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Exploring the Items for Measuring Managing Manufacturing Flow (MMF) in the Manufacturing Organizations in the Context of Nigeria: An Exploratory Factor Analysis

Dr. Naimot Folake Popoola
School of Business, Technology and Management, ALFA University College, Malaysia
Email: naimatpf@gmail.com

Dr. Popoola Mufutau Olapoju
Innovative Assets Ltd
Email: popoolamufti@gmail.com

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Abstract

This research intends to perform instrument validation for the items of Managing Manufacturing Flow (MMF) through exploratory factor analysis (EFA). The data collection instrument utilized is questionnaires which was administrated to employees in the manufacturing companies in Nigeria. 100 questionnaires were collected to do the EFA. The outcomes show that the Bartletts' Test of Sphericity is significant (P-Value < 0.05). Kaiser-Meyer-Olkin (KMO) is excellent as it exceeds the require 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 the all the constructs items, this indicates that these items are all reliable. This present research contributes to the field of supply chain management by examining the items of the construct of managing manufacturing flow which could enhance performance in manufacturing companies in Nigeria context.

Keywords: Exploratory Factor Analysis, Supply Chain Management, Managing Manufacturing Flow, Manufacturing Companies, Employees

Introduction

Effective supply chain management is important in manufacturing companies in order for them to have a competitive edge. For the last two decades, companies have profoundly depended on supply-chain management in gaining competitive-advantages as well as to advance interior and exterior opportunities (Um and Kim, 2019). The tactical values of supply chain management had been documented as companies try to move to new markets (Chen

et al., 2017), and for advanced competences in their procurements, plans, industrial, as well as delivery (Soosay and Hyland, 2015). Hence several manufacturing organizations shifted their focus to supply chain management.

Supply chain management practice comprises the manufacturing organizations actions meant to improve movement of raw materials from sources of supply, production, to delivery of finished products to customers, comprising procurements, production schedule, order process, inventory management, transportation, warehouse as well as consumer services (Ateke & Didia, 2017). Therefore, supply chain management practice are activities undertaken by organizations to improve their capability in managing the flow of materials, adapting and responding to changes in market conditions; as well as to attain competitive advantage in the volatile market place. Better supply chain management processes influence the whole supply chain, its parts, or critical processes (Cuthbertson & Piotrowicz, 2018; Rok, 2021).

The intention of the manufacturing companies is to be successful via improvement and sale of products (Singh et al., 2020a). This indicate that improvement in the management of manufacturing flow is essential for success in manufacturing companies. Companies should be capable of controlling the flow of materials from suppliers used processes which could add values through distribution channels to consumers.

Managing manufacturing flow is the supply chain management procedure that comprises all activity essential in obtaining, implementing, waste reduction, operational effectiveness, as well as managing manufacturing flexibilities in the supply chain and for movement of goods via the plants (Ronald, 2012; Tzokas et al., 2015). According to Ronald, (2012), managing manufacturing flow involves the entire actions essential in moving products via the plants. Managing manufacturing flow is important to optimize production related to lowering costs and increasing productivity (Ronald, 2012). Inappropriate way of managing the manufacturing flow could increases costs and as well as decreases productivity (Denkena, et al., 2014). This suggest that it is very vital to manage efficiently the manufacturing flow in manufacturing organization to reduce costs, improve productivity and satisfying consumer need. Inappropriate management of manufacturing flow could result to high costs and disruption in supply chain.

For instance, each year, about 70% of organizations experience a supply chain disruption, which is defined as a situation that impairs the flow of manufacturing materials or supplies, funds or resources and affects an organization's capacity to provide services to customers (Scholten et al., 2019). Managing manufacturing flow successfully is fundamental for survival in manufacturing companies, and the manufacturing companies are the drivers of economic growth. In advanced countries, the manufacturing sector is seen as an important leading part of innovation and formation of skilled employment creation, and the manufacturing sector is also part of the economy and a vital source of income (Tybout, 2017). Despite the importance of proper management of manufacturing flow in manufacturing companies, the search of previous research that is focused on this domain is scarce. The objective of this research is to perform instrument validation for the items of Managing Manufacturing Flow (MMF) through exploratory factor analysis (EFA). This research contributes to knowledge by examining the items of the construct of managing manufacturing flow which are capable to enhance performance in manufacturing companies.

