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Empirical Implementation of Industry 4.0 Model among Malaysian and Nigerian SMEs

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Abstract— **The primary objective of this study is to examine the factors that influence the implementation of Industry 4.0 among Malaysian and Nigerian Small and Medium Enterprises. The Questionnaires were distributed to SMEs operators in both countries while analysis was done with 74 and 95 responses from Malaysia and Nigeria respectively using Partial Least Square Structural Equation Modelling (PLS-SEM 3). Based on the findings from Malaysian data, information access, cost reduction, and efforts coordination significantly and positively influence the implementation of IR 4.0 while reluctance behaviour is not significant. For Nigerian data, information access, reluctance behaviour and effort coordination significantly and positively influence implementation of Industry 4.0 while effort coordination is not significant. The implications for both academia, practitioners, and policy makers are highlighted.**

Keywords— *Information Access, Cost Reduction, Reluctance Behavior, Information Access, Efforts Coordination.*

1. Introduction

Industry 4.0. is a term reputedly first used to describe a high-technology strategy proposed by the German government [1]. The primary purpose of the Industry 4.0 is to create an intelligent, self-regulating and interconnected industrial value for manufacturing industry [2] through which the future competitiveness of the stakeholders can be enhanced [3], [4] especially for the large firms. Potentially, Industry 4.0 may bring about a change from isolated manufacturing activities to automated, optimised and fully integrated product and data flows within (global) value chains [1]. While it is often argued that the Industry 4.0 is majorly targeted at large firms, a number benefits of the new industrial trend have equally been acknowledged for SMEs to include smart manufacturing, robotics and the Industrial Internet of Things (IIOT) which will significantly increase production volume and reduce dependency on foreign labour [5]. This therefore implies that any SME that employs the new trend just like their large industrial counterparts will achieve efficiency in production capacity, precision and accuracy,

minimize errors in production process, high quality product with lower price and will be able to compete globally. It is estimated that its benefits and other related digital technologies will amount to £74 billion by 2035 [6].

Despite the importance of industry 4.0 and other related digital technologies, experience has shown that the penetration rate among SMEs in developing countries is generally low when compared with that of developed and newly industrialized nations [7]. This low penetration is attributed to lack of appropriate model to implement the new technology trend culminating from lack of fundamental knowledge about Industry 4.0., low level of digitization and constraints in accessing other resources [8]. This is also in line with the argument of [9] that SMEs in developing countries generally have apathy towards advanced technology. For instance, it was reported that only 20% of SMEs use ICT application, 16% explore e-commerce, 40% assumed that they don't need internet while a large number believe that technology is a cost rather than an investment [10].

Meanwhile, a number of arguments have been put forward recognizing the importance of SMEs across the globe especially in the areas of jobs creation, participation in international trade, and a substantial contribution to GDP [7], [11]. In Malaysia, nearly 99.2% of all existing business organizations are SMEs [12], 13] while in Nigeria, there are about 37, 067, 416 (thirty-seven million, sixty-seven thousand, and four hundred and sixteen) micro, small and medium enterprises [14].

However, in developing countries, the performance of SMEs is generally low [9], [11], [15]. For instance, while SMEs in Malaysia contribute about 32% to the country's GDP, their counterparts in India and Indonesia are contributing 45% and 60.6% respectively [12], [16]. A report by [17] also indicates that performance of SMEs in Nigeria calls for concern as Nigeria SMEs still fall below expectation in terms of contributing to the

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sustainable economic growth of the country. This assertion has been advocated by a number of scholars who also affirm that the SMEs have been unable to meet up with the expectations of contributing to the economic development of developing countries generally [9], [11]. The failure of the SMEs in this regard has been largely attributed to the sector's inability to effectively implement advanced technology [18] [19], [11], such as Industry 4.0 [20].

