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Research Article

Assessing Lean Six Sigma's Role in Enhancing Quality Control in Food and Beverage Production, Enugu State, Nigeria

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Abstract

The study examined the Assessment of Lean Six Sigma's Role in Enhancing Quality Control in Food and Beverage Production in Enugu State, Nigeria. The specific objectives are to ascertain the effect of leader development on the operational safety of food and beverage manufacturing firms, and to determine the impact of control processes on the quality of service in food and beverage manufacturing firms in South-Eastern Nigeria. a survey research design was chosen. Data for the study was gathered using a structured questionnaire design using a point Likert scale. The mean, standard deviation, and basic percentages were used to examine the data. (Descriptive statistics software, SPSS version 20, was used for the analysis.). The result revealed that Leader development has a significant positive effect on the operational safety of food and beverage manufacturing firms with a Kolmogorov-Smirnov Z-value of 7.006 < 11.160, while the critical Z-value of.000. Control processes have a significant positive effect on the quality of service of food and beverage manufacturing firms With Kolmogorov-Smirnon Z – value of 6.342 < 11.215, the critical Z-value of .000 South-East, Nigeria. In conclusion, Lean Six Sigma not only enhances quality control but also empowers leaders and reinforces control processes, paving the way for sustainable growth in the food and beverage industry in Enugu State. The study recommends that Organizations should prioritize the training and development of leaders within the food and beverage sector.

Keywords: Lean Six Sigma; Quality Control; Food and Beverage Production; Beverage Manufacturing Firms

Introduction

In the competitive landscape of the food and beverage manufacturing industry, maintaining high standards of quality control is paramount for success. As consumer expectations rise and regulatory standards become more stringent, companies are increasingly turning to methodologies like Lean Six Sigma to enhance their quality control processes. Lean Six Sigma combines the principles of Lean manufacturing, which focuses on waste reduction, with Six Sigma's emphasis on reducing variability and defects. This synergistic approach not only streamlines operations but also fosters a culture of continuous improvement. The implementation of Lean Six Sigma in food and beverage production can lead to substantial improvements in product quality and consistency. By systematically identifying inefficiencies and addressing the root causes of defects, firms can enhance their quality control processes, thereby reducing waste and improving overall performance.

Research has shown that Lean Six Sigma practices can lead to better quality outcomes and increased profitability in manufacturing settings, including the food and beverage sector.

In the context of Enugu State, where local firms must navigate both market pressures and regulatory frameworks, the effective application of Lean Six Sigma is essential for achieving sustainable growth. This study aims to assess the role of Lean Six Sigma in enhancing quality control within food and beverage production in Enugu State, Nigeria. By exploring the methodologies employed and the outcomes achieved, we seek to provide valuable insights into how Lean Six Sigma can drive operational excellence and foster a culture of continuous improvement in this critical industry.

Statement of the Problem

The food and beverage production sector in Enugu State, Nigeria, faces significant challenges related to quality control, which is critical for maintaining consumer trust and meeting regulatory standards. Despite the increasing demand for high-quality products, many manufacturers struggle with inefficiencies, high defect rates, and inconsistent product quality. Traditional quality management practices often fall short in addressing these issues, leading to increased waste, higher operational costs, and diminished customer satisfaction.

Lean Six Sigma presents a promising solution to these challenges by combining waste reduction techniques with a focus on minimizing defects. However, the extent to which Lean Six Sigma has been effectively implemented and its impact on quality control within the food and beverage industry in Enugu State remains under explored. There is a lack of empirical evidence demonstrating how these methodologies can be tailored to local contexts and their effectiveness in enhancing quality control processes.

This study aims to fill this gap by assessing the role of Lean Six Sigma in improving quality control in food and beverage production in Enugu State. Understanding the specific challenges and benefits associated with its implementation is essential for developing strategies that can enhance operational performance and ensure compliance with industry standards.

Objective of the Study

The main objective of this study is the Assessment of Lean Six Sigma's Role in Enhancing Quality Control in Food and Beverage Production, Enugu State, Nigeria. The specific objectives are to;

i. Ascertain the effect of leader development on the operational safety of food and beverage manufacturing firms in South-East, Nigeria.
ii. Determine the effect of control processes on the quality of service of food and beverage manufacturing firms in South-East, Nigeria.

