatabadi, 2015; Walter, 2021).

These findings highlight the significance of I4.0 technologies for remote work, implying that firms that use these tools may be better prepared to handle the difficulties of remote work and enhance their performance and agility. The study contends explicitly that I4.0 tools can account for approximately half of the variation in remote working. That good organizational agility may account for a comparable amount of the variation.

Furthermore, the results from the multiple regression analysis revealed a strong moderating role for remote work in the relationship between AI, big data, cloud computing, IoT, and organizational performance. The statistics revealed that in the presence of remote work as a moderator, the relationship between AI and organizational performance was 54% stronger than previously (34%). Likewise, the relationship between big data and organizational performance and the presence of remote work as a moderator were explained by 57.6% which previously was 45%, concerning the relationship between cloud computing and organizational Performance results indicated an increase in performance by 16.6% in the presence of remote work as a moderator. Lastly, the results revealed an increase in variance between IoT and organizational performance from 54% to 61.6% in the presence of remote work as a moderator.

Mentioned above findings are consistent with former research emphasizing the potential for I4.0 tools to promote agility and improve performance. However, the study adds a new dimension by demonstrating how I4.0 tools can benefit organizations transitioning to remote work arrangements. As remote work becomes more common, organizations adopting I4.0 tools may be better positioned to succeed in this new environment by leveraging them to enhance their organizational performance and agility (Gadekar et al., 2022). Indeed, the present study has ample research to suggest that remote working and adopting I4.0 tools can help organizations achieve agility and improve their performance, particularly for IT-related organizations (Staples, 2001).

Another study conducted by PwC in 2021 found that organizations that had invested in I4.0 technologies such as Cloud Computing artificial intelligence, Internet of Things (IoT), and Big Data were better able to respond to disruptions and changing market conditions. These organizations were also more agile and adaptable than those that had not invested in these technologies. Additionally, a study found that remote work and collaborative technologies can improve employee productivity and job satisfaction. The study also found that remote work can reduce costs for organizations by eliminating the need for physical office space and reducing employee turnover (Virmani et al., 2023)

Overall, the evidence suggests that remote work and the adoption of I4.0 technologies can help organizations achieve greater agility and performance. These technologies can enable organizations to respond quickly to changes and disruptions in the market, improve productivity and efficiency, and reduce costs. As such, IT-related organizations, in particular, stand to benefit from the adoption of these technologies (Tortorella et al., 2023). In conclusion, implementation of Industry 4.0 tools in the IT sector is crucial for the growth and development of businesses in Asia. While some countries in the region have made significant progress in adopting these tools, others are still lagging. Bridging the gap in adopting Industry 4.0 tools in the IT sector will require a concerted effort from governments, companies, and other stakeholders. Governments must develop supportive policies, provide funding for the necessary IT infrastructure, and invest in developing a skilled workforce. Companies must also be willing to make the necessary investments and embrace the changes in Industry 4.0 technologies. With the right policies, investments, and mindset, Asia can catch up with other regions in adopting Industry 4.0 tools and technologies. Undoubtedly, a growing body of research points to the potential of Industry 4.0 (I4.0) technologies to improve performance and agility inside enterprises (Frederico et al., 2021).

Chapter 5: Conclusion and Recommendation

5.1 Conclusion

Several businesses were forced to make significant adjustments as a result of the covid pandemic, reevaluating key aspects of their business processes and using technology to go on with operations while adhering to a changing landscape of norms and new practices. This research offered a comprehensive overview of many significant obstacles and underlying concerns facing businesses and society from information systems and technological perspectives. It sought to investigate the role of I4.0 technologies while considering data security, worker productivity, and organizational impact. Industry 4.0 was the acceptance of digitalization and the shift to digital production in the global industrial sector (Al-Azzawi & Kaya, 2021).

AI has become a top technology objective for businesses due to the availability of vast amounts of data, the development of sophisticated methods, and the creation of infrastructure. Companies, however, faced many barriers that hindered them from realizing performance gains. According to Global Research, seven out of ten organizations claimed that Industry 4.0 technologies had a significant commercial influence on the agility and performance of their operations. Due to acceptance and restructuring delays, businesses had to invest additional resources to make the most of their industry 4.0 equipment expenditures (Mikalef & Gupta, 2021).