Specifically, it has been argued that SMEs sector is generally cautious about IR 4.0 implementation while others advocate that this sector is ill-equipped to face these new possibilities regarding their production planning and control functions [21], [22]. Generally, experience has shown that adoption of ICT and other related technology among SMEs in developing countries is very low. In Malaysia and Nigeria, previous findings have positioned that SMEs are slow to adopting technology when compared with similar Asian countries such as Indonesia, India and China. In particular, the implementation of Industry 4.0 seems to be lagging behind, while this sector has been unable to take the advantage of this new trend to improve their activities. Schroder, [22] in this regard, pathetically positioned that "four out of ten SMEs do not have a comprehensive Industry 4.0 strategy compared with two out of ten among large companies" [p. 13].

Given its importance and reality, researches on IR 4.0 in the recent time have only focused on the technological aspects that are related to cyber-physical systems [23] while its implementation at the organizational level has been largely ignored [21]. Even though recent scholars have begun to study the value creation aspect of IR 4.0 [e.g., 24], the main focus has been on the large industry [25] despite that there is a difference between SMEs and large organizations with respect to their size, methods, and access to resources [9].

In this context, a very significant question is how the features of an organization, such as size and resource, access to information, cost reduction, reluctance behavior towards technology [8], [21] and other related factors affect its capability to implement new technologies.

2.1 Literature Review

The Theory of Planned Behavior (TPB), which extends Theory of Reasoned Action [26] is extensively used to investigate the adoption, acceptance and implementation of technology. It is the most common framework that explains antecedents and determinants of various technologies adoption and implementation either at individual or organizational level [27]. For this reason, this theoretical framework is adopted in this study. The tenet of TPB is that a technology is accepted if it meets the preferences of the users with respect to perception of control, influence of friends/relatives that matters, attitude, intention and behaviour of individual. Despite the wide usage of TPB, various scholars have called for its extension either to fit the context or content of the study as the theory does not holistically explain all the factors that underlie usage or acceptance of technology. Following a number of extensions of TPB, e.g., [27], [28], this study has equally incorporated cost reduction, availability of information, and efforts coordination to explain implementation of IR 4.0. Majority of previous studies that used TPB or its extension, did not consider these factors while explaining the factors that influence adoption or implementation of technology generally.

2.1.1 Information Access

Information about technology and its usage/implementation generally serves as the primary consideration for actual or potential customers. One of the barriers to accepting and adopting a technology is the lack of information and comprehension of the advantages that can be gained from the usage of such technology [29], [30]. This early stage of awareness of a new technology like IR 4.0 is regarded as the initial stage in the technology adoption process [31], and can significantly influence the perception of users [32]. A number of technological issues which revolve round usage and implementation of technology such as cloud computing are anchored on the awareness of the benefits and risks of such technology. The investigation and comprehension of awareness is therefore a critical factor to ensure that any enterprise remains successful and competitive in the industry. A number recent researches have reported positive relationship between information awareness and the use of technology [33], [34] leading to effective implementation. Therefore, the following hypotheses are presented:

H1a: Information has positive and significant effect on implementation of IR 4.0 among SMEs in Malaysia

H1b: Information has positive and significant effect on implementation of IR 4.0 among SMEs in Nigeria

2.1.2. Cost Reduction

Cost is one of the essential factors that is often considered before a new technology is accepted. Most importantly, the prospect of cost in this instance may constitute hindrance to the adoption

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of a new technology such as IR 4.0 among SMEs since many of these organizations may prefer to wait until reductions in costs of using or implementing the new invention takes place [8]. In line with [35], most small firms may be unwilling to accept ICT based on the perception that the cost of developing and maintaining such a technology platform may be higher than the benefits that accrues from it. Notably, the implementation of IR 4.0 has to be specifically designed to take care of varied production scenarios within an organization, for instance regarding different production structures or company size [8], [36]. Such implementation is rather challenging, mostly if the organizations in questions do not possess enough financial resources to employ the new invention [36].

