



Exploring the Items for Measuring Flexible Supply Chain Management in the Organization in the Context of Nigeria: An Exploratory Factor Analysis

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Abstract

The aim of this research to conduct instruments validation for the items of flexible supply chain management (FSCM) through exploratory factor analysis (EFA). The data collection tool employed is questionnaires which was administrated to employees in the manufacturing companies in Nigeria. 100 questionnaires were collected to do the EFA. The results reveal that the Bartlett's Test of Sphericity was less than 0.05 (<0.05) which is Significant ($P\text{-value} < 0.05$). Kaiser-Meyer-Olkin (KMO), Measure of Sampling Adequacy was higher than 0.6 (> 0.6), and this indicates that the sample is adequate in size. Cronbach's Alpha test was higher than 0.7 for the all the constructs items, this indicates that these items are all reliable. This study found a valid and reliable instrument for measuring the components of flexible supply chain management that could boost performance in manufacturing companies in Nigeria context. This study was applied to the manufacturing companies in Nigeria. This study adds to the measurement of the FSCM. This study contributes to the field of supply chain by evaluating and testing items that fit for testing the construct of flexible supply chain management.

Keywords: Exploratory Factor Analysis, Flexible Supply Chain Management, Construct, Manufacturing Companies, Employees

Introduction

In the past decade, more attention has been paid on Supply Chain Management (SCM) in the organizations. Partly, this is because of the crucial effect that globalization has on manufacturing locally and internationally. Um (2017) contended that supply chain flexibility is the capability of ease to changes in production stages, raw materials procurements as well as transport capability. An organization could adjust as well as responding efficiently to change in customer request, market conditions, interruptions, and other factors that might have effect on the flow of products and services (Siagian et al., 2021). Via expansion of the market place and increased competitions, globalization lead customers to put more demand

on manufacturers to improve quality service and flexibility, while maintaining competitive cost (Laosirihongthong and Dangayach, 2005). Therefore, organizations are looking for ways to secure costs, improve quality, technology and consumers added-value as means to grow in competitive environment. To be successful, companies ought to decrease costs, advance quality and offer quick responses to consumer need. For instance, Um and Han (2021) cited the need of flexibility in order to deal with supply chain risk like materials supply interruptions or labour deficiencies. Additionally, Singh (2024) stressed that companies could alleviate the effect of interruptions by applying pro-active flexibilities that involve anticipation of possible risks as well as implementation of adaptable resolutions before time.

Contemporary supply chain management needs huge flexibilities and resilience to steer worldwide difficulty as well as increase in customers demand (Lai, 2024). It is suggested that Pointers of supply-chain flexibilities comprise lead-time, fill-rate, inventory's turnover, responses and resilience. Okyere et al. (2015) describe lead-time as the entire time it takes from getting a consumer demand to the time it takes deliver the final goods. Basically, it shows how fast supply chain could respond to consumer request.

The goal of a flexible supply-chain is to reduce lead time by simplifying operations, improvement of communication with suppliers, and accepting effective production approaches (Kimwaki, 2024). According to Darko et al. (2018) shorter lead-times improve consumer satisfactions and it permit firms to adapt quicker to changes in demands. Previous literatures suggests that flexible supply chain management is vital for better organization performance. Flexibility is the capability of an organization to competently and effectively adapt to predicted and unexpected changes (Tummala et al., 2006).

Siagian et al. (2021) define flexible supply chain as a firm's capability in adapting and responding efficiently to changes in customer demands, markets situations, interruptions as well as other factors which could affect the flowing of products. Flexible supply chain is a company's capability to rapidly change and re-configure its supply chain procedures, resources, and approaches in response to external or internal alterations (Huo et al., 2018). Moreover, Um (2017) claimed that supply chain flexibility is the capacity to alter with ease the levels of production, raw materials procurement as well as transportations ability.

