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PROMOTING COST REDUCTION THROUGH OPERATIONAL RESILIENCE IN THE FOOD AND BEVERAGES INDUSTRY

Prof. **Asikhia, Olalekan. U**.
DVC Research, Innovation, Strategy and Administration, Caleb University, Lagos, Nigeria
olalekan.asikhia@calebuniversity.edu.ng

Amos-Fidelis, Nneoma Benita, PhD
School of Graduate Studies, Valley View University, Oyibi, Accra, Ghana
benita.fidelis@vvu.edu.gh

Makinde, Olubisi Grace, PhD
School of Management Sciences, Department of Business Administration and Marketing, Babcock University, Ilishan-Remo, Ogun State, Nigeria
makindeo@babcock.edu.ng

Dogo, Edafe Bawa
School of Management Sciences, Department of Business Administration and Marketing, Babcock University, Ilishan-Remo, Ogun State, Nigeria
dogoe@babcock.edu.ng

Abstract

Cost reduction with the goal of maximising profit is a major objective of production and operations managers, especially, in view of rising cost of production raw materials, labour, technology, and production processes. The turbulence in the food and beverages manufacturing sector occasioned by, increased volatility, shocks, and unexpected changes has weakened the goal of cost reduction. This research expanded the concept of operational resilience and studied its effect on cost reduction through technological resilience, recoverability, workplace resilience, disruption absorption, and resilient culture. A survey research design was used to obtain data *from a sample of 491 staff. The response rate of 82.7% was analysed with Partial Least Square-Structural Equation Modelling. Cronbach's alpha reliability coefficients for the constructs were within the accepted threshold of ≥ 0.7. Findings revealed that four dimensions of operational resilience (technological resilience, workplace resilience, disruption absorption, and resilient culture) have positive significant effect on cost reduction, while recoverability had an insignificant negative effect on cost reduction. The study concluded that operational resilience dimensions have a significant effect on the cost reduction therefore; management of food and beverages manufacturing companies should insist on and develop operational resilience capabilities to improve cost reduction in their companies.*

Keywords: Operational resilience, Recoverability, Workplace resilience, Disruption absorption, Resilient culture, Cost reduction

INTRODUCTION

Globally, the growing concern of production and operations managers for cost reduction in their business operations is quite substantial. Most manufacturing systems are exacerbated by challenges of increasing levels of production costs and are constantly seeking out ways of creating their products at the lowest possible total cost. Manufacturers are persistently finding out better ways of utilizing the available resources to produce as many products in a way that minimizes waste. The need for cost reduction is amplified by the frequent turbulence and random fluctuations experienced in the manufacturing environment, such that the progresses made in production are easily eroded by wastes occasioned by these disruptive events. Although the food and beverages manufacturing sector of Nigeria, accounts for 66% of total consumer expenditure, 22.5% of the manufacturing industry value (Oladejo et al., 2021; Oyedijo et al., 2021), and contributes 4.6% of the GDP which is N17.7 billion (Amos et al., 2020; Oladejo et al., 2021; Oyedijo et al., 2021), and the sector accounts for 38% of the manufacturing sector in Nigeria, with its total manufacturing output standing at N46.6 billion as at 2019 (Flanders, 2020). The sector is bewildered by rising costs of production which is hampering its performance.

According to the National Bureau of Statistics Report (2021), the Nigerian manufacturing sector is dominated by the production of food, beverages and tobacco, with sugar and bread products generating the greatest value of output. It is also responsible for generating 1.5 million jobs (Flanders, 2020), and its unique role of expanding economies due to its general use to human life and health, is deemed responsible for its growth (Oladejo et al., 2021). Despite this level of contribution, the comparison of the real manufacturing sectors' growth between 2018 and 2020 in percentage, show a decline from 3.39 in 2018 first quarter to 0.18 in 2019 first quarter, with the second quarter of 2019 recording a negative growth of -0.13, as at 2020 first quarter, the growth was 0.45 which is still a decline as compared to its 2018 position (Nigerian Bureau of Statistics, 2020).

Similar to other African countries, the Nigerian manufacturing environment is highly unstructured. Despite being considered the biggest economy in Africa with a gross domestic product (GDP) of US$484.9 billion (Oyedijo et al., 2021), resource optimization and cost reduction challenges stiffens the production efficiency of the manufacturing sector. Trade Economics/World Bank (2022) shows a decline in the GDP growth rate of Nigeria with -14.66 as at June 2022. Hence, industry regulators, the government, and operations managers are seeking new interventions to close this gap of increasing production cost in the food and beverages sector.

The problem of rising production cost is heightened by global disruptions and crisis such as the Covid_19 pandemic, the Ukraine-Russia war, the Turkey earthquake, among others shocks. This has caused a shift from safety, quality, security and integrity performance, to issues of cost reduction that leads to survival (Ali et al., 2021). Disruptive events such as harsh government policies, stern COVID-19 effects, and several factory closures within the last five years are evident in the Nigerian food and beverages sector. Ten food and beverages companies closed down in Nigeria following several disruptions these companies include Bendel Brewery Limited; Danico West Africa Limited; International Breweries Limited; Pal Breweries Plc; Port Harcourt Flour Mills Limited; Scoa Foods Limited; Standard Biscuit & Agro Products, Jos; UTC Foods Plc; Vitamalt Plc; Ranona Limited; and Deli Foods Limited (Olaleye, 2021).

Research on the effect of operational resilience and cost reduction is gaining interest in recent studies (Birkie et al., 2017; Chowdhury & Quaddus, 2017; Essuman et al., 2020; Ivanov, 2023). This is not far from the increase in the price of products experienced today, which has been tied to the current rise in the cost of production in the manufacturing sector (Amos et al., 2020). On year-on-year basis, food inflation, between the first quarter of 2019 to the fourth quarter of 2020, maintained an upward trend to 19.6% as against 16.7% in the preceding quarter (National Bureau of Statistics, 2021). Food inflation, coupled with increasing operating expenses in the food and beverages manufacturing sector of Nigeria are evident in literature. Nestle Nigeria Plc reported a 1% decline in revenue in its first quarter 2020 annual report. While it’s gross profit grew year on year by 1% due to a lower production cost, operating profit decreased by 8% because of a higher operating expense. However, operating cost spiked year on year by 14% eroding the gains of a lower production cost due to a large record of 53%

increase in administrative expenses (Nestle Nigeria Annual Report, 2020). On the weight of higher operating expenses, Nestle's operating profit declined year on year by 8% from N19.09bn at the end of 2019 to N17.54bn in the first quarter of 2020.

Based on the foregoing issues, gaps and problems identified, this study investigated the effect of operational resilience on cost reduction in the food and beverages manufacturing industry, Nigeria. The study therefore, seeks to answer the question in what way does operational resilience (technological resilience, recoverability, workplace resilience, disruption absorption and resilience culture) affect cost reduction in the food and beverages manufacturing industry.

LITERATURE REVIEW

Scholarly discourse on diverse views of operational resilience and cost reduction are captured in this section to broaden the scope and deepen understanding along conceptual, empirical and theoretical lines.

Operational Resilience

The operational resilience discuss, though not altogether new, has become much more crucial in current research work owing to the increasing and sever levels of crisis facing production and operations of various systems. The concept of resilience is a multidimensional one (Essuman et al., 2020; Ivanov, 2023; Lotfi & Saghiri, 2018; Lohmer et al., 2020; Melián-Alzola et al., 2020) and this is responsible for the level of variations in its conceptualization, in addition to the fact that this concept is relatively incipient, growing, and has attracted increasing attention (Dubey et al., 2019; Manhart et al., 2020). The resilience concept however, is evolving fast to become an important tool for managing production and operations activities (Dubey et al, 2019; Essuman et al., 2020; Lodorfos et al., 2023). The conceptual element as well as the type of system within which resilience is applied in various fields of study should guide scholars to present aptly this very relevant concept. Resilience as a concept originates from mathematics, engineering and material science describes the ability of materials to rebound or recoil after going through stress (Nyaupane et a., 2020).