Importantly, extant studies have highlighted the significance of cost in the utilization and technology of the technology generally [37] and found significant and direct influence of cost on adoption of technology [38]. For instance, [39] argued that cost effectiveness is one of the important variables in the adoption of new technology. This argument has been corroborated by [40] with the assertion that SMEs tend to respond positively to technology such as social media due low cost of entry or participation. Recent studies on IR 4.0 reported that cost reduction is a significant challenge towards implementation of IR 4.0 generally and among SMEs in particular [8]. Hence, the following hypotheses are presented:

H2a: Cost reduction has positive and significant effect on IR 4.0 implementation among SMEs in Malaysia
H2b: Cost reduction has positive and significant effect on IR 4.0 implementation among SMEs in Nigeria

2.1.3. Efforts Coordination

Efforts coordination can generally be regarded as a form of collaboration. Collaboration has been widely viewed as a significant change process which can lead to sustainable business development [41], [42]. It involves formulation of a set of strategies through which two or more organizations that possess different complementary competences or abilities to accomplish their common goals and aspirations in a competitive environment which cannot be achieved independently [42-44]. Such efforts are required for the purpose of understanding the organizational policies towards adopting the concepts of technology such as IR 4.0

[44]. The collaboration for instance, with suppliers is exigent for better communication mechanisms, innovation, and improved service deliveries [45].

A number of literature has emerged on collaboration strategy e.g. [41], [46], [47] but very little attention has been paid to how collaboration can be achieved towards implementation of IR 4.0 among SMEs especially. Even though basic researches with respect to how collaboration can significantly enhance implementation of strategies have been conducted, major gap still exists in literature. Due to their limited human and financial resources collaboration is however exigently required among SMEs and other large organizations [41] as such coordinated efforts can be a good strategy to overcoming many of these constraints while reinforcing and improving their level of innovation [45]. Recent studies have reported positive relationship between collaboration and implementation of other strategies and use of technology [47], [48]. In this regard, the following hypotheses are proposed:

H3a: Efforts coordination has positive and significant effect on implementation of IR 4.0 among SMEs in Malaysia

H3b: Efforts coordination has positive and significant effect on implementation of IR 4.0 among SMEs in Nigeria

2.1.4   Reluctance Behavior

IR 4.0 in the recent time has gained tremendous attention among academic scholars and practitioners due to many of its assumed benefits. Despite these assumed benefits, majority of industries, especially SMEs are still not familiar and equally unsure with the topic of IR 4.0. Notably, many organizations due to the lack of knowledge of the likely benefits of IR 4.0, bulk of practitioners are still reluctant to adopt this technology [8], [49]. In line with the arguments of [50], lack of understanding about possible benefits, absence of clear implementation specifics, and the seemingly large investments required have made many organizations not to embrace IR 4.0 [45].

In addition to lack of awareness about the possible benefits of IR 4.0, recent studies indicate that such reluctance among SMEs can be ascribed to resource poverty categorized into lack of internal skills, expertise and knowledge, lack of technological and financial resources [51]. In fact, researches related to issues of resources availability have reported that SMEs whose CEOs possess certain characteristics have the tendency to use the IS [52]. Remarkably however, even though such characteristics do influence the decision to adopt

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technology generally, the degree of the adoption may be questionable [61]. This therefore indicates that there are other resource issues which may include the characteristics of the individual that is making decision to use, external expertise support and attributes of the system in question. Some of these studies have linked resource availability to intention to use the innovative IS by SMEs. Considering the positions of previous studies with respect to resource issues, benefits of technology, lack of implementation specifics and huge investment requirement, reluctance behaviour has been introduced as an important determinant of implementation of IR 4.0 [45], [52]. Within this reach, this study argues that when SMEs operators possess the right capability, have adequate knowledge of technology usage, have required necessary expertise support, the organizations would develop the right behaviour to implement a technology system such as IR 4.0 [53], [39]. Hence, the following hypotheses are posited:

H4a: Reluctance behavior has positive and significant effect on IR 4.0 implementation among SMEs in Malaysia

H4b: Reluctance behaviour has positive and significant effect on IR 4.0 implementation among SMEs in Nigeria