Settembre-Blundo et al. (2021) contended that flexible systems improve a company's organic potentials by allowing it to challenge as well as react to unanticipated environment and operation issues. This organic capability is vital because it allows companies to adapt rapidly to change internally as well as externally, this is vital to maintain a competitive advantage. Based on Sandberg (2021), the interconnection of production, logistics, as well as other flexibility features is vital, hence combination of production as well as logistic flexibility assist in speeding up products development flexibilities. These flexibilities could provide some competitive edge for a manufacturing company. Hence, companies need to collaborate with suppliers and adjust speedily to improve their agility and responsiveness (Narayanan et al., 2015). A flexible supply chain enables companies to rapidly reorganise as well as readjust resources in response to disturbances (Enrique et al., 2022).

Flexibility in numerous features, like distributions, productions facilities, supply bases, and work force skills, meaningfully adds to the whole flexibility of supply chains (Piprani et al.,

2022). This flexibility enables companies to provide quickly response effectively during stormy times, enabling resources reconfiguration and increasing their capacity to adjust to unexpected issues (Agrawal et al., 2023). Then, integrations of flexibilities in the supply chains strengthens resilience, allowing companies to uphold the continuation of their operation and keenness in dynamics environment (Chunsheng et al., 2020).

Despite the importance of flexible supply chain management in the manufacturing companies, the search of the previous literature reveal studies in this domain is scanty most particularly in developing countries and Nigeria in particular where there is decline in manufacturing firms.

For instance, due to of low performance as well as decrease in incomes, several manufacturing companies had vanished from the manufacturing industry in Nigeria (NBS, 2012, 2020). Therefore, the main objective of this research is to perform instrument validation of the items of flexible supply chain management construct through exploratory factor analysis (EFA).

Methodology

This study used the quantitative method through survey. Flexible supply chain management has been measured in previous studies (Fantazy 2007) and Fantazy et al., 2009). In line with the above literature, the same items were adapted to measure flexible supply chain management in this study. The data for this study was gathered by using a self-administered (face-to-face) method which is in line with many researchers (Davis, 1989; Wang et al., 2003; Pikkarainen et al.; 2004), who used questionnaire survey to collect the data, and face-to-face self-administered method (Alsajjan and Dennis 2010; Abbasi et al., 2011). Moreover, as stated by Awang et al., (2016) that 10 points of Likert scale are more effective than 5 points of Likert scale in operating of the measurement model (Awang et al., 2016). Hence, this study applied the interval scale of 10, where the respondents select a statement amongst several statements from 1-10. Where number 1 stands for strongly disagree, while, number 10 stands for strongly agree. The population of this study comprised the employees in manufacturing firms in Nigeria. The target respondents for this study are the manufacturing companies' employees since this study is focused on supply chain management in manufacturing firms and these employees were suitable respondents for this study. Basically, 100 questionnaires were distributed to the participants. The data was analyzed using Exploratory Factor Analysis in order to explore and assess the dimensionality of items measuring every construct in the research.

Findings

As mentioned above, Exploratory Factor Analysis (EFA) was used in this study to explore and evaluate the dimensionality of items that measure each construct in the study. Several scholars, for example Awang (2010, 2012), Hoque et al. (2017, 2018), Noor et al. (2015), and Yahaya et al. (2018) stressed that the scholar needs to use Exploratory Factor Analysis (EFA) method for each construct to determine if the dimensionality of items have changed from previous study where the dimensions were developed. The dimensionality of items might change when the existing research is different from previous research in terms of difference in industry, the difference in culture and socio-economic status between the two population, and also the lapse in time (duration) between the existing research and the previous studies.

In other words, the dimensions obtained by previous studies might not hold specifically when the present research is conducted in different environment and different industry (Awang, 2010, 2012).

The Exploratory Factor Analysis (EFA) for Flexible Supply Chain Management

This construct has 24 items in the questionnaire. The EFA results in Table 1 show the descriptive statistics for every item measuring Flexible Supply Chain Management. This construct was measured using 24 items in the questionnaire with the interval scale from 1 (strongly disagree) to 10 (strongly agree) with the given item statement (Awang et al., 2016; Hoque et al., 2018). The item statement, the mean and standard deviation of the score for every item is presented in Table 1.

