

## PROCESS CONTROL AND SUPPLY CHAIN PERFORMANCE OF FOOD AND BEVERAGE MANUFACTURING FIRMS IN PORT HARCOURT

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### Abstract

This study probed the relationship between process control and supply chain performance of food and beverage manufacturing firms in Port Harcourt. Specifically, the study determined the relationship between process control and measures of supply chain performance (waste reduction, delivery flexibility) of food and beverage manufacturing firms in Port Harcourt. This study was anchored on technology Acceptance Model. A correlation research design was adopted. The population comprised 30 food and beverages firms. The entire population was surveyed. Primary data were collected using questionnaire. The data collected were analyzed using simple percentages, mean score rating, standard deviation, while the hypotheses were tested using Pearson Product Moment Correlation. The study found that a very strong positive relationship exists between process control and measures of supply chain performance of food and beverage manufacturing firms in Port Harcourt. Thus, the study concluded process control is essential to improving supply chain performance and recommends that management of food and beverage manufacturing firms in Port Harcourt should establish standardized processes and procedures to ensure consistency and control across the supply chain to enable better visibility, tracking and management.

**Keywords:** Delivery flexibility, process control, supply chain performance, waste reduction,

### Introduction

Firms in today's highly competitive environment continuously seek to improve their supply chain performance and gain competitive edge (Christopher, 2016). One of the key avenues through which firms have sought supply chain performance and competitive advantage is process control. Christopher (2015) opine that process control is a critical determinant of organizational competitiveness and success. This is especially so when engineering and statistical models are combined to monitor and adjust a process to maintain desired output.

Process control is invoked to monitor and manage the conditions in which firms transport products to ensure conformity and quality, limit waste and reduce cost. Ledford and Hill (2007) suggests that process employs systematic use of information, procedures, and technology to regulate quality of processes relied upon to achieve desired outcomes.

Studies (Ekeh, 2023; Namusonge et al., 2016; Nwankwo & Ezeibe, 2021) have stressed that failure to implement process control results in significant losses in business operations. This is even as environmental changes have impact modes of operation and performance levels of manufacturing firms in Nigeria (Ebuzoeme, 2022). Manufacturing companies must now find ways to provide customers with high-quality goods at lower prices, and that the only way to do this is through process control (Namusonge et al., 2016).

Namusonge et al. (2016) also stressed the necessity for manufacturing companies to look for ways to upgrade current products and offer new ones in a more lucrative way if they are to remain competitive and preserve their place in the market. This has put pressure on them to adopt process control as a performance improvement tactic. Therefore, this study analyzed the relationship between process control and supply chain performance of food and beverage manufacturing firms in Port Harcourt.

### **Baseline Theory**

The theoretical foundation of this study is Technology Acceptance Model (TAM), a prominent framework developed by Davis (1986) to explain how users come to accept and use an innovation. TAM is particularly significant in understanding user behavior in the context of information systems and technology adoption. At its core, are two key constructs: perceived usefulness (PU) and perceived ease of use (PEOU). PU refers to the degree to which a person believes that using a particular system would enhance their job performance. PEOU on the other hand, denotes the degree to which a person believes that using a system would be free of effort.

Research has connected the main strengths of TAM PU which explains person's intention to use technology and degree to which an individual acknowledges that a specific system will improve performance and PEOU which explains a person's belief that using a specific system would not cost anything or will be effortless (Davis, 1989).

TAM has been widely criticized, despite its frequent use, leading the original proposers to attempt to redefine it several times. Criticisms of TAM as a theory include its questionable heuristic value, limited explanatory and predictive power, triviality, and lack of any practical value (Chittur, 2012). Davenport (2013) suggests that TAM has diverted researchers' attention from other important research issues and has created an illusion of progress in knowledge accumulation. This theory is relevant to the current study given that process control is the epicenter of modern day supply chain management.

### **Concept of Process Control**

Process control refers to the systematic use of information, procedures, and technology to regulate the quality of a process to achieve desired outcomes (Ledford & Hill, 2007). It is a critical component of quality management that aims to regulate and monitor processes to ensure they produce high-quality products. The concept of process control has its roots in the early 20th century, with the work of pioneers such as Shewhart and Deming laying the foundation for modern process control methods. Since then, process control has evolved to encompass a wide range of techniques and methodologies, including Six Sigma, Lean Six Sigma, and other quality management approaches, which have helped organizations drive continuous improvement.