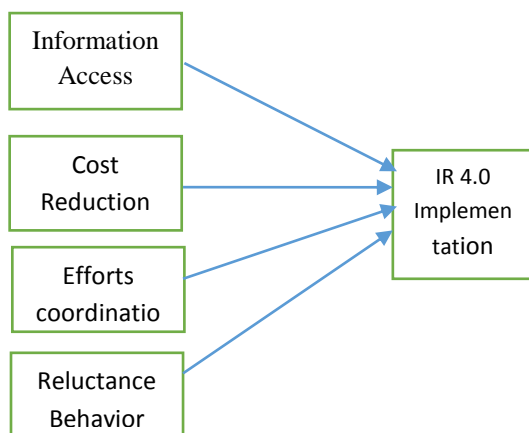Based on the above arguments and hypotheses, the conceptual framework is presented:

Figure 1: Conceptual Framework

3.1. Research Methodology

The targeted population of this research are the SMEs in Malaysia and Nigeria. The sample size of was 100 SMEs that operate within Kedah region of Malaysia and Northern Region, Kaduna State, Nigeria. Simple random sampling technique was adopted against probability sampling particularly in Nigeria where standardized and readymade

sampling frame was not available. In addition, the budget and time to conduct this research are very limited. In this regard, the coverage of study was therefore limited to Northern region of Malaysia for about 100 respondents only. The same method was applied in Kaduna State Nigeria as the population about 10 million.

In order to conduct this study, primary data were utilized. The researchers collected the data through convenience method at the premises of the SMEs both in Kedah State in Malaysia and Kaduna State in Nigeria. Structurally, the questionnaire was divided into two parts: Part A and Part B. Part A concerning implementation of Industry 4.0 with respect to five factors: IR 4.0 implementation, Information Access, Cost Reduction, Efforts Coordination and Reluctance Behavior. In part B, demographic information concerning the Gender of the participants, Marital Status, the Age, Level of Education, Position in the Organization, Experience, number of Employees, the Sector, total Estimated Asset and annual Sales Turnover. The descriptive data from both countries show that majority of the respondents are in manufacturing sector and have some experience in using technology.

The PLS-SEM was used to analyse the data considering the measurement model and structural model of the study. Through the PLS-SEM, researchers were able to determine the significance of the hypothesized relationship, the effect size, the quality prediction of the model and coefficient determinant of the model.

3.1.2 Measurement Model

For the purpose of examining the measurement model, it is required to assess the content validity, convergent validity, and discriminant validity and composite reliability [54]. For the content validity, the researchers are required to check the loadings of the item, the average variance explained (AVE) and Composite validity. Based on the rule of thumb, all the loadings of the items must be above 0.7 while the AVEs must not less be than 0.5 [54]. The composite reliability must be above 0.5 as well to show validity and reliability of the items. It should be noted that the convergent validity, the discriminant validity and composite reliability are generally used to determine the fitness of the model as there is no single parameter to be used in judging the fitness of the model in PLS-SEM [54]. For the measurement model of Malaysia, three items were deleted while for Nigeria measurement model only one item was deleted for not measuring up to the

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specified threshold. The AVEs, and Composite Reliability therefore obtained show that the models are valid and reliable as can be seen in Table 1 and which implies that the convergent reliability of the measurement model has been met and as specified in the measurement models for both Malaysia (Figure 2) and Nigeria (Figure3).