Table 1

CONSTRUCT: Flexible Supply Chain Management

Label	Item Statement	Mean	Std. Deviation
FS11		7.99	1.535
FS12		7.80	1.857
FS13		7.61	1.846
FS14		7.71	1.807
FS15		8.49	1.427
FS16		8.01	1.622
FS17		8.35	1.270
FS18		8.27	1.315
FS21		8.18	1.264
FS22		8.35	1.055
FS23		8.19	1.149
FS24		8.68	0.922
FS25		8.51	1.079
FS26		8.40	1.074
FS27		8.35	1.154
FS28		8.32	1.250
FS31		8.27	1.309
FS32		7.95	1.399
FS33		8.47	1.085
FS34		8.64	1.189
FS35		7.70	1.532
FS36		8.09	1.338
FS37		8.01	1.120
FS38		7.87	1.406

The Exploratory Factor Analysis (EFA) employing the extraction method of Principal Component with Varimax (Variation Maximization) Rotation was performed on these 24 items measuring the Flexible Supply Chain Management construct. The results in Table 2 indicate that the Bartlett's Test of Sphericity is significant (P-Value < 0.05). Furthermore, the measure of sampling adequacy by Kaiser-Meyer-Olkin (KMO) is excellent since it exceeded the required value of 0.6 (Awang, 2010, 2012; Hoque et al., 2015; and Noor et al., 2015). These two results (Bartlett's Test is significant and KMO > 0.6) indicate that the data is adequate to

proceed further with the data reduction procedure in EFA (Awang, 2010, 2012; Noor et al., 2015; Hoque and Awang, 2016; Hoque et al., 2017, 2018; and Yahaya et al., 2018).

Table

The KMO and Bartlett's Test Score

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.858
Bartlett's Test of Sphericity	Approx. Chi-Square	2914.248
	df	276
	Sig.	.000

The Dimensions or Components and Total Variance Explained

The results in Table 3 show that there are three dimensions or components that emerged from the EFA procedure based on the computed Eigenvalue greater than 1.0. The eigenvalues ranged between 2.325 and 9.588. The variance explained for component 1 is 39.949%, component 2 is 15.433% and component 3 is 9.689%. The total variance explained for measuring this construct is 65.070%. The total variance explained is acceptable since it exceeds the minimum 60% (Awang, 2010, 2012; Noor et al., 2015; Hoque and Awang, 2016; Hoque et al., 2017, 2018; and Yahaya et al., 2018).

Table 3

Total Variance Explained

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.588	39.949	39.949	9.588	39.949	39.949
2	3.704	15.433	55.382	3.704	15.433	55.382
3	2.325	9.689	65.070	9.689	9.689	65.070

Extraction Method: Principal Component Analysis.

The scree plot in Figure 1 indicates three dimensions or components that emerged from EFA procedure for this latent construct. In other words, the EFA procedure has grouped 24 items into 3 dimensions or components. Each dimension or component has its own set of measuring items. The rotated component matrix will determine exactly which items belong to which component (Awang, 2010, 2012).