Aslam et al. (2020) and Chowdhury et al. (2019) posited that operational resilience is the capability to develop required level of readiness, response and recovery to manage disruption risks, and get back to the original state or even a better state after disruption. This definition reveals that operational resilience helps firms to achieve a more improved state of operation than they were before a disruption occurred. Supporting this definition, Essuman et al. (2020) posits that operational resilience is the extent to which a firm's operations are able to absorb and recover from disruptions. Thereby stressing the disruption absorption and recoverability (OBR) capability of resilient firms, it is the ability to return to a stable state after facing a disruption (Aslam et al., 2020; Lohmer et al., 2020; Rai et al., 2021) and maintain its function (Kahiluoto & Makinen, 2020). Romero et al. (2021) study defined manufacturing resilience as a strategic ability to explore and exploit key issues and trends impacting the day-to-day operations of a manufacturing enterprise or supply chain. Further, manufacturing resilience is the extent to which manufacturing activities are able to withstand, or quickly recover from disruptions that pose threats to manufacturing operations. This definition adds to the relevance of resilience in the manufacturing sector, linking both production and operations activities within a system. Therefore, either at the supply chain level, manufacturing or systems level of a firm, resilience is key.

The function of operational resilience includes the ability to sense, build, reconfigure, re-enhance and sustain (Birkie et al., 2017). Operational resilience is characterized by flexibility, diversity, connectivity, knowledge, redundancy and robustness (Lodorfos et al., 2023; Morisse & Prigge, 2017). Specific resilience strategies proposed in literature (Ivanov et al., 2019; Lohmer et al., 2020) include backup capacity and inventory, recovery time, response effort, increased security, economical supply incentives, postponement, supplier relationship building, demand forecasting, as well as the development of IT infrastructure and information sharing. Resilience assets are considered expensive (Essuman et al., 2020; Ivanov, 2022) especially when not properly used for value creation. This is the major disadvantage of operational resilience application in the manufacturing organization. defined in this work as the capability of an manufacturing system to sense, adapt, and bounce back from the effect of a crisis, while focusing on the impacts of such event, develop risk appetite and tolerance levels for disruption of product or service delivery. It is the ability to identify targeted diversity or crises, activate capabilities that will help the firm maintain continuity, and identify possible improvement to respond, recover from, and thrive in the business environment.

The study adopts the output based resilience approach (Essuman et al., 2020; Wong et al., 2020) and is measured by technological resilience, recoverability, workplace resilience, disruption absorption and resilience culture. Technological resilience embraces technological breakthroughs adopted by manufacturing system that prevents them from repeating past errors (Bustinza et al., 2019). Firms respond to technological changes through their technological capabilities and supports less down time, faster response times, improved communication, and streamlined return to normalcy (Bustinza et al., 2019; Kahiluoto & Makinen 2020; Tremblay et al., 2023; Tukamuhabwa et al., 2017). Rai et al. (2021) defines recoverability as the ability to restore the manufacturing system to either the previous state or to an improved state. It is the ability of a firm to restore operations to a prior normal level of performance after being disrupted (Esumman et al., 2020). Workplace resilience builds a multi-skilled and adaptable workforce, which in turn helps businesses not only reduce the chance of failure in daily operations but strengthens their ability to rebound quickly from unforeseen disruptions (Ali et al., 2018). The workplace resilience is strengthened by the knowledge and skills acquired in the workplace which form part of organizational capital or resources (Irawan et al., 2021).

The disruption absorption dimension is defined as the ability of a firm to maintain the structure and normal functioning of operations in the face of disruptions (Brandon-Jones et al., 2014; Esumman et al., 2020). Manufacturing operations that have high disruption absorption can accommodate disruptions or keep on in the face of disruptions. Disruption absorption naturally precedes recoverability. Resilient culture is the risk management culture of organizations (Scholten et al., 2019). Resilient culture is the organizational practice constantly developing ways of identifying possible risks within and without the production system, and maintaining risk management approach to reducing the vulnerability of the production system to possible changes in the surrounding environment, through organisation-wide set of shared beliefs and knowledge.

Cost Reduction

Cost reduction involves taking necessary steps to see whether there could be a possibility of cost savings from the use of material, labour, overheads, and so on in the production process. Cost reduction can be understood as the process of real and unchanging reduction in the unit costs of goods manufactured, without damaging their suitability for the use intended as well as quality. Consequently, cost reduction means any real or sincere saving in production, administration, and selling occasioned by the elimination of wasteful and unnecessary elements from the design of the product, as well as, the techniques and practices carried out in the production process. The study by Udokporo et al. (2020) defined cost reduction as the extent to which practices adopted by an organization contribute to the reduction of production costs. The compulsion for cost reduction becomes more evident when the profit margin has to be increased without affecting sales volume of the product (Akeem, 2017). Hence, cost reduction is a major indicator of performance (Singh & Hong, 2020). Waste reduction or elimination has proven to be a viable tool for cost reduction in the manufacturing sector (Nimeh et al., 2018; Udokporo et al., 2020).

The achievement of cost reduction is majorly through the removal of activities that do improve product value from a firm's manufacturing operations (Agyabeng-Mensah et al., 2020). Also, cost reduction should not be at the expense of essential characteristics or product quality.

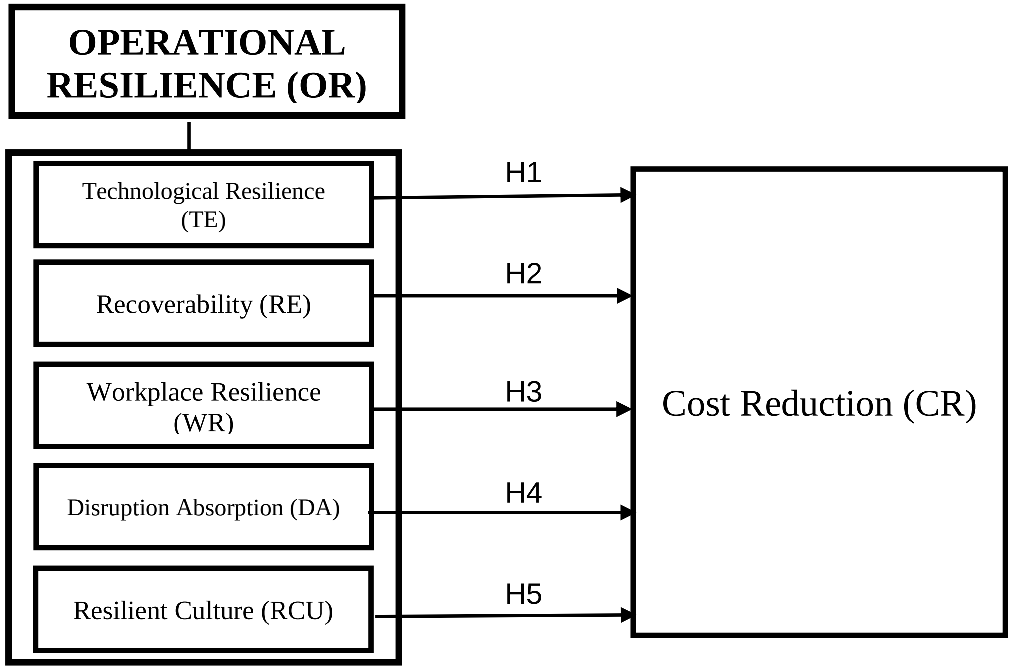
A major benefit of cost reduction is its positive impact on profit levels. It helps in price reduction, which in turn increases sales and improves the image of the firm. However, the limitations of cost reduction, is that over emphasis of it may lead to lower product quality. This study therefore defines cost reduction as the process of minimizing the associated costs of production such as cost of raw material, machines, wages and transportation in a way that improves the overall production process.