Although the number of Industry 4.0 tools had increased fourfold in the previous year and by 270% over the preceding four, firms still needed help achieving performance gains. Since technology has gained much attention, businesses have been investing in AI, which could potentially increase their bottom lines. The Internet of Things (IoT) can change business operations, plans, and capacities across various sectors. In order to continue operating, businesses had to establish a policy of enabling employees to work from home in response to the COVID-19 outbreak. Industry 4.0 technologies supported businesses in actively enhancing operational efficiency and effectiveness, collaboration, and integration. They also supported the strategic vision, product/service quality, appropriate technology, cost-effectiveness, quick introduction of new products, knowledgeable change management, and competent change management (Gangwar, 2017).

This research has revealed a critical need for conceptual clarity and a shared knowledge of how to use I4.0 tools to nurture organizational agility and improve overall organizational performance. There needed to be a consensus on how to define and operationalize organizational agility or the role of Industry 4.0 technologies in accomplishing it, even though there was much interest in this area. The problem of a lack of conceptual clarity and widespread knowledge of adopting I4.0 to achieve organizational agility may have been solved with the successful completion of these study objectives. The study may have offered more insight into how I4.0 tools can be applied to boost organizational performance and maintain agility in environments where remote workers are present. The study's conclusions help firms embrace I4.0 tools for increased performance and organizational agility. The study might have improved the comparability of research findings in this field and assisted the researcher in speaking the same language. The importance of organizational agility in improving the relationship between technical elements and organizational success is highlighted in this study. It demonstrates that agility improves the association of AI and performance by 30%, while big data as well as cloud computing improve it by 18% and 26%, respectively. Furthermore, organizational agility helps to increase the association among IoT and performance by 14%. This emphasizes the significance of 4.0 industry tools and effective operational reformatting in developing organizational agility. In today's competitive corporate climate, prioritizing and improving agility through innovative technology can result in significant performance gains. This research might have helped develop a more complete and unified understanding of organizational agility and its link with I4.0. By examining the effect of I4.0 tools on organizational performance and the connection between I4.0 tools and organizational agility, the study aims to solve this issue. Also, the study sought to determine how Industry 4.0 technologies may affect remote work and how it may improve corporate performance and maintain organizational agility.

The current study employed a deductive approach since its objectives were established by formulating hypotheses that may be accepted or rejected based on the data results. A plan of action that guided the researcher's thoughts and efforts was known as a research strategy. The researchers and survey designers calculated the sample size required for a particular population and the acceptable margin of error using an internet application called Raosoft Population Calculator. The calculator recommended an n=377 sample size for any population larger than 20,000. Online survey tools like Google Forms were used to gather data from Asian IT companies, and then they were downloaded as an Excel file. After the first screening, the relationship between the study's variables was investigated using SPSS v22. Following the first screening, 310 repositories were determined reliable, and correlation, descriptive, and linear regression analyses were carried out.

The results indicated that the capacity to automate repetitive and regular work is one of the primary advantages of I4.0 technologies, allowing staff members to concentrate on more complex jobs that call for innovation and brainstorming. This can raise efficiency and output while lowering mistakes and raising quality. The capacity to gather, examine, and act on data in real time is another essential advantage of I4.0 technology. This can aid businesses in decision-making, operational optimization, and rapid response to market changes. I4.0 technologies may help firms become more adaptive and flexible by enabling them to change their systems and processes to satisfy shifting demands swiftly. This can be especially useful in businesses where demand could be more stable or more stable. I4.0 technologies also ease cooperation and communication across different areas of the company and with external partners and suppliers. This can lessen the possibility of misunderstandings or delays and increase cooperation and alignment.

Moreover, the present study's results found the unique role of the remote office and organizational agility in enhancing organizational performance with the help of I4.0 Tools. Lastly, I4.0 technologies may support businesses in their efforts to innovate and create fresh goods and services. Businesses may obtain new insights and create previously unimaginable possibilities using tools like big data, artificial intelligence, the Internet of Things (IoT), and cloud computing. The study emphasizes the significance of remote labor as a mediator in the relationship between technical elements and organizational effectiveness. Remote work improves the interaction between artificial intelligence, big data, as well as cloud computing by 20%, 12.6%, and 16.6%, respectively. When paired with remote work, cloud computing and IoT demonstrate considerable improvements, with a 7.6% boost in performance. The report emphasizes the importance of accepting remote work as an essential component of organizational efforts, especially in the ever-changing digital context. The research indicates that I4.0 technologies may aid businesses in achieving effective performance and increasing their agility through increased productivity, real-time decision-making, collaboration, and innovation. The study's findings shed light on how Industry 4.0 solutions may increase organizational performance and agility through remote working. As I4.0 technologies and remote working have a strong link, it is possible to use these tools to improve productivity and organizational performance in remote working settings. The study also found that IoT had the most vital link with remote work, underscoring the significance of this technology in contexts where remote workers are common. Firms can increase their overall performance and agility by using remote work, as suggested by the positive association between remote work and organizational performance and agility. Also, the linear regression analysis revealed that the I4.0 tools might account for a sizable portion of the variance in remote working, underscoring the potential benefits of applying these tools in remote working situations.

