

Article

Exploring the Items for Measuring Product Development and Commercialization (PDC) in Flexibility of Supply Chain Management in the Manufacturing Companies in Nigeria: An Exploratory Factor Analysis

Naimot Folake Popoola^{*1}, Popoola Mufutau Olapoju²

1,2. Alfa University College, Malaysia

* Correspondence: naimatpf@gmail.com

Citation: Popoola N. F., Olapoju, P. M. Exploring the Items for Measuring Product Development and Commercialization (PDC) in Flexibility of Supply Chain Management in the Manufacturing Companies in Nigeria: An Exploratory Factor Analysis. International Journal on Economics, Finance and Sustainable Development (IJEFS) 2026, 8(1), 189-194.

Received: 14th Aug 2025Revised: 20th Oct 2025Accepted: 05th Dec 2025Published: 07th Jan 2026

Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

Abstract: The aim of this research is to execute instrument validation for the items of product development and commercialization (PDC) through exploratory factor analysis (EFA). The data collection tool employed is questionnaires which was administered to employees in the manufacturing companies in Nigeria. 100 questionnaires were gathered to do the EFA. The results show that the Bartlett's Test of Sphericity is significant (P-Value < 0.05), Kaiser-Meyer-Olkin (KMO) is excellent as it exceeds the required value of 0.6. These two results (Bartlett's Test is significant and KMO > 0.6) indicate that the data is adequate in size. The Cronbach's Alpha test was higher than 0.7 for all items of the constructs, this suggests that these items are all reliable. This research adds to the domain of supply chain management by assessing the items of the construct of product development and commercialization (PDC) that could improve performances in manufacturing organizations in the context of Nigeria.

Keywords: Exploratory Factor Analysis, Supply Chain Management, Product Development and Commercialization, Manufacturing Companies, Employees, Performance

1. Introduction

Product development and commercialization is the supply chain management procedure which offers structures to grow and bring to market new-products together with consumers as well as suppliers [1], [2]. Effective implementations of the product development procedure with flexibility in the organization not only allows management to coordinate the effective flow of new products across the supply chain, but also helps supply chain associates with the ramp up of manufacturing, logistic, marketing and other connected activities to support the commercialization of the products [3], [4]. Furthermore, to be successful in product development, organization need to adapt their flexible abilities that can develop varieties of products with minimum efficiency (Jitendra, 2019). Rapid development of products and commercialization associated to the flexibility of SC in the firm and their efficient movement into the marketplace is essential for long-term corporate success [5]. The objective of this research is to perform instrument validation for the items of Product development and commercialization through exploratory factor analysis (EFA). This research adds to knowledge by investigating the items of the construct of Product development and commercialization that are able to improve performance in manufacturing organizations, most especially in Nigeria.

Literature Review

Previous researches were conducted to investigate product development and commercialization in different contexts. For instance, conducted research on the need for new product development capabilities from digitalization, sustainability, and servitization trends [6]. The results of their research revealed a significant positive connection between product development and flexible supply chain management. Moreover, previous research suggests that product development and commercialization are linked to the flexibility of supply chain management. The findings of, for example, show that there is a positive relationship between product development and flexible supply chain management. [7]. Likewise, Faisal & Christian conducted a study on how to improve the new product development [8]. The outcomes of their study depict a positive relationship between product development and flexibility in supply. Besides, in another research, Irena et al conducted a study to investigate the new product development process. The findings of their research show that there is a positive correlation between product development and commercialization and flexibility in supply chain management. Product development and commercialization are vital for development in manufacturing companies; however, research in this area is scarce. And the existing research is not focused on Sub-Saharan Africa [3], [6].

2 Methodology

In this present study quantitative method was employed. The data for this study were collected by using a self-administered method, which is in line with various research. Additionally, a 10-point Likert scale was utilized, as stated by Awang et al, that a 10-point Likert scale is more effective than a 5-point Likert scale in operating the measurement model [9]. Therefore, this research used the interval scale of 10, where the respondents select a statement amongst several statements from 1-10, which is considered to reflect the perceived quality of the subject. The target participants for this research were the employees of manufacturing organizations in Nigeria. Hence, 100 questionnaires were distributed to the respondents. The data was analysed using Exploratory Factor Analysis in order to explore and assess the dimensionality of items measuring every construct of product development and commercialization (PDC).

3 Results and Discussion

This product development and commercialization (PDC) construct has 7 items in the survey. The EFA outcomes in Table 3.35 illustrate the descriptive statistics for each item that measures Product Development and Commercialization. This construct was measured employing 7 items in the questionnaire with the interval scale from 1 (strongly-disagree) to 10 (strongly-agree) with the given item statement [9], [10], [11]. The item statement, the mean, and the standard deviation of the score for each item are shown in Table 1.

Table 1. Construct: Product Development and Commercialization.