Statement of the Hypotheses

i. Leader development does not have a significant effect on the operational safety of food and beverage manufacturing firms in South-East, Nigeria.
ii. Control processes do not have a significant effect on the quality of service of food and beverage manufacturing firms in South-East, Nigeria.

Review of Related Literature

Conceptual Review

Lean Six Sigma is a robust methodology that integrates two well-established approaches: Lean manufacturing and Six Sigma. Lean focuses on the elimination of waste and the optimization of processes, while Six Sigma emphasizes the reduction of variability and defects through statistical analysis. Together, they provide a comprehensive framework for improving operational efficiency and enhancing product quality across various industries (John, 2022).

Six Sigma is a methodology for process improvement that was first introduced by engineers Bill Smith and Mikel Harry at Motorola in 1986. It gained significant recognition when Jack Welch made it a central part of General Electric's business strategy in 1995. Since then, many companies globally have adopted Six Sigma as their standard operational practice (Hung & Sung, 2011). Six Sigma involves various methodologies and tools aimed at improving business processes by minimizing defects, errors, and variations, thereby enhancing quality and efficiency. The goal of Six Sigma is to achieve nearly perfect quality, with only 3.4 defects per million opportunities (Nnabuife & Ohue, 2021). The term "Six Sigma" represents a statistical measure of process deviation from perfection. It is a disciplined, data-driven approach extensively used in project management to foster process improvement and defect reduction. This involves streamlining processes, lowering defects, improving quality, and optimizing resources to deliver greater value with less effort (Pankaj, 2023). Six Sigma practitioners use statistics, financial analysis, and project management to enhance business functionality and superior quality control by identifying and correcting errors or defects in existing processes.

Quality control

Quality control is as old as industry itself (Duncan, 2020). In the ages before the industrial revolution, good craftsmen and artisans learnt quickly through the intimate contact with their customers that quality products meant satisfied customers and satisfied customers meant continued business. However, with the Industrial Revolution came the mass production of products by people who rarely interacted with customers. As a result, the cost decreased, and the emphasis also decreased (Earnst & Young, 2019). In addition, as the products made and the services provided became more complex, the need for a formal system to ensure the quality of the final product and all its components became increasingly important. Quality control is a process by which entities review the quality of all factors involved in production. International Standard Organization (ISO) 9000 defines quality control as "a part of quality management focused on fulfilling quality requirements. A major aspect of quality control is the establishment of well-defined measures that will help standardize production, delivery, and reactions to quality issues. In the long run, investments in quality control measures can protect the reputation of a company, prevent products from being unreliable, and increase trust on the side of consumers (Ofunya, 2019). These processes are determined through rigorous methodology and testing, as well as industry standards and best practices. Moreover, quality control is necessary because it ensures that a company will look at evidence-based data and research, not just anecdotal observations, to ensure that products are living up to their standard necessary for business growth.

Leadership

There is no single, clear, concise, and generally accepted definition for leadership. Charisma, communication, power, influence, control, and intelligence are some of the terms associated with leadership (Aritz et al., 2017; Jain & Duggal, 2016; Shamir & Eilam-Shamir, 2017; Williams et al., 2018). In summary, leadership is a position of influence, authority, and control, and a state in which the leader takes charge of coordinating, managing, and supervising a group of people (Shamir & Eilam-Shamir, 2017). Leaders use their positions of influence to deliver goals and objectives (Aritz et al., 2017). Dalmau and Tideman (2018) opined that leaders are change agents who use their behaviours and skills to communicate and engender change among their followers and team members. Effective leadership is a critical success factor for CI and sustainable growth (Gandhi et al., 2019). Leadership is an essential ingredient and one of the most potent factors for driving organizational growth (Torlak & Kuzey, 2019; Williams et al., 2018). In organizations, leadership encompasses individuals' ability, called leaders, to influence and guide other individuals, teams, and the entire organization (Kim & Beehr, 2020).

