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LEAN MANUFACTURING AND OPERATIONAL EFFICIENCY: EMPIRICAL EVIDENCE FROM THE NIGERIAN MANUFACTURING INDUSTRY

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ABSTRACT

This research investigated the association between Lean Manufacturing (LM) and operational efficiency (OE) within the Nigerian manufacturing industry. A sample of one hundred (100) executives and managers from fourteen (14) purposively chosen manufacturing firms in Nigeria participated. The study utilised a quasi-experimental research configuration and embraced a cross-sectional questionnaire for data gathering. The Statistical Package for Social Sciences (SPSS) Version 25 was employed for data analysis, using structural equation modelling (SEM) via the AMOS software. The results reveal a robust positive and significant correlation between lean manufacturing (LM) and operational efficiency (OE) within the Nigerian manufacturing industry. Specifically, the result of data analysis revealed a robust positive and significant association between leanness and operational efficiency measures (quality of output and delivery time/pace) within the Nigerian manufacturing industry. Similarly, the research also revealed a robust positive and significant correlation between waste reduction and operational efficiency (quality of output and delivery time/pace) within the Nigerian manufacturing sector. In light of these findings, the study concludes that leanness and waste reduction play significant roles in enhancing the quality of output and delivery time/pace within the Nigerian manufacturing sector. The theoretical and managerial implications of these findings were also discussed.

KEYWORDS

Lean Manufacturing, Leanness, Waste Minimization, Operational Efficiency, Quality of Output, Delivery Time/Speed, Resource-Based Theory, Structural Equation Modelling, Manufacturing Industry, Nigeria.

Introduction

Contemporary manufacturing and production settings confront hurdles in handling and diminishing overproduction, waste, and rivalry, prompting the quest for organizational production tactics to boost competitiveness and effectiveness (Panigrahi et al., 2023). Operational efficiency and flexibility have become the dominant manufacturing paradigms for many industries. The increased level of globalization, technological leaps, and shortening product life cycles create pressures for companies to respond to customer demands rapidly and effectively. Realizing these imperatives has prompted many companies to adopt operational strategies and practices that seek to reduce the lead time of their supply chain activities while still providing high-quality products to customers at lower cost. To fit these requirements of the modern economy, the manufacturing process has evolved in the past few decades from mass production to lean manufacturing. (Valamede and Akkari, 2020; Yadav et al., 2020; Ghobadian et al., 2020; Prasad et al., 2020; Sartal et al., 2020). Operational efficiency contributes to stakeholders' prosperity, business expansion, profitability, client contentment, internal business methodologies, innovation, and originality (Bayo-Moriones and Merino-Díaz de Cerio, 2002). Supplementary benefits encompass cost reduction, adaptability, and enhanced excellence.

Operational efficiency can amplify economic benefits for entities and stakeholders (Islami, 2022). It is linked to the organisation's internal operations, such as efficiency, merchandise excellence, and client contentment (Feng et al., 2007; Nugraha and Indrawati, 2017; Kuo and Chen, 2015). It is typically assessed alongside criteria such as percentage returns (Rosenzweig et al., 2003; Poirier and Quinn, 2004), percentage faults (Frohlich and Westbrook, 2001), delivery velocity (Buzzell & Ortmeyer, 1995), production expenses, production lead time, stock turnover (Zhu & Karemer, 2002; Ranganathan et al., 2004), and adaptability.

Given the advantages of operational efficiency and the obstacles encountered by modern organisations, numerous scholars have proffered various suggestions and recommendations for enhancing their level of operational efficiency. Some of these recommendations include but are not limited to: originality (Tabatabae, 2000), employee work-life balance (Armstrong, 2001; Bartoli & Blatrix, 2015), information compliance and integration (Block & Hire, 1978), and employees' involvement and expression (Blundell et al., 1995). Other scholars, like Leonard and Milton (1963), Bunn and Taylor (2001), and Chann (2000), have recommended escalated adoption of automation and substantial organisational adjustments in response to new manufacturing, as mentioned in Corradi and Swanson (2006).

Conversely, one suggested strategy for ameliorating organisational effectiveness is lean manufacturing. Implementing lean manufacturing is crucial because it furnishes industries an advantage in administering their operational and strategic gains, consequently diminishing waste. Certain researchers propose that to secure a competitive edge, entities require suitable production systems and technologies emphasising premium product quality, curtailing product design duration, demand-driven production, and waste and stock management (Womack & Jones, 1996). This brings us to the topic of lean manufacturing.

Lean manufacturing is a concept that can be executed at diverse tiers and represents a commitment to continuous enhancement that significantly influences an organisation's welfare, prosperity, and competitiveness (Henderson & Larco, 1999). Global competition has elevated the urgency for manufacturing facilities to refine operational efficiency and performance. Traditionally, organisations adopted broad production practices, making refining or satisfying clients strenuous. Consequently, lean manufacturing is now imperative for attaining superior performance (Emiliani, 2006). Lean entities can yield superior-quality commodities in lesser volumes and swiftly deliver them to the market. Lean management involves operating the most efficient and effective organisation, with minimal expenditure and no wastage, while fulfilling client demand.

From the discourse above, it can be contended that lean manufacturing, a modern approach with myriad organisational benefits, is one of the less-discussed subjects related to operational efficiency. Though numerous studies have been probing the impact of lean manufacturing on organisational performance, Chen and Tan (2011) observed that few have scrutinized its effect on operational performance. Furthermore, the limited exploration on lean manufacturing has primarily been conducted in the Western hemisphere, with most of the theoretical foundations stemming from research conducted in Western nations. Hence, there is a necessity for research within the Nigerian milieu. To address the gap in the management literature, this study endeavours to probe the correlation between lean manufacturing and operational efficiency in the Nigerian manufacturing industry. Understanding the correlation between lean manufacturing and operational efficiency in the Nigerian context holds significance. Our study diverges from prior research by examining this correlation and furnishing empirical evidence to address the identified gap in the management literature.

Conceptual Framework

Figure 1 below presents the conceptual framework that will guide this study.

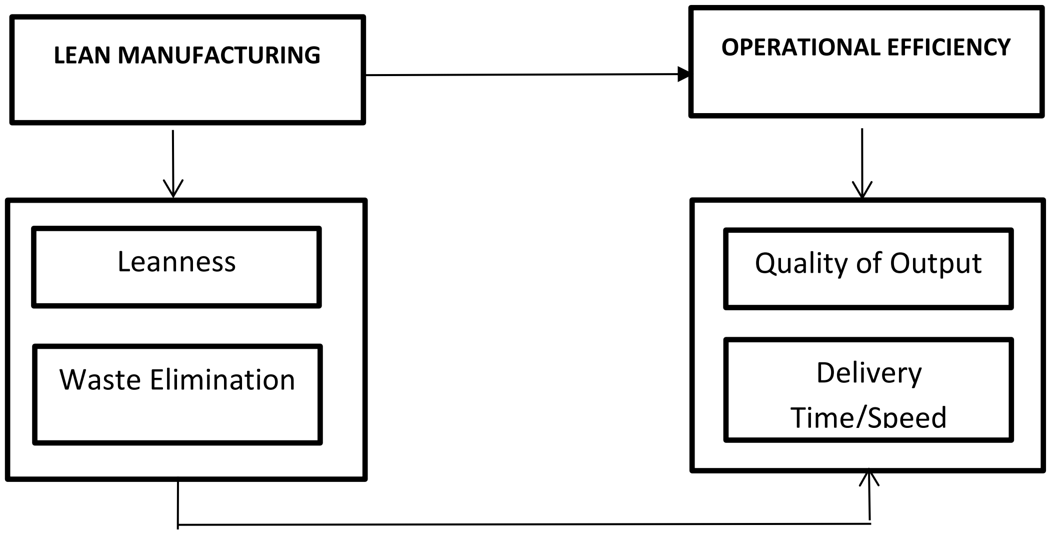

Fig 1: Conceptual Framework showing the Hypothesized Relationship between Lean Manufacturing and Operational Efficiency.

