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Effects of Fourth Industrial Revolution on the Performance of Manufacturing Firms in Abia State Nigeria

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ABSTRACT: This study examined the Prospects and Challenges of Transitioning to Fourth Industrial Revolution: A Case Study of Manufacturing Industries in Abia State. The specific objective sought to; Examine the primary challenges and barriers hindering the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries, evaluate the strategies and policies that can be formulated to overcome these challenges and facilitate a successful transition to the Fourth Industrial Revolution within Abia State's manufacturing sector. The study employs a mixed-methods research approach, including surveys, interviews, and a comprehensive review of existing literature. Preliminary findings suggest that while there is significant potential for enhancing productivity, competitiveness, and sustainability through 4IR technologies, Abia State's manufacturing industries face several challenges. These challenges include limited access to advanced technology infrastructure, a shortage of skilled labor, and financial constraints. Moreover, regulatory and policy frameworks need to be adapted to facilitate the seamless integration of 4IR technologies into the local manufacturing landscape. The study concluded that to fully harness the significant prospects presented by the transition to Fourth Industrial Revolution for the manufacturing industries in Abia State, the challenges and the barriers must be holistically addressed. Thus, it was recommended that the government and relevant stakeholders should prioritize infrastructure development, particularly in the areas of power supply and internet connectivity.

KEYWORDS: Challenges, Fourth, Industrial, Prospects, Revolution

I. INTRODUCTION

The world is at the very precipice of a new technological revolution that will fundamentally change our way of being, life, work, and ways of interaction with each other. In its scale, scope and complexity, the transformation/changes will differ considerably from anything experienced by humanity so far. How it will evolve is not yet clear, but one thing becomes apparent: the response should be universal and comprehensive, including all active participants in world politics, from the public-private sectors to the intellectual and civil society. Fourth Industrial Revolution (4IR) has ushered in an era of transformative technological advancements that are reshaping industries and societies worldwide. With the fusion of digital, physical, and biological technologies, the 4IR is revolutionizing the way goods and services are produced, distributed, and consumed. The Fourth Industrial Revolution (4IR), characterized by the fusion of digital technologies, artificial intelligence, the Internet of Things (IoT), and advanced robotics, has ushered in a transformative era across the global industrial landscape. This revolution has the potential to reshape the way businesses operate, interact with customers, and deliver products and services. As the world advances towards this new technological paradigm, understanding its prospects and challenges is imperative for regions, industries, and organizations seeking to remain competitive and adaptive in this rapidly evolving landscape.

For manufacturing industries, this revolution represents both unprecedented prospects and formidable challenges. In the context of Abia State, Nigeria, a region with a burgeoning manufacturing sector, the transition to the 4IR is a critical imperative for sustained economic growth and competitiveness. This case study delves into the prospects and

challenges faced by manufacturing industries in Abia State, as they navigate the intricate path towards embracing the Fourth Industrial Revolution, shedding light on the opportunities for growth and innovation, as well as the hurdles that must be overcome to achieve a successful transformation.

This research endeavors to explore the prospects and challenges of transitioning to the Fourth Industrial Revolution within the manufacturing sector, with a specific focus on Abia State, Nigeria. Abia State, located in the southeastern region of Nigeria, has long been recognized for its vibrant manufacturing industries, particularly in textiles, footwear, and food processing. These industries have played a pivotal role in the state's economic development, providing employment opportunities and contributing significantly to the Gross Domestic Product (GDP) of Nigeria.

However, the manufacturing landscape in Abia State, like many regions worldwide, stands at a critical juncture. The emergence of the Fourth Industrial Revolution promises immense opportunities, such as increased efficiency, improved product quality, and enhanced competitiveness. At the same time, this technological transformation presents formidable challenges, including the potential displacement of human labour, the need for substantial capital investment, and the urgency for upskilling the workforce to harness the benefits of advanced technologies effectively. In this exploration, we aim to gain valuable insights into the dynamics of technological adoption and adaptation, workforce development, infrastructure enhancement, and policy formulation that will shape the future of manufacturing in Abia State during this era of rapid technological change.

