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TOWARDS A DIGITAL SUPPLY CHAIN AMONG RICE MILLERS: AN APPLICATION OF AJZEN MODEL

Muhammed Yazeed[1], Ahmad Sani Usman[2], Suleiman Usman[3], Aliyu Magaji Mafindi[4]

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Abstract

Despite advancements in technology worldwide, the understanding of digital supply chain is still in its early stages. The study focuses on Nigerian rice millers and employs the theory of planned behavior by Ajzen to investigate their intention to adopt digital supply chain. The research finds that previous studies have overlooked the role of perceived behavioral control in the relationship, thus the study examines its moderating effect on the relationship between attitudes and subjective norms and digital supply chain adoption. The research methodology involves a survey of 50 registered rice milling companies in Kaduna state, using a structural equation modeling (SEM) technique in conjunction with partial least squares. The findings reveal that a positive attitude and favorable subjective norms significantly influence digital supply chain adoption. Moreover, the study highlights that perceived behavioral control plays a significant moderating role between attitude and digital supply chain adoption.

Keywords: *Social Norms; Descriptive Norm; Injunctive Norm; Entrepreneurial Orientation, Start-up Intention.*
JEL Codes: *M15*

Introduction

The rise of information and communication technology (ICT) has led to the emergence of digital disruption (Beutel & Brettel, 2019; Neykova, 2019), which has threatened traditional business models that rely heavily on physical labor (Büyüközkan & Göçer, 2018). This shift to digitalization has impacted all industries and has resulted in new

[1] Department of Business Administration, Ahmadu Bello University, Zaria, PhD Business Administration; E-mail: yazeedmuhammed3@gmail.com, ORCID ID: 0000-0001-8072-8680
[2] Department of Accounting, Ahmadu Bello University, Zaria, MSc Procurement and Supply Chain Management; E-mail: ahmaddawaki1@gmail.com, ORCID ID: 0000-0002-0764-5317
[3] Department of Business Administration, Ahmadu Bello University, Zaria, MSc international business management; E-mail: suleimanusman@abu.edu.ng, ORCID ID:0000-0002-4996-3874
[4] Petroleum Training Institute (PTI) Effurun, Delta State, PhD /Director of Finance and Accounts (DFA), E-mail: aliyu.mafindi@pti.edu.ng, ORCID ID: 0009-0007-8474-3176

partnerships and collaborations between companies and individuals (World Economic Forum, 2016; Bogdanova, 2022). Digitization has enabled supply chains to access, store, and analyze vast amounts of data, both internally and externally. This has created a need for traditional supply chains to transition to digital supply chains (DSCs) to accommodate new production models, transportation methods, and customer experiences that require real-time information sharing. Consequently, businesses worldwide are evaluating digitization as a prerequisite for developing effective strategies (Galyarski & Mironova, 2021; Radilov, 2019).

According to Ajzen (2020) and Atanasova (2022), the widespread use of technology has simplified daily life and increased productivity. However, it also requires individuals to acquire new skills to keep up with the rapidly changing technological landscape (Stavrova, Zlateva, Pinelova, 2021; Yuleva, 2019). Understanding people's reactions to developing technologies is important to design effective treatments that can help individuals adjust their behavior to meet the demands of a high-tech society (Dimova, 2022; Katamadze et al., 2021). As a result, Nigeria's rice revolution, which was initiated by the CBN's Anchor Borrower Programme to diversify the economy and boost agriculture, has led to a significant increase in national output from 5.4 million metric tonnes in 2015 to over nine million metric tonnes in 2021. The productivity per hectare of smallholder farmers has also improved from 2.4 metric tonnes per ha in 2015 to about five metric tonnes per ha in 2021. These developments have not only made Nigeria the largest rice producer in Africa but have also attracted significant private sector investment in the rice value chain. As a result, rice production in Nigeria has increased to over 7.5 million metric tonnes annually.