Source: Conceptualized by the Researchers

As illustrated in Figure 1 above, the independent variable in this study is Lean Manufacturing. Its dimensions are Leanness and waste elimination, and they were adapted from Udeze, Ugbam, and Ugwu (2020) and Bagshaw (2018). Conversely, the dependent variable in this research is Operational Efficiency. Its measures are quality of output and delivery time/speed, and they were adapted from Rasi, Rakiman, and Ahmad (2015).

2.0 REVIEW OF RELATED LITERATURE

THEORETICAL FOUNDATION: RESOURCE-BASED THEORY

The rationale behind a company's triumph or downfall in augmenting the desired performance could plausibly be associated with the resources employed by a company (Porter, 1991). Drawing upon the aforementioned, the resource-based view (RBV) theory accentuates resources as the fundamental determinant of competitive advantage. The RBV constitutes a theoretical perspective that endeavours to delineate and prognosticate how firms can attain sustainable competitive advantage through acquiring and overseeing internal resources (Barney, 1991; Wernerfelt, 1984). The essence of RBV primarily lies in utilising superior resources, enabling companies to preserve their resource advantages and sustain their competitive edges (Barney, 1991). More specifically, as articulated by Ramayah, Sulaiman, Jantan, and Ng (2004), the foundational premise of RBV is harnessing firms' resources and core competencies to engender a sustained competitive advantage, which subsequently translates into enhanced firms' performance.

Resources contemplated within the RBV are not confined solely to physical resources. Zahra and Das (1993) categorised resources into tangible and intangible resources. Tangible resources, such as machinery, equipment, etc, are discernible; their values can be precisely ascertained. Tangible resources encompass human, financial, informational, and technological resources. Conversely, intangible resources evade observation, encompassing a company's reputation, managerial skills, etc. Barney (1991) further encapsulated the conceivable resources possessed by a company by classifying them into three categories: (1) physical capital resources, encompassing all physical technologies employed, facilities and equipment, geographical location, and access to raw materials; (2) human capital resources, encompassing training, judgments, intelligence, relationships, experiences, and insights of individual employees; and (3) organisational capital resources such as the company's structure, planning, controlling, coordinating systems, as well as informal relations among groups within a company and between a company and its environment.

Relevant to the RBV, to distinguish between strategic and non-strategic resources, Barney (1991) formulated the VRIN criteria, as enumerated below, as pivotal characteristics of a strategic resource that can enable a company to sustain its competitive advantage. They are:

i. Valuable. A resource is deemed valuable when it empowers a firm to comprehend and implement strategies that augment its performance.

ii. Rare. Other companies cannot possess a resource. If a company executes a value-creating strategy, other companies cannot simultaneously execute the strategy.

iii. Inimitable. Competitors lacking a resource cannot acquire and replicate it. Valuable and rare resources allow a company to achieve a short-term competitive advantage. Sustained competitive advantage can be attained if the valuable and rare resources are inimitable.

iv. Non-substitutable. A resource must lack strategically equivalent value that empowers competitors to implement similar strategies.

Nevertheless, Makadok (2001) contested the paradigm shift regarding the mechanism of creating competitive advantage. The former mechanism of creating competitive advantage posited being more effective in selecting resources over competitors, while the latter mechanism suggested being more effective at deploying resources. The former paradigm contended that heterogeneity in performance stems from resource ownership that exhibits differential productivity and that competitive advantage can be engendered by possessing superior resource-picking skills, enabling a company to prognosticate the future value of the resources accurately. Mahoney and Pandian (1992) criticized this paradigm by introducing a novel paradigm to attain sustainable competitive advantage: capability building. According to Makadok (2001), capability building was first introduced by Schumpeter (1950), embodying the codification of the dynamic capability view.

It seems imperative to differentiate between the two terms to attain a clearer understanding concerning resources and capabilities. Amit and Schoemaker (1993), followed by Makadok (2001), delineated a clear distinction of the terms. They defined resources as reservoirs of available elements possessed and controlled by a company. At the same time, capabilities pertain to the organisation's capacity to orchestrate and exploit resources to achieve a specific outcome. By these definitions, Makadok (2001) provided a lucid distinction to differentiate capabilities and resources. Makadok (2001) states that capabilities are entrenched in the organisation and its processes. Consequently, capabilities are firm-specific, whereas resources are not. Due to their embeddedness, capabilities are inimitable and non-transferable. If a company is completely dissolved, its capabilities may be forfeited, whereas its other resources can persist for an extended period in the hands of the new owner. Makadok (2001) exemplified this by stating that if a company is entirely dissolved, the company can effortlessly transfer its resources (such as ownership, plants, equipment, patents, locations, etc.) to the new owner, but it cannot transfer its capabilities (e.g., skills, talents, and knowledge) in developing the next generation of products.

LEAN MANUFACTURING

There has been a degree of ambiguity among academics and practitioners in operations management regarding the terms of just-in-time (JIT), Toyota Production System (TPS), and lean manufacturing. Slack, Chambers, and Johnston (2010) elucidated the similarity between Lean Manufacturing and JIT. Schonberger (2007) asserted that practices under lean manufacturing mirrored those of JIT. Conversely, Heizer and Render (2011) contended that there exists a scant disparity between TPS, JIT, and Lean Manufacturing in practice; thus, the terms TPS, JIT, and Lean Manufacturing were frequently employed interchangeably. However, the present study staunchly concurs with the stance of Chavez et al. (2013) that Lean Manufacturing alludes to a production system instigated by Toyota, which is recognised as TPS. This stance is further bolstered by Arif-Uz-Zaman and Ahsan (2014), who argued that the bedrock of lean manufacturing is TPS, founded on JIT. In alignment with the assertions of Heizer and Render (2011), Schonberger (2007), and Slack et al. (2010), as mentioned earlier, notwithstanding the evolving, broadening, and evolving definitions of Lean Manufacturing as the Lean Manufacturing concept garners more global acceptance (Goyal & Deshmukh, 1992), there is consensus that the primary objective of lean manufacturing is to enhance organisational efficiency through waste elimination. Examples of definitions of Lean Manufacturing from several well-known studies are as follows: a.

i. Lean manufacturing is a philosophy, approach, technique, and integrated management system that synergistically address enhancement of operational efficiency in a production system (Bartezzaghi & Turco, 1989).

ii. Lean manufacturing is a production philosophy encompassing the procurement of the right items of the right quality and quantity in the right place and at the right time, thereby correlating with higher productivity, superior quality, lower costs, and increased profits (Cheng and Podolsky, 1993).

iii. Lean manufacturing is a holistic approach to continuous improvement grounded on the notion of eliminating non-value-added activities in a production system (Sakakibara et al., 1997).