The study's findings are consistent with earlier research showing how I4.0 technology and operational reformatting may improve organizational performance and agility. The Internet of Things (IoT) has become more prevalent and has dramatically impacted many aspects of our lives, including how we work. A network of interconnected gadgets can connect and interact with each other over the internet by using IoT technology. The study suggests that organizations leverage I4.0 technologies to improve their organizational performance, agility, and capacity to deploy remote workers. By utilizing I4.0 technology and effective remote working practices, organizations may gain a competitive edge and better respond to evolving market conditions.

Nonetheless, it is crucial to remember that I4.0 technologies and remote working tactics can be successfully implemented and managed to produce the best outcomes. Industry 4.0 technology has completely changed how businesses run, and I4.0 tools offer advantages beyond the factory floor. An indispensable tool for remote workplaces, cloud computing, is a concept for offering on-demand computing resources, including storage, servers, and applications over the internet. The Internet of Things (IoT) makes data sharing and connection possible. Big data may support organizational agility by providing real-time data and insights, enhancing productivity and efficiency, optimizing processes, and cutting waste. Big data maintains organizational agility by offering insights that can guide decision-making (Virmani et al., 2023).

5.2 Recommendations

There are various recommendations for academia, future research, and the Asian IT sector based on the study's findings:

5.2.1 Novelty

The current study investigates the association among Industry 4.0 tools with organizational performance in Pakistan's IT sector, with a particular emphasis on the moderating influence of remote work and organizational agility. The study uses a quantitative research method, with 377 questionnaires given online to senior or executive-level IT organizations. The findings are applicable to IT enterprises in Pakistan and might be regarded "better practices" for improving organizational performance, specifically in the Pakistan. The study also emphasizes the practical consequences of implementing Industry 4.0 tools towards sustaining the present working environment and preventing potential future disruptions. This contribution to the literature provides value by giving perspectives on the practical use of Industry 4.0 tools in the technology sector, especially for work continuity as well as resilience.

5.2.2 Practical Contribution

The study's conclusions have real-world repercussions for Pakistan IT companies. The findings imply that I4.0 technologies may significantly improve organizational performance, productivity, and remote working. IT companies might use these technologies to enhance their remote working capabilities and acquire a competitive edge. The report also emphasizes the significance of organizational agility in contexts where people operate remotely, suggesting that IT companies should prioritize creating and sustaining agile organizational structures and procedures. It is recommended for Asians. IT businesses use Industry 4.0 technologies like AI, Big Data, IoT, and Cloud Computing to boost productivity, decision-making, and customer service. Companies should encourage remote work and use Industry 4.0 technology to support and manage it. Enabling people to work from any location, lowering the requirement for physical infrastructure, and enabling a more flexible and responsive organizational structure, can increase organizational agility. Based on the findings of the current study, it is recommended that IT-related companies in Pakistan to adopt AI as well as Cloud Computing systems when creating remote offices, as this will improve organizational performance and agility. Companies may promote experimentation, risk-taking, and continual development by fostering an innovative culture. In conclusion, firms in Asia may increase their performance and agility using Industry 4.0 technology. Organizations may innovate by putting money into these technologies, encouraging remote work, and creating an innovative culture.

5.2.3 Theoretical Contribution

The research proves the connection between Industry 4.0 tools, remote labor, organizational performance, and agility. The research farmwork is developed using Digital Transformational Theory which acts as value addition to the literature as it illustrates technology advancement increase organizational performance. Academic literature on the uptake and effects of I4.0 technologies in remote working situations can benefit from these insights. The methods through which I4.0 tools promote remote working might be explored in more detail, as well as how businesses can use these technologies to their fullest potential.

5.2.4 Implications for future research

The study results point to the need for more investigation into the usage of I4.0 technologies in remote working settings. Further research might examine the actual uses of these technologies in various organizational settings and industry sectors. Research may also look at the elements that affect how well I4.0 technologies are implemented and managed in situations with remote workers. Future academics are encouraged to investigate how 4.0 HR might be used to manage distant workplaces and boost productivity. Utilizing Credit Suisse's case demonstrates how it interferes with personnel onboarding, developing talent, and off-boarding processes.