Abia State, like many other regions, is currently experiencing the advent of the Fourth Industrial Revolution (4IR), characterized by the integration of digital technologies, artificial intelligence, automation, and data-driven processes into manufacturing industries. However, the transition to the 4IR presents a complex set of prospects and challenges for the manufacturing sector in Abia State.

This study aims to investigate and analyze the specific prospects and challenges faced by manufacturing industries in Abia State as they navigate this transformative technological era. By understanding these issues, the research seeks to provide valuable insights and recommendations to policymakers, industry stakeholders, and business leaders in Abia State to effectively harness the opportunities and address the obstacles associated with the 4IR transition. Studying the prospects and challenges of transitioning to the Fourth Industrial Revolution in manufacturing industries in Abia State is essential for fostering economic growth, job creation, sustainability, innovation, and global integration, while also addressing potential hurdles and ensuring a brighter future for the state's residents.

The following objectives were followed to achieve the aim of this study.

i. Examine the effect of primary challenges and barriers hindering the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries.
ii. Evaluate the effect ofstrategies and policies that promote the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries.

1.1 Research Questions

i. What are the primary challenges and barriers hindering the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries?
ii. What strategies and policies can be formulated to promote the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries?

1.2 Statement of Hypotheses

i. The primary challenges and barriers have no significant effect on the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries.

Strategies and policies have no significant effect on promoting the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries.

II. LITERATURE REVIEW

2.1 Primary challenges and barriers hindering the adoption and integration of Fourth Industrial Revolution technologies.

Núbia et al, (2018) conducted research on Manufacturing in the Fourth Industrial Revolution: A positive prospect in sustainable manufacturing. Industrialization throughout history has been one of the main contributors to pollution, disregard for environmental issues, resulting in an unsustainable production model. A change from this context, the imminent new industry model called the Fourth Industrial Revolution or Industry 4.0, aims for a manufacturing system that is both viable and sustainable. This paper described the main forms of collaboration of Industry 4.0 in relation to

sustainability. Scientific works point out the advantages provided by the new industry model such as improved product life cycles, manufacturing works in an integrated way with the use of cyber-physical systems allied to the principles of this industry, such as decentralization, virtualization, interoperability, among others which lead to more adaptability to natural resources availability and environmental costs. Smaller batches can lead to a more accurate response to the demand curves and consequently lessen the waste for production.

Min Xu et al, (2018) conducted research on the Fourth Industrial Revolution: Opportunities and Challenges. The Fourth Industrial Revolution, a term coined by Klaus Schwab, founder, and executive chairman of the World Economic Forum, describes a world where individuals move between digital domains and offline reality, with the use of connected technology to enable and manage their lives. The first industrial revolution changed our lives and economy from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Oil and electricity facilitated mass production in the second industrial revolution. In the third industrial revolution, information technology was used to automate production. Although each industrial revolution is often considered a separate event, together they can be better understood as a series of events building upon innovations of the previous revolution and leading to more advanced forms of production. The article discussed the major features of the Fourth Industrial Revolutions, the opportunities of the Fourth Industrial Revolution, and the challenges of the Fourth Industrial Revolution.

Ndagi and Salihu, (2018) Conducted a study on Fourth Industrial Revolution: Prospects and Challenges for Africa. Industrial Revolution is the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Industrial revolution has evolved through different eras, starting with the First Industrial Revolution era, from 1760 to 1840, characterized by the development of machines, steam engines and weaving looms. The objectives of the paper were to further create awareness of the Fourth Industrial Revolution, to identify prospects inherent in the Fourth Industrial Revolution for Africa and to identify challenges of the Fourth Industrial Revolution for Africa and Africans. The findings from the study revealed that, the major beneficiaries were consumers that were able to afford and access the digital world, since technology grants access to new products and services that enhance the quality of life.