In line with the definitions from previous studies, it can be inferred that Lean Manufacturing can be regarded as an approach that synergistically addresses enhancing operations performance and business performance through waste elimination. In succinct terms, lean denotes producing without waste. Russell and Taylor (2008) and Eiji Toyoda (former president of TMC) defined waste as "anything other than the minimum amount of equipment, materials, parts, space, and time, which are essential to add value to the products." As used in this context, waste applies not only within a company but also to its supply-chain networks within and across companies (Shah and Ward, 2007). Hence, it primarily focuses on eliminating the consumption of resources that adds no value to the products and processes.

i. Leanness

Organizational leanness entails a series of activities wherein waste and non-value-added (NVA) operations are eradicated as much as possible from the entire production process, commencing from product planning and design, through the procurement of raw material up to the end of the supply chain, with the aim of enhancing the value-added (VA) process within the organization (Vengopal and Yadhu, 2003). Although management of many organizations is cognizant of the significant value added to their organisations through leanness, they are yet to take the significant step from merely possessing the knowledge to implementing it in their supply chain. Organisational efficiency implies that organisations accomplish their production objectives at the lowest cost possible while maximising the available resources. The relevance of this to the subject matter is that Lean Manufacturing, by all standards, assists organisations in being efficient and thus improving performance.

ii. Waste Elimination

Waste elimination is one of the most effective means to augment the profitability of any business. To eliminate waste, developing and implementing strategies to reduce or obliterate its impact on the firm's activities is imperative, thereby ameliorating overall performance and quality. These wastes manifest in the form of overproduction, waiting, transportation, and defects. Goldiah (1999), in his theory of constraints, has reiterated that an hour lost in a bottleneck process is one hour lost to the entire factory's output and can never be recovered; thus, organisations institute all measures to minimise waste.

OPERATIONAL EFFICIENCY

Operational efficiency constitutes the cornerstone of every industrial, financial, commercial, or institutional endeavour. Operational efficiency alludes to the capacity of a company to curtail management costs, order time, and lead time while enhancing the effectiveness of utilising raw material and distribution capacity (Heizer & Render, 2008). Operational efficiency holds paramount significance for firms as it aids in improving the efficacy of production activities and creating high-quality products (Kaynak, 2003), culminating in increased revenue and profit for organisations. Operational efficiency refers to the profitable, efficient, and judicious use of resources available to an organisation in perfect consonance with clearly laid-down policies relating to the operation (Dhillon & Vachhrajani, 2012).

Operational efficiency pertains to the reduction of waste and the optimization of resources to deliver quality goods and services to consumers. It involves devising new operational procedures aimed at enhancing quality and productivity. The primary impact of heightened operational efficiency is on the profit margin of organizations. When operational efficiency is enhanced, the organisation's profitability also increases. Weston and Brigham (1992) highlighted that "to the financial manager, profit is the gauge of efficiency and a measure of control; to the owners, an indicator of the value of their investment; to the creditors, the safety net; to the government, a measure of taxable capacity and the foundation of legislative action in the country." Maximising operational efficiency varies for each organization, as each employs diverse strategies or techniques to optimise their operational efficiency and minimise inefficiencies. Operational efficiency denotes a business's capacity to deliver goods or services to clients at a low cost while maintaining the highest product and service quality. It can be achieved by restructuring company processes to responsively adapt to continually shifting market dynamics in a cost-effective manner. Operational efficiency entails eliminating inefficiencies and embracing optimal business practices. It occurs when the right combination of personnel, processes, and technology converge to enhance the productivity and value of any business operation while reducing the cost of routine operations to the desired level. This study gauges operational efficiency using the quality of output and delivery time.

i. Quality of Output

In recent times, the manufacturing landscape has undergone significant changes, with cost minimization no longer being the sole crucial factor for manufacturers. Nowadays, the quality of output is increasingly becoming a paramount concern for businesses, not only in manufacturing organizations but also for service-rendering entities. It has been a highly debated topic in the literature concerning organizational operational performance measurement. Various studies have linked lean manufacturing to quality performance. Neely (2007) defined quality in terms of adherence to predetermined specifications. It refers to how consistently a product meets the predetermined specifications. Specifically, it describes the compliance of each product with design specifications. Chong et al. (2001) employed the terms internal quality and external quality to denote these quality performance measures. Additionally, the present study also evaluates quality performance in terms of yield. Yield refers to the percentage of products that pass final inspection the first time.

Delivery Time/Speed

Product delivery time/speed encompasses the time it takes for a product to reach the customer. In today's highly competitive market, where customer expectations constantly increase, businesses are pressured to reduce lead time and ensure faster delivery than their competitors. Timely product delivery to the customer has become a crucial factor in measuring operational performance in the manufacturing industry. (Moktadir et al.2020)(Munir et al., 2020; Vafaei-Zadeh et al., 2020; Kaydos, 2020) Achieving efficient and prompt delivery enhances customer satisfaction and boosts a company's overall competitiveness (Madhani, 2020). By streamlining internal processes, optimising logistics networks, and leveraging advanced technology, companies can strive to exceed customer expectations and establish themselves as industry leaders in product delivery speed. (Raval et al., 2020). Investing in cutting-edge supply chain management systems, automating order processing, and collaborating closely with fulfilment partners are some of the strategies that businesses are adopting to expedite product delivery (Li et al., 2020; Camargo et al., 2020; Attaran, 2020a; Attaran, 2020b; Alzoubi & Yanamandra, 2020).

Furthermore, monitoring key performance indicators such as on-time delivery rates and optimising scheduling and route planning enable companies to continually improve their delivery speed while maintaining high levels of service quality. (Li & Shang, 2020; Gawankar et al.2020) To stay ahead in today's dynamic market, companies must prioritise product delivery time and continuously innovate their approach to meet the ever-evolving demands of customers. By doing so, they can not only gain a competitive edge but also create long-lasting customer loyalty, fueling their growth and success in the manufacturing industry (Sheth et al., 2020; Annarelli et al., 2020; Alzoubi et al., 2020; Baierle et al., 2020; Herden, 2020)

EMPIRICAL REVIEW

Several studies have underscored the importance of operational performance measures in lean manufacturing environments. This is because organisations can continuously improve their operational condition by assessing, controlling, and enhancing operational measures. However, while many researchers have investigated the effect of lean manufacturing on performance, Chen and Tan (2011) observed that only a few have examined its effect on operational performance, despite Durden, Hassel, and Upton (1999) emphasising the importance of utilising operational performance measures as an integral component of management control systems. Similarly, Bartezzaghi and Turco (1989) asserted that the primary objective of operations strategy adoption (e.g., lean manufacturing) is to enhance operational efficiency rather than business performance, as improvements in operating conditions may eventually enhance business performance.

This study examines the correlation between lean manufacturing and operational efficiency in the Nigerian manufacturing industry. Drawing a conclusion from the examined literature on the dimensions and measures of the predictor and criterion variables which constitute the focus of this study, the subsequent hypotheses were formulated:

Ho$_1$: *There is no significant relationship between leanness and quality of output.*

Ho$_2$: *There is no significant relationship between leanness and delivery time/speed.*

Ho$_3$: *There is no significant relationship between waste elimination and output quality.*

Ho$_4$: *No significant nexus exists between waste elimination and delivery time/speed.*

3.0 RESEARCH METHODS

This study adopted a descriptive and cross-sectional survey approach. The target population comprised all 814 registered manufacturing firms in Nigeria. Of these, 71 are listed on the Nigerian stock exchange, operating across seven dominant sectors. Manufacturing firms have a significant impact on any economy. In the Nigerian economy, the sub-sector accounts for 10% of the total GDP annually and provides job opportunities for about 12% of the labour force. For convenience, 14 manufacturing firms were examined. The study is conducted at the organisational level, and all inquiries and investigations are directed to management staff. Companies were chosen through judgmental and convenience sampling techniques based on accessibility.

The independent variable in this study is Lean Manufacturing, which has dimensions as leanness and waste elimination. The dependent variable is operational efficiency, which is measured by product quality and delivery time.