Figure 2: Measurement Model (Malaysia)

Figure 3: Measurement Model (Nigeria)

Table 1: Construct Reliability

		Cost	EFC	INFA	RB	IMP
MY	AVE	0.748	0.688	0.765	0.675	0.722
	CR	0.922	0.898	0.929	0.912	0.928
NG.	AVE	0.518	0.830	0.719	0.555	0.723
	CR	0.811	0.961	0.927	0.856	0.929

Key: MY=Malaysia, NG. =Nigeria, AVE=Average Variance Explained, CR=Composite Reliability, EFC=Effort Coordination, INFA=Information Access, RB=Reluctance Behavior, IMP=Implementation

Apart from accessing the convergent reliability of the models, discriminant validity which refers to the degree to which items of a construct significantly differ from the items of other constructs was also accessed. In testing for the discriminant validity, the AVEs for all the constructs were calculated to ensuring that they are greater than 0.5 while their square roots were eventually compared with the inter-construct correlations. The results reveal that the threshold is met for the discriminant validity for both Malaysia and Kaduna since the square roots of the AVEs are > than the relationships of the construct with all other constructs [55].
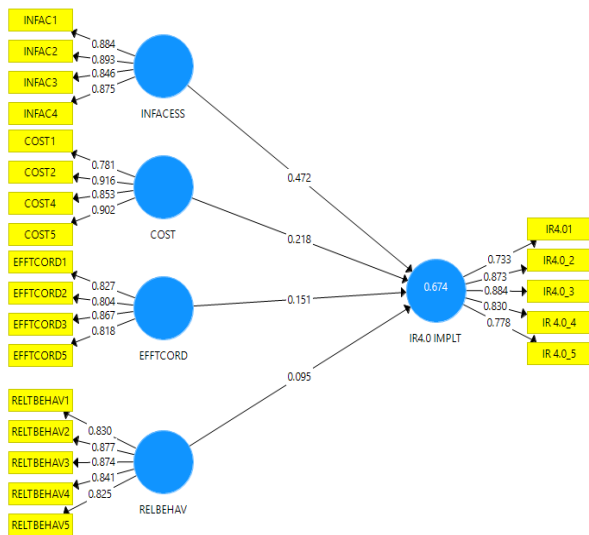
3.1.3 Structural Model

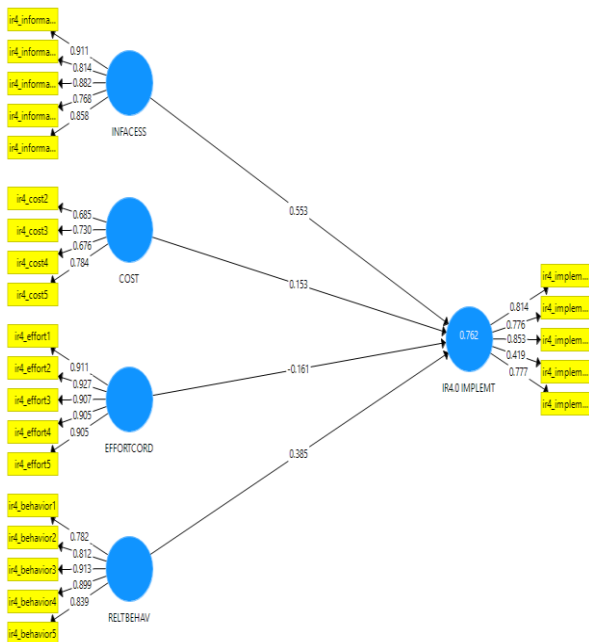Having discussed the measurement model in the previous section, this section presents the structural model. Hair et al (2014) describe the structural model as the model that enables the researcher to test the hypothesized relationship of the study. Through the structural model, the researchers can equally examine effect size (F^2) and predictive relevance (Q^2) of the model. For the significance of the hypotheses to be tested, the researchers employed the bootstrapping approach as suggested by [54]. In running the bootstrapping, 1000 sub sample was used [54]. The products of bootstrapping are shown in figure 5 (Malaysia Data) and Figure 6 (Nigeria Data) as well as in Table 2 (Malaysia Data) and Table 3 (Nigeria Data).
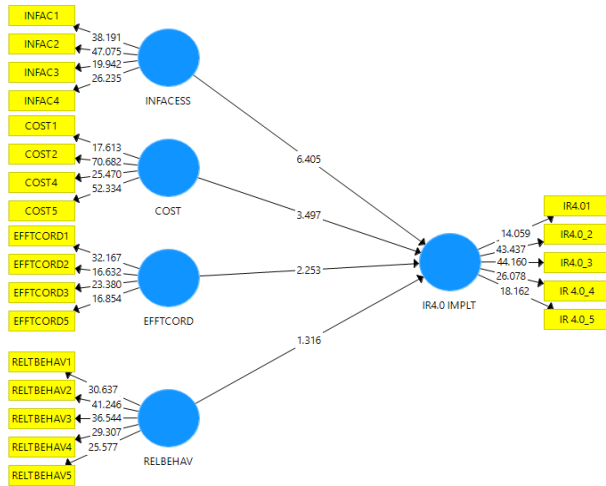
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Figure 4: Structural Model (Malaysia)