5.3 Limitations of the Present Study

The present study has enormous limitations. Firstly, a useable response of 310 may not sufficiently represent all Asian IT enterprises in the region. A bigger sample size could have produced more conclusive and broadly applicable results. Also, the study relied on participants' self-reported data, which might contain biases and mistakes. Additionally, because the study was cross-sectional, it could not determine if one variable caused another. The direction of causality would need to be determined by longitudinal investigations. Just the effects of Industry 4.0 technologies on organizational performance and agility in Asian IT enterprises were the subject of the study. Future studies may examine how these technologies affect various sectors of the economy and regional areas. Furthermore, the study employed a deductive methodology, but alternative research approaches might have offered new insights and viewpoints, including inductive or mixed methods. While analyzing the results of the current study and planning future research in this field, it is crucial to consider these limitations.

References

Abiodun, M. K., Awotunde, J. B., Ogundokun, R. O., Misra, S., Adeniyi, E. A., Arowolo, M. O., & Jaglan, V. (2021). Cloud and Big Data: A Mutual Benefit for Organization Development. *Journal of Physics: Conference Series, 1767*(1), 12020. https://doi.org/10.1088/1742-6596/1767/1/012020

Abutabenjeh, S., & Jaradat, R. (2018). Clarification of research design, research methods, and research methodology. *Teaching Public Administration*, *36*(3), 237–258. https://doi.org/10.1177/0144739418775787

Aceto, G., Persico, V., & Pescapé, A. (2020). Industry 4.0 and Health: Internet of Things, Big Data, and Cloud Computing for Healthcare 4.0. *Journal of Industrial Information Integration*, *18*, 100129. https://doi.org/10.1016/j.jii.2020.100129

Aguilar-Rodríguez, I. E., Bernal-Torres, C. A., Artieda-Cajilema, C. H., & Tapia-Andino, G. F. (2023). Smart working and base technologies in corporate performance: new directions in emerging firms. *Asia Pacific Management Review*. https://doi.org/10.1016/j.apmrv.2022.12.008

Alashhab, Z. R., Anbar, M., Singh, M. M., Leau, Y.-B., Al-Sai, Z. A., & Abu Alhayja'a, S. (2021). Impact of coronavirus pandemic crisis on technologies and cloud computing applications. *Journal of Electronic Science and Technology*, *19*(1), 100059. https://doi.org/10.1016/j.jnlest.2020.100059

Al-Azzawi, T., & Kaya, T. (2021). The impact of cloud computing on organizational performance. *International Journal of Cloud Applications and Computing*, *11*(4). https://doi.org/10.4018/IJCAC.2021100108

Albelaihi, A., & Khan, N. (2020). Top benefits and hindrances to cloud computing adoption in Saudi Arabia: A brief study. *Journal of Information Technology Management*, *12*(2). https://doi.org/10.22059/JITM.2020.75795

Arshad, M., Kun Yu, C., Qadir, A., Ahmad, W., & Rafique, M. (2022). The impact of big data analytics on organizational sustainability: The influencing factors of autonomous research and development and absorptive capacity. *International Journal of Engineering Business Management*, *14*, 184797902211415. https://doi.org/10.1177/18479790221141537

Bag, S., Wood, L. C., Xu, L., Dhamija, P., & Kayikci, Y. (2020). Big data analytics as an operational excellence approach to enhance sustainable supply chain performance. *Resources, Conservation and Recycling*, *153*, 104559. https://doi.org/10.1016/j.resconrec.2019.104559

Borangiu, T., Trentesaux, D., Thomas, A., Leitão, P., & Barata, J. (2019). Digital transformation of manufacturing through cloud services and resource virtualization. *Computers in Industry*, *108*, 150–162. https://doi.org/10.1016/j.compind.2019.01.006

Calış Duman, M., & Akdemir, B. (2021). A study to determine the effects of industry 4.0 technology components on organizational performance. *Technological Forecasting and Social Change*, *167*, 120615. https://doi.org/10.1016/j.techfore.2021.120615

Campbell, M. (2019). Sample size: methods of calculation and reporting. *African Journal of Midwifery and Women's Health*, *13*(2), 1–9. https://doi.org/10.12968/AJMW.2019.0007

Chatterjee, S., Chaudhuri, R., Shah, M., & Maheshwari, P. (2022). Big data driven innovation for sustaining SME supply chain operation in post COVID-19 scenario: Moderating role of SME technology leadership. *Computers & Industrial Engineering*, *168*, 108058. https://doi.org/10.1016/j.cie.2022.108058