Today, process control is increasingly being supported by technology, with the advent of advanced tools and systems such as computerized maintenance management systems, enterprise resource planning systems, and Internet of Things (IoT) providing new ways for organizations to monitor and regulate their processes in real-time (Li et al., 2019). However, despite these technological advancements, the human element remains crucial in process control, with skilled operators and quality managers playing key roles in identifying and addressing process issues and driving continuous improvement.

The core focus of process control is to ensure that a process operate as intended, and produce high-quality outputs that meet customer expectations and regulatory standards (Campbell et al., 2020; Montgomery, 2015). It is a critical component of quality management that enable organizations monitor and maintain consistent quality of products (Pande et al., 2019) by monitoring and measuring a process to ensure it is operating within certain parameters; and identifying and addressing deviations.

### **Supply Chain Performance**

Warren et al. (2012) regard supply chain performance as extended supply chain ability to meet end-customer requirements, including product availability, on-time delivery. Supply chain performance is also perceived as the ability to meet end-customer demands efficiently (Hausman, 2005). Supply chain performance crosses company boundaries since it includes basic materials, components, subassemblies and finished products, and distribution through various channels to end-users; and crosses traditional functional lines such as procurement, manufacturing, distribution, marketing & sales, and research & development.

Price Water House Coopers survey report (2013) notes that supply chain performance will depend on the ability to respond quickly to changes in demand and supply through the ups and downs of business cycles, as well as during crises. The definition of supply chain seems to be more common across authors than the definition of supply chain performance.

Lambert et al. (2018) define a supply chain as the alignment of firms that brings products or services to market. Note that these concepts of supply chain include the final consumer as part of the supply chain. It is the network of organizations involved through upstream and downstream linkages, in the different processes and activities that produce value delivered to the ultimate consumer. In other words, a supply chain consists of multiple firms, both upstream (i.e., supply) and downstream (i.e., distribution) and the ultimate consumer.

Martin and Patterson (2009) and Gunasekaran et al. (2004) discussed three main classes of performance measurement: inventory, cycle time and financials. Joel et al. (2009) identify five world class supply chain performance measures: quality, cost, flexibility, dependability and innovation; and argue that a performance criterion that guides a firm's decision-making must be easy to implement, understand and measure; they must be flexible and consistent with the firm's objectives; and must be implemented in areas that are viewed as critical to the success of the firm. In this study, supply chain performance is measured using waste reduction and delivery flexibility.

### **Waste reduction**

Increase in industrial activities result in heightened resource consumption and waste generation (Zhang et al., 2022). Wastes are materials that no longer find usefulness; are residues of industrial activities; have become obsolete, lost their integrity or been damaged in transit or due to improper handling (Ateke et al., 2025). Business activities also generate waste in the form of by-products or resources that have been used improperly, partially or sub-optimally (Van Engeland et al., 2020, as cited in Ateke et al., 2025).

Waste reduction include reusing products such as plastic and glass containers, purchasing more durable products, and using reusable products, such as dishrags instead of paper towels (Alireza & Mahdi, 2012). Waste reduction also involve using less material and energy to minimize waste generation and preserve natural resources.

Waste reduction is broader in scope than recycling and incorporates ways to prevent materials from ending up as waste before they reach the recycling stage. In general, waste reduction offers several environmental benefits, including greater efficiency in production, less energy consumption, resulting in less pollution, natural resources preservation, and less solid waste in landfills. Waste reduction also means economic savings because fewer materials and less energy is used when waste is reduced (Alireza & Mahdi, 2012).

### **Delivery flexibility**

Delivery flexibility refers to the ability of a company to adapt its delivery processes and options to meet evolving customer needs and market conditions (Kumar & Singh, 2020). This includes offering delivery options, and allowing adjustments in response to sudden changes or disruptions (Eyers et al., 2018). Delivery flexibility is also the ability to adapt delivery lead-time on customer demand (Kuo et al., 2016). The ability to adapt to volatile customer demands - is an ever-important customer service element (Ustundag & Ungan, 2020).