Methodology

Quantitative method was used in this research. The data for this research was gathered by using a self-administered method which is in line with many researchers. Moreover, 10 points of Likert scale was used 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 which is considered to reflect the perceived quality of the subject. Where number 1 stands for strongly disagree, while, number 10 stands for strongly agree. The target respondents for this study were the manufacturing companies' employees. 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 the construct of managing manufacturing flow.

Findings

As mentioned above, Exploratory Factor Analysis (EFA) was used in this study to explore and evaluate the dimensionality of items that measure the construct of managing manufacturing flow 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 results of exploratory factor analysis (EFA) are discussed below.

The Exploratory Factor Analysis (EFA) for Managing Manufacturing Flow (MMF)

This construct has 8 items in the questionnaire. The EFA outcomes in Table 1 display the descriptive statistics for each item measuring Managing Manufacturing Flow. This construct was measured utilizing 8 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; Muda et al., 2018). The item statement, the mean as well as standard-deviation of the score for each item is depicted in Table 1.

Table 1
Construct: Managing Manufacturing Flow

Label	Item Statement	Mean	Std. Deviation
MM1	The company has a cross-functional team for manufacturing flow management	8.27	1.309
MM2	The team develops and implements a master production schedule	7.95	1.399
MM3	The team produces a detailed capacity plan and a time-phased requirement plan	8.47	1.085
MM4	The team identifies manufacturing constraints and determines manufacturing capabilities	8.64	1.189
MM5	The company develops programs and implements actions to augment manufacturing flexibility	7.70	1.532
MM6	The team measures manufacturing cycle time	8.09	1.338
MM7	The team measures the level of work in process	8.01	1.120
MM8	There are procedures to define manufacturing priorities	7.87	1.406

The Exploratory Factor Analysis (EFA) employing the extraction method of Principal Component with Varimax (Variation Maximization) Rotation was carried out on these 8 items that measure the Managing Manufacturing Flow construct. The outcomes in Table 2 show that the Bartletts' Test of Sphericity is significant (P-Value < 0.05). Additionally, the measurement of sampling suitability by Kaiser-Meyer-Olkin (KMO) is excellent as it exceeds the require value of 0.6 (Noor et al., 2015; Muda et al., 2018, 2020; Bahkia et al., 2019; Fitriana et al., 2022; Anuar et al., 2023). 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 process in EFA (Awang, 2010, 2012; Noor et al., 2015; Hoque et al., 2017, 2018; and Yahaya et al., 2018).

Table 2
The KMO and Bartlett's Test Score

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.899
Bartlett's Test of Sphericity	Approx. Chi-Square	750.640
	df	28
	Sig.	.000

The Dimensions or Components and Total Variance Explained
The outcomes in Table 3 depict that there is one dimensions or components that emerge from the E.F.A. process according to the computed Eigenvalue greater than 1.0. The eigenvalue range is 5.060. The variance-explained for component 1 is 63.256%. The total-variance-explained to measure this construct is 63.256%. The total-variance-explained is satisfactory as it exceeds the minimum 60% (Noor et al., 2015; Muda et al., 2018, 2020; Bahkia et al., 2019; Fitriana et al., 2022; Anuar et al., 2023).

Table **Error! No text of specified style in document.**
Total Variance Explained

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.060	63.256	63.256	5.060	63.256	63.256
Extraction Method: Principal Component Analysis.						

The scree plot in Figure 1 specifies one dimension or component that emerge from E.F.A. process for this latent-construct. Otherwise, the E.F.A. process had grouped 8 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 (Awang, 2010, 2012; Muda et al., 2018, 2020).