Even with the progress in technology, the understanding of digital supply chains (DSCs) is still in its early stages worldwide (Büyüközkan & Göçer, 2018; Zlateva, 2020). To investigate the intention of Nigerian rice millers to adopt DSCs, the theory of planned behavior (TPB) by Ajzen is used. In the TPB, the intention to adopt DSCs is the immediate precursor to behavior, meaning that the stronger the intention, the more likely the behavior will follow (Ajzen, 2020). This intention is formed by positive attitudes and subjective norms that make people believe they can engage in the behavior in question (Tornikoski, 2019). Additionally, the importance of attitudes and subjective norms in determining intentions is expected to vary across different behaviors, populations, and time periods. Therefore, the study's hypotheses are formulated as follows:

H01: Attitude does not significantly affect digital supply chain adoption among rice millers in Kaduna State

H02: Subjective Norms do not significantly affect digital supply chain adoption among rice millers in Kaduna State

H03: Perceived Behavioural control does not significantly moderate the relationship between attitude and digital supply chain adoption among rice millers in Kaduna State

H04: Perceived Behavioural control does not significantly moderate the relationship between attitude and digital supply chain adoption among rice millers in Kaduna State

Literature Review and Hypotheses Development

The Theory of Planned Behaviour and digital supply chain adoption

The theory of planned behavior (TPB) utilizes an expectancy-value formulation to explain how attitudes toward a behavior are formed. Specifically, the attitude toward the behavior is believed to be a result of readily available beliefs about the expected outcomes of the behavior, which are referred to as behavioral beliefs. A behavioral belief is an individual's subjective assessment of the likelihood that engaging in a particular behavior will lead to a specific outcome or experience (Ajzen, 2020). Previous studies have shown a significant interaction between attitude (ATT) and perceived behavioral control (PBC) in predicting intention (Kothe & Mullan, 2015; Yzer & van den Putte, 2014). As per expectations, a stronger relationship between attitude and intention results in a greater perceived control over action. This interaction effect was observed as a positive regression coefficient for the ATT x PBC factor in a multiple regression analysis. In our study, we expect to find a similar outcome.

Subjective norms and supply chain adoption

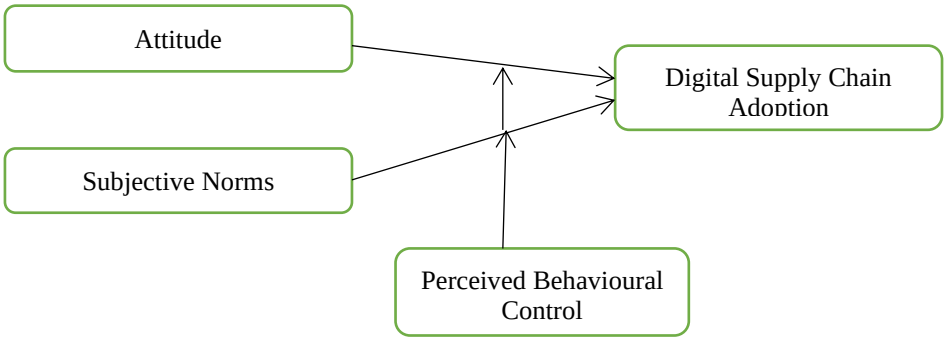
Ajzen (2020) defines subjective norm as the social pressure a person feels to perform or not perform a behavior, which is based on normative beliefs. Normative beliefs are the beliefs about what important individuals or groups in a person's life expect them to do, multiplied by the person's motivation to comply with those expectations (Tornikoski, 2019). Two types of normative beliefs exist: injunctive and descriptive (Ajzen, 2015). Injunctive normative beliefs refer to the expectation or subjective likelihood that a certain person or group approves or disapproves of a behavior, while descriptive normative beliefs refer to the belief about whether significant people perform the behavior themselves. Both types of normative beliefs contribute to the total social pressure felt to engage in the behavior or subjective norm. The evidence on the interaction between subjective norm and perceived behavioral control (PBC) has been inconsistent. Some studies have found no significant effect of PBC on the prediction of intention from SN (Kothe & Mullan, 2015; Umeh & Patel, 2004), while others have reported a positive effect, such that the prediction

of intention from SN was better under high rather than low PBC (Yzer & van den Putte, 2014). One study found a significant relationship (Castanier et al., 2013).

Moderating role of Perceived Behavioural Control

According to Ajzen (2020), the TPB proposes that perceived behavioral control moderates the influence of attitude and subjective norm on intention. This means that a positive attitude and supportive social pressure contribute to forming favorable behavioral intentions only if individuals feel capable of performing the behavior. However, empirical evidence supporting the moderating effects of perceived behavioral control is scarce due to methodological issues. Despite theoretical soundness, few studies have investigated the moderation effects of PBC (Castanier et al., 2013; Umeh & Patel, 2004), and the existing evidence is insufficient to fully understand the interaction effects of PBC on attitudes and subjective norms (Yzer & van den Putte, 2014).

Figure no. 1 Conceptual Framework



Source: Author's Conceptual Framework

Methodology

This study employs a cross-sectional research approach and responses were collected from Kaduna State Rice millers using self-administered questionnaire. The state was chosen because it is the first in the World Bank ranking of ease of doing business in the country. The Population of the study constitutes fifty (50) rice millers registered with their association. Census sampling technique was used given the fact that the population is not too large.