Table 2: Structural Model Result (Malaysia)

Hyp/paths	b	SE	TV	Decision
H1a: INFA->IMP	0.472	0.074	6.405	Supported
H2a: Cost ->IMPL	0.218	0.062	3.497	Supported
H3a: EFC-> IMPL	0.151	0.067	2.253	Supported
H4a: RB-> IMPL	0.095	0.072	1.366	Not supported
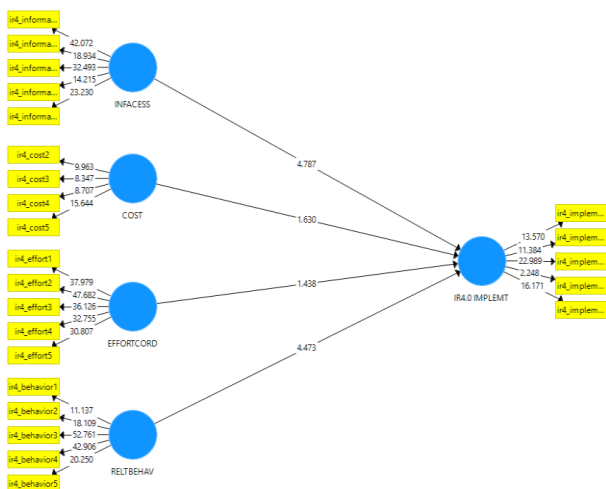
Figure 5: Structural Model (Nigeria)

Table 3: Structural Model Result (Nigeria)

Hyp/Paths	b	SE	TV	Decision
H1b: IFACC-> IMPL	0.553	0.116	4.787	Supported
H2b: Cost-> IMPL	0.153	0.094	1.630	Supported
H3b: EFC-> IMPL	-0.161	0.112	1.438	Not Supported
H4b: RB-> IMPL	0.383	0.086	4.473	Supported

As revealed in Figure 4 and Table 2 (Malaysia structural model), there are four direct hypotheses. One out of these four hypotheses is not supported by the data. In this regard, Hypothesis 1a which states that Information Access has a significant and positive effect on IR 4.0 implementation ($\beta=0.472$, t=6.405) is supported. Hypothesis 2a which states that Cost Reduction has a significant and positive influence on IR 4.0 implementation ($\beta=0.218$, t=3.497) is also supported. Hypothesis 3a which states that Effort Coordination has a positive and significant influence on IR 4.0 implementation ($\beta=0.151$, t=2.253) is equally supported. However, Hypothesis 4a which states that Reluctance Behavior has a positive and significant effect on IR 4.0 implementation ($\beta=-0.095$, t=1.316) is not supported due negative beta value. In this respect, the Hypotheses H1a, H2a, H3a are supported while hypothesis H4a is rejected accordingly for Malaysia data

Likewise, as shown in Figure 5 and Table 3 (Nigeria structural model) above, there are four predicted direct hypotheses. Three out of four these hypotheses are supported while one hypothesis is supported. In this regard, H1b which states that Information Access has positive and significant effect on IR 4.0 implementation ($\beta=0.553$, t=4.787) is supported. H2b which states that Cost Reduction has significant and positive effect on IR 4.0 implementation ($\beta=0.153$, t=1.630) is supported. Additionally, H3b which states that effort coordination has a positive and significant on IR 4.0 implementation ($\beta=-0.161$, t=1.438) is not supported while H4b which states that reluctance behavior has a positive and significant effect on IR 4.0 implementation ($\beta=-0.095$, t=1.316) is supported. In this respect, the Hypotheses H1b and

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H2b and H3b are supported while hypotheses H4b is not supported for Kaduna Data.