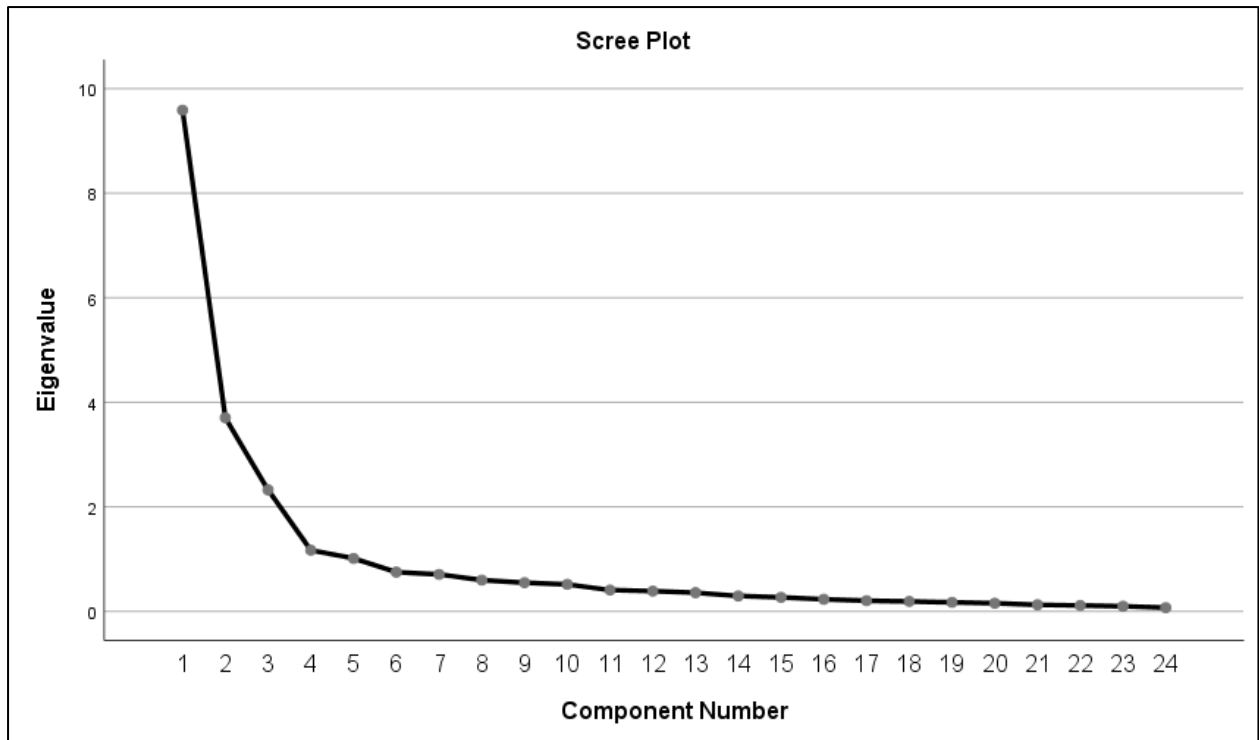


Figure 1: The Scree Plot shows three components emerged from the EFA procedure

The following table, Table 4 present the three dimensions or components emerged and their respective items resulted from the EFA procedure. The factor loading for every item should be greater than 0.6 in order to be retained (Awang, 2012; and Yahaya et al., 2018). Thus, a few items from each component need to be deleted since they failed to achieve the minimum requirement for factor loading of 0.6 (Awang, 2010, 2012, 2014, & 2015, Noor et al., 2015; Hoque and Awang, 2016; Hoque et al., 2017, 2018; and Yahaya et al., 2018). The deleted items (due to low factor loading < 0.6) and the retained items are shown in Table 4.

Table 4

The components and their respective items

Rotated Component Matrix			
Label	Component		
	1	2	3
FS11			.681
FS12			.880
FS13			.765
FS14			.777
FS15			.724
FS16			.669
FS17			
FS18			.761
FS21	.742		
FS22	.840		
FS23	.718		
FS24	.750		
FS25	.719		
FS26	.776		

FS27			
FS28			
FS31		.825	
FS32		.750	
FS33		.696	
FS34		.806	
FS35		.638	
FS36		.856	
FS37		.817	
FS38			

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

The Internal Reliability for the Instrument Measuring Flexible Supply Chain Management

Finally, the study needs to compute the value of Cronbach's Alpha which reflect the Internal Reliability for the retained items in measuring this latent construct. The internal reliability or internal consistency indicates how strong the respective items are holding together in measuring the respective construct. The value of Cronbach's Alpha should be greater than 0.7 for the items to achieve the Internal Reliability (Awang, 2012). Table 5 present the Cronbach Alpha for each component. The Cronbach Alpha for each component is greater than 0.7 as shown in the table 5, which means that these items are reliable.