Label	Item Statement	Mean	Std. Deviation
PD1	The company has a cross-functional team for product development and commercialization process management	8.35	1.055
PD2	The team includes customer and supplier members	8.19	1.149
PD3	The company has methodology to create new products and services	8.68	0.922
PD4	There are defined guidelines for new product development.	8.51	1.079
PD5	The company designs and builds prototypes	8.40	1.074
PD6	The team determines marketing and distribution	8.35	1.154

	channels		
PD7	The team interacts with manufacturing flow management and supplier relationship management process teams for product rollout	8.32	1.250

The E.F.A. employing the extraction technique of Principal-Component with Varimax (Variation Maximization) Rotation was conducted on these 7 items that measure the Product-Development and Commercialization construct. The outcomes in Table 2 specify that Bartlett's Test of Sphericity is significant (P-Value < 0.05). Additionally, the measure of sampling suitability by Kaiser-Meyer-Olkin (KMO) is excellent as it exceeds the required value of 0.6 [12], [11], [13], [14], [15]. These two outcomes (Bartlett's Test is significant and KMO > 0.6) specify that the data is acceptable in proceeding further with the data reduction process in E.F.A. [16], [12], [17], [18].

Table 2. The KMO and Bartlett's Test Score.

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.868
Bartlett's Test of Sphericity	Approx. Chi-Square		738.805
	df		21
	Sig.		.000

The Dimensions or Components and Total Variance Explained

The outcomes in Table 3 illustrate that there is one dimension or component that emerges from the EFA process according to the computed Eigenvalue greater than 1.0. The eigenvalue range is 4.738. The variance explained for component 1 is 67.688%. The total variance explained to measure this construct is 67.688%. The total variance explained is adequate as it exceeded the minimum 60% [12], [11], [13], [14], [15].

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	4.738	67.688	67.688	4.738	67.688	67.688
Extraction Method: Principal Component Analysis.						

The scree plot in Figure 1 specifies one dimension or component that emerges from the EFA process for this latent construct. Otherwise, the E.F.A. process had grouped 7 items into 1 dimension or component. The dimension or component had its own set of measuring items. The rotated-component-matrix determines precisely which items belong to which component [16].

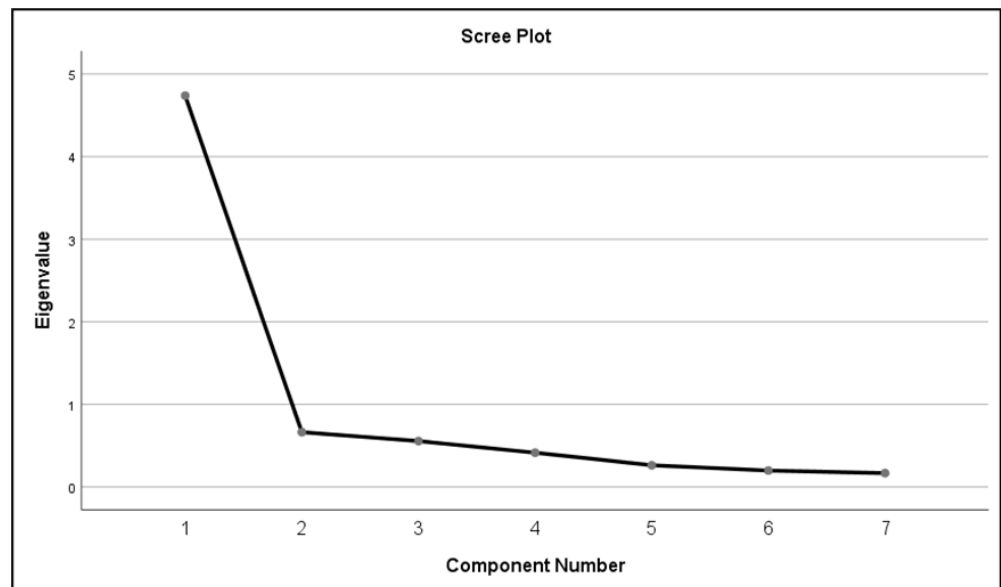


Figure 1. The Scree Plot shows that one component emerged from the EFA procedure.

The subsequent table, Table 4, depicts one dimension or component that emerges and the corresponding items resulting from the EFA process. The factor loading for each item must be greater than 0.6 so as to be retained [12], [11], [13], [14], [15] as shown in Table 3.38.

Table 4. The component and its respective items.

Component Matrix	
Label	Component
	1
PD1	.872
PD2	.790
PD3	.760
PD4	.801
PD5	.862
PD6	.879
PD7	.788
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

Lastly, the research has to compute the value of Cronbach's Alpha, which reflects the internal reliability of the retained items to measure this latent construct. The internal reliability or internal consistency specifies how strongly the corresponding items hold together to measure the corresponding construct. The value of Cronbach's Alpha must be greater than 0.7 for the items to attain the internal reliability [19]. Table 5 presents the Cronbach's Alpha for every component. The Cronbach Alpha for the component is greater than 0.7, as shown in Table 5, which indicates that these items are reliable.

Table 5. The Internal Reliability for the Product Development and Commercialization Construct.