3.1.4 R-Square (R^2) and Effect Size (F^2)

Having assessed the path coefficient significance of the hypotheses based on the structural models for Malaysia and Kaduna (Nigeria), it is equally important to consider the coefficient determinants (R-square value (R^2)) and effect size (F^2) of the two models [54]. Based on the suggestion of [56], the strength of the R^2 value can be ascertained if the value is 0.02 (weak), 0.13 (moderate) and 0.26 (substantial). Considering the classification of [56], the value of the F^2 and R^2 obtained in this study and as depicted in Table 4 below revealed substantial value for both countries. The effect sizes obtained are also in line with the recommendation of [56].

Table 4: F^2 and R^2

		IMPL	COST	EFC	INFAC	RB
MY	R^2	67.4%	N/A	N/A	N/A	N/A
	F^2	N/A	0.218	0.151	0.472	0.095
NG	R^2	72.6%	N/A	N/A	N/A	N/A
	F^2	N/A	0.153	0.161	0.553	0.385

Key=Malaysia, NG=Nigeria

4.1 Discussion of findings

The first research hypothesis of this study is to consider whether information access has influence on the implementation of IR 4.0 among SMEs in Malaysia and Kaduna, Nigeria. The finding of the study, based on the data collected from both countries show that the independent variable (information Access) has significant and positive effect on the implementation of IR 4.0 and in line with the findings of previous studies [e.g. 57]. This therefore indicates that there is a need to increase the level awareness and information accessibility among SMEs operators generally and particular, their CEOs. This would enable them eventually to deploy IR 4.0 tools for their businesses. This is very germane as experience has equally shown the SMEs value information for their production and manufacturing processes generally as they may equally share such information with other SMEs.

The second research hypothesis of this study is to consider whether cost reduction has influence on the implementation of IR 4.0 among SMEs in Malaysia and Kaduna, Nigeria. The finding of the study, based on the data collected from Malaysia shows that the independent variable (cost reduction) has a significant and positive effect on the implementation of IR 4.0. Similar findings have been reported by previous studies [58]. This finding indicates that cost is not regarded as a major inhibitor of implementation of IR 4.0 in Malaysia as the cost technology acquisition seems to be declining in Malaysia [59].

Similar finding is applicable to Nigeria This result seems to indicate that SMEs in Nigeria consider implementation of IR 4.0 to be highly cost-efficient and in line with the findings of previous studies [60]. Recently, experience has shown that within the context of Nigeria, the price of software and hardware with respect to technology is not really expensive among the populace, and in SMEs in particular. Nigeria is an emerging market in West Africa, and the ease of doing business seems to be on the increase. The ease of doing business has attracted so many IT technology company providers to Nigeria and which have brought about competition and eventually reduction in cost.

The third research hypothesis of this study is to consider whether efforts coordination has influence on the implementation of IR 4.0 among SMEs in Malaysia and Kaduna, Nigeria The finding of the study, based on the data collected from both countries show that the independent variable (efforts coordination) has significant and positive effect on the implementation of IR 4.0 among SMEs in Malaysia. Recent studies within the field IT adoption and implementation have equally reported similar findings [36], [39]. This finding therefore indicates that, efforts coordination, which is a form of collaboration among SMEs is a key determinant to the implementation of IR 4.0 and other associated technology.