Leaders are a critical subject for business because of their roles and their influence on individuals, groups, and organizational performance (Ali & Islam, 2020; Ceri-Booms et al., 2020; Kim & Beehr, 2020). Williams et al. (2018) summarized leaders as individuals who guide their organizations by performing leadership activities. These leaders perform various leadership activities to achieve business goals. In today's competitive business environment, organizations are searching for leaders who can drive superior performance and deliver sustainable results (Ali & Islam, 2020). Organizational leaders are involved in crafting, deploying, and institutionalizing improvement strategies for business performance (Fahad & Khairul, 2020; Khan et al., 2019; Shumpei & Mihail, 2018). Leadership has implications for business improvement and growth and is a critical subject for beverage managers who intend to drive CI. Thus, the leader's role in the business environment is crucial for CI and organizational success in a beverage firm. The next section includes an overview of leadership in the beverage industry and beverage industry leaders' impact on CI and performance.

Control Processes

The process through which the standards are established and met with standards is called control. This process consists of observing our activity performance, comparing the performance with a standard, and then taking action if the observed performance is significantly different from the standard. The control process involves a universal sequence of steps as follows: choose the control object, choose a unit of measure, set the standard value, choose a sensing device that can measure, measure actual performance, interpret the difference between actual and standard, and take action. Control charts, also known as Shewhart charts or process-behaviour charts, are essential tools in Lean Six Sigma for monitoring process variation over time. These charts are used to determine whether a manufacturing process is stable and in control, or if there are variations that need to be addressed. By plotting data points over time, control charts help identify trends, shifts, and any unusual patterns in the process that may indicate issues.

Theoretical Framework

Dynamic Capabilities Theory (David Teece, Gary Pisano, and Amy Shuen, 1997)

Dynamic Capabilities Theory focuses on a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. It emphasizes the need for organizations to adapt, innovate, and renew their capabilities to sustain competitive advantage. The theory was introduced by David Teece, Gary Pisano, and Amy Shuen in 1997 (Buzzao & Rizzi, 2021). The dynamic capabilities theory supports objectives one and two of the study. It highlights the importance of continuous improvement and the ability to adapt processes over time. Food and beverage manufacturing firms can use Lean Six Sigma to continually refine and optimize their operations, which is crucial for maintaining profitability in a competitive and dynamic market. (Cyfert, Chwiłkowska-Kubala, Szumowski, & Miśkiewicz, 2021). By fostering a culture of continuous improvement, firms can remain agile and responsive to market changes, ensuring that processes are continually enhanced to improve efficiency and reduce costs. This adaptability is vital for sustaining long-term profitability in the food and beverage sector.

Moreover, developing leaders with dynamic capabilities is essential for operational safety. Leaders who can drive change and adapt to new safety standards and practices ensure that the firm maintains high safety levels in its operations (Vu, 2020). Leaders trained in dynamic capabilities are better equipped to anticipate and respond to emerging safety challenges. Their ability to lead change initiatives and foster a proactive safety culture can significantly enhance operational safety, reducing the risk of accidents and ensuring compliance with safety regulations.

Empirical Review

Peters (2019) conducted a study on the leadership skills owners- managers used to sustain their businesses for longer than 5 years. Research participants were 4 owner-managers of SMEs from the manufacturing industry in Trinidad and Tobago who sustained their businesses for at least 5 years. The contingency leadership model and the skill-based leadership model formed the conceptual lens for this study. Data were collected using semi-structured interviews and direct observations. Data were analysed using Miles and Huberman's analytical strategies and Morse's cognitive process of coding, pattern matching, interpreting, and summarizing the data. Five themes emerged from the data analysis: leadership skills, leadership values, development of leadership skills, leadership challenges, and improvement in leadership skills. The findings from this study could influence positive social change by providing insights on leadership skills SME leaders could use to sustain their operations for the long term, resulting in reduced failure of SMEs. A decrease in the failure rate of SMEs might contribute to improved economic conditions, leading to the reduction of poverty in families and communities.

Aniefiok and Onuoha (2023) conducted a study on the Strategic Leadership and Organizational Performance of Food and Beverage Firms in Port Harcourt. The study ascertains the relationship between strategic leadership and the profitability of beverage firms in Rivers State. The study used a survey design, and a total of one hundred and thirty (130) managers of different food and beverage firms were covered. The primary data for the study was collected using copies of well-structured questionnaire. The data was analysed using the spearman rank order correlation coefficient. Based on the analysis, the result revealed that there exist a significant and positive correlation between the strategic leadership and organizational performance of food and beverages firm in Port Harcourt. In conclusion, Strategic leadership is related to performance of the food and beverage firms in Rivers State.