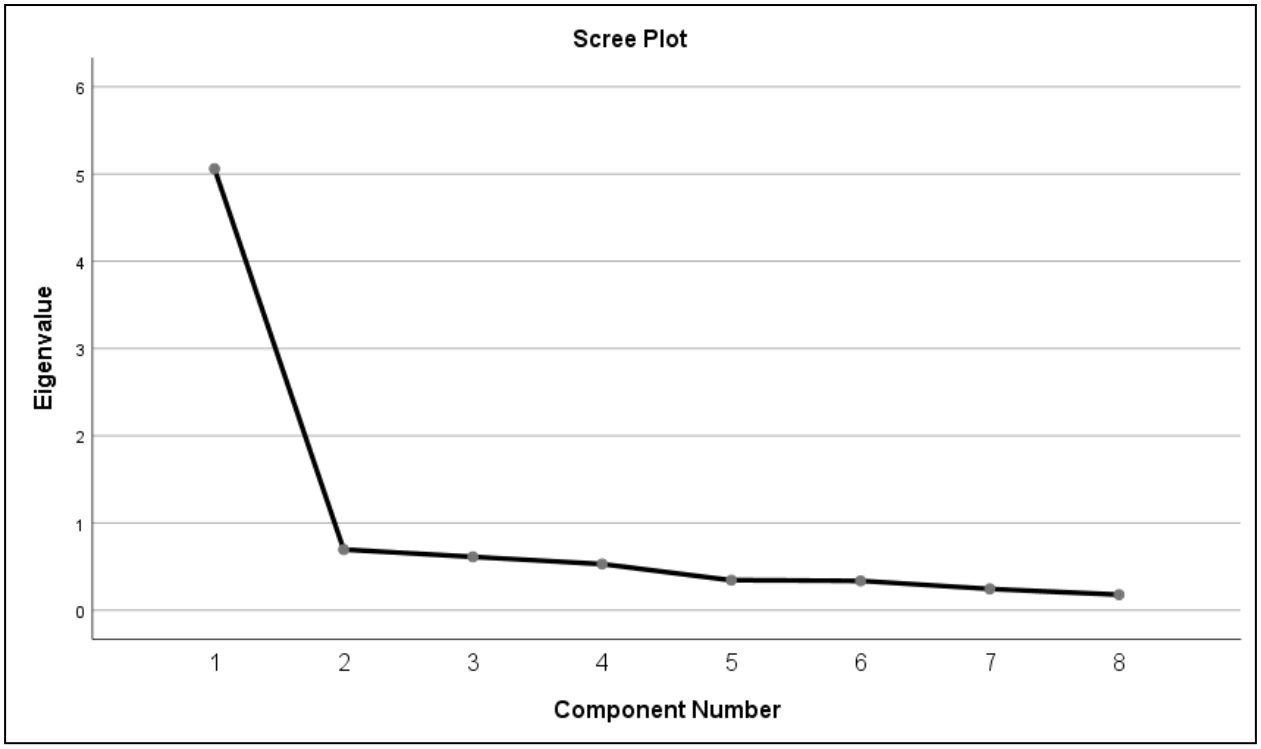

Figure 1 The Scree Plot shows one component emerged from the EFA procedure

The subsequent table, Table 4 depicts one dimension or component emerged and their corresponding items resulted from the E.F.A process. The factor-loading for each item must be greater than 0.6 so as to be retained (Noor et al., 2015; Muda et al., 2018, 2020; Bahkia et al., 2019; Fitriana et al., 2022; Anuar et al., 2023) as shown in Table 4.

Table 4
The component and its respective items

Component Matrix

Label	Component 1
MM1	.842
MM2	.764
MM3	.743
MM4	.826
MM5	.661
MM6	.850
MM7	.852
MM8	.805

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Lastly, the research has to compute the value of Cronbach Alpha that reflect the Internal-reliability for the retained items in measuring this latent-construct. The internal-reliability or internal consistency specifies how stronger the corresponding items are holding together to measure the corresponding construct. The value of Cronbach Alpha must be greater than 0.7 for the items to attain the Internal-reliability (Awang, 2012; Muda et al., 2018, 2020). Table 5

depicts the Cronbach Alpha for every component. The Cronbach Alpha for component is greater than 0.7 as presented in the Table 5, which indicates that these items are reliable.

Table 5
The Internal Reliability for the Managing Manufacturing Flow Construct

Name of construct	Number of Items	Cronbach Alpha
Managing Manufacturing Flow	8	0.912

Conclusion

The findings reveal that the Bartlett's Test of Sphericity was less that 0.05 (<0.05) which is Significant (P-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. The total-variance-explained is satisfactory as it exceeds the minimum 60%. Cronbach's Alpha test was higher than 0.7 for the construct items, this indicates that these items are all reliable. This research found a valid and reliable instrument to measure the items of the construct of managing manufacturing flow that could enhance performance in the manufacturing organizations in Nigeria context.

Contribution

This present study contributes to the measurement of the construct of managing manufacturing flow in the field of supply chain management by evaluating and testing items that fit for examining the construct of managing manufacturing flow which could enhance performances in manufacturing companies in Nigeria. Evaluating these items of the construct of managing manufacturing flow is a methodological contribution for the domain of supply chain management.

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