Rekha and Amit, (2020) conducted research on the Fourth Industrial Revolution Key Drivers, Opportunities and Challenges at a Glance. The advent of the 4th Industrial Revolution pledges substantive social and economic opportunities and challenges. All the aspects of this revolution force people to rethink how countries develop, how organizations create. The Fourth Industrial Revolution captivates the idea of the confluence of new technologies and their cumulative impact on our world. The advent of the 4th Industrial Revolution promises significant social and economic opportunities, and challenges value and even what it means to be human. We can utilize the Fourth Industrial Revolution as an opportunity to nurture everyone, including leaders, policymakers and people from all income groups and nations, to harness converging technologies to create an inclusive, human-centered future.

Valeriy (2020) conducted research on the Fourth Industrial Revolution: Challenges, Risks and Opportunities. Modern challenges, risks and opportunities of a new technological paradigm of human development. The social costs and consequences were discussed in detail. The impact of the Fourth Industrial Revolution on business development was analyzed. Development of information platforms of supply and demand was presented as the creation of new business models. When considering the impact of the Fourth Industrial Revolution on the state, it was concluded that the state had increased control over society, while changing the mechanisms of interaction between the state and civil society, the development of competition and decentralization of power. It was pointed out that the ability of state structures and authorities to adapt to the conditions of the Fourth Industrial Revolution would determine their survival in the new conditions. If they are able to face the world of revolutionary change openly, the ability to change their state structures and make them transparent and effective, would allow the state to maintain its competitive advantages and withstand the tests of a new technological paradigm of human development. Artificial intelligence was considered in detail as the main driver of the Fourth Industrial Revolution.

2.2 Strategies and Policies that Promote the Adoption and Integration of Fourth Industrial Revolution Technologies

Maruf et al, (2020) conducted research on the Fourth Industrial Revolution in Bangladesh: Prospects and Challenges. The stream of globalization is impelling Bangladesh to adopt the technologies of the Fourth Industrial Revolution (FIR). This study examined the opportunities and problems created by the adoption of FIR in Bangladesh. Findings showed that the adaptation of FIR can create enormous difficulties for the country with some new opportunities. Sustainable ICT development, increase in productivity, women, and citizen empowerment will bring positive effects. However, social inequality, colossal unemployment, a threat to social security, the domination of Multinational

Corporations (MNCs) could harm the economy badly. FIR will also influence the political system. Hence, a comprehensive plan and sound policymaking can help to exploit the opportunity of FIR. Professional development training for human resources, job-based educational system, sensitive labor policies, alternative employment sector with updated technologies, and investment in SMEs were expected to tackle the challenges of FIR in Bangladesh. Furthermore, the findings may be used to take the anticipatory role in the future for becoming a beneficiary of the FIR.

Pratim (2021) conducted research on the Promise and Challenges of the Fourth Industrial Revolution (4IR). The Fourth Industrial Revolution is upon us. Yet not many students understand its evolution or impacts. This teaching case examined the socio-technical evolution from 1IR (First Industrial Revolution) to 4IR (Fourth Industrial Revolution). It concluded by exemplifying 4IR's promises and perils with a mini case on how 4IR that quietly helped the COVID-19 vaccine development could also pose cyberthreats and erode privacy.

Tanja et al, (2021) conducted research on the Challenges of the Fourth Industrial Revolution: A Case Study of Bosnia and Herzegovina. A review of the literature on Industry 4.0 and the current prospect of it in the developing countries was presented. This study aimed to explore the main challenges, along with some opportunities to apply in Industry 4.0 in Bosnia and Herzegovina. The challenges that were tested included poor infrastructure, harmonization of the education system and labour market, expensive installation of technologies, lack of government support and growing trend of depopulation. Through the insight into the structure of world trade and technology achievement, the study also looked at the fact that the new industrial revolution would bring an even greater gap between developed and developing countries and tried to answer the question of why such a disproportion in development occurred. As this is one of the first research projects regarding Industry 4.0 in Bosnia and Herzegovina, the findings of the study generated some recommendations and proposed some alternatives that could be useful for the decision-makers, both in government and the private sector.