Ebeh and Onuoha, (2023) conducted a study on Production Control and Operational Efficiency of Food and Beverage Firms in Akwa Ibom State. This study examined the influence of production control on operational efficiency of food and beverage firms in Akwa Ibom State. The aim of the study was to determine the relationship between production control on operational efficiency of food and beverage firms. The study employed the theory of Constraints by (Eli Goldratt, 1984). The study adopted the survey research design. Based on the research questions, a structured questionnaire was administered to 321 respondents comprising (management staff of food and beverage firms). A total of 302 copies of the distributed questionnaire were retrieved and utilized. These copies were analysed and the hypotheses were tested using the Spearman Rank Order Correlation analytical tool via the SPSS package (version 21.0). Findings revealed a significant relationship between inventory management and operational

efficiency. Also; there was a significant relationship between quality control and operational efficiency of food and beverage firms.

Nnadi, Akawnonu, and Okafor (2018) conducted a study on An Empirical Analysis of Quality Control Techniques and Product Quality in Manufacturing Firms in South East Nigeria. The study interrogated the link between quality control technique and product quality in manufacturing firms in South East Nigeria. The study specifically aimed to examine the effect of inspection technique on relationship between quality control technique and product designing was used in this study. The total population used for this study is nine thousand two hundred and eighty-five (9,285) personnel, but utilized a total sample size of five hundred and sixty-four (564), which constitutes the actual number of staff who issued the questionnaire. Data collected were presented in a table, and the statistical tools used for data analysis were the Pearson Correlation with the aid of the Statistical Package for Social Sciences (SPSS). The result of the study revealed that the inspection technique has a significant positive effect on production control, and that the quality control technique has a significant positive effect on product design

Methodology

For the study, a survey research design was chosen. Data for the study was gathered using a structured questionnaire design using a point Likert scale. Employees of the chosen food and beverage production companies in South-East Nigeria make up the study's population. Senior and junior staff members from several departments of food and beverage manufacturing companies comprised the workforce. Three, five hundred and sixty-five (3,565) employees comprised the study population. Three hundred and forty-seven (347) respondents made up the study sample size. The statistical formula developed by Freund and William was used to determine the sample size. The mean, standard deviation, and basic percentages were used to examine the data. (Descriptive statistics software, SPSS version 20).

Data Presentation and Analyses

Distribution and Return of Questionnaire

Table 1: Distribution and Return of the Questionnaire

Firms	*Distributed*	*No Returned*	*percent*	*No not Returned*	*Percent*
1. Nigeria Breweries, Aba	50	49	14	2	1
2.M.O. Nnaji Bakeries, Aba	17	16	5	1	-
3.Tummy Tummy foods, Nnewi	37	35	10	2	1
4.Nigeria Bottling Co. Ltd., Onitsha	44	42	12	2	1
5.Jaypee Enterprises, Uburu	24	23	7	1	-
6 Abakaliki Rice Cluster	46	42	12	4	1
7.Nigerian Breweries Plc, Enugu	37	35	10	2	1
8.Aqua Ralpha Investment, 9th Mile	42	36	10	6	2
9.Emmerald food, Owerri	38	37	11	1	-
10.Jacob Wine, Orlu	12	11	3	1	-
Total	**347**	**326**	**93.0**	**21**	**7.0**

Source: Field Survey, 2024

According to Table 1, out of the 347 copies of the questionnaire that were given, 326 (326) were returned, accounting for 91% of the total, and were used, while 21 (21) copies, or 7% of the total, were not returned and were not used. This indicates a high rate of responders.

Bio Data

The bio-data shows the gender distribution, marital status of respondents, educational qualifications, years of experience, and age of the respondents under study.

Table 2: Gender Distribution

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Male	183	56.1	56.1	56.1
Female	143	43.9	43.9	100.0
Total	**326**	**100.0**	**100.0**	

Source: Field Survey, 2024

According to Table 2, 143 respondents, or 43.9 percent of the sample, were female, whereas 183 respondents, or 56.1 percent of the sample, were male. This suggested that there were more men than women.