Chu, H., & Ke, Q. (2017). Research methods: What's in the name? *Library & Information Science Research*, *39*(4), 284–294. https://doi.org/10.1016/j.lisr.2017.11.001

Ciampi, F., Faraoni, M., Ballerini, J., & Meli, F. (2022). The co-evolutionary relationship between digitalization and organizational agility: Ongoing debates, theoretical developments and future research perspectives. *Technological Forecasting and Social Change*, *176*, 121383. https://doi.org/10.1016/j.techfore.2021.121383

Csizmadia, T., Obermayer, N., Bogdány, E., Purnhauser, P., & Banász, Z. (2023). Examining Industry 4.0 through the lens of human resource and knowledge management: Implications for SMEs. *Management & Marketing*, *18*(1), 1–19. https://doi.org/10.2478/mmcks-2023-0001

Cudanov, M., Krivokapic, J., & Krunic, J. (2011). The Influence of Cloud Computing Concept on Organizational Performance and Structure. *Management*, *60*.

Dan, C., Kieltyka, L., Minh Hiep, P., Thi Hong Dao, M., Thong Minh, D., & Author, C. (2022). Comparative analysis of business strategy of Hung Thinh and Novaland real estate developers using McKinsey matrix. *International Journal of Multidisciplinary Research and Growth Evaluation, 3*(1). www.allmultidisciplinaryjournal.com

Ebert, H. (2020). Hacked IT superpower: how India secures its cyberspace as a rising digital democracy. *India Review*, *19*(4), 376–413. https://doi.org/10.1080/14736489.2020.1797317

Edu, A. S. (2022). Positioning big data analytics capabilities towards financial service agility. *Aslib Journal of Information Management*, *74*(4), 569–588. https://doi.org/10.1108/AJIM-08-2021-0240

Eickemeyer, S., Busch, J., Liu, C.-T., & Lippke, S. (2021). Acting Instead of Reacting—Ensuring Employee Retention during Successful Introduction of i4.0. *Applied System Innovation*, *4*(4), 97. https://doi.org/10.3390/asi4040097

El Alami, A., Sadok, H., & Elhaoud, N. (2015). Cloud computing & the organizational performance: Different approach of assessment. *Proceedings of 2015 International Conference on Cloud Computing Technologies and Applications, CloudTech 2015*. https://doi.org/10.1109/CloudTech.2015.7337007

Enholm, I. M., Papagiannidis, E., Mikalef, P., & Krogstie, J. (2021). *Artificial Intelligence and Business Value: a Literature Review*. https://doi.org/10.1007/s10796-021-10186-w/Published

Enholm, I. M., Papagiannidis, E., Mikalef, P., & Krogstie, J. (2022). Artificial Intelligence and Business Value: a Literature Review. *Information Systems Frontiers*, *24*(5), 1709–1734. https://doi.org/10.1007/s10796-021-10186-w

Fosso Wamba, S. (2022). Impact of artificial intelligence assimilation on firm performance: The mediating effects of organizational agility and customer agility. *International Journal of Information Management*, *67*. https://doi.org/10.1016/j.ijinfomgt.2022.102544

Frederico, G. F., Kumar, V., Garza-Reyes, J. A., Kumar, A., & Agrawal, R. (2021). Impact of I4.0 technologies and their interoperability on performance: future pathways for supply chain resilience post-COVID-19. *The International Journal of Logistics Management*. https://doi.org/10.1108/IJLM-03-2021-0181

Gadekar, R., Sarkar, B., & Gadekar, A. (2022). Investigating the relationship among Industry 4.0 drivers, adoption, risks reduction, and sustainable organizational performance in manufacturing industries: An empirical study. *Sustainable Production and Consumption*, *31*, 670–692. https://doi.org/10.1016/j.spc.2022.03.010

Gangwar, H. (2017). Cloud computing usage and its effect on organizational performance. *Human Systems Management*, *36*(1). https://doi.org/10.3233/HSM-171625

Gawankar, S. A., Gunasekaran, A., & Kamble, S. (2020). A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context. *International Journal of Production Research*, *58*(5), 1574–1593. https://doi.org/10.1080/00207543.2019.1668070

Gao, T., & Xu, M. (2023). *Cost Control and Efficiency Optimization in Maintainability Implementation of Wireless Sensor Networks Based on Serverless Computing* (pp. 219–241). https://doi.org/10.1007/978-3-031-26633-1_9

Ghanem, S., & Alshahrani, S. (2021). The Effect of Cloud Computing Adoption on Organizational Performance of SMEs in Saudi Arabia. *International Journal of Contemporary Management and Information Technology (IJCMIT)*, *1*(2).