Operational Resilience Dimensions and Cost Reduction

Previous research has demonstrated that operational resilience looks for ways to support cost reduction. Saryatmo and Sukhotu (2021) examine the digital supply chain and operational performance. The study findings showed that digital supply chain has a positive effect on quality, productivity and cost reduction performance. Birkie et al. (2017) found that increase in manufacturing unit cost is a current challenge to the performance of most manufacturing companies. The studies showed that operational resilience has a direct effect on cost performance of manufacturing companies. These findings were corroborated by Rai et al. (2021) and revealed that cost reduction as an economic sustainability goal of organizations especially in developing economies, and found a positive significant effect of crisis anticipation and recoverability on economic sustainability. Similarly, Lotfi and Saghiri (2018) found out that higher level of resilience has a positive effect on decreased cost, better delivery performance and decreased time to recovery.

Wong et al. (2020) findings showed no support for the effect of resilience on financial performance under changing degrees of disruptions. However, Esumman et al. (2020) found that when disruption levels are low, application of disruption absorption measures may tend to increase total cost. The challenge of cost reduction is visible in manufacturing firms (Gill et al., 2014), and effort at cost reduction to minimize operating expenses and increase asset and inventory turnover is rewarded by an increase in financial performance and sustainability (Osazefua, 2019). Cost savings or reduction was found to be both a short term and long-term efficiency outcome (Amos et al., 2022; Eferakeya & Erhijakpor, 2020; Osazefua, 2019). Rai et al. (2021) results showed a positive significant effect of crisis anticipation on economic sustainability. According to Umoh and Wokocha (2013) cost reduction is closely associated with production improvement function. Li et al. (2017) results that show that operational resilience has significant impact on firms' financial outcomes while Ecksteina et al. (2015) found a positive effect of supply chain agility and adaptability on cost performance and operational performance. While Blome et al. (2013) study revealed that organizational ambidexterity has no significant moderating effect on the relationship between ambidextrous governance and cost performance in such a way that higher levels of organizational ambidexterity does not enhance the influence of ambidextrous governance on cost performance.

Figure 1: Proposed Research Model



The figure 1 shows the conceptual model linking the dimensions of operational resilience (technological resilience, recoverability, workplace resilience, disruption absorption, and resilient culture) which make up the independent variables, to cost reduction (the dependent variable).

Hypotheses Development and Operationalization of Variables

Past studies on operational resilience and cost reduction shows a variation of empirical finding. Li et al. (2020) revealed a positive significant effect of supply chain resilience on financial performance, while Li et al. (2017) showed a significant positive effect of supply chain preparedness, supply chain alertness and supply chain agility on financial performance. In addition, Lohmer et al., (2020) confirmed that blockchain technology affected disruption cost, and Gill et al. (2014) examining the impact of operational efficiency on the future performance of Indian manufacturing firms, showed a negative impact of changes in operating expenses on the future performance of the firm. Supplier and customer relationship were found to have a significant effect on market performance (Nimeh et al., 2018) as a means to combat shortages of raw materials as well as the recent rising cost of production. These findings call for more attention to drivers of cost in the food and beverages manufacturing industry, Nigeria.

Birkie et al. (2017) studies on the effectiveness of resilience capabilities in mitigating disruptions leveraging on supply chain structural complexity, identified cost reduction as a performance indicator. Thus, identifying that increase in manufacturing unit cost is a current challenge to the performance of most manufacturing companies, and fronting that operational resilience has a direct effect on cost performance of manufacturing companies. The challenge of cost reduction in developing countries was also found in literature, and the findings showed positive significant effect of higher levels of resilience on decreased cost, better delivery performance and decreased time to recovery; while crisis anticipation and recoverability positively affected economic sustainability (Lotfi & Saghiri, 2018; Rai et al., 2021). However, divergent views revealed no significant effect of production scheduling on cost minimization in the Nigerian Manufacturing Industry, and no significant effect of supply chain resilience on financial performance (Li et al. (2020; Umoh & Wokocha, 2013). Hence, the need to establish the relationship between operational resilience and cost reduction within the food and beverages companies of Nigeria.

In this study, there are two constructs; independent and dependent variables. The independent variables are operational resilience dimensions of technological resilience, recoverability, workplace resilience, disruption absorption, and resilient culture, while the dependent variable is cost reduction.

Hence, the five dimensions of operational resilience (OR) (the independent variable) include:

x_1 = Technological Resilience (TR)

x_2 = Recoverability (RE)

x_3 = Workplace Resilience (WR)

x_4 = Disruption Absorption (DA)

x_5 = Resilient Culture (RCU)

The dependent variable was presented as

Y = Cost Reduction

Hence, in establishing the effect of OR on cost reduction, five hypotheses were raised, these are:

H_{01} Technological resilience has no significant effect on cost reduction

H_{02} Recoverability has no significant effect on cost reduction

H_{03} Workplace resilience has no significant effect on cost reduction

H_{04} Disruption absorption has no significant effect on cost reduction

H_{05} Resilient culture has no significant effect on cost reduction

METHODOLOGY

The empirical context of the study consisted of the food and beverages manufacturing industry in Nigeria. A well-structured adapted research instrument (questionnaire) with a six-point Likert scale ranging from 6=Strongly Agree to 1=Strongly was administered to the top, middle, and lower level staff of the seven selected food and beverages manufacturing companies listed on the Nigerian Stock Exchange (NSE). The target respondents were selected based on their knowledge and experience about operational resilience and production efficiency. The data was gathered through a survey. Multiple channels were used to deliver the survey instrument and gather data from the respondents; this included the use of printed copies of the questionnaires as well as the online google form. To ensure that all questions were answered and to reduce the occurrence of invalid responses, adequate follow-up through persistent calls and text message reminders was made. Through the help of research assistants and the Human Resource officer or Talents Unit officer of the selected food and beverages companies, the researcher was able to get updates, clarify queries, and obtain timely responses. Potential respondents were assured strict anonymity and confidentiality (Atlay et al., 2018). Out of the 491 distributed questionnaires, 406 responses were retrieved and found usable for the analysis following thorough examination of the survey responses and dropping some of the responses found not useable and invalid. The absence of missing values, outliers, and the close examination of the measures of central tendency showed that the questionnaire were valid and usable. The resulting dataset has 406 responses, representing an effective response rate of 82.7% (Wu et al., 2022).

To test the proposed theoretical model and research hypotheses, the two-step process construct definition and development of measurement items was performed. Firstly, organizational studies and operations management literature were reviewed to help conceptualize the constructs used in theoretical model, and a list of measurement items for each construct verified by previous studies was identified. The items were then adapted to fit the context of food and beverages manufacturing. Professors of production and operations management, and industry experts were asked to fill out the questionnaire and indicate any inconsistencies found, thus establishing content validity. A pilot study was carried out using companies not included in the study's population, and the data obtained were tested for validity and reliability of the research instrument. The factor loading values on the latent variable with its indicators were more than 0.7 and considered very good (Sembiring & Widuri, 2023). Cronbach Alpha for the items was 0.7 and above, while the composite reliability (CR) of each construct used fell within the acceptable threshold of 0.70 (Essuman et al, 2020; Hair et al., 2021). Also, the average variance extracted (AVE) of 0.5 and above, indicated that the measurements used in the study was reliable and responsible for at least 50% of the variation in the items. Hence, convergent validity was established. Further, Fornell and Larcker (1981) recommendations for factor loading was adopted and the results were found to be within the acceptable range and they are significant at the 95% confidence level where the square root of the AVE is greater than all of the inter-construct correlation, showing strong evidence that the scales demonstrate discriminant validity (Hair et al., 2021).