The hypotheses were tested using structural equation modelling (SEM), which is comprised of both a measurement model and a structural model. Validation and significance testing decision criteria were set at a 95% confidence level. Descriptive statistics were measured using the mean and standard deviation, captured via the Statistical Package for Social Sciences (SPSS) software version 25. A 5-point Likert-type scale was utilised for ordinal data, which tends towards normality with large sample sizes, enabling testing using SEM tools if consisting of several observations. AMOS (Analysis of Moment Structure) software was utilised in this study due to its user-friendly graphical interface and clear model representation, among other advantages. Sub-sector details and study firm information are provided below.

Table 1: Sub-Sector classification, Names of Firms and Numbered administered and Returned

S/N	Selected Organization Manufacturing Firms	No. Distributed	No. Returned
A	**CEMENT/LIMESTONE**		
1	Dangote Cement	8	7
2.	BUA	7	5
B	**NOODLES/FOODS**		
1.	Dufil Prima Foods PLC	8	5
2.	Golden Penny	6	5
C	**DRINKS**		
1.	Nigerian Bottling Co. PLC	9	7
2.	Nigerian Breweries	7	5
D	**BEVERAGES**		
1.	Nestle Nigeria	7	6
2.	Unilever Nigeria	10	7
E	**CONSTRUCTION**		
1.	Julius Berger Nigeria Plc	7	6
2.	Reynold Construction Firm	6	5
F	**TEXTILES**		
1.	African Textiles Man. Limited	6	5
2.	Apapa Sunrise Stores	7	6
G	**COSMETICS**		
1.	PZ Cussion	6	5
2.	Givanas Nig Ltd	6	5
	TOTAL	100	79

This research, predominantly quantitative, gathered data using a structured questionnaire. 100 copies of the questionnaire were distributed to targeted manufacturing firms and completed within a specified timeframe. The distribution and retrieval of copies were facilitated through established contacts in the chosen manufacturing organisations. Out of the 100 copies distributed, 79 were returned and utilised for analysis, constituting a success rate of 98.8%.

Reliability Assessment

Reliability denotes the capacity of a specific measuring tool to produce consistent outcomes when applied to the same scenario in different instances. The Analysis of Moments Structure (AMOS) will be utilised to calculate reliability values. Hence, the initial reliability assessment will be executed using the Cronbach Alpha with the assistance of the Statistical Package for Social Sciences (SPSS) version

25. Only items yielding alpha values of 0.70 and higher will be retained, as this threshold value is generally acknowledged and deemed sufficient for this study (Nunnally, 1978; Nunnally & Bernstein, 1994). The reliability metrics for the constructs are outlined in Table 2 below.

Table 2: Reliability Statistics for Pilot Test

S/NO	CONSTRUCTS	NO. OF ITEMS	CRONBACH'S ALPHA
1	Leanness	6	0.794
2	Waste Elimination	5	0.832
3	Quality of Output	7	0.793
4	Delivery Time/Speed	5	0.860

Source: Result of Reliability Statistics Pilot Test, 2023

4.0 RESEARCH RESULTS

Table 3: Measurement Model Analysis of Leanness

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Leanness	(2df) =4.49, p>0.000	0.98	0.95	0.98	0.62	LE 1	0.87	0.48
						LE 2	0.74	0.32
						LE 3	0.81	0.28
						LE 4	0.66	0.31
						LE 5	0.92	0.61

Source: Amos 24.0 output on research data, 2023

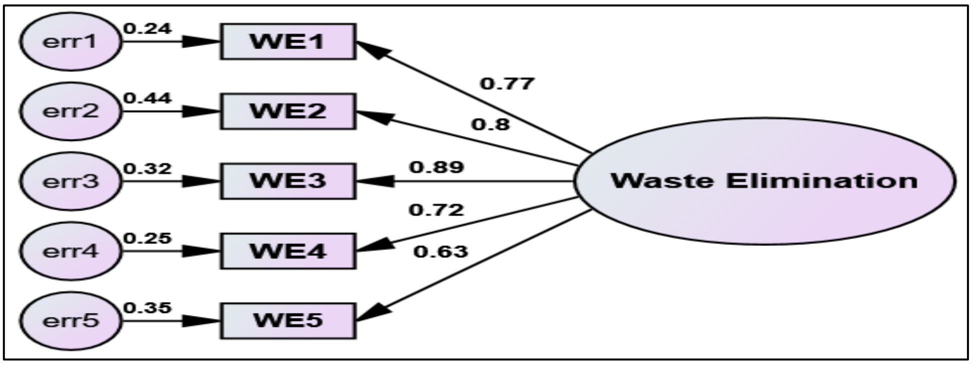

Fig 2: Measurement Model of Waste Elimination

Table 4: Measurement Model Analysis of Waste Elimination

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Waste Elimination	(34df) =242, p>0.000	1.0	0.59	1.0	0.14	WE1	0.77	0.24
						WE2	0.80	0.44
						WE3	0.89	0.32
						WE4	0.72	0.25
						WE5	0.63	0.35

Source: Amos 24.0 output on research data, 2023

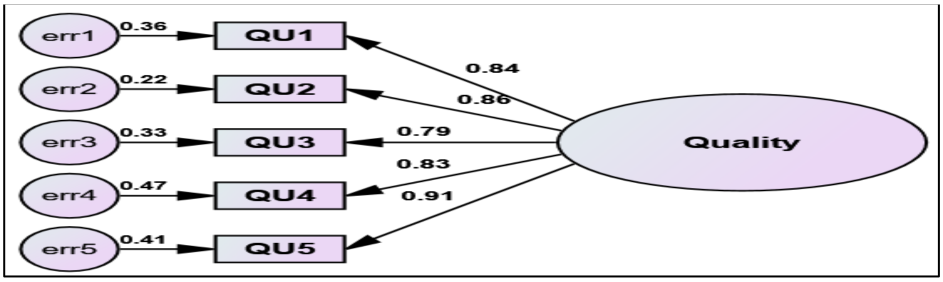

Figure 3: Measurement Model of Quality

Table 5: Measurement Model Analysis of Quality

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Quality	(33df) =231, p>0.000	0.80	0.72	0.82	0.15	QU1	0.84	0.36
						QU2	0.86	0.22
						QU3	0.79	0.33
						QU4	0.83	0.47
						QU5	0.91	0.41

Source: Amos 24.0 output on research data, 2023

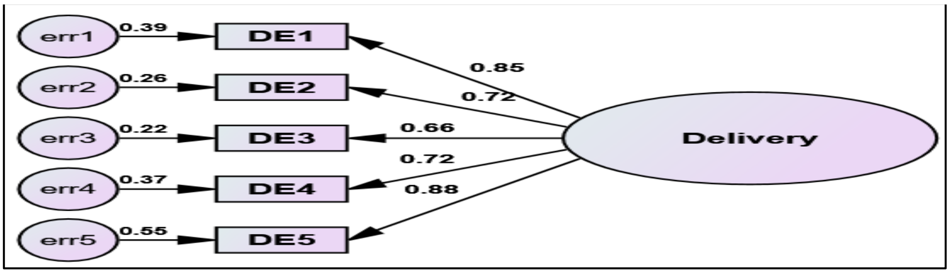

Figure 4: Measurement Model of Delivery

Table 6: Measurement Model Analysis of Delivery

Model	Chi-Square (df), Significance	NFI	TLI	CFI	RMSEA	Variable	Standardized Factor Loading Estimates	Error VAR
Delivery	(33df) =231, p>0.000	0.80	0.72	0.82	0.15	DE1	0.85	0.39
						DE2	0.72	0.26
						DE3	0.66	0.22
						DE4	0.72	0.37
						DE5	0.88	0.55