Gill, S. S., Tuli, S., Xu, M., Singh, I., Singh, K. V., Lindsay, D., Tuli, S., Smirnova, D., Singh, M., Jain, U., Pervaiz, H., Sehgal, B., Kaila, S. S., Misra, S., Aslanpour, M. S., Mehta, H., Stankovski, V., & Garraghan, P. (2019). Transformative effects of IoT, Blockchain and Artificial Intelligence on cloud computing: Evolution, vision, trends and open challenges. *Internet of Things*, *8*, 100118. https://doi.org/10.1016/j.iot.2019.100118

Gonçalves, D., Bergquist, M., Alänge, S., & Bunk, R. (2022). How Digital Tools Align with Organizational Agility and Strengthen Digital Innovation in Automotive Startups. *Procedia Computer Science*, *196*, 107–116. https://doi.org/10.1016/j.procs.2021.11.079

Gopala, M., & Sriram, K. (2020). *Edge computing vs. Cloud computing: an overview of big data challenges and opportunities for large enterprises*. www.irjmets.com

Grabowska, S., & Saniuk, S. (2022). Assessment of the Competitiveness and Effectiveness of an Open Business Model in the Industry 4.0 Environment. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(1), 57. https://doi.org/10.3390/joitmc8010057

Herczeg, B., Pintér, É., & Bagó, P. (2023). How green and digital transformation shapes industries. *Vezetéstudomány / Budapest Management Review*, 51–63. https://doi.org/10.14267/VEZTUD.2023.05.05

Humayun, M. (2020). Role of Emerging IoT Big Data and Cloud Computing for Real Time Application. In *IJACSA) International Journal of Advanced Computer Science and Applications* (Vol. 11, Issue 4). www.ijacsa.thesai.org

Hussain, A., Farooq, M. U., Habib, M. S., Masood, T., & Pruncu, C. I. (2021). COVID-19 Challenges: Can Industry 4.0 Technologies Help with Business Continuity? *Sustainability*, *13*(21), 11971. https://doi.org/10.3390/su132111971

Irfan, M., Wang, M., & Akhtar, N. (2019). Impact of IT capabilities on supply chain capabilities and organizational agility: a dynamic capability view. *Operations Management Research*, *12*(3–4), 113–128. https://doi.org/10.1007/s12063-019-00142-y

Rajamanickam, M., Royan, E. N. J. G., Ramaswamy, G., Rajendran, M., & Vadivelu, V. (2023). Fourth Industrial Revolution. In *Integration of Mechanical and Manufacturing Engineering with IoT* (pp. 41–84). Wiley. https://doi.org/10.1002/9781119865391.ch2

Jenatabadi, H. S. (2015). An Overview of Organizational Performance Index: Definitions and Measurements. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2599439

Johnson, M., Jain, R., Brennan-Tonetta, P., Swartz, E., Silver, D., Paolini, J., Mamonov, S., & Hill, C. (2021). Impact of Big Data and Artificial Intelligence on Industry: Developing a Workforce Roadmap for a Data Driven Economy. *Global Journal of Flexible Systems Management*, *22*(3), 197–217. https://doi.org/10.1007/s40171-021-00272-y

Kabugo, J. C., Jämsä-Jounela, S.-L., Schiemann, R., & Binder, C. (2020). Industry 4.0 based process data analytics platform: A waste-to-energy plant case study. *International Journal of Electrical Power & Energy Systems*, *115*, 105508. https://doi.org/10.1016/j.ijepes.2019.105508

Khan, S. A. R., Piprani, A. Z., & Yu, Z. (2022). Supply chain analytics and post-pandemic performance: mediating role of triple-A supply chain strategies. *International Journal of Emerging Markets*. https://doi.org/10.1108/IJOEM-11-2021-1744

Khayer, A., Jahan, N., Hossain, M. N., & Hossain, M. Y. (2021). The adoption of cloud computing in small and medium enterprises: a developing country perspective. *VINE Journal of Information and Knowledge Management Systems*, *51*(1). https://doi.org/10.1108/VJIKMS-05-2019-0064

Kumar, P., Bhamu, J., & Sangwan, K. S. (2021). Analysis of Barriers to Industry 4.0 adoption in Manufacturing Organizations: an ISM Approach. *Procedia CIRP*, *98*, 85–90. https://doi.org/10.1016/j.procir.2021.01.010

Lee, K. L., Romzi, P. N., Hanaysha, J. R., Alzoubi, H. M., & Alshurideh, M. (2022). Investigating the impact of benefits and challenges of IOT adoption on supply chain performance and organizational performance: An empirical study in Malaysia. *Uncertain Supply Chain Management*, *10*(2), 537–550. https://doi.org/10.5267/j.uscm.2021.11.009

Lehman-Wilzig, S. N. (2021). *FRANKENSTEIN UNBOUND Towards a legal definition of Artificial Intelligence*.