Surprising, the data from Nigeria do not support the hypothesis which therefore indicates that efforts coordination is not a significant factor in the implementation of IR 4.0 among SMEs in Nigeria. This empirical evidence suggests that the SMEs in Nigeria do not value coordination of efforts or collaboration as such may not translate properly into effective implementation of technology like IR 4.0. The majority of the organisations tend to disregard technology diffusion as a means of achieving successful collaboration performance. This finding may be further be rationalised as experience has shown that majority of SMEs in Nigeria seem to operate in isolation without necessarily associate with any of their counterpart SMEs.

The last hypothesis of this study is to consider whether reluctance behaviour has influence on the implementation of IR 4.0 among SMEs in Malaysia

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and Kaduna, Nigeria. The finding of the study, based on the data collected from Malaysia show that the independent variable has no significant effect on the implementation of IR 4.0 and in line with the findings of previous studies [36]. The finding indicates that SMEs in Malaysia are not reluctant in accepting IR 4.0 and which implies that to a greater extent, the selected participants have access to resources that could make them implement IR 4.0 successfully. This finding further shows that as an emerging country whose level of technology is at higher level, the SMEs operating within this vicinity tend to appreciate technology such as IR 4.0 through their positive disposition. It further shows that the SMEs operators in Malaysia possess the right capability, have adequate knowledge of technology usage, have required necessary expertise support and which explained their good disposition towards the implementation of technology system such as IR 4.0

On the other hand, the data from Nigeria supports the hypothesis as the relationship between Reluctance behaviour and IR 4.0 is significant. Previous studies have reported similar findings [8]. This finding seems to indicate that SMEs are still very reluctant to implement IR 4.0 due to the newness of the technology. Evidence in literature and experience have shown that SMEs in developing and many of the third world countries are still lagging behind in technology usage generally due to lack of familiarity, doubts about the benefits of the technology, lack of resources, lack of government support, the assumed risks involved and other similar factors.

4.1.2 Implications

The primary purpose of this study was to examine factors for the implementation of IR 4.0 among SMEs in Malaysia and Nigeria. Since IR 4.0 is just coming up and has been adjudged as an important technology/strategy that can assist the SMEs in their operations, it is imperative that the SMEs in both countries fully utilize this current trend, especially, that they need to compete favourably with large companies that have fully embraced IR 4.0.

Academically, this study has contributed to the body of knowledge by bridging the gap of empirical studies that address implementation of IR 4.0 especially in Malaysia and Nigeria. Thus, by extending the TPB this study has conceptualized a new model that can be used by academic to predict how SMEs can implement IR 4.0 and other similar technologies. This study has equally contributed to practice through its findings. The results of this study will specifically guide the SMEs on how to develop cooperation when implementing IR 4.0

and other similar technologies as this sector is still in the earlier stage of implementations.

The findings of this study will equally be useful for the government and policy makers in both countries. Since IR 4.0 is still at the early stage across the globe, this study thereby provides insight and direction for the government to come up with policies that can assist the SMEs to work together as an entity that boost the economy of both countries. In fact, the governments of both countries can formulate policies to ensure that SMEs in Malaysia and in Nigeria work together as an entity that can contribute to the development of the two nations through active implementation of IR 4.0. This can be achieved, for instance, when the cost of acquiring technology is further reduced. Apart from that, efforts should be made by the provider of technology such as IR 4.0 to increase the rate of awareness among the SMEs.

4.1.3 Future Research Recommendations

This study just like any other research has some limitations that should be considered in the course of interpreting its results. First, the sample used is very limited as most SMEs in both countries are still not too familiar with IR 4.0. The method of the data collection also poses a limitation since the data of the study were collected through non-probability system. The variables considered in this study for the implementation of IR 4.0 are equally limited to four and which may be a limitation as there can be other variables that can improve the implementation.

In view of the limitations that are stated above, it is suggested that future studies should increase number of samples that may be used in the future. This is necessary in order to sample wider opinion that may lead to effective generalization of the result. Additionally, the method of data collection should be improved as the method used in this study tends towards convenience sampling due to limited time, and resources. As part of future research recommendation, future researchers should include more factors such as government support, security concerns, financial constraints, lack of integration of technology platforms as identified by previous studies.

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