Flexibility is a broad term with little consensus as to its definition (Mishra, 2020). Customer order flexibility can now be defined as the ability of the supplier to adapt customer orders according to the demanded order quantities and delivery lead-times. When organizations are acting in uncertain environments it is important for organizations to have the ability to meet the uncertain changes (Manders et al., 2017). Flexibility enable organization react with a low penalty in time, effort, cost or performance (Sánchez & Pérez, 2005).

### **Process Control and Supply Chain Performance**

Jawad and Mark (2017) carried out a research on process control and construction project performance in Saudi Arabia. The study found out that process control measures significantly correlate with project performance ( $r = 0.83$ ,  $p < 0.01$ ); and concluded that process control significantly improve construction project performance by reducing defects and enhancing overall quality.

Liu et al. (2018) undertook a systematic review and meta-analysis review on process control and project performance. The study found out that Process control measures significantly impact project performance ( $r = 0.83$ ,  $p < 0.01$ ). The result of the study showed that quality control, schedule control, and cost control predict project success. The study concluded that Process control measures enhance project performance.

Jha and Iyer (2017) carried out a study on process control and project success in Indian Infrastructure Projects in India. The study revealed that process control predict project success. The result shows that quality control and schedule control significantly correlate with project success. The study concluded that Process control practices improve project success in Indian infrastructure projects.

Oyegoke (2017) carried out a research on process control and project performance in Nigerian. The study found out that process control significantly correlate with project performance; that concluded that process control measures enhance project performance in Nigerian construction industry. In the study of Chen et al. (2020) on process control and project performance in Chinese construction industry, it was found that process control predict project performance. The result showed that schedule control and quality control significantly correlate with project performance.

Alzahrani and Emsley (2017) carried out a study on process control and construction project performance in Saudi Arabia. A descriptive survey design was used. The study revealed that process control significantly reduce project defects; and that quality control and schedule control predict project performance.

The foregoing empirical review shows that process control is a key determinant of supply chain performance. However, due to the need to conduct statistical analyses and interpretation, we hypothesize as follows:

$H_01$ : Process control has no significant correlation with waste reduction of food and beverage firms in Port Harcourt.

$H_02$ : Process control has no significant correlation with delivery flexibility of food and beverage firms in Port Harcourt.

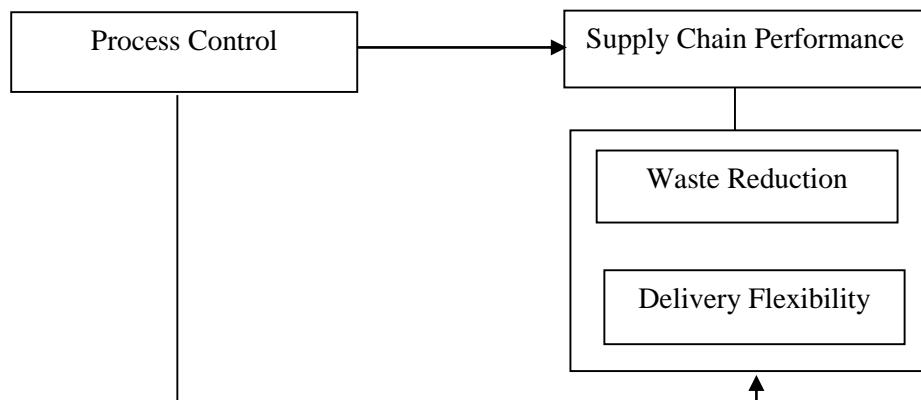


Fig. 1: Conceptualized framework of relationship between process control and supply chain performance

## Methodology

This study adopted a correlational research design. The population comprised 30 food and beverage firms in Port Harcourt. The study adopted a census method in which the entire thirty 30 food and beverage firms were surveyed. 5 managers (marketing manager, production manager, procurement/purchasing manager, customer service manager and development manager) were drawn from each firm. This raised the number of respondents to 150. The data for the study was collected using questionnaire. The Cronbach alpha was used to assess the reliability of the study instrument. Descriptive statistics was used to analyses the data collected, while the Pearson Product Moment Correlation (PPMC) statistic was used to test the hypotheses formulated. All analyses was done through the application of Statistical Package for Social Science (SPSS) version 27.0.