Table 1: Validity and Reliability Results

S/N	**VARIABLES**	**Number of Items**	**Cronbach's Alpha**	**Composite Reliability**	**AVE**	**Remark**
1.	Technological Resilience	4	0.885	0.888	0.744	Accepted
2.	Recoverability	4	0.899	0.901	0.766	Accepted
3.	Workplace Resilience	4	0.894	0.897	0.758	Accepted
4.	Disruption Absorption	5	0.893	0.895	0.701	Accepted
5.	Resilient Culture	5	0.907	0.907	0.730	Accepted
6.	Cost Reduction	4	0.881	0.885	0.737	Accepted

Table 2: Discriminant Validity Statistics

Variables	Disruption Absorption	Recoverability	Resilience Culture	Technological Resilience	Workplace Resilience	Cost Reduction
Disruption Absorption	**0.837**					
Recoverability	0.605	**0.876**				
Resilience Culture	0.717	0.68	**0.855**			
Technological Resilience	0.612	0.460	0.677	**0.862**		
Workplace Resilience	0.59	0.637	0.633	0.693	**0.870**	
Cost Reduction	0.648	0.460	0.578	0.558	0.517	**0.858**

The study's hypotheses were tested using Partial Least Square Structural equation Modelling (PLS-SEM) based on the ability of PLS-SEM to deal with reflective multilevel constructs that are not easy to be dealt with in a single covariance-based SEM (Birkie et al., 2017; Hair et al., 2019). The assumptions of PLS-SEM are that model estimation involves linearly combining the indicators of a measurement model to form composite variables. These composite variables are assumed to be comprehensive representations of the constructs, and, therefore, valid proxies of the conceptual variables that is being examined (Hair et al., 2021). This model fitted the data as SRMR = 0.049, squared Euclidean distance (d_ULS) = 0.839, and NIF = 0.857 were compared with the threshold of 0.08, >0.5, and 0.9 respectively and found acceptable (Birkie, 2017).

3Model Specification

An econometric equation was developed to test the linearity in the relationship between operational resilience dimensions and cost reduction. The formulated model was:

Y= f(X)n

Where:

Y = Cost Reduction (CR)

X = Operational Resilience (OR)

$(x_1, x_2, x_3, x_4, x_5)$ = (OR)

The dimensions for operational resilience are technological resilience (TR), recoverability (RE), workplace resilience (WR), disruption absorption (DA), and resilient culture (RCU).

The functional relationship of the model is presented as:

$CR = \alpha_0 + \beta_1 TR_i + \beta_2 RE_i + \beta_3 WR_i + \beta_4 DA_i + \beta_5 RCU_i + \varepsilon_i$ ………………………… eq. 1

Where:

α_0 = Constant term

$\beta_1 – \beta_5$ = Coefficient of operational resilience dimensions

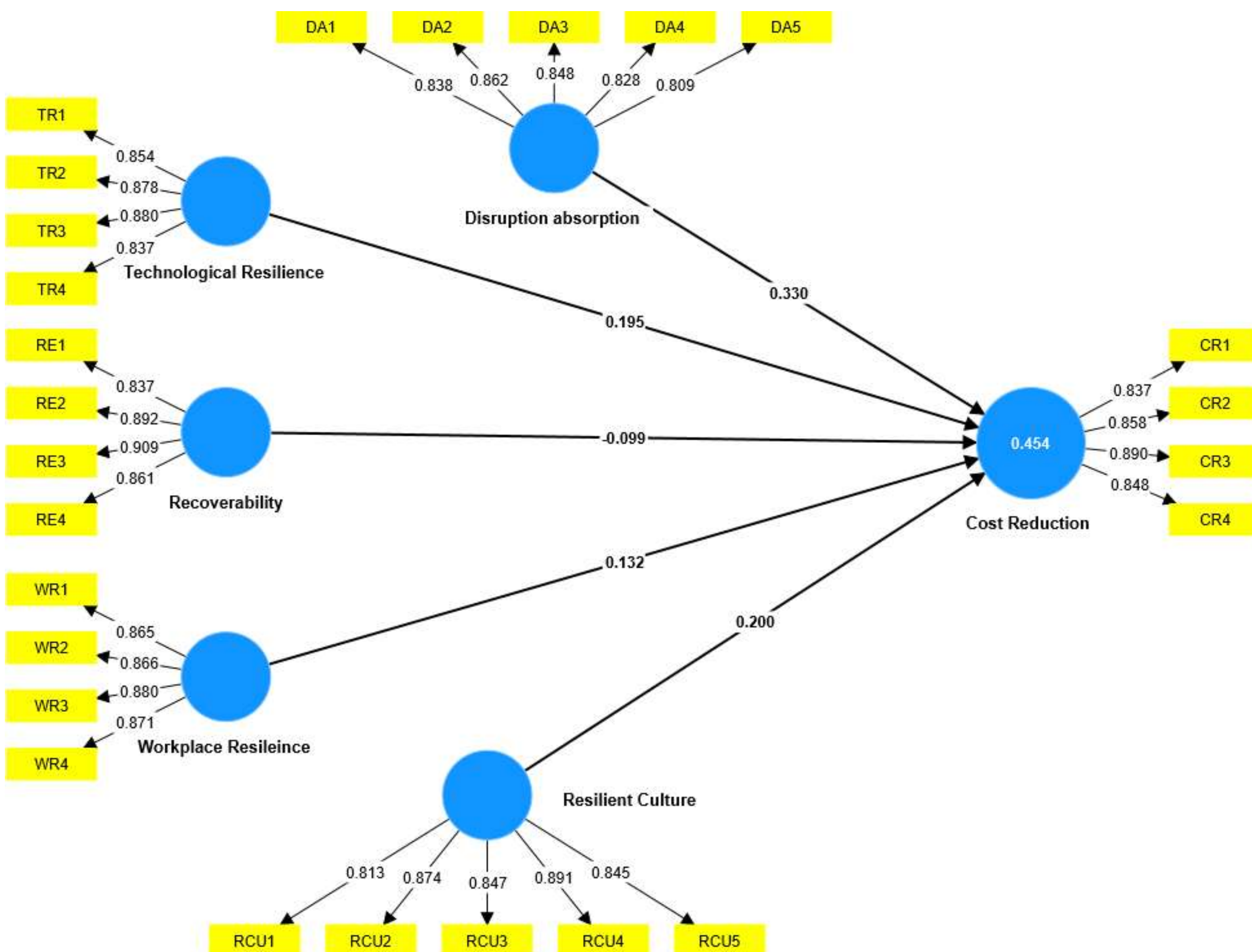
μ = Error term (Stochastic variable).

The preposition was that operational resilience dimensions have no significant effect on cost reduction of the food and beverages manufacturing industry in Nigeria. The *apriori* expectation is a positive and significant effect between the variables. Ethical considerations in research were adequately observed with, issues of confidentiality, anonymity, and secrecy in the data collection and processing were complied with.

ANALYSIS AND FINDINGS

To test the hypotheses operational resilience dimensions of technological resilience, recoverability, workplace resilience, disruption absorption, and resilient culture have no significant effect on cost reduction in the food and beverages manufacturing industry, Nigeria, multiple linear regression through Partial Least Squares Structural Equation Modeling (PLS-SEM) implemented via Smart-PLS version 4.0.8.8 software was used. The partial least square structural equation model (PLS-SEM) was used to carry out both the measurement and the structural equation modelling which studied the relationship between latent variables and verified the model. In the path analysis, the value of T-statistic is used to determine whether the hypothesis is true or not, T value that is > 1.96, means that the model is significant at 95% confidence level, and the hypothesis stated in the null should be rejected (Huang, 2021). In PLS-SEM, structural path co-efficient (β-value), T-statistic value, R-Square i.e., the coefficient of determination (R^2), and the degree of goodness-of-fit model help to determine the level of influence and relationship between the independent and dependent variables as well as the model fitness. F- Square (f^2) and Q – Square (Q^2) were determined to analyze the effect size, and the predictive relevance measure of the model.