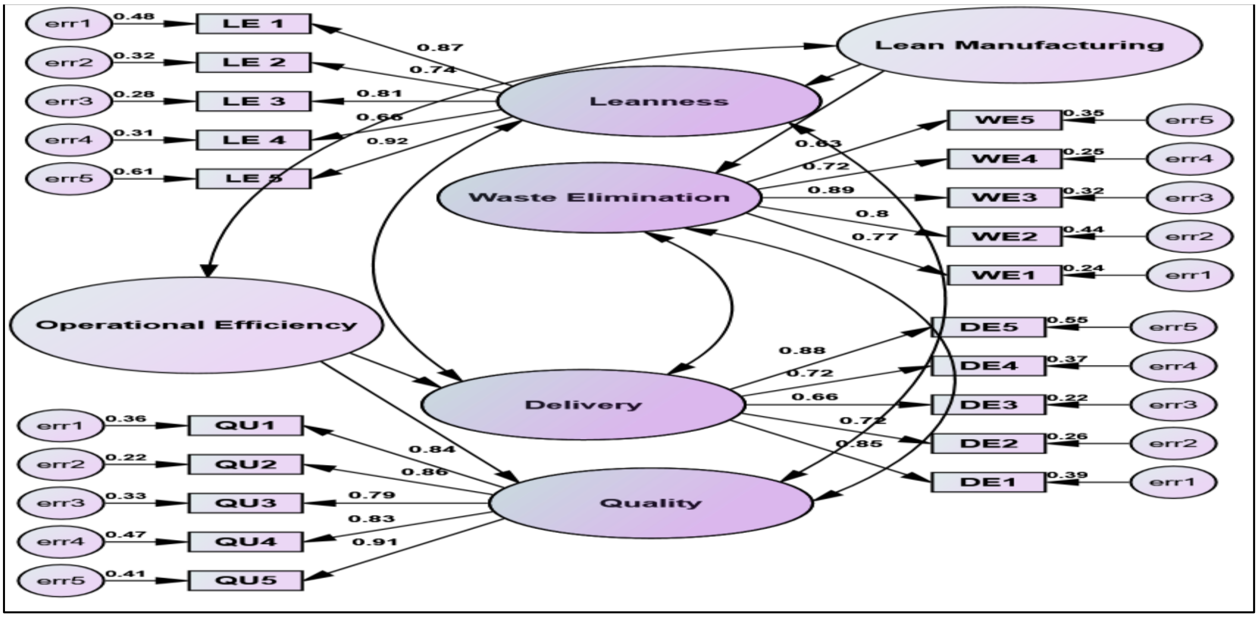

Figure 5: Structural Equation Model

Hypotheses Testing

Table 7: Result of standardized and unstandardized regression estimate of the model.

S/N	Mediation Stage	Relationships	Std. Beta (β)	Actual Beta (r)	S.E.	C.R.	P	Remark
1.	X →Y (Hypothesis 1)	Leanness and Quality of Output	0.49	0.87	0.12	2.33	0.000	Not Supported
2.	X →Y (Hypothesis 2)	Leanness and Delivery Time/Speed	0.67	0.84	0.33	3.22	0.000	Not Supported
3.	X →Y (Hypothesis 3)	Waste Elimination and Quality of Output	0.52	0.86	0.14	4.16	0.000	Not Supported
4.	X →Y (Hypothesis 4)	Waste Elimination and Delivery Time/Speed	0.54	0.80	0.19	3.27	0.000	Not Supported

Hypothesis One

***Ho₁:** There is no significant relationship between leanness and quality of Output in the Nigerian manufacturing industry.*

Mediation Stage	Relationship	Std. Beta	Actual Beta	S.E.	C.R.	P	Remark
X →Y (Hypothesis 1)	Leanness and Quality of Output	0.49	0.87	0.12	2.33	0.000	Not Supported

The initial hypothesis (Ho_1) aimed to explore the relationship between leanness and output excellence within the Nigerian manufacturing sector. As depicted in Table 7 above, the data scrutiny outcome revealed $\beta=0.49$, $r=0.87$, and $p = 0.000$. Following the stipulated decision criteria, which dictate that the null hypothesis should be accepted if $\beta<0.3$, $r<0.7$, and $p > 0.05$ or rejected if $\beta>0.3$, $r>0.7$, and $p < 0.05$), we consequently reject the null hypothesis and accept the alternative form. This outcome indicates an exceedingly robust positive and statistically significant correlation between leanness and output quality in the Nigerian manufacturing domain ($\beta=0.49 > 0.3$, $r = 0.87 > 0.7$, and $p = 0.000 < 0.05$). The first hypothesis (Ho_1) is not corroborated. Grounded on this revelation, the study concludes that leanness indeed wields a markedly robust and substantial influence in enhancing output quality in the Nigerian manufacturing industry.

Hypothesis Two

***Ho₂:** There is no significant relationship between leanness and delivery Time/Speed in the Nigerian manufacturing industry.*

Mediation Stage	Relationship	Std. Beta	Actual Beta	S.E.	C.R.	P	Remark
X →Y (Hypothesis 2)	Leanness and Delivery Time/Speed	0.67	0.84	0.33	3.22	0.000	Not Supported

The second hypothesis (Ho_2) aimed to explore the relationship between leanness and delivery time/speed within the Nigerian manufacturing industry. As delineated in table 7 presented above, the outcome of data analysis unveiled $\beta=0.67$, $r=0.84$, and $p = 0.000$. In accordance with the decision criteria stipulating the acceptance of the null hypothesis if $\beta<0.3$, $r<0.7$, and $p > 0.05$ or the rejection of the null hypothesis if $\beta>0.3$, $r>0.7$, and $p < 0.05$), we therefore reject the null hypothesis and accept the alternate form. This outcome signifies an exceedingly robust positive and statistically significant correlation between leanness and delivery time/speed in the Nigerian manufacturing sector ($\beta=0.67 > 0.3$, $r = 0.84 > 0.7$, and $p = 0.000 < 0.05$). Ho_2 is not substantiated. Grounded on this discovery, the study concludes that leanness indeed exerts a markedly robust and substantial influence in enhancing delivery time/speed in the Nigerian manufacturing industry.

Hypothesis Three

Ho3: *There is no significant relationship between waste elimination and output quality in the Nigerian manufacturing industry.*

Mediation Stage	Relationship	Std. Beta	Actual Beta	S.E.	C.R.	P	Remark
X →Y (Hypothesis 3)	Waste Elimination and Quality of Output	0.52	0.86	0.14	4.16	0.000	Not Supported

The third hypothesis (Ho_3) aimed to explore the relationship between waste elimination and output quality within the Nigerian manufacturing sector. As demonstrated in Table 7 above, the outcome of data analysis unveiled β=0.52, r=0.86, and p = 0.000. Following the decision criteria, which stipulate the acceptance of the null hypothesis if β<0.3, r<0.7, and p > 0.05 or the rejection of the null hypothesis if β>0.3, r>0.7, and p < 0.05), we consequently reject the null hypothesis and accept the alternate form. This outcome of data analysis indicates an exceedingly robust positive and statistically significant correlation between waste elimination and quality of output in the Nigerian manufacturing industry (β=0.52 > 0.3, r = 0.86 > 0.7, and p = 0.000 < 0.05). Ho_3 is not substantiated. Grounded on this discovery, the study concludes that waste elimination indeed exerts a markedly robust and substantial influence in enhancing the quality of output in the Nigerian manufacturing industry.