Sanjay (2021) conducted a study on the Fourth Industrial Revolution - Its Impact on the South African Public Sector. South Africa is at the precipice of the "Fourth Industrial Revolution" which it is perceived will fundamentally disrupt and transform the way people work. This new rubric of technological innovations is characterised by a fusion of technologies that blur the lines between the physical, digital, biological and neuro-technological spheres. The apprehension over human jobs being replaced with cobots, a robot intended to physically interact with humans in a shared workspace, is palpable. Skills instability is expected to impact all industries. There are fears that the poor and non-skilled would be plunged into even deeper deprivation with the rise of the digital era. The country has one of the most militant working classes in the world and the labour unions as members of the tripartite alliance, mitigate that South Africa needs to invest in human capital rather than technology. One of the challenges facing South Africa is that its leaders are stuck in a protectionist mode; yet embrace technology.

Bikse et al, (2022) conducted research on the Consequences and Challenges of the Fourth Industrial Revolution and the Impact on the Development of Employability Skills. The research methodology applied in this research study involved examining and analysing literature and Internet sources. To identify possible solutions for the development of employability skills in the context of challenges of the Fourth Industrial Revolution, the Analytic Hierarchy Process (AHP) was used. The results of the research indicated that the promotion of youth employability requires close cooperation between educational institutions and entrepreneurs, as well as that significant attention should be paid to investment in human capital and the digital transformation of business. The research expanded and provided insights into the situation in Latvia regarding the impact of the Fourth Industrial Revolution on the development of employability skills and performed an analysis of the main possible solutions for the successful development of employability skills in Latvia that could be ensured by investing in human capital and improving the business environment, the digital transformation of SMEs and the modernization of the education system. In this context, it is crucial to promote more collaboration among educators, academics, policymakers, and practitioners.

The research gap which this study tends to fill is on the need for a comprehensive, region-specific investigation into the prospects and challenges of transitioning to the Fourth Industrial Revolution within the manufacturing industries of Abia State, Nigeria. This gap calls for more empirical research, a focus on industry-specific analysis, an exploration of barriers, a case study approach, regional perspective, and consideration of policy implications to enhance our understanding of this critical issue.

III. METHODOLOGY

This study adopted a cross-sectional survey design. This design is a type of research methodology used in various fields, including social sciences and market research. This design involves the collection of data from a sample of individuals or entities at a single point in time, providing a snapshot of a population's characteristics, behaviors, attitudes, or other variables of interest at that specific moment. Cross-sectional surveys are often used to describe the prevalence of certain conditions, attitudes, or behaviors within a population and to identify potential associations or patterns.

The data of the study are of two kinds: primary and secondary data. The primary data was gotten from the respondents through structured questionnaire. The questionnaire was structured in line with the variables of the study already stated in the hypotheses. The secondary data were retrieved from textbook, journals, magazines, newspapers, and Internet.

3.1 Population of the Study

The population of the study comprised all the employees of six manufacturing firms in Abia state as shown in Table 1. The sample size was determined using Taro Yamane formula of Equation 1.

$$n = \frac{N}{1 + N(\alpha)^2} \tag{1}$$

N = Population of the study = 391
α = 0.05
n = Sample size = 198

The total population of the employees of the firms are three hundred and ninety-one (391). After selecting the sample size, we allocated this proportionately to each firm depending on the proportion of the entire population that come from the stratum, which was later selected using stratified random sampling techniques.

Table 1: Population of the study

Firms	Population	Percentage (%)
Chealsyl Industries Ltd	67	17.1%
Chrismore Best Enterprise (Aba)	55	14.1%
System Metal Industries Ltd	83	21.2%
A Farms &Agro Allied Industries Ltd	91	23.3%
Zodoson Industries Limited	54	13.8%
Blessed Gozie Investment	41	10.5%
Total	391	100%

3.2   Stratified Random Sampling Technique

To determine the size of the strata to be included from each of the stratum, Kumar (1976) proportional allocation formula was utilized. This formula is given by:

$$n_h = n(N_h) \tag{2}$$

Where:
n_h = size of sample stratum sough
n = the total sample size
N_h = the number of items in each stratum of the population

Therefore, the sample allocation is presented in the below table 3.2.1.