Table 5

The Internal Reliability for the Flexible Supply Chain Management Construct

Name of construct	Component	Number of Items	Cronbach Alpha
Flexible Supply Chain Management	FS1	7	0.885
	FS2	6	0.900
	FS3	7	0.899

Conclusion

The findings reveal that the Bartlett's Test of Sphericity was less than 0.05 (<0.05) which is Significant ($P\text{-value} < 0.05$). Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was higher than 0.6 (> 0.6), and this indicates that the sample is adequate in size. Cronbach's Alpha test was higher than 0.7 for the all the constructs items, this indicates that these items are all reliable. This research found a valid and reliable instrument to measure the flexible supply chain management components that could enhance performance in the manufacturing organizations in Nigeria context.

Contribution

This research contributes to the field of supply chain management by evaluating and testing items that fit for testing the construct of flexible supply chain management which could lead to improvement of the performances in manufacturing firms in Nigeria. Evaluating this instrument is a methodological contribution for the field of supply chain management.

References

- Awang, Z., Afthanorhan, A., & Mamat, M. (2016). The Likert scale analysis using parametric based Structural Equation Modeling (SEM). *Computational Methods in Social Sciences*, 4(1), 13.
- Awang, Z. (2010). *Research Methodology for Business and Social Sciences*. Universiti Teknologi MARA. Malaysia
- Awang, Z. (2012). *Research methodology and data analysis*: Penerbit Universiti Teknologi, MARA Press.
- Bahkia, A. S., Awang, Z., Afthanorhan, A., Ghazali, P. L., & Foziah, H. (2019). Exploratory factor analysis on occupational stress in the context of Malaysian sewerage operations. Paper presented at the AIP Conference Proceedings.
- Bahkia, A. S., Awang, Z., Rahlin, N. A., Zulkifli, A. R. (2020). The Importance of Supportive Leadership in the Sewerage Operation Industry: A case of Indahwater Konsortium Private (IWK). *Humanities & Social Science Reviews*, 8(3), 2020, 149-162. <https://doi.org/10.18510/hssr.2020.8317>.
- Chunsheng, L., Wong, C. W., Yang, C. C., Shang, K. C., & Lirn, T. C. (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>
- Darko, S., Terkper, V. D., Novixoxo, J. D., & Anning, L. (2018). Assessing the effect of lead time management on customer satisfaction. *International Journal of Developing and Emerging Economies*, 6(1), 1-22.
- Enrique, D. V., Lerman, L. V., de Sousa, P. R., Benitez, G. B., Santos, F. M. B. C., & Frank, A. G. (2022). Being digital and flexible to navigate the storm: How digital transformation enhances supply chain flexibility in turbulent environments. *International Journal of Production Economics*, 250, 108668. <https://doi.org/10.1016/j.ijpe.2022.108668>
- Fitriana, N., Hutagalung FD., Awang Z., Zaid, SM. (2022). Happiness at work: A cross-cultural validation of happiness at work scale. *PLoS ONE* 17(1): e0261617. <https://doi.org/10.1371/journal.pone.0261617>.
- Hoque, A.S.M.M, Awang, Z., Jusoff, K., Salleh, F., and Muda, H (2017). Social Business Efficiency: Instrument Development and Validation Procedure using Structural Equation Modelling. *International Business Management*, 11(1), 222-231.
- Hoque, A. S. M. M., Siddiqui, B. A., Awang, Z. B., & Baharu, S. M. A. T. (2018). Explortory Factor Analysis of Entrepreneurial Orientation in the Context of Bangladesh Small and Medium Entreprises (SMES). *European Journal of Management and Marketing Studies*.
- Huo, B., Gu, M., & Wang, Z. (2018). Supply chain flexibility concepts, dimensions and outcomes: an organisational capability perspective. *International Journal of Production Research*, 56(17), 5883-5903. <https://doi.org/10.1080/00207543.2018.1456694>
- Kimwaki, B. M. (2024). Supply Chain Performance in the Manufacturing Sector: The Role of Lead-Time Management Strategies. *Journal Integration of Social Studies and Business Development*, 2(1), 1-12. <https://jurnal.integrasisainsmedia.co.id/index.php/JISSBD/article/download/142/139>
- Laosirihongthong and Dangayach, (2005) A Comparative Study of Implementation of Manufacturing Strategies in Thai and Indian Automotive Manufacturing Companies *Journal of Manufacturing Systems* Vol. 24/ /No. 2

