



Impact of Adoption of Lean Philosophies on Performance