Table 3: Marital Status of Respondents

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Single	109	33.4	33.4	33.4
Married	191	58.6	58.6	92.0
Widowed	20	6.1	6.1	98.1
Divorced	6	1.9	1.9	100.0
Total	**326**	**100.0**	**100.0**	

Source: Field Survey, 2024

According to Table 3, 191 respondents, or 58.6 percent, were married, whereas 109 respondents, or 33.4 percent, were single. Twenty of the respondents, or 6.1%, were widowed. Six responders, or 1.9% of the sample, were divorced.

Table 4: Educational qualifications of the Respondents

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
WASC/GCE	88	27.0	27.0	27.0
OND/NCE	88	27.0	27.0	54.0
HND/B.Sc.	92	28.3	28.3	82.3
MBA/M.Sc.	37	11.3	11.3	93.6
PhD	21	6.4	6.4	100.0
Total	**326**	**100.0**	**100.0**	

Source: Field Survey, 2024

According to Table 4, 88 out of 326 respondents, or 27.0 percent, had a WASC or GCE, 88 out of 326 respondents, or 27.0 percent, had an NCE or OND, 92 out of 326 respondents, or 283 percent, had an HND or BSC, 37 out of 326 respondents, or 11.3 percent, had a master's degree, and 21 out of 6 percent had a doctorate.

Table 5: Years of Experience

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
less than 2 years	82	25.2	25.2	25.2
3-5years	208	63.8	63.8	89.0
6-10years	30	9.2	9.2	98.2
11 years and above	-6	1.8	1.8	100.0
Total	**326**	**100.0**	**100.0**	

Source: Field Survey, 2024

Table 5 shows that 82 out of 326 respondents, or 25.2%, had less than one to two years of experience, 208 out of 63.8 percent had three to five years of experience, 30 out of 9.2 percent had six to ten years of experience, and 6 out of 1.8 percent had eleven years or more.

Table 6: Age of the respondents

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
25-30years	53	16.3	16.3	16.3
31-35years	77	23.6	23.6	39.9
36-40years	89	27.3	27.3	67.2
45- 50years	19	5.8	5.8	73.0
51years and above	88	27.0	27.0	100.0
Total	**326**	**100.0**	**100.0**	

Source: Field Survey, 2024

Table 6 shows that 53 out of 326 respondents, or 16.2 percent, were between the ages of 25 and 30; 77 respondents, or 23.6 percent, were between the ages of 31 and 35; 89 respondents, or 27.3 percent, were between the ages of 36 and 40; 19 respondents, or 5.8 percent, were between the ages of 45 and 50; and 88 respondents, or 27.0 percent, were between the ages of 51 and over. This suggests that a larger percentage of responders are between the ages of 36 and 40.

Data Presentation and Analyses

The effect of leader development on the operational safety of food and beverage manufacturing firms in South-East, Nigeria

Table 7: Responses on the effect of leader development on the operational safety of food and beverage manufacturing firms in South-East, Nigeria.

		5 SA	*4 A*	*3 N*	*2 DA*	*1 SD*	*∑FX*	*- X*	*SD*	*Decision*
1	Leader's training helps improve employee safety.	580 116 35.6	360 92 28.2	45 15 4.6	138 69 21.2	34 34 10.4	1157 326 100.0	3.55	1.418	Agree
2	The level of leader's education promotes treating staff and customers in safe environment.	715 143 43.9	440 110 33.7	48 16 4.9	8 4 1.2	53 53 16.3	1264 326 100.0	3.88	1.411	Agree
3	Investing in development of leader's enhances growth and promotes staff skills.	945 189 58.0	360 90 27.6	45 15 4.6	54 18 5.5	14 14 4.3	1418 326 100.0	4.35	1.072	Agree
4	Making learning programs and experiences flexible and relevant boost leaders and improve employee safety.	820 164 50.3	476 119 36.5	39 13 4.0	36 18 5.5	12 12 3.7	1383 326 100.0	4.24	1.020	Agree
5	Enhancing the leadership abilities of any member of an organization reduces customer's risk.	450 90 27.6	588 147 45.1	39 13 4.0	108 54 16.6	22 22 6.7	802 326 100.0	2.46	1.226	Agree
	Total Grand mean and standard deviation							**18.48**	**6.1447**	