Figure 2: Path Analysis Showing the Measurement and Structural model for the Study's Hypotheses (Smart PLS 4.0.8.8 output)



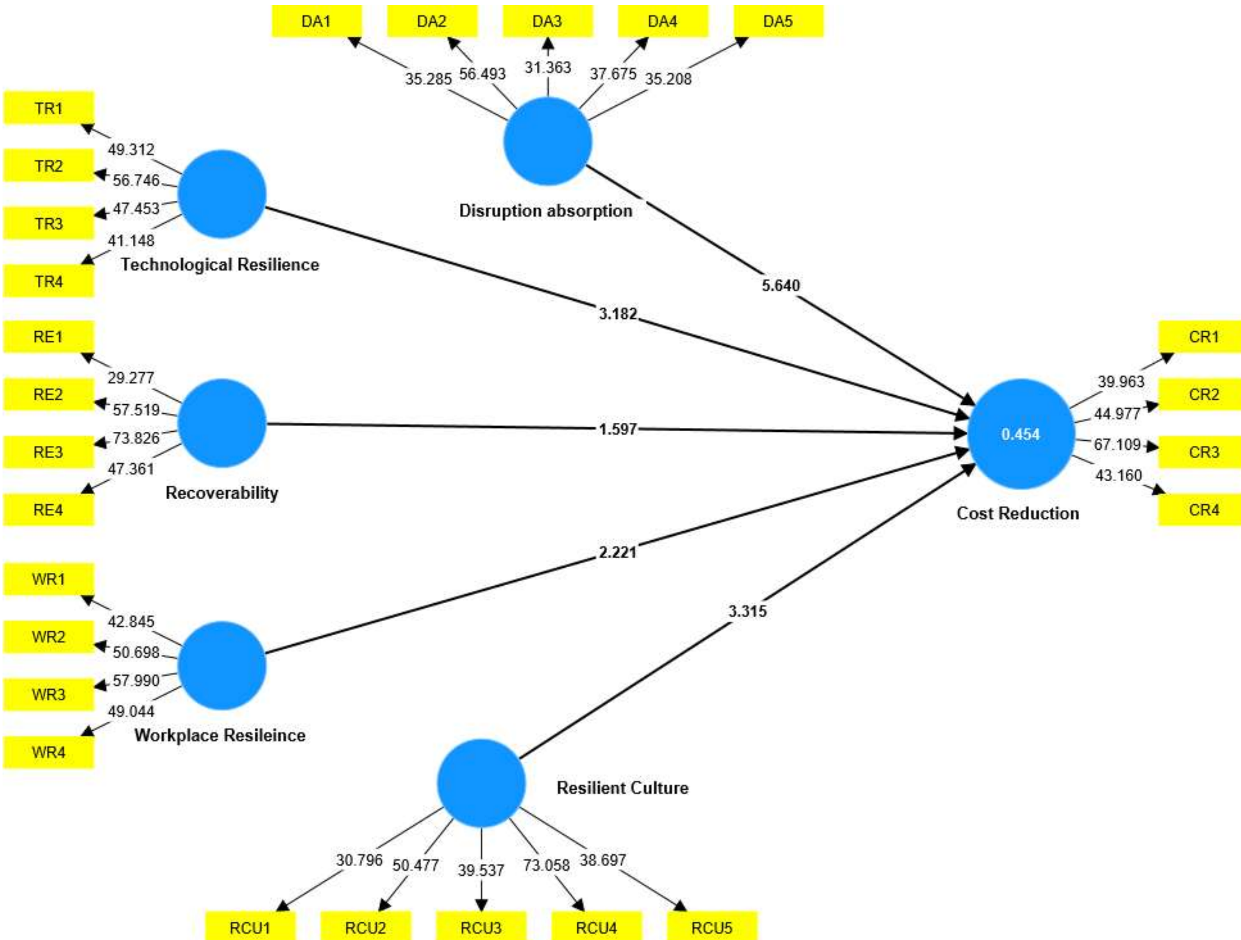


Figure 3: T- Statistics for the Study's Hypotheses (Smart PLS 4.0.8.8 output)

Table 3: Summary of PLS – SEM for the Effect of Operational Resilience dimensions on Cost Reduction in the Food and Beverages Manufacturing Industry, Nigeria (Smart PLS 4.0.8.8 output)

Path Description	**Original Sample (o) Unstandardized Beta (β)**	**T**	**Sig.**	**F^2**	**R**	**R^2**	**Adj. R^2**	**Q^2**
Technological Resilience -> Cost Reduction	0.195	3.182	0.001	0.024	0.674	0.454	0.447	0.436
Recoverability -> Cost Reduction	-0.099	1.597	0.110	0.007				
Workplace Resilience -> Cost Reduction	0.132	2.221	0.026	0.015				
Disruption Absorption -> Cost Reduction	0.330	5.640	0.000	0.085				
Resilient Culture -> Cost Reduction	0.200	3.315	0.001	0.026				

The PLS-SEM path coefficient (Figure 2) shows the measurement model (outer model) and the structural equation modelling (inner model) which studied the relationship between latent variables. From the outer model it was observed that the factor loadings for the items of each dimension of operational resilience and cost reduction were within the accepted threshold of ≥ 0.7 (Hair et al., 2019). In addition, the results shows that there are positive and significant effects of technological resilience (β = 0.195, t = 3.182, p<0.05) and workplace resilience (β = 0.132, t = 2.221, p<0.05) on cost reduction. Therefore, H_{01} and H_{03} were rejected. H_{04} which denotes an insignificant effect of disruption absorption (DA) on cost reduction (CR) is rejected as the results shows a positive relationship between of 33% (β = 0.330, t = 5.640, p<0.05). The fifth hypothesis (H_{02}) is rejected as resilient culture was found to have a positive and significant effect on cost reduction (β = 0.200, t = 3.315, p<0.05). However, Recoverability showed a negative and insignificant effect on cost reduction (β = -0.099, t = 1.597, p>0.05). Hence H_{02} was accepted. The results of the analysis revealed that four of the dimensions of operational resilience (technological resilience, workplace resilience, disruption absorption, and resilient culture) have significant and positive effect on the cost reduction in the food and beverages manufacturing industry, Nigeria. The T- statistics further confirms this result as technological resilience (t =3.182 > 1.96), workplace resilience (t =2.221 > 1.96), disruption absorption (t = 5.640 >1.96), and resilient culture (t=3.315 >1.96) had t-statistic values greater than 1.96. This implied that, technological resilience, workplace resilience, disruption absorption, and resilient culture are important determinants of cost reduction in the food and beverages manufacturing industry, Nigeria. The results suggest that improving technological resilience, workplace resilience, disruption absorption, and resilient culture would lead to an improvement in cost reduction ability of the industry.

R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables can, as a general rule of thumb, be accordingly defined as substantial, moderate, or weak, according to academic research that focuses on social sciences (Hair et al., 2011; Mertler et al., 2021). Hence, the study results reveal that a moderate positive relationship (R= 0.674) exists between the dimensions of operational resilience (technological resilience, workplace resilience, disruption absorption, and resilient culture) and cost reduction, and these dimensions of operational resilience together account for 44.7% ($Adj\ R^2$ = 0.447) of the variation in cost reduction. The remaining 55.3% variation in cost reduction was explained by other exogenous variables different from operational resilience dimensions considered in this study. In addition, there are weak effect sizes (f^2 = 0.024, 0.085, and 0.026) for three dimensions of operational resilience (technological resilience, disruption absorption, and resilient culture) on the change in R^2 of cost reduction. However, recoverability and workplace resilience f^2 results showed negligible effect on the R^2 when removed from the model (f^2 =0.007 and 0.015 respectively). Hence, the R^2 value of cost reduction would not be affected when recoverability and workplace resilience were removed from the model. The effect size was determined using Cohen's f^2 metric. According to Cohen (1988) f^2 >0.35, >0.15, and >0.02 could be considered as strong, moderate, and weak, respectively. The Q^2 value of 0.436 obtained indicates that the model has sufficiently large predictive quality based on the threshold of small, medium, and large predictive relevance (0.02, 0.15, and 0.35) respectively (Chin, 1998).