Table 2: Sample Allocation of the Study

Firms	Population	Percentage (%)
Chealsyl Industries Ltd	34	17.2%
ChrismoreBest Enterprise (Aba)	28	14.1%
System Metal Industries Ltd	42	21.2%
A Farms &Agro Allied Industries Ltd	46	23.2%
Zodoson Industries Limited	28	14.1%
Blessed Gozie Investment	20	10.1%
Total	198	100%

3.3   Research Instrument for Data Collection

Data was collected from selected manufacturing firms in Abia state, Nigeria. A census research design was used, with a self-administered questionnaire administered to 198 participants from a population of 391 using the Taro Yamane formula. The questionnaire included the construct items adapted from previous studies. The respondents were required to complete the questionnaire voluntarily and the researcher aided in filling up the questionnaires where necessary. 141 of the questionnaires were returned and were checked for plausibility, integrity, and completeness. 136 were usable wile 5 were not completed. Hence, a response rate of 68.7% was ascertained.

The instrument for data collection utilized for the study was structured questionnaire. The Likert-type scale or category was adopted for analysis, namely: Very Great Extent; (VGE); Great Extent (GE); Some Extent (SE); Little Extent (LE); and Very Little Extent (VLE). Each level was assigned a number ranging from 5 (VGE) to 1 (VLE). Also used were Very High (VH); High (H); Neutral (N); Low (L); very Low (VL). Each level was assigned a number ranging from 5 (VH) to(VL).

3.4 Method of data Analysis

 The data gathered was analyzed and processed by application of Structural Equation Modeling (SEM) techniques using Smart PLS 4.0. Excel with Microsoft 365 MSO (Version 2304 Build 16.0.16327.20200) was used to analyze the data and then converted to comma delimited (*.csv) file.

3.5 Validity of Research Instrument

Chisnalli, (1989) defines validation as the appropriateness of an instrument in measuring what it tends to measure. To validate the research instrument, the researcher presented the questionnaire to the supervisor for validation to ensure that the variables under study are evaluated and validated. This was done to find out if the instrument contained misleading and ambiguous questions, which will make it impossible for every respondent to understand, or whether it will require further recast by the researcher. All these were properly taken care off.

The researcher conducted a pilot study before the actual study to test for the reliability of the study. Reliability on the other hand, is defined as the degree to which a given measurement procedure will give the same description of that phenomenon if the measurement is repeated (Ebo, 2009). Thirty (30) copies of questionnaire were sent to the respondents in the organization chosen for the pilot study which were completed and returned. The Fornell-Larcker criterion was used as the statistical tool. According to the criterion, the square root of the average variance extracted by a construct must be greater than the correlation between the construct and other construct. In this case, the criterion was met, which confirms the validity of the study; and thus affirmed the reliability of the instrument for data collection (see Table 6).

The overall Cronbach Alpha correlation for the study's instrument of data collection was 0.74, while the overall composite Reliability (rho_c) was 0.83. (See table 5)

IV. PRESENTATION OF DATA

4.1 Data Presentation on Research Question One

What are the primary challenges and barriers hindering the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries?

Table 3: *Data Distribution from survey conducted on Research Question One*

S/N	Measurement Item	VGE	GE	SE	LE	VLE	Total
PCB1	To what extent do you agree that **Limited Infrastructure** hinders the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	54	62	13	7	0	136
PCB2	To what extent do you agree that **Cost of Implementation** hinders the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	60	52	19	5	0	136
PCB3	To what extent do you agree that **Lack of Technical**	54	61	12	6	3	136

		VGE	GE	SE	LE	VLE	Total
	Skills hinders the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?						
PCB4	To what extent do you agree that **Security Concerns** hinder the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	40	61	22	13	0	136

PCB = Primary Challenges and Barries
VGE = Very Great Extent, GE = Great Extent, SE = Some Extent, LE = Low Extent, VLE = Very Low Extent