## Data Analysis and Results

**Table 1: Descriptive Statistics for Study Variables**

	N	Minimum	Maximum	Mean	Std. Deviation
Process Control	125	1.33	5.00	3.7520	.70317
Waste Reduction	125	1.00	5.00	3.7707	.68052
Delivery Flexibility	125	1.33	5.00	3.7653	.71093
Valid N (listwise)	125				

Source: SPSS Output, 2025

Table 1 illustrates the descriptive statistics for process control, waste reduction and delivery flexibility with mean scores of 3.75, 3.77 and 3.76 respectively, which indicates a high and positive response.

**Table 2: Correlation between Process Control and Waste Reduction**

		Process Control	Waste Reduction
Process Control	Pearson Correlation	1	.772**
	Sig. (2-tailed)		.000
	N	125	125
Waste Reduction	Pearson Correlation	.772**	1
	Sig. (2-tailed)	.000	
	N	125	125

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2025

Table 2 shows the summary of results of test of correlation between process control and waste reduction of food and beverage manufacturing firms in Port Harcourt. The Table shows a correlation coefficient of .772\*\*. This means that a strong correlation exists between process control and waste reduction of food and beverage manufacturing firms in Port Harcourt. The positive sign of the coefficient means that a positive correlation exists between process control and cost reduction. In addition, the test produced a probability value of 0.000 which is less than 0.05. This means that the correlation between process control and waste reduction is statistically significant. On the strength of these facts, the null hypothesis which states that there is no significant relationship between process control and waste reduction of food and beverage manufacturing firms in Port Harcourt was hereby rejected.

**Table 3: Correlation between Process Control and Delivery Flexibility**

		Process Control	Delivery Flexibility
Process Control	Pearson Correlation	1	.981**
	Sig. (2-tailed)		.000
	N	125	125
Delivery Flexibility	Pearson Correlation	.981**	1
	Sig. (2-tailed)	.000	
	N	125	125

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2025

The summary of results of test of correlation between process control and flexibility is shown in Table 3. The results show a correlation coefficient of .981\*\* on the correlation between process control and waste reduction. This very high P(r) coefficient means that a very strong correlation exists between process control and delivery flexibility of food and beverage manufacturing firms in Port Harcourt. The positive sign of the coefficient means that the correlation between process control and delivery flexibility is positive, implying that increase in process control will result to increase delivery in flexibility. In addition, the test produced a probability value of 0.000 which is less than 0.05. This means that the correlation between process control and delivery flexibility is statistically significant. Thus, the null hypothesis which states that there is no significant relationship between process control and delivery flexibility of food and beverage manufacturing firms in Port Harcourt was rejected.

### Discussion of Findings

The result of hypotheses showed that there is a strong positive relationship between process control and waste reduction; and a very strong positive relationship between process control and delivery flexibility of food and beverage manufacturing firms in Port Harcourt. These findings support the findings of Jawad and Mark (2017) who examined the link between process control and project performance of construction companies in Saudi Arabia and found that process control significantly improve project performance by reducing defects and enhancing overall quality.

Our findings also agree with the findings of Liu et al. (2018) who assessed the relationship between process control and project performance, and found that quality control, schedule control, and cost control predict project success. In addition, our findings corroborate the report that quality control and schedule control predict project success (Jha & Iyer, 2017).

### Conclusion and Recommendations

Based on the findings of the study, we conclude that process control is essential to improving supply chain performance by increasing efficiency, reducing errors, and enhancing quality. Integrated process control across the supply chain leads to better operational and financial outcomes, and the integration of process management with strategic goals is key to achieving optimal performance. Ultimately, a lack of process control leads to increased costs, and customer dissatisfaction, whereas effective control drives higher performance.

Based on the results of findings, we recommend as follows:

1. Management of food and beverage manufacturing firms in Port Harcourt should establish standardized procedures to ensure consistency and control across their supply chain to enable better visibility, tracking, and management.
2. Management of food and beverage firms in Port Harcourt should regularly monitor and analyze key performance metrics, such as lead times, inventory levels, and shipment accuracy, to identify areas for improvement and optimize process control.
3. Management of food and beverage firms in Port Harcourt should leverage technology and automation to enhance process control, reduce errors, and improve overall supply chain performance.

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