DISCUSSION OF FINDINGS

Findings from the test of hypotheses are supported by literature conceptually, empirically, and theoretically. From the conceptual perspective, Suryaningtyas et al. (2019) and Jia et al. (2020) showed that operational resilience is the capacity of a system to absorb change, or deal with change while persisting in developing its original form amidst disturbances and changing conditions. In addition, resilient systems reduce the probability of failure as well as the consequences of failure (Irawan et al., 2021). Lee et al. (2018) conceptualized technological resilience as the long-term capacity of a system to maintain its levels of technological knowledge creation in the context of technological crises. This definition highlights technological knowledge creation as key to attaining technological resilience in the time of a crisis. Further, Bustinza et al. (2019) study revealed that technological resilience is the technological breakthroughs in job scheduling, communication, visibility, and so on adopted by manufacturing system that prevents them from repeating past errors. Hence technological resilience helps organizations to take proactive steps to forestall future crisis through information sharing, investment in technology, and the acquisition of the requisite technological knowledge. This suggests that where there is no adequate presence of technological resilience, cost reduction is adversely affected.

Similarly, Lohmer et al. (2020) as a management developed capacity that causes effective adaptation to be more likely. It is the physiological, behavioural, psychological or social mechanisms that make effective adaptation possible. Similarly, McEwen and Boyd (2018) revealed that workplace resilience is the positive indicator that effective adaptation has occurred such that employees can show recovery, bounce back or maintain equilibrium, or a combination of these. In addition, Brandon-Jones et al. (2014) and Esumman et al. (2020) adding to the dimensions of operational resilience found disruption absorption to be the ability of a firm to maintain the structure and normal functioning of operations in the face of disruptions. This ability suggests that high levels of disruption absorption capabilities enables manufacturing firms achieve cost reduction. This is because disruption absorption measure of operational resilience offers a more active usage of resilient asset (Ivanov, 2022). Disruption absorption starts from the planning stage of the manufacturing process; hence a major characteristic of this dimension of operational resilience is that it is proactive in nature Romero et al., 2021). In addition, resilient culture was defined as the risk management culture of organizations (Scholten et al., 2019). It helps organizations adapt to the surrounding environment by providing coordinated approach for identifying and managing production risk in order to reduce system vulnerability (Bui et al., 2020). The striking advantage of resilient culture is its ability to harmonize the goals of all the units of the production system towards risk management and this has a strong influence on cost reduction (Birkie, 2017). As literature has showed cost reduction to be the extent to which practices adopted by an organization contribute to the reduction of production costs (Udokporo et al., 2020).

Empirically, the findings of this study supported Rai et al. (2021) results, which showed a positive significant effect of crisis anticipation on economic sustainability through the conservation of resources and sustainable production. Similarly, Li et al. (2020) results showed that operational resilience dimensions of technological resilience and resilient culture had a significant effect on increased performance through cost reduction. These findings corroborate Li et al. (2017) results that show that operational resilience has significant impact on firms' financial outcomes, as well as Ecksteina et al. (2015) findings that revealed a positive effect of supply chain agility and adaptability on cost performance and operational performance. Birkie et al. (2017) studies on the effectiveness of resilience capabilities in mitigating disruptions while leveraging on supply chain structural complexity. As the study identified cost reduction as a performance indicator, their results showed that operational resilience has a direct effect on cost performance of manufacturing companies.

Similarly, Lotfi and Saghiri (2018) study found that higher level of resilience had a positive effect on decreased cost. Although Wong et al. (2020) findings showed no support for the effect of resilience on financial performance under changing degrees of disruptions, which is contrary to the results obtained in this study. Further examination of the findings of Esumman et al. (2020) revealed that the effect of operational resilience dimension on cost reduction are better evident under a high operational disruption situation, as the dimensions of operational resilience do not yield the same efficiency gains. Esumman et al. (2020) findings were corroborated by this study's results as the beta values from Table 4.2.2.1 of the dimensions of operational resilience adopted in this study showed that disruption absorption ($\beta = 0.329$, $p<0.05$) had the highest positive and significant effect on cost reduction in the food and beverages industry than the other dimensions of operational resilience. Relatively, resilient culture ($\beta = 0.2$, $p<0.05$) possessed a more positive significant effect on cost reduction than technological resilience (β = 0.194, $p<0.05$), and workplace resilience (β = 0.132, $p<0.05$). Esumman et al. (2020) also found that, disruption absorption, unlike recoverability, is largely built at the pre-disruption stage and involves more resource investment in buffers. The implication is that lower levels of disruption will make the application of disruption absorption tend to increase total cost. In that, when operational disruption is low, increasing levels of disruption absorption can generate lower efficiency gains.

Theoretically, findings of this study corroborate the underpinning theoretical assumptions of dynamic capability theory used in this study. This is sustained as dynamic capability theory helps explain the need for organizations to sense, shape, seize opportunities, and maintain competitiveness by enhancing, combining, protecting and reconfiguring firm's resources (Altay et al., 2018; Bustinza et al., 2019). Reconfiguring activities are iterative such that minor adjustments made by organizations, may be adequate to exploit current opportunities that help in cost reduction. The theory constitutes a relevant framework that explains how manufacturing organizations coordinate their resources and capabilities in response to risks and disruptions, as companies' performance is the ultimate aim of dynamic capabilities. Consequently, enhancing operational resilience through technological, workplace resilience, making contingency plans and building resilient culture helps provide valuable, rare, inimitable and non-substitutable (VRIN) dynamic capabilities that translates to production efficiency and cost reduction. The results of this study are in concomitance with this theoretical perspective. Hence, findings of this study suggested that food and beverages manufacturing industry in Nigeria should pay more attention to the development of technological resilience, workplace resilience, disruption absorption, and resilient culture to attain and improve cost reduction.

CONCLUSION AND RECOMMENDATION

The critical productions and operations management goal of achieving and sustaining cost minimization formed the focal point the findings of this study addressed. The findings distilled the ambiguity of the operational resilience construct through its well-focused dimensions (technological resilience, recoverability, workplace resilience, disruption absorption, and resilient culture) that were found to significantly promote cost reduction. The management's herculean task of achieving production efficiency through achieving cost reduction was established. Therefore, the sector's management should pay optimal attention to the adoption of advanced technologies adoption, new production methods, information sharing with customers and suppliers to enable the industry achieve reduction of its core operations costs. Workplace resilience would bring about reduction in extra workforce cost and general overhead cost. Since cost minimization is one the major goal of production and operations managers, the development of disruption absorption capabilities, coupled with sustaining a resilient culture will help achieve this objective.

This study was limited to the food and beverages companies, and focused specifically on seven listed food and beverages manufacturing companies in Nigeria. This limitation presents potential opportunities for further studies. Further studies may adopt a longitudinal research design to help establish the relationship between operational resilience dimensions and cost reduction over a long period of time to observe the unique developmental trends, and how current decisions can influence future outcomes of the same population, or other manufacturing or service sectors.