Table 4: *Data Distribution from survey conducted on Research Question Two*

Item	Measurement Item	VGE	GE	SE	LE	VLE	Total
SP1	To what extent do you believe that formulating strategies and policies to **Invest in Digital Infrastructure** would promote the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	55	63	14	3	1	136
SP2	To what extent do you believe that formulating strategies and policies for **Cyber Security and Data Protection** would promote the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	49	62	22	3	0	136
SP3	To what extent do you believe that formulating strategies and policies that **Support Startups and Innovation Hubs** would promote the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	66	55	11	3	1	136
SP4	To what extent do you believe that formulating strategies and policies that **Enhance Public Awareness and Digital Literacy** would promote the adoption and integration of Fourth Industrial Revolution technologies in manufacturing industries in your state?	54	57	24	1	0	136

SP = Strategies and Policies

Data Analysis
In this section, the data presented in the previous section (section 4.1) were analysed quantitatively. The analysis was conducted by application of Structural Equation Modeling (SEM) techniques using SmartPLS 4.0
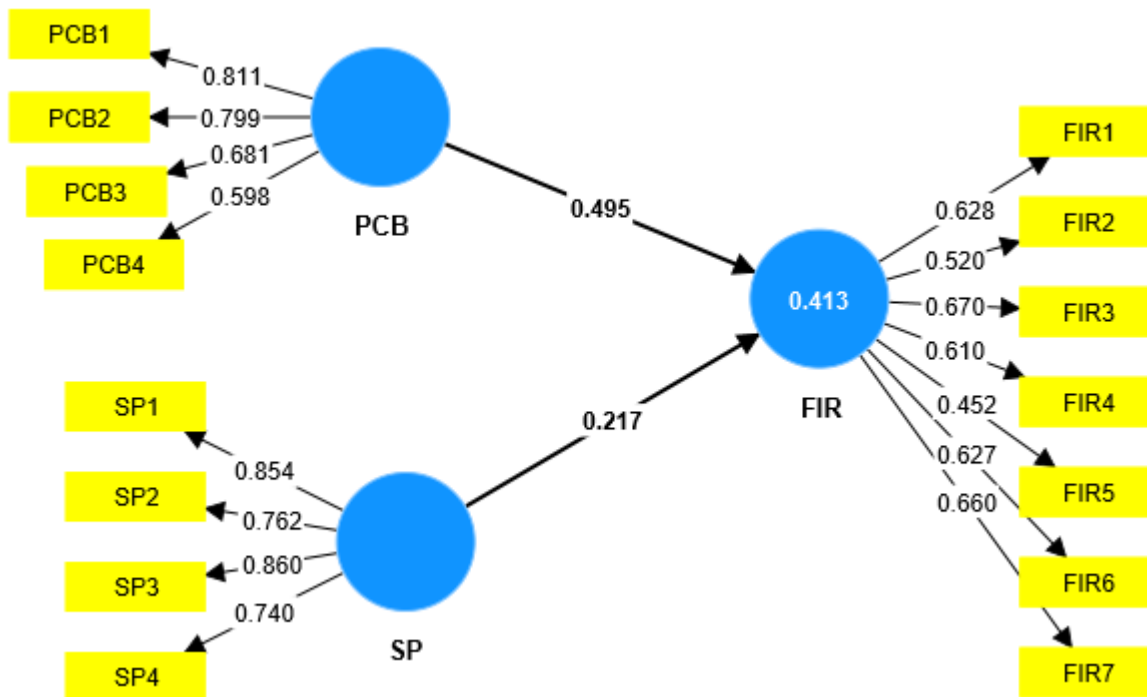
Figure 1,0 Measurement Model of the Current Study - relationship between problems challenges/barriers and strategies/policies with Fourth Industrial Revolution in Abia state.

Table 5: Measurement reliability for each construct

Construct	No. of Items	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)
Fourth Industrial Revolution (FIR)	7	0.705	0.72	0.795
Primary Challenges and Barriers (PCB)	4	0.701	0.734	0.816
Strategies and Policies (SP)	4	0.827	0.878	0.88

Table 5 shows the internal consistency reliability for each of the three variables. All the constructs in the survey questionnaire were analyzed to validate their reliability. Scores =>0.70 indicate good reliability for the measurements. All the constructs had acceptable scores. Since these constructs are proposed for the current study, further analysis in future research could be addressed.