Hypothesis Four

Ho4: *There is no significant correlation between waste elimination and delivery Time/Speed in the Nigerian manufacturing industry.*

Mediation Stage	Relationship	Std. Beta	Actual Beta	S.E.	C.R.	P	Remark
X →Y (Hypothesis 4)	Waste Elimination and Delivery Time/Speed	0.54	0.80	0.19	3.27	0.000	Not Supported

The fourth hypothesis (Ho_4) aimed to investigate the connection between waste elimination and delivery Time/Speed within the Nigerian manufacturing industry. As displayed in table 7 above, the outcome of data analysis unveiled β=0.54, r=0.80, and p = 0.000. According to the decision criteria, which dictate the acceptance of the null hypothesis if β<0.3, r<0.7, and p > 0.05; or the rejection of the null hypothesis if β>0.3, r>0.7, and p < 0.05), we therefore reject the null hypothesis and accept the alternate form. This outcome of data analysis indicates an exceedingly robust positive and statistically significant correlation between waste elimination and delivery Time/Speed in the Nigerian manufacturing industry (β=0.54 > 0.3, r = 0.80 > 0.7, and p = 0.000 < 0.05). Ho_4 is not upheld. Grounded on this discovery, the study concludes that waste elimination indeed plays a robust and significant role in enhancing delivery Time/Speed in the Nigerian manufacturing industry.

5.0 **DISCUSSION OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS**

The data analysis results indicate a robust and significant positive correlation between leanness and output quality in the Nigerian manufacturing industry. Based on this finding, the study concludes that leanness plays a robust and significant role in enhancing output quality in the Nigerian manufacturing industry. This finding may be explained by the fact that the fundamental objective of lean manufacturing can be summarised as the pursuit of perfection. The pursuit of quality within this context undoubtedly manifests in the overall output of the organisation. Lean thinking, processes, and practices have long been associated with process-oriented thinking and quality enhancement. The connection between lean and quality is simple: in a lean environment, the identification of problems is facilitated through visual management. Once a problem is identified, the process can be halted to prevent its recurrence, and immediate changes can be implemented immediately to eliminate the issue. Lean thinking, processes, and practices foster a corporate culture that embraces curiosity and continuous learning. Lean manufacturing establishes a culture where standardised, repeatable, and attainable processes are the bedrock of ongoing improvement. In a lean environment, prioritising quality is paramount, as the long-term consequences of delivering poor-quality products to customers or encountering service issues can be detrimental. Shortening production lead times ensures earlier access to information and the product itself and enables prompt implementation of necessary modifications and immediate detection of any production-related complications. Consequently, this leads to improved quality of outputs, reduced costs, and enhanced efficiency.

Similarly, the outcome of the data analysis also manifests a remarkably robust and statistically significant positive correlation between leanness and delivery Time/Speed in the Nigerian manufacturing realm. Drawing from this discovery, the study concludes that leanness plays a notably solid and significant role in enhancing delivery Time/Speed in the Nigerian manufacturing sector. This observation might be explained by the reality that the primary objective of lean manufacturing is to diminish the duration needed to execute a task by simplifying, refining, and enhancing the processes and methodologies, thereby leading to an amelioration in the delivery time/speed for products and services.

Furthermore, the result of the data analysis showcases a highly robust positive and statistically significant correlation between waste elimination and quality of output in the Nigerian manufacturing industry. Inferring from this finding, the study deduces that waste elimination plays a powerful and significant role in enhancing output quality in the Nigerian manufacturing sector. This observation could be explained by the fact that Nigerian manufacturing organisations can optimise their operations and processes within the domain of lean manufacturing by eradicating non-value-added tasks and concentrating solely on value-added activities. This results in a substantial enhancement in overall output quality. The fundamental principle of lean manufacturing is waste elimination and continuous improvement, entailing constant enhancement of the production process by eliminating unnecessary steps and reducing defects. Waste elimination encompasses implementing diverse techniques and tools to streamline production processes. It is pertinent to note that while there exist varying perspectives on what constitutes waste (depending on the context), the most commonly acknowledged definition is "any activity that consumes resources but generates no value for the customer." Standardised work and employee empowerment are also emphasised, alongside inventory levels and lead time reduction. The cumulative effect of these measures ultimately culminates in enhanced output quality, heightened productivity, and improved operational efficiency. By eliminating these wastes, companies can streamline operations, bolster output quality, enhance efficiency, and curtail costs. Given that the ultimate goal of lean manufacturing is to provide perfect value to the customer through a perfect value creation process that has zero waste, it is not surprising that, as the empirical evidence in this study illustrates, waste elimination wields a substantial and influential impact in enhancing the quality of outputs in the Nigerian manufacturing industry. The ultimate ambition of lean manufacturing is to dispense flawless value to the customer through a waste-free value-creation process.

It is also noteworthy that in the realm of manufacturing, quality embodies a pinnacle of excellence devoid of any defects or discernible deviations. It encompasses not solely the quality of products but also the calibre of processes, methodologies, services, and human relations, particularly the interactions with customers. A quality product is devoid of defects and precisely tailored to meet the customer's preferences, adhering to their stipulations and requisites. In the Nigerian context, customers have grown accustomed to high-quality products at reasonable prices. To thrive in today's fiercely competitive market, manufacturing organisations must continuously improve product quality while minimising production costs. Nonetheless, a misconception exists that enhancing quality invariably engenders escalated costs, leading to inflated prices for goods and services. This is where lean manufacturing comes into play.

The result also indicates a strong positive and statistically significant correlation between waste elimination and delivery Time/Speed in the Nigerian manufacturing industry. Based on this finding, the study concludes that waste elimination significantly enhances delivery Time/Speed in the Nigerian manufacturing industry. This finding may be attributed to waste elimination, enabling manufacturing organisations to establish a streamlined and efficient workflow through pull production. This is advantageous because it aligns with customer preferences and ultimately reduces production durations, guaranteeing that products are readily available to customers. By reducing production time, manufacturing organisations can promptly meet every customer's specific product or service requirements, thereby optimising value creation and minimising waste. Considering those mentioned above, it is unsurprising that waste elimination was found to have a substantial and meaningful impact on enhancing delivery time/speed in the present study.

The lean management system focuses on minimising waste and maximising efficiency in production processes; it assumes that organisations should always be continuously improving, continuously removing waste, reducing non-value-added activities, and increasing efficiencies and productivity. Indeed, it could be argued that survival in the Nigerian manufacturing industry will depend to a large extent on the organisation's ability to adapt, evolve, and improve and that the formula of continuous improvement is appropriate for any industry or organisation.

By understanding the value-added activities involved in taking raw materials and producing a finished product or service for a customer and eliminating all non-value-added activities, Nigerian manufacturing organisations can improve their competitive position. To be successful, Nigerian manufacturing organisations must work hand in hand with their supply chain partners to synchronise their efforts and eliminate redundancies. In essence, money is being placed on what the market demands at the right time and place, and the waste of inventory of materials is being eliminated from operations.

Based on the findings and conclusion drawn from this investigation, the following recommendations are proposed:

i. Nigerian manufacturing industry managers should embrace lean thinking approaches, principles, and practices to enhance the quality of their products and/or services.

ii. Managers in the Nigerian manufacturing industry should similarly embrace lean thinking approaches, principles, and practices to mitigate intrinsic fluctuations with suppliers.

iii. Managers in the Nigerian manufacturing industry should also adopt lean thinking approaches, principles and practices to curtail inherent fluctuations in response to customers' demands for heightened effectiveness and efficiency.

iv. Managers in the Nigerian manufacturing industry should implement lean practices as they foster improved oversight over initial pass yield and quality.

v. To thrive in the fiercely competitive marketplace, Nigerian manufacturing organisations must incessantly refine their product quality and delivery time/speed by integrating waste elimination strategies while minimising production expenditures.