REFERENCES

Abeysekara, N., Wang, H., & Kuruppuarachchi, D. (2019). Effect of supply-chain resilience on firm performance and competitive advantage: A study of the Sri Lankan apparel industry. *Business Process Management Journal, 25*(7), 673-1695. https://doi.org/10.1108/BPMJ-09-2018-0241

Akeem, L. B. (2017). Effect of cost control and cost reduction techniques in organizational performance. *International Business and Management, 14*(3), 19-26. https://doi:10.3968/9686

Ali, I., Nagalingam, S., & Gurd, B. (2018). A resilience model for cold chain logistics of perishable products. *The International Journal of Logistics Management, 29*(3), 922-941. https://doi.org/10.1108/IJLM-06-2017-0147

Ali, M. H., Suleiman, N., Khalid, N., Tan, K. H., Tseng, M., & Kumar, M. (2021). Supply chain resilience reactive strategies for food SMEs in coping to COVID-19 crisis. *Trends in Food Science and Technology, 109*, 94-102. https://doi.org/10.1016/j.tifs.2021.01.021

Altay, N., Gunasekaran, A., Dubey, R., & Childe, S. J. (2018). Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within humanitarian setting: A dynamic capability view. *Production Planning and Control, 29*(14), 1158-1174. https://doi.org/10.1080/09537287.2018.1542174

Amos, N. B., Ariguzo, V. A., Egwakhe, A. J., & Abiodun, A. J. (2020). Lean manufacturing and production efficiency of the food and beverages sector in Nigeria. *International Journal of Advanced Operations Management, 12*(4), 330-350. https://doi.org/10.1504/IJAOM.2020.112726

Amos, N. B., Dogo, E. B., Egwakhe, J. A., & Umukoro, J. E. (2022). Operational resilience and efficiency of private universities in Southwest Nigeria: The COVID-19 Pandemic experience. *Journal of Business and Entrepreneurship, 10*(1), 1-13. https://doi.org/10.46273/job&e.v9i2.203

Ampah, J., Ribeiro, J. X. F., Bugyei, K. A., Kumi, F., Akowuah, J. O., Ofori, H., & Otchere, C. (2021). Status, challenges and prospects of food processing equipment fabricators in Ghana. *Scientific African, 12*, e00843. DOI.org/10.1016/j.sciaf.2021.e00843

Aslam, H., Blome, C., Roscoe, S., & Azhar, T. M. (2018). Dynamic supply chain capabilities: How market sensing, supply chain agility and adaptability affect supply chain ambidexterity. *International Journal of Operations & Production Management*, 38(12), 2266-2285. https://doi.org/10.1108/IJOPM-09-2017-0555

Aslam, H., Khan, A. Q., Rashid, K., & Rehman, S. (2020). Achieving supply chain resilience: The role of supply chain ambidexterity and supply chain agility. *Journal of Manufacturing Technology Management, 31*(6), 1185-1204. https://doi.org/10.1108/JMTM-07-2019-0263

Birkie, S. E., Trucco, P., & Campos, P. F. (2017). Effectiveness of resilience capabilities in mitigating disruptions: Leveraging on supply chain structural complexity. *Supply Chain Management: An International Journal*, *22*(6), 506-521. https://doi.org/10.1108/SCM-01-2017-0009

Blome, C., Schoenherr, T. & Rexhausen, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: A dynamic capabilities perspective. *International Journal of Production Research, 51*(4), 1295-1318. DOI: 10.1080/00207543.2012.728011

Brandon-jones, E., Squire, B., Autry, C. W., & Petersen, K. J. (2014). A contingent resource-based perspective of supply chain resilience and robustness. *Journal of Supply Chain Management, 50*(3), 55-74. https://doi.org/10.1111/jscm.12050

Bui, T., Tsai, F. M., Tseng, M., Tan, R. R., Yu, K. D. S., & Lim, M. K. (2020). Sustainable supply chain management towards disruption and organizational ambidexterity: A data driven analysis. *Sustainable Production and Consumption, 26,* 373-410. https://doi.org/10.1016/j.spc.2020.09.017

Bustinza, O. F., Vendrell-Herrero, F., Perez-Arostegui, M., & Parry, G. (2019). Technological capabilities, resilience capabilities and organizational effectiveness. *The International Journal of Human Resource Management*, 30(8), 1370-1392. https://doi.org/10.1080/09585192.2016.1216878

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research, 295*(2), 295-336.

Chowdhury, M. M. H., & Quaddus, M. (2017). Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics, 188*, 185-204. https://doi.org/10.1016/j.ijpe.2017.03.020

Chowdhury, M. M. H., Quaddus, M., & Agarwal, R. (2019). Supply chain resilience for performance: Role of relational practices and network complexities. *Supply Chain Management: An International Journal, 24*(5), 506-521. https://doi.org/10.1108/SCM-09-2018-0332

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd Ed.). New York: Routledge.

Dubey, R., Gunasekaran, A., Childe, S. J., Wamba, F. S., & Foropon, C. (2019). Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. *International Journal of Production Research, 59*(1), 110-128. https://doi.org/10.1080/00207543.2019.1582820

Ecksteina, D., Goellnera, M., Blomeb, C., & Henkec, M. (2015). The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity. *International Journal of Production Research*, *53*(10), 3028-3046. DOI: 10.1080/00207543.2014.970707

Eferakeya, E. I., & Erhijakpor, A. E. O. (2020). Determinants of operating efficiency of Nigeria's banking sector. *Palarch's Journal of Archaeology of Egypt/Egyptology, 17*(7), 13151- 13166.

Essuman, D., Boso, N., & Annan, J. (2020). Operational resilience, disruption, and efficiency: Conceptual and empirical analyses. *International Journal of Production Economics, 229*, 1-11. https://doi.org/10.1016/j.ijpe.2020.107762

Flanders Investment and Trade (2020). Food and beverages market overview in Nigeria. https://www.flandersinvestmentandtrade.com/export/sites/trade/files/market_studies/Food%20%26%20Beverage%20Nigeria-2020.pdf

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. https://doi.org/10.1177/0022243781018001

Gill, A., Singh, M., Mathur, N., & Mand, H. S. (2014). The impact of operational efficiency on the future performance of Indian manufacturing firms. *International Journal of Economics and Finance*, 6(10), 259-269. http://dx.doi.org/10.5539/ijef.v6n10p259

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice, 19*(2), 139-152.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review, 31*(1), 2-24. DOI: 10.1108/EBR-11-2018-0203

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *An introduction to structural equation modeling. In Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R* (pp. 1-29). Springer, Cham.

Irawan, D., Prabowo, H., Kuncoro, E. A., & Thoha, N. (2021). Operational resilience and human capital toward corporate sustainable longevity in Indonesian "Jamu" industry. *Journal of Asian Finance, Economics and Business, 8*(3), 1035–1044. DOI: 10.13106/jafeb.2021.vol8.no3.1035

Ivanov, D. (2022). Lean resilience: AURA (Active Usage of Resilience Assets) framework for post-COVID-19 supply chain management. *The International Journal of Logistics Management*, 33(3), 1196-1217. https://doi.org/10.1108/IJLM-11-2020-0448.