Source: Field Survey, 2024

According to Table 7, 208 out of 326 respondents, or 63.8 percent, agreed that training for leaders improves employee safety (mean score: 3.55, standard deviation: 1.418). 253 respondents, or 77.6 percent, agreed that a leader's education level encourages treating employees and customers in a safe environment (mean score: 3.88, standard deviation: 1.411). 279 respondents, or 85.6 percent, agreed that investing in developing leaders enhances growth and promotes staff skills (mean score: 4.35, standard deviation: 1.072). 237 respondents, or 72.7 percent, agreed that improving an organization's

leadership skills lowers customer risk, with a mean score of 2.46 and a standard deviation of 1.226. 185 respondents, or 86.8 percent, agreed that making learning programs and experiences flexible and relevant boosts leaders and improves employee safety, with a mean score of 4.24 and a standard deviation of 1.020.

Test of Hypotheses

Hypothesis One: Leader development has a significant effect on the operational safety of food and beverage manufacturing firms in South-East, Nigeria

Table 8: One-Sample Kolmogorov-Smirnov Test

		Leader's training helps improve employee safety	The level of leader's education promotes treating staff and customers in safe environment	Investing in development of leader's enhances growth and promotes staff skills	Making learning programs and experiences flexible and relevant boost leaders and improve employee safety.	Enhancing the leadership abilities of any member of an organization reduces customer's risk.
N		326	326	326	326	326
Uniform Parameters[a,b]	Minimum	1	1	1	1	1
	Maximum	5	5	5	5	5
Most Extreme Differences	Absolute	.388	.526	.606	.618	.477
	Positive	.104	.163	.043	.037	.067
	Negative	-.388	-.526	-.606	-.618	-.477
Kolmogorov-Smirnov Z		7.006	9.499	10.939	11.160	8.612
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

a. Test distribution is Uniform.
b. Calculated from data.

Decision Rule

Reject the null hypothesis and accept the alternative hypothesis by the computed Z-value if it exceeds the critical Z-value (i.e., Zcal > Zcritical). outcome on Asymp and with a Kolmogorov-Smirnov Z-value of 7.006 < 11.160. The replies from the respondents, as shown in the table, have a normal distribution with a significance level of 0.000. This supports the claim made by the majority of respondents that the operational safety of food and beverage manufacturing companies in South-East Nigeria was significantly improved by leader development. Choice

Additionally, the null hypothesis was rejected when the computed Z-value of 7.006 < 11.160 was compared to the critical Z-value of.000 (2-tailed test with 97 percent level of confidence). The alternative hypothesis, according to which the operational safety of food and beverage manufacturing companies in South-East Nigeria was significantly improved by leader development, was therefore accepted.

The effect of control processes on the quality of service of food and beverage manufacturing firms in South-East, Nigeria

Table 9: Responses on the effect of control processes on the quality of service of food and beverage manufacturing firms in South-East, Nigeria

		5 SA	*4 A*	*3 N*	*2 DA*	*1 SD*	*∑FX*	*- X*	*SD*	*Decision*
1	A careful collection of information from customers are made and helps fast action taking	505 101 31.0	380 95 29.1	69 23 7.1	152 76 23.3	31 31 9.5	1137 326 100.0	3.49	1.383	Agree
2	Ensuring of standard about customers information helps quick attention to them	700 140 42.9	552 138 42.3	48 16 4.9	10 5 1.5	27 27 8.3	1337 326 100.0	4.10	1.131	Agree
3	The control process in the organisation ensures that the leaders figure out how the organization are doing and attends to customers without wasting time	885 177 60.1	400 100 17.3	51 17 4.4	36 18 7.7	14 14 10.5	1386 326 100.0	4.25	1.069	Agree
4	Performance standards are in place which ensure that plans or target are met at the required time	810 162 49.7	488 122 37.4	39 13 4.0	36 18 5,5	11 11 3.4	1384 326 100.0	4.25	1.002	Agree
5	Effective cooperation, teamwork, and collaborative effort are made, and better results are achieved	420 84 25.8	672 168 51.5	39 13 4.0	94 47 14.4	14 14 4.3	1239 326 100.0	3.80	1.107	Agree
	Total Grand mean and standard deviation							**19.89**	**5.692**	