Table 6: Measurement of Discriminant validity established on Fornell-Larcker Criterion

	FIR	PCB	SP
FIR	0.6		
PCB	0.617	0.728	
SP	0.497	0.566	0.806

To check the validity, we used the diagonal constructs to determine the correlation of a construct with other constructs. The rule of thumb is that to successfully establish the discriminant validity of your study, the diagonal constructs should be higher than other constructs in the same row.

4.2 Hypothesis Result

The hypothesis formulated in this study was tested using the p-value, which is a measure of the strength of evidence against the null hypothesis. The rule of thumb is that if $p<0.5$, the null hypothesis would be rejected, otherwise it would be accepted.

Table 7: Regression Result Output – path coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ($|O/STDEV|$)	P values
Primary challenges and barriers ->adoption and integration of Fourth Industrial Revolution technologies	0.495	0.505	0.069	7.198	0.000
Strategies and policies ->promoting the adoption and integration of Fourth Industrial Revolution technologies	0.217	0.224	0.073	2.960	0.003

Table 8: Summary of Hypothesis Testing Result

Research Hypothesis	Decision
H_{01}: Primary challenges and barriers have no significant effect on the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries	Reject H_{01}
H_{02}: Strategies and policies to has no significant effect on promoting the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries.	Reject H_{02}

V. DISCUSSION OF FINDINGS

From Table 7, it is evident that primary challenges and barriers have a statistically significance influence on the adoption and integration of Fourth Industrial Revolution technologies in Abia state ($\beta=0.495$, $p<0.05$). The firms under study have shown that challenges, like limited infrastructure, cost of implementation, lack of technical skills and security concerns have significant effects on the adoption and integration of 4IR technologies. This is an important finding with great practical implications. This finding collaborates the study by Ndagi and Salihu, (2018), which revealed that the major beneficiaries of 4IR were consumers that could afford and access the digital world.

Similarly, the results shown in Table 7 shows that strategies and policies have a strong and positive effect on promoting the adoption and integration of Fourth Industrial Revolution Technologies in Abia state ($\beta=0.217$, $p<0.05$). The firms strongly believe that government policies and strategies that prioritize investment in digital infrastructure, support start-ups and innovation hubs and enhance public awareness and digital Literacy would promote the adoption and integration of Fourth Industrial Revolution technologies in Abia State's manufacturing industries. This result further confirms the study carried out by Bikse et al, (2022), which indicated that attention should be paid to investment in human capital and the digital transformation of business to utilize the benefits of 4IR technologies.

The findings at the end of this study are summarized as follows:

The hypothesis one revealed that the primary challenges/barriers have a statistically significant effect on the adoption and integration of fourth revolution technologies in Abia state manufacturing industries with a regression result of (($\beta=0.495$, $p<0.05$)).

With a regression result of ($\beta=0.217$, $p<0.05$), the hypothesis two revealed that strategies and policies have a strong and statistically significant effect on the adoption and integration of fourth revolution technologies in Abia state manufacturing industries.

VI. CONCLUSION AND RECOMMENDATIONS

The transition to the Fourth Industrial Revolution (4IR) in Abia, which presents significant prospects for the manufacturing industries in Abia State, is not without its challenges. Addressing these challenges and leveraging the opportunities presented by 4IR will require a concerted effort from the government, industry stakeholders, and the academic community. With the right strategies and investments, Abia State's manufacturing sector can position itself as a competitive player in the global 4IR landscape, driving economic growth and prosperity for the state and its citizens.

The recommendations are as follows.

i. The government and relevant stakeholders should prioritize infrastructure development, particularly in the areas of power supply and internet connectivity. Policymakers should collaborate with industry experts to develop and implement regulations and policies that promote 4IR adoption while ensuring the protection of intellectual property and data security.

ii. Training programs and initiatives should be put in place to up-skill the local workforce, ensuring that there is a pool of talent capable of leveraging 4IR technologies. Financial institutions should create favourable lending conditions and financial packages to support manufacturers in their adoption of 4IR technologies.

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