Lv, X., & Li, M. (2021). Application and Research of the Intelligent Management System Based on Internet of Things Technology in the Era of Big Data. *Mobile Information Systems*, *2021*, 1–6. https://doi.org/10.1155/2021/6515792

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics and firm performance: Findings from a mixed-method approach. *Journal of Business Research*, *98*, 261–276. https://doi.org/10.1016/j.jbusres.2019.01.044

Mikalef, P., & Gupta, M. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information & Management*, *58*(3), 103434. https://doi.org/10.1016/j.im.2021.103434

Mirrazavi, S., & Khoorasgani, G. H. (2016). The Impact of Cloud Computing Technology on Organizational Performance; Financial, Customer, Operational (Case Study: Zarin Iran Porcelain Industries Co.). *Mediterranean Journal of Social Sciences*. https://doi.org/10.5901/mjss.2016.v7n4s1p279

Munirathinam, S. (2020). *Industry 4.0: Industrial Internet of Things (IIOT)* (pp. 129–164). https://doi.org/10.1016/bs.adcom.2019.10.010

Narayanamurthy, G., & Tortorella, G. (2021). Impact of COVID-19 outbreak on employee performance – Moderating role of industry 4.0 base technologies. *International Journal of Production Economics*, *234,* 108075. https://doi.org/10.1016/j.ijpe.2021.108075

Nižetić, S., Šolić, P., López-de-Ipiña González-de-Artaza, D., & Patrono, L. (2020). Internet of Things (IoT): Opportunities, issues and challenges towards a smart and sustainable future. *Journal of Cleaner Production*, *274*, 122877. https://doi.org/10.1016/j.jclepro.2020.122877

Omair, A. (2014). Sample size estimation and sampling techniques for selecting a representative sample. *Journal of Health Specialties*, *2*(4), 142. https://doi.org/10.4103/1658-600x.142783

Pagliosa, M., Tortorella, G., & Ferreira, J. C. E. (2019). Industry 4.0 and Lean Manufacturing. *Journal of Manufacturing Technology Management*, *32*(3), 543–569. https://doi.org/10.1108/JMTM-12-2018-0446

Persaud, A. (2021). Key competencies for big data analytics professions: a multimethod study. *Information Technology & People*, *34*(1), 178–203. https://doi.org/10.1108/ITP-06-2019-0290

Picoto, W. N., Crespo, N. F., & Carvalho, F. K. (2021). The Influence of the Technology-Organization-Environment Framework and Strategic Orientation on the Use of Cloud Computing, Enterprise Mobility and Performance. *Revista Brasileira de Gestao de Negocios*, *23*(2). https://doi.org/10.7819/rbgn.v23i2.4105

Pulakos, E. D., Kantrowitz, T., & Schneider, B. (2019). What leads to organizational agility: It's not what you think. *Consulting Psychology Journal: Practice and Research*, *71*(4), 305–320. https://doi.org/10.1037/cpb0000150

Raosoft. (2023). *Raosoft: Sample size calculator*. 2023. Retrieved March 20, 2023, from http://www.raosoft.com/samplesize.html

Ranaldo, S., Dell'Atti, V., & Turco, M. (2021). *The Application of Artificial Intelligence to Business Models: A Systematic Literature Review* (pp. 287–298). https://doi.org/10.1007/978-3-030-80737-5_22

Saad, S. M., Bahadori, R., Bhovar, C., & Zhang, H. (2023). Industry 4.0 and Lean Manufacturing – a systematic review of the state-of-the-art literature and key recommendations for future research. *International Journal of Lean Six Sigma*. https://doi.org/10.1108/IJLSS-02-2022-0021

Sivathanu, B., & Pillai, R. (2018). Smart HR 4.0 – how industry 4.0 is disrupting HR. *Human Resource Management International Digest*, *26*(4), 7–11. https://doi.org/10.1108/HRMID-04-2018-0059