Source: Field Survey, 2024

Table 9, 196 respondents out of 326, representing 60.1 percent, agreed that a careful collection of information from customers is made and helps fasten action taking with a mean score of 3.49 and a standard deviation of 1.383. 278 respondents representing 85.2 percent agreed that ensuring standards about customer information helps quick attention to them, with a mean score of 4.10 and a standard deviation of 1.131. 277 respondents representing 77.4 percent agreed that the control process in the organisation ensures that the leaders figure out how the organization is doing and attends to customers without wasting time, with a mean score of 4.25 and a standard deviation of 1.069. 284 respondents representing 87.1% agreed that Performance standards are in place, which ensures that plans or targets are met at the required time, with a mean score of 3.25 and a standard deviation of 1.002. 252 respondents representing 77.3 percent agreed that Effective cooperation, teamwork, and collaborative effort are made and better results are achieved with a mean score of 77.3 and a standard deviation of 1.107.

Hypothesis Two: Control processes have a significant effect on the quality of service of food and beverage manufacturing firms in South-East, Nigeria

Table 10: One-Sample Kolmogorov-Smirnov Test

		A careful collection of information from customers are made and helps fasten action taking	Ensuring of standard about customers information helps quick attention to them	The control process in the organisation ensures that the leaders figure out how the organization are doing and attends to customers without wasting time.	Performance standards are in place which ensure that plans or target are met at the required time.	Effective cooperation teamwork and collaborative effort are made and better results achieved.
N		326	326	326	326	326
Uniform Parameters[a, b]	Minimum	1	1	1	1	1
	Maximum	5	5	5	5	5
Most Extreme Differences	Absolute	.351	.603	.600	.621	.523
	Positive	.095	.083	.043	.034	.043
	Negative	-.351	-.603	-.600	-.621	-.523
Kolmogorov-Smirnov Z		6.342	10.883	10.828	11.215	9.443
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

a. Test distribution is Uniform.

b. Calculated from data.

Decision Rule

If the calculated Z-value is greater than the critical Z-value (i.e., $Z_{cal} > Z_{critical}$), reject the null hypothesis and accept the alternative hypothesis accordingly.

Result

With Kolmogorov-Smirnon Z – value of 6.342 < 11.215 and on Asymp. Significance of 0.000, the responses from the respondents, as displayed in the table, are normally distributed. This affirms the assertion of most of the respondents that control processes had a significant positive effect on the quality of service of food and beverage manufacturing firms in South-East, Nigeria.

Decision

From the result of hypothesis two, the calculated Z-value of 6.342 < 11.215 against the critical Z-value of .000 (2-tailed test at 97 percent level of confidence), the null hypothesis was rejected. Thus, the alternative hypothesis was accepted, which states that control processes had a significant positive effect on the quality of service of food and beverage manufacturing firms in South-East, Nigeria.

Conclusion

The assessment of Lean Six Sigma's role in enhancing quality control within the food and beverage production sector in Enugu State, Nigeria, reveals critical insights into operational efficiency and safety. The findings indicate that effective leadership development significantly contributes to improving the operational safety of manufacturing firms in the region. This leadership fosters a culture of continuous improvement and accountability, essential for maintaining high safety standards.

Moreover, the implementation of rigorous control processes directly correlates with enhanced service quality, underscoring the importance of systematic methodologies in food and beverage production. By integrating Lean Six Sigma principles, firms can streamline operations, reduce waste, and ensure consistent product quality, ultimately leading to greater customer satisfaction and competitiveness in the market.

In conclusion, Lean Six Sigma not only enhances quality control but also empowers leaders and reinforces control processes, paving the way for sustainable growth in the food and beverage industry in Enugu State. Emphasizing these practices will be crucial for firms aiming to thrive in an increasingly demanding market environment.

Recommendations

Based on the assessment of Lean Six Sigma's impact on quality control in the food and beverage production sector in Enugu State, Nigeria, the following recommendations are proposed:

i. Organizations should prioritize the training and development of leaders within the food and beverage sector. Implementing structured leadership programs will enhance operational safety and cultivate a culture of continuous improvement.
ii. Establishing and maintaining rigorous control processes is essential. Companies should regularly review and refine these processes to ensure they effectively contribute to service quality and operational stability.

Reference

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