Measurement of Constructs

The Likert scale was utilized to gather responses to a questionnaire measuring ATT, SN, PBC, and DSC, which was adapted from the work of Liñán and Chen (2009). The questions were structured as closed-ended and rated on a five-point scale ranging from "strongly agree" to "strongly disagree." ATT consists of 5 items including; “Digital supply chain adoption is attractive to me”, “Adopting digital supply chain implies more advantage than disadvantage”. Subjective Norms consist of 3 items including; “My friends are positive and accept my plan of adopting digital supply chain”, “My peers see digital supply chain adoption as a logical choice for me”. PBC consist of 6 items including, “Adopting digital supply chain and keeping it working would be easy for me”, “I’m prepared to adopt digital supply chain”. Digital Supply Chain Adoption is measured by 6 items including “I will adopt digital supply chain soon”, “I am determined to adopt digital supply chain”.

Assessment of PLS Path Model

Before conducting the main analysis, the data was checked for normality and multicollinearity, as per the guidelines of Hair et al. (2017). After confirming that all assumptions were met, the collected data was analyzed using SmartPLS software, which is a statistical method that estimates the causal relationship between multiple constructs based on a theoretical framework (Vinzi, Trinchera, & Amato, 2010, p. 47). To ensure the validity and reliability of the model used in this study, Hair et al. (2017) suggested a two-stage evaluation process: measurement models (also called external models) and structural models (also called internal models).

Measurement Model

The researchers assessed the reliability of the items measuring each construct, as well as their internal consistency reliability (which includes composite reliability and Cronbach's alpha), discriminant validity, and convergence validity, in order to evaluate the measurement model of the study (Henseler et al., 2009). While Hair et al. (2017) suggested that an outer loading of 0.70, AVE of 0.50, and composite reliability/Cronbach's alpha of 0.70 are acceptable indicators for scale development, the validity and reliability results were presented in a table below.

Table no. 1 - Measurement Model

Constructs	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Attitude	ATT1	0.91	0.94	0.96	0.82
	ATT2	0.90			
	ATT3	0.91			
	ATT4	0.90			
	ATT5	0.90			
Digital Supply Chain	DSC1	0.87	0.91	0.93	0.69
	DSC2	0.87			
	DSC3	0.85			
	DSC4	0.88			
	DSC5	0.86			
	DSC6	0.63			
Perceived Behavioural Control	PBC1	0.87	0.95	0.96	0.78
	PBC2	0.90			
	PBC3	0.90			
	PBC4	0.88			
	PBC5	0.89			
	PBC6	0.87			
Subjective Norms	SN1	0.91	0.88	0.92	0.78
	SN2	0.94			
	SN3	0.80			

Source: PLS Output

Table 1 above shows that all of the constructs are reliable since their values are all above the minimum threshold.

Furthermore, Duarte and Amaro (2018) advocated the usage of Heterotrait-multimethod (HTMT) matrix as an alternate way to determining discriminant validity as presented in table 2 below.

Table no. 2 - Discriminant validity (Heterotrait-multimethod (HTMT)

Constructs	Attitude	Digital Supply Chain Adoption	Perceived Behavioural Control	Subjective Norms
Attitude				
Digital Supply Chain Adoption	0.56			
Perceived Behavioural Control	0.32	0.74		
Subjective Norms	0.07	0.11	0.15	

Source: PLS Output

The HTMT results in Table 2 show that the discriminant validity is achieved since the values are less than 0.85 as recommended by (Hair et al., 2017).

Structural Model

The structural model is evaluated after all the measurement model requirements are satisfied. In particular, bootstrapping was used on a sampled instance of 50 using 5,000 bootstrap samples to examine the relevance of constructs (Hair et al., 2017).