REFERENCES

1. Alzoubi, H., Ahmed, G., Al-Gasaymeh, A., & Kurdi, B. (2020). Empirical study on sustainable supply chain strategies and its impact on competitive priorities: The mediating role of supply chain collaboration. Management Science Letters, 10(3), 703-708. growingscience.com
2. Amit, R., & Paul J. H. Schoemaker. (1993). Strategic Assets and Organizational Rent. Strategic Management Journal, 14(1), 33–46. http://www.jstor.org/stable/2486548
3. Annarelli, A., Battistella, C., & Nonino, F. (2020). Competitive advantage implication of different Product Service System business models: Consequences of 'not-replicable'capabilities. Journal of Cleaner Production. e-tarjome.com
4. Arif-Uz-Zaman, K., and Ahsan, A. M. M. N. (2014). Lean supply chain performance measurement. International Journal of Productivity and Performance Management, 63(5), 588-612. Retrieved from doi: 10.1108/ijppm-05-2013-0092
5. Armstrong, M. (2001) A Handbook of Human Resource Management. 8th Edition, Kogan Pag Publishers, London.
6. Attaran, M. (2020a). Digital technology enablers and their implications for supply chain management. Supply Chain Forum: An International Journal. cendekiaku.com
7. Attaran, M. (2020b). 3D printing role in filling the critical gap in the medical supply chain during COVID-19 pandemic. American Journal of Industrial and Business Management, 10(05), 988. scirp.org
8. Bagshaw, K.B. (2018) Lean Application and Efficiency of Manufacturing Firms: An Empirical Study of Manufacturing Firms in Rivers State, Nigeria. International Journal of Management Excellence, 11, 1553-1558. https://doi.org/10.17722/ijme.v11i2.466
9. Baierle, I. C., Benitez, G. B., Nara, E. O. B., Schaefer, J. L., & Sellitto, M. A. (2020). Influence of open innovation variables on the competitive edge of small and medium enterprises. Journal of Open Innovation: Technology, Market, and Complexity, 6(4), 179. sciencedirect.com
10. Barney, J. B. (1991). Firm resources and sustained competitive advantage. Journal Management Decision, 41(9), 2-6.
11. Bartezzaghi, E., and Turco, F. (1989). The impact of the just-in-time approach on production system performance: An analytical framework. International Journal of Operation and Production Management, 9(9), 40-61. Doi: 10.1108/EUM0000000001257
12. Bartoli, A., & Blatrix, C. (2015). Management dans les organisations publiques: Défis et logiques d’action (4e éd.). Dunod
13. Bayo-Moriones, A. and Merino-Díaz de Cerio, J. (2002). Human resource management, in strategy research: A comparison of approaches. Academy of Management Review, 11(4), 801-814.

14. Block, M.O., and Hire, G. (1978). Fundamental of Financial management. Richard D. Irwid Inc. Homewood Illinois.
15. Blundell, R., Gri¢th, R. and van Reenen, J. (1995). Market dominance, market value, and innovation in a panel of British manufacturing firms," London: Institute for Fiscal Studies Working Paper 95-112.
16. Bunn, D. W., and Taylor, J. W. (2001). Setting Accuracy Targets for Short-Term Judgmental Sales Forecasting. International Journal of Forecasting pp.159-169.
17. Camargo, C. P., Tempski, P. Z., Busnardo, F. F., Martins, M. D. A., & Gemperli, R. (2020). Online Learning and COVID-19: A Meta-synthesis Analysis. Clinics, Vol. 75, e2286. scielo.br
18. Chann, K. K. (2000). Forecasting Demand and Inventory Management Using Bayesian Systems, 11,331 – 339.
19. Chavez, R., Gimenez, C., Fynes, B., Wiengarten, F., and Yu, W. (2013). Internal lean practices and operational performance: The contingency perspective of industry clockspeed. International Journal of Operations and Production Management, 33(5), 562-588.
20. Chen, Z.-X., and Tan, K. H. (2011). The perceived impact of JIT implementation on operations performance: Evidence from Chinese firms. Journal of Advances in Management Research, 8(2), 213-235.
21. Cheng,T. C. E., & Podolsky, S. (1993). Just-in-time manufacturing: An Introduction. Chapman and Hall, London.
22. Chong, H., White, R. E., and Prybutok, V. (2001). Relationship among organizational support, JIT implementation, and performance. Industrial Management and Data Systems, 101(6), 273-280.
23. Corradi, V. & Swanson, N. R. (2006). Predictive density evaluation, in „Handbook of Economic Forecasting", North-Holland, Amsterdam, The Netherlands.
24. Dhillon, A. & Vachhrajani, H. (2012). Impact of Operational Efficiency on Overall Profitability- A Case Study of GIPCL. Amrita School of Business Working Paper No.136/2012.
25. Durden, C.H., Hassel, L.G. & Upton, D.R. (1999) Cost Accounting and Performance Measurement in a Just-in-Time Production Environment. Asia Pacific Journal of Management Vol. 16. PP. 111–125. https://doi.org/10.1023/A:1015414320195
26. Emiliani, L. (2006). Linking leader's beliefs to their behaviours and competencies.
27. England: Pearson Education Ltd.
28. Feng, M., Terziovski, M., and Samson, D. (2007). Relationship of ISO 9001:2000 quality system certification with operational and business performance: A survey in Australia and New Zealand-based manufacturing and service companies. J. Manuf. Technol. Manage., 1(9), 22-37.
29. Frohlich, M. T., and Westbrook, R. (2001). Arcs of integration: An international study of supply chain strategies. J. Operat. Manage., 1(9), 185-200.
30. Gawankar, S. A., Gunasekaran, A., & Kamble, S. (2020). A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context. International journal of production research, 58(5), 1574-1593. researchgate.net
31. Ghobadian, A., Talavera, I., Bhattacharya, A., Kumar, V., Garza-Reyes, J. A., & O'regan, N. (2020). Examining legitimatisation of additive manufacturing in the interplay between innovation, lean manufacturing and sustainability. International Journal of Production Economics, 219, 457-468. aston.ac.uk