Ivanov, D. (2023). The Industry 5.0 framework: Viability-based integration of the resilience, sustainability, and human-centricity perspectives. International Journal of Production Research, 61(5), 1683-1695. doi.org/10.1080/00207543.2022.2118892

Jia, X., Chowdhury, M., Prayag, G., & Chowdhury, M. M. H. (2020). The role of social capital on proactive and reactive resilience of organizations post-disaster. *International Journal of Disaster Risk Reduction, 48,* 101614. https://doi.org/10.1016/j.ijdrr.2020.101614

Kahiluoto, H., & Makinen, H. (2020). Supplying resilience through assessing diversity of responses to disruption. *International Journal of Operations & Production Management, 40*(3), 271-292. https://doi.org/10.1108/IJOPM-01-2019-0006

Lee, P., Chen, S., & Su, H. (2018). Exploring technological resilience at the country level with patents. *Technology Analysis & Strategic Management* 1105-1120. https://doi.org/10.1080/09537325.2018.1442572

Li, C., Wong, C. W. Y., Yang, C., Shang, K., & Lirn, T. (2020). Value of supply chain resilience: roles of culture, flexibility, and integration. *International Journal of Physical Distribution & Logistics Management, 50*(1), 80-100. https://doi.org/10.1108/IJPDLM-02-2019-0041

Li, X., Wu, Q., Holsapple, C. W., & Goldsby, T. J. (2017). An empirical examination of firm financial performance along dimensions of supply chain resilience. *Management Research Review, 40*(3), 254-269. https://doi.org/10.1108/MRR-02-2016-0030

Lodorfos, G., Kostopoulos, I., Konstantopoulou, A., & Shubita, M. (2023). Guest editorial: Sustainable business resilience and development in the pandemic economy: insights from organizational and consumer research. *International Journal of Organizational Analysis, 31*(1), 1-6. https://doi.org/10.1108/IJOA-02-2023-008

Lohmer, J., Bugert, N., & Lasch, R.. (2020). Analysis of resilience strategies and ripple effect in blockchain-coordinated supply chains: An agent-based simulation study. *International Journal of Production Economics, 228*, 1-35.

Lotfi, M., & Saghiri, F. (2018). Disentangling resilience, agility and leanness: Conceptual development and empirical analysis. *Journal of Manufacturing Technology Management, 29*(1), 168-197. https://doi.org/10.1016/j.ijpe.2020.107882

Manhart, P., Summers, J. K., & Blackhurst, J. (2020). A meta-analytic review of supply chain risk management: assessing buffering and bridging strategies and firm performance. *Journal of Supply Chain Management, 56*(3), 66-87. https://doi.org/10.1111/jscm.12219

McEwen, K., & Boyd, C. M. (2018). A measure of team resilience: Developing the resilience at work team scale. *Journal of Occupational and Environmental Medicine, 60*(3), 258-272. DOI: 10.1097/JOM.0000000000001223

Melián-Alzola, L., Fernández-Monroy, M., & Hidalgo-Peñate, M. (2020a). Hotels in contexts of uncertainty: Measuring organisational resilience. *Tourism Management Perspectives, 36*, 1-14. https://doi.org/10.1016/j.tmp.2020.100747

Mertler, C. A., Vannatta, R. A., & LaVenia, K. N. (2021). Advanced and multivariate statistical methods: Practical application and interpretation. Routledge.

Morisse, M., & Prigge, C. (2017). Design of a business resilience model for industry 4.0 manufacturers. *Twenty-third Americas Conference on Information Systems*, 1-10.

National Bureau of Statistics (2021). Nigerian Gross Domestic Report first quarter 2021. https://nairametrics.com/2021/05/23/nigerias-gdp-grows-marginally-by-0-51-in-q1-2018

Nestle Nigeria Annual Report, 2020. https://africanfinancials.com/document/ng-nestle-2022-ar-

Nimeh, H. A., Abdallah, A. B., & Sweis, R. (2018). Lean supply chain management practices and performance: Empirical evidence from manufacturing companies*. International Journal of Supply Chain Management, 7*(1), 1-15.

Nyaupane , G. P., Prayag , G., Godwyll, J., & White, D. (2020). Toward a resilient organization: Analysis of employee skills and organization adaptive traits. *Journal of Sustainable Tourism*, *29*(4), 1-20. https://doi.org/10.1080/09669582.2020.1822368

Oladejo, M., Yinus, S. O., Shittu, S., & Rutaro, A. (2021). Internal audit proactive and financial reporting quality: Perspective from Nigerian quoted foods and beverages firms. *KIU interdisciplinary Journal of Humanities and Social Sciences, 2*(1), 410-428.

Olaleye, B. R., Anifowose, O. N., Efuntade, A. O., & Arije, B. S. (2021). The role of innovation and strategic agility on firms' resilience: A case study of tertiary institutions in Nigeria. *Management Science Letters, 11*, 297–304. DOI: 10.5267/j.msl.2020.8.003

Osazefua, I. J. (2019). Operational efficiency and financial sustainability of listed manufacturing companies in Nigeria. *Journal of Accounting and Taxation, 11*(1), 17-31. DOI: 10.5897/JAT2018.0329

Oyedijo, A., Adams, K., & Koukpaki, S. (2021). Supply chain management systems in Africa: Insights from Nigeria. In *Business in Africa in the Era of Digital Technology* (pp. 121-140). Springer, Cham. DOI: 10.1007/978-3-030-70538-1_8

Rai, S. S., Rai, S., & Singh, N. K. (2021). Organizational resilience and social-economic sustainability: COVID-19 perspective. *Environment, Development and Sustainability*, 1-18.

Romero, D., Stahre, J., Larsson, L., & Ronnback, A. O. (2021). Building Manufacturing Resilience through Production Innovation. 27th International ICE-Conference on Engineering, Technology and Innovation. 1-15. https://www.researchgate.net/publication/352106450_Building_Manufacturing_Resilience_through_Production_Innovation

Saryatmo, M. A., & Sukhotu, V. (2021). The influence of the digital supply chain on operational performance: a study of the food and beverage industry in Indonesia. *Sustainability, 13*(9), 5109. https://doi.org/10.3390/su13095109

Scholten, K., Scott, P. S., & Fynes, B. (2019). Building routines for non-routine events: Supply chain resilience learning mechanisms and their antecedents. *Supply Chain Management: An International Journal, 24*(3), 430-442. https://doi.org/10.1108/SCM-05-2018-0186

Sembiring, F. N. B., & Widuri, R. (2023). The effect of auditor experience, big data and forensic audit as mediating variables on fraud detection. Journal of Theoretical and Applied Information Technology, 101(6), 2324-2337.

Singh, N. P., & Hong, P. C. (2020). Impact of strategic and operational risk management practices on firm performance: An empirical investigation. *European Management Journal*, 1-10 https://doi.org/10.1016/j.emj.2020.03.003

Suryaningtyas, D., Sudiro, A., Troena-Eka, A., & Irawanto-Dodi, W. (2019). Organizational resilience and organizational performance: Examining the mediating roles of resilient leadership and organizational culture. *Academy of Strategic Management Journal, 18*(2), 1-7.

Tremblay, M. C., Kohli, R., & Rivero, C. (2023). Data is the new protein: How the commonwealth of Virginia built digital resilience muscle and rebounded from opioid and covid shocks. *MIS Quarterly, 47*(1), 423-449. DOI:10.25300/MISQ/2022/17260

Tukamuhabwa, B., Stevenson, M., & Busby, J. (2017). Supply chain resilience in a developing country context: A case study on the interconnectedness of threats, strategies and outcomes. *Supply Chain Management, 22*(6), 486-505. https://doi.org/10.1108/SCM-02-2017-0059

Udokporo, C.K., Anosike, A.I., Lim, M.K., Nadeem, S.P., Garza-Reyes, J.A., & Ogbuka, C.P. (2020). Impact of lean, agile and green (LAG) on business competitiveness: An empirical study of fast moving consumer goods businesses. *Resources, Conservation & Recycling, 156*, 1-10. DOI: 10.1016/j.resconrec.2020.104714

Umoh, G. I., & Wokocha, I. H. (2013). Production improvement function and corporate operational efficiency in the Nigerian manufacturing industry. *Journal of Information Engineering and Applications, 3*(10), 39-45.

Wong, C. W., Lirn, T. C., Yang, C. C., & Shang, K. C. (2020). Supply chain and external conditions under which supply chain resilience pays: An organizational information processing theorization. *International Journal of Production Economics*, *226*, 107610. https://doi.org/10.1016/j.ijpe.2019.107610

Wu, M. J., Zhao, K., & Fils-Aime, F. (2022). Response rates of online surveys in published research: A meta-analysis. *Computers in Human Behavior Reports, 7*, 100206. https://doi.org/10.1016/j.chbr.2022.100206