- Muda, H., Baba, Z. S., Awang, Z., Badrul, N. S., Loganathan, N., & Ali, M. H. (2020). Expert review and pretesting of behavioral supervision in higher education. *Journal of Applied Research in Higher Education*.
- Muda, H., Loganathan, N., Awang, Z., Jusoh, H., & Baba, Z.S. (2018). *Application of Theory, Methodology and Analysis in Conducting Research. A Practical Guide to Quantitative Research and Thesis Writing*, UniSZA Publisher, ISBN: 978-967-2231-11-0
- Narayanan, S., Narasimhan, R., & Schoenherr, T. (2015). Assessing the contingent effects of collaboration on agility performance in buyer–supplier relationships. *Journal of Operations Management*, 33, 140-154. <https://doi.org/10.1016/j.jom.2014.11.004>
- National Bureau of Statistics (2012). *Review of Nigerian Economy*. Nigeria: Abuja.
- National Bureau of Statistics (2020). *Review of Nigerian Economy*. Nigeria: Abuja.
- Noor, N. M., Aziz, A. A., Mostapa, M. R., & Awang, Z. (2015). Validation of the Malay version of the Inventory of Functional Status after Childbirth questionnaire. *BioMed research international*, 2015.
- Okyere, S., Annan, J., & Anning, K. S. (2015). Evaluating the effect of lead time on quality service delivery in the banking industry in Kumasi Metropolis of Ghana. *Journal of Arts and Humanities*, 4(7), 29-44. <https://doi.org/10.18533/journal.v4i7.760>
- Piprani, A. Z., Jaafar, N. I., Ali, S. M., Mubarik, M. S., & Shahbaz, M. (2022). Multi-dimensional supply chain flexibility and supply chain resilience: the role of supply chain risks exposure. *Operations Management Research*, 15(1), 307-325. <https://doi.org/10.1007/s12063-021-00232-w>
- Siagian, H., Tarigan, Z. J. H., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in COVID-19 era. *Sustainability*, 13(9), 4669. <https://doi.org/10.3390/su13094669>
- Singh, R. K. (2024). Strengthening resilience in supply chains: the role of multi-layer flexibility, supply chain risks and environmental dynamism. *The International Journal of Logistics Management*, 35(6), 1807-1826. <https://doi.org/10.1108/IJLM-08-2023-0337>
- Settembre-Blundo, D., González-Sánchez, R., Medina-Salgado, S., & García-Muiña, F. E. (2021). Flexibility and resilience in corporate decision making: a new sustainability-based risk management system in uncertain times. *Global Journal of Flexible Systems Management*, 22(Suppl 2), 107-132. <https://doi.org/10.1007/s40171-021-00277-7>
- Sandberg, E. (2021). Dynamic capabilities for the creation of logistics flexibility—a conceptual framework. *The international journal of logistics management*, 32(2), 696-714. <https://doi.org/10.1108/IJLM-07-2020-0266>
- Um, J. (2017). Improving supply chain flexibility and agility through variety management. *The International Journal of Logistics Management*, 28(2), 464-487. <https://doi.org/10.1108/IJLM-07-2015-0113>
- Um, J., & Han, N. (2021). Understanding the relationships between global supply chain risk and supply chain resilience: the role of mitigating strategies. *Supply Chain Management: An International Journal*, 26(2), 240-255. <https://doi.org/10.1108/SCM-06-2020-0248>
- Yahaya, T., Idris, K., Suandi, T., & Ismail, I. (2018). Adapting instruments and modifying statements: The confirmation method for the inventory and model for information sharing behavior using social media. *Management Science Letters*, 8(5), 271-282.