Sovey, S., Osman, K., & Effendi, M. (2022). Exploratory and Confirmatory Factor Analysis for Disposition Levels of Computational Thinking Instrument Among Secondary School Students. *European Journal of Educational Research*, *11*(2), 639–652. https://doi.org/10.12973/eu-jer.11.2.639

Staples, D. S. (2001). A Study of Remote Workers and Their Differences from Non-q Remote Workers. *Journal of Organizational and End User Computing*, *13*(2), 3–14. https://doi.org/10.4018/joeuc.2001040101

Suler, P., Palmer, L., & Bilan, S. (2021). Internet of things sensing networks, digitized mass production, and sustainable organizational performance in cyber-physical system-based smart factories. *Journal of Self-Governance and Management Economics*, *9*(2), 42–51. https://doi.org/10.22381/jsme9220214

SÜRÜCÜ, L., & MASLAKÇI, A. (2020). VALIDITY AND RELIABILITY IN QUANTITATIVE RESEARCH. *Business & Management Studies: An International Journal*, *8*(3), 2694–2726. https://doi.org/10.15295/bmij.v8i3.1540

Surya WANASIDA, A., Bernarto, I., Sudibjo, N., & Purwanto, A. (2021). The Role of Business Capabilities in Supporting Organization Agility and Performance During the COVID-19 Pandemic: An Empirical Study in Indonesia. *Agus PURWANTO / Journal of Asian Finance*, *8*(5), 897–0911. https://doi.org/10.13106/jafeb.2021.vol8.no5.0897

Tortorella, G., Fogliatto, F. S., Kumar, M., Gonzalez, V., & Pepper, M. (2023). Effect of Industry 4.0 on the relationship between socio-technical practices and workers' performance. *Journal of Manufacturing Technology Management*, *34*(1), 44–66. https://doi.org/10.1108/JMTM-04-2022-0173

Tortorella, G., Fogliatto, F. S., Kumar, M., Gonzalez, V., & Pepper, M. (2023). Effect of Industry 4.0 on the relationship between socio-technical practices and workers' performance. *Journal of Manufacturing Technology Management*, *34*(1), 44–66. https://doi.org/10.1108/JMTM-04-2022-0173

Timmermans, S., & Tavory, I. (2012). Theory Construction in Qualitative Research. *Sociological Theory*, *30*(3), 167–186. https://doi.org/10.1177/0735275112457914

Tschang, F. T., & Almirall, E. (2021). Artificial Intelligence as Augmenting Automation: Implications for Employment. *Academy of Management Perspectives*, *35*(4), 642–659. https://doi.org/10.5465/amp.2019.0062

ur Rehman, M. H., Yaqoob, I., Salah, K., Imran, M., Jayaraman, P. P., & Perera, C. (2019). The role of big data analytics in industrial Internet of Things. *Future Generation Computer Systems*, *99*, 247–259. https://doi.org/10.1016/j.future.2019.04.020

Virmani, N., Sharma, S., Kumar, A., & Luthra, S. (2023). Adoption of industry 4.0 evidence in emerging economy: Behavioral reasoning theory perspective. *Technological Forecasting and Social Change*, *188*, 122317. https://doi.org/10.1016/j.techfore.2023.122317

Walter, A.-T. (2021). Organizational agility: ill-defined and somewhat confusing? A systematic literature review and conceptualization. *Management Review Quarterly*, *71*(2), 343–391. https://doi.org/10.1007/s11301-020-00186-6

Walter, M., & Andersen, C. (2016). *Indigenous Statistics*. Routledge. https://doi.org/10.4324/9781315426570

Wang, Z., Wang, N., Su, X., & Ge, S. (2020). An empirical study on business analytics affordances enhancing the management of cloud computing data security. *International Journal of Information Management*, *50*, 387–394. https://doi.org/10.1016/j.ijinfomgt.2019.09.002

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind Jensen, T. (2021). Unpacking the Difference Between Digital Transformation and IT-Enabled Organizational Transformation. *Journal of the Association for Information Systems*, *22*(1), 102–129. https://doi.org/10.17705/1jais.00655

Yang, L., Holtz, D., Jaffe, S., Suri, S., Sinha, S., Weston, J., Joyce, C., Shah, N., Sherman, K., Hecht, B., & Teevan, J. (2021). Author Correction: The effects of remote work on collaboration among information workers. *Nature Human Behaviour, 6*(1), 164–164. https://doi.org/10.1038/s41562-021-01228-z