Table no. 3 - Hypotheses test

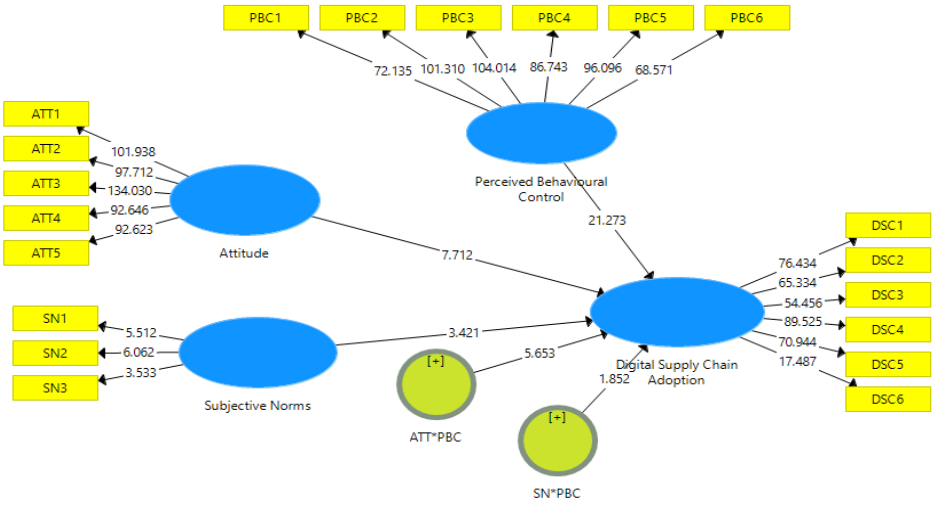
Relationship	Beta Values	Standard Deviation	T Statistics	P Values
ATT*PBC -> Digital Supply Chain Adoption	0.15	0.03	5.65	0.00
Attitude -> Digital Supply Chain Adoption	0.29	0.04	7.71	0.00
SN*PBC -> Digital Supply Chain Adoption	0.06	0.03	1.85	0.06
Subjective Norms -> Digital Supply Chain Adoption	0.16	0.05	3.42	0.00

Source: PLS Output

The table above presents the bootstrapping outcomes, indicating that all relationships were significant except for SN*PBC. The study discovered that both attitude and subjective norms are significantly associated with the adoption of digital supply chains. As for the interaction between ATT and PBC, it was found to have a positive and significant effect on digital supply chain adoption. However, SN*PBC was found to have a positive but insignificant relationship with digital supply chain adoption. Table 3 and Figure 2 below

present the results of the hypotheses, with T-values indicated on the lines connecting the independent and dependent variables.

Figure no. 2 Structural Model



Source: Smart PLS Output

Coefficient of Determination *(R2)*, Effect size (*f*2) and Predictive Relevance *(Q2)*

In order to measure the extent to which external latent factors explain the variation in endogenous latent variables, researchers use the coefficient of determination, also known as the R-square level. According to Chin's 2010 study, R2 values of 0.67, 0.33, and 0.19 are considered substantial, moderate, and weak, respectively. To evaluate the impact of a specific exogenous variable on the endogenous variable, researchers use f2 values, where 0.02, 0.15, and 0.35 are considered small, medium, and large values, respectively, based on Cohen's 1988 study. In this particular study, the predictive correlation (Q2) of external latent factors was analyzed using cross-validated redundancy criteria that represent endogenous latent variables, as presented in Table 4 below.

Table no. 4 - R-Square, F-Square and Q-Square

Indicator	R Square	R Square Adjusted	
DSC	0.63	0.62	
Indicators	**DSA**	**Effect Size**	
ATT	0.19	Medium	
PBC	0.95	Large	
SN	0.06	Small	

Table 4 reveals that ATT, PBC, and SN together explain 60% (0.63) of the variation in Digital Supply Chain adoption. The R2 score indicates that these latent factors have a moderate effect on the target endogenous latent variable. In terms of impact size, ATT has a medium effect, PBC has a large effect, and SN has a small effect.

Conclusion

In conclusion, the study suggests that ATT and SN are reliable predictors of digital supply chain adoption among rice millers, based on their significant contributions. Therefore, developing ATE and SN can help enhance digital supply chain adoption among rice millers. However, PBC is found to be a good moderator only with attitude and not subjective norms.

Implications of the Study

The study provides valuable insights on the interplay between PBC, attitude, and subjective norms, thereby expanding the usage of the TPB framework. While the TPB model is widely used to predict social behavior, previous studies have mainly focused on the direct relationship between the three constructs and intention. However, Ajzen (2020) argues that PBC is better viewed as a moderator rather than an independent variable. Therefore, this study is unique in its approach by including perceived behavioral control as a moderator within the TPB model, rather than as an independent variable.

From a practical perspective, interventions based on the TPB model should focus on fostering positive social norms and enabling supportive behaviors, in addition to promoting a positive attitude towards digital supply chain adoption. For rice millers to adopt digital supply chain, they need to have a positive attitude and subjective norm, coupled with the ability to control a digitalized system. In other words, the adoption of digital supply chain is more likely to occur when rice millers have a positive attitude and subjective norm, multiplied by their ability to control a digitalized system.

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