Name of construct	Number of Items	Cronbach Alpha
Product Development and Commercialization	7	0.918

4 Conclusion

The results show 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), which indicates that the sample is adequate in size. The total variance explained is satisfactory, as it surpasses the minimum of 60%. Cronbach's Alpha test was higher than 0.7 for the construct items, which indicates that all the items are reliable. This research found a valid and reliable instrument to measure the items of the construct of product development and commercialization (PDC) that could enhance performance in the manufacturing organizations in the context of Nigeria.

REFERENCES

- [1] D. S. Rogers, D. M. Lambert, and A. M. Knemeyer, "The product development and commercialization process," *Int. J. Logist. Manag.*, vol. 15, no. 1, pp. 43–56, 2004.
- [2] B. Dong, W. Tang, and C. Zhou, "Managerial flexibility strategies under supply and demand risks: Quantity postponement vs. Price postponement," *Int. J. Mach. Learn. Cybern.*, vol. 10, no. 7, pp. 1747–1763, 2019.
- [3] D. Lambert, *Supply Chain Management: Process, Partnerships, Performance*. Jacksonville: The Hartley Press, Inc., 2008.
- [4] N. Tzokas, Y. A. Kim, H. Akbar, and H. Al-Dajani, "Absorptive capacity and performance: The role of customer relationship and technological capabilities in high-tech SMEs," *Ind. Mark. Manag.*, vol. 47, pp. 134–142, 2015.
- [5] A. T. Chan, E. W. Ngai, and K. K. Moon, "The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry," *Eur. J. Oper. Res.*, vol. 259, no. 2, 2017.
- [6] H. Sophie, I. Ola, and Ø. R. Anna, "Need for New Product Development Capabilities from Digitalization, Sustainability, and Servitization Trends," *Sustainability*, vol. 2, 2020, [Online]. Available: www.mdpi.com/journal/sustainability
- [7] Y. Allam *et al.*, "The Effect of Operational Flexibility on Performance," *Montenegrin J. Econ.*, vol. 15, no. 1, pp. 47–60, 2019.
- [8] S. Faisal and B. Christian, "How to Improve the New Product Development," *Saudi J. Eng. Technol.*, vol. 1, no. 4, pp. 127–134, 2016.
- [9] Z. Awang, A. Afthanorhan, and M. Mamat, "The Likert scale analysis using parametric based Structural Equation Modeling (SEM)," *Comput. Methods Soc. Sci.*, vol. 4, no. 1, p. 13, 2016.
- [10] A. S. M. M. Hoque, B. A. Siddiqui, Z. Awang, and S. M. A. T. Baharu, "Exploratory Factor Analysis of Entrepreneurial Orientation in the Context of Bangladesh Small and Medium Enterprises (SMEs)," *Eur. J. Manag. Mark. Stud.*, 2018.
- [11] H. Muda, N. Loganathan, Z. Awang, H. Jusoh, and Z. S. Baba, *Application of Theory, Methodology and Analysis in Conducting Research: A Practical Guide to Quantitative Research and Thesis Writing*. UniSZA Publisher, 2018.
- [12] N. M. Noor, A. A. Aziz, M. R. Mostapa, and Z. Awang, "Validation of the Malay version of the Inventory of Functional Status after Childbirth questionnaire," *Biomed Res. Int.*, vol. 2015, 2015.
- [13] A. S. Bahkia, Z. Awang, A. Afthanorhan, P. L. Ghazali, and H. Foziah, "Exploratory factor analysis on occupational stress in the context of Malaysian sewerage operations," in *AIP Conference Proceedings*, 2019.
- [14] N. Fitriana, F. D. Hutagalung, Z. Awang, and S. M. Zaid, "Happiness at work: A cross-cultural validation of happiness at work scale," *PLoS One*, vol. 17, no. 1, p. e0261617, 2022, doi: 10.1371/journal.pone.0261617.
- [15] N. Anuar, M. M. Muhammad, and Z. Awang, "Development and Validation of Critical Reading Intention Scale (CRIS) for University Students using Exploratory and Confirmatory Factor Analysis," *Asian J. Univ. Educ.*, vol. 19, no. 1, 2023.
- [16] Z. Awang, *Research Methodology for Business and Social Sciences*. Malaysia: Universiti Teknologi MARA, 2010.
- [17] A. S. M. M. Hoque, Z. Awang, K. Jusoff, F. Salleh, and H. Muda, "Social Business Efficiency: Instrument Development and Validation Procedure using Structural Equation Modelling," *Int. Bus. Manag.*, vol. 11, no. 1, pp. 222–231, 2017.

- [18] T. Yahaya, K. Idris, T. Suandi, and I. Ismail, "Adapting instruments and modifying statements: The confirmation method for the inventory and model for information sharing behavior using social media," *Manag. Sci. Lett.*, vol. 8, no. 5, pp. 271–282, 2018.
- [19] Z. Awang, *Research Methodology and Data Analysis*. Malaysia: Universiti Teknologi MARA Press, 2012.