32. Goyal, S. K., and Deshmukh, S. G. (1992). A critique of the literature on just-in-time manufacturing. International Journal of Operations and Production Management, 12(1), 18-28.
33. Heizer, J. H., and Render, B. (2011). Operations management (10th ed.). New Jersey:
34. Heizer, J. H. and B. Render (2008) Operations Management. Pearson Prentice Hall,
35. Henderson, A., and Larco, L. (1999). Lean Transformation: How to Change Your Business into a Lean Enterprise. Richmond, VA: The Oaklea Press url={https://api.semanticscholar.org/CorpusID:167196660}
36. Herden, T. T. (2020). Explaining the competitive advantage generated from Analytics with the knowledge-based view: the example of Logistics and Supply Chain Management. Business Research. springer.com
37. Kaydos, W. (2020). Operational performance measurement: increasing total productivity.
38. Kaynak, H. (2003) The Relationship between Total Quality Management Practices and Their Effects on Firm Performance. Journal of Operations Management, 21, 405-435. https://doi.org/10.1016/S0272-6963(03)00004-4
39. Kuo, M. P., and Chen, Y. M. (2015). A study on the relationships among body sensory experience, customer satisfaction and customer loyalty-Beauty SPA center as an example. Intl. J. Bus. Administrative Stud. 1, 61-67.
40. Li, Y. & Shang, H. (2020). Service quality, perceived value, and citizens' continuous-use intention regarding e-government: Empirical evidence from China. Information & Management. sciencedirect.com
41. Madhani, P. M. (2020). Customer-focused supply chain strategy: developing 4Rs framework for enhancing competitive advantages. International Journal of Services and Operations Management, 36(4), 505-530.
42. Mahoney, J.T. and Pandian, J.R. (1992) The Resource-Based View within the Conversation of Strategic Management. Strategic Management Journal, 13, 363-380. http://dx.doi.org/10.1002/smj.4250130505
43. Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability views of rent creation. Strategic Management Journal, 22, 387–401. Retrieved from doi: 10.1002/smj.158
44. Moktadir, M. A., Dwivedi, A., Rahman, A., Chiappetta Jabbour, C. J., Paul, S. K., Sultana, R., & Madaan, J. (2020). An investigation of key performance indicators for operational excellence towards sustainability in the leather products industry. Business Strategy and the Environment, 29(8), 3331-3351.
45. Munir, M., Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. International Journal of Production Economics, 227, 107667. academia.edu
46. Neely, A. (2007) The Servitization of Manufacturing. Proceedings of the 14th EurOMA Conference, Ankara, 17-20 June 2007. http://www.cambridgeservicealliance.org/uploads/downloadfiles/2011 The%20servitization%20of%20manufacturing.pdf
47. Nugraha, P., and Indrawati, A. (2017). The effect of social media experiential marketing towards customers' satisfaction (A study in Chingu Korean fan cafe Bandung Indonesia). Intl. J. Bus. Administrative Stud., 3, 56-63.
48. Nunnally, J.C. (1978) Psychometric theory. 2nd Edition, McGraw-Hill, New York.

49. Nunnally, J.C. and Bernstein, I.H. (1994) The Assessment of Reliability. Psychometric Theory, 3, 248-292.
50. Poirier, C. C., and Quinn, F. J. (2004). How are we doing? A survey supply chain progress. Supply Chain Manage. Rev. 8, 24-31.
51. Porter, M. E. (1991). Towards a dynamic theory of strategy. Strategic Management Journal, 12(Special Issue), 95-117. Retrieved from doi: 10.1002/smj.4250121008
52. Prasad, M. M., Dhiyaneswari, J. M., Jamaan, J. R., Mythreyan, S., & Sutharsan, S. M. (2020). A framework for lean manufacturing implementation in Indian textile industry. Materials today: proceedings, 33, 2986-2995.
53. Prytz, K. (1993). Just-in-Time Manufacturing. An Introduction. By T. C. E. Cheng and S. Podolsky & lpar; Chapman & amp; Hall, London, 1993) ISBN 0–412–45690–7 [pp. 226]. £3500. Production Planning & Control, 4(4), 422. https://doi.org/10.1080/09537289308919465
54. Ramayah, T., Sulaiman, M., Jantan, M., and Ng, F.C. (2004). Organizational learning, Proprietary Technology and Manufacturing Performance: A Glimpse from the Malaysian Manufacturing Firms. International journal of innovation and incubation 1(1), 63-90
55. Ranganathan, C., Dhaliwal, J. S., and Teo, T. S. H. (2004). Assimilation and diffusion of web technologies in supply-chain management: An examination of key drivers and performance impacts. Int. J. Electron. Commerce, 9, 127-161.
56. Rasi, R. Z., Rakiman, U. S., and Ahmad, F. B. (2015). Relationship between Lean Manufacturing and operational performance in the manufacturing industry. IOP Conference Series: Materials Science and Engineering, 3(5), 1-10.
57. Raval, S. J., Kant, R., & Shankar, R. (2020). Analyzing the Lean Six Sigma enabled organisational performance to enhance operational efficiency. Benchmarking: An International Journal, Vol. 27 No. 8, pp. 2401-2434. https://doi.org/10.1108/BIJ-05-2019-0221
58. Rosenzweig, E. D., Roth, A. V., and Dean Jr, J. W. (2003). The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers. J. Operat. Manage., 2(1), 437-456.
59. Russell, R. S., and Taylor, B. W. (2008). Operations management, along the supply chain (6th ed.). New Jersey: John Willey and Sons, Inc.
60. Sakakibara, S., Flynn, B. B., Schroeder, R. G., and Morris, W. T. (1997). The impact of just-in-time manufacturing and its infrastructure on manufacturing performance. Management Science, 43(9), 1246-1257.
61. Sartal, A., Bellas, R., Mejías, A. M., & García-Collado, A. (2020). The sustainable manufacturing concept, evolution and opportunities within Industry 4.0: A literature review. Advances in Mechanical Engineering, 12(5), 1687814020925232. sagepub.com
62. Schonberger, R. J. (1996). World class manufacturing: The next decade. New
63. Schonberger, R. J. (2007). Japanese production management: An evolution-with mixed success. Journal of Operations Management, 25, 403–419. Retrieved from doi: 10.1016/j.jom.2006.04.003
64. Schumpeter, J. (1950). Capitalism, socialism, and democracy. New York: Harper.
65. Shah, R., and Ward, P. T. (2007). Defining and developing measures of lean production. Journal of Operations Management, 25, 785-805. Retrieved from doi: 10.1016/j.jom.2007.01.019

66. Sheth, J., Jain, V., & Ambika, A. (2020). Repositioning the customer support services: the next frontier of competitive advantage. European Journal of Marketing. academia.edu
67. Slack, N., Chambers, S., and Johnston, R. (2010). Operations management (6th ed.).
68. Students and researchers. London: SAGE Publications.
69. Vafaei-Zadeh, A., Ramayah, T., Hanifah, H., Kurnia, S., & Mahmud, I. (2020). Supply chain information integration and its impact on the operational performance of manufacturing firms in Malaysia. Information & Management, 57(8), 103386.
70. Valamede, L. S., & Akkari, A. C. S. (2020). Lean 4.0: A new holistic approach for the integration of lean manufacturing tools and digital technologies. International Journal of Mathematical, Engineering and Management Sciences, 5(5), 851. semanticscholar.org
71. Vengopal, G and Yadhul, G. (2003). Lean S t r a t e g y I m p l e m e n t a t I o n. (www.slideshare.net/yadhugopinnath/lean-strategy-implementation retrieved on 10/01/14).
72. Wernerfelt, B. (1984). A resource-based view of the firm. Strategic Management Journal, 5(2), 171-180. doi: 10.1002/smj.4250050207
73. Weston J.F., Brigham, E.F. (1992). Essentials of Managerial Finance. (Tenth Edition). Japan: Dryden Press,
74. Womack, J. P. and Jones, D. T. (1996). Lean Thinking: Banish Waste and Create Wealth in your Corporation. Simon and Schuster, London.
75. Yadav, G., Luthra, S., Huisingh, D., Mangla, S. K., Narkhede, B. E., & Liu, Y. (2020). Development of a lean manufacturing framework to enhance its adoption within manufacturing companies in developing economies. Journal of Cleaner Production, 245, 118726. diva-portal.org
76. Zahra, S. A., and Das, S. R. (1993). Building competitive advantage on manufacturing resources. Long Range Planning, 26(2), 90-100. Retrieved from doi: 10.1016/0024- 6301(93)90140-B
77. Zhu, K., and Kraemer, K. L. (2002). E-commerce metrics for Net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector. Inform. Syst. Res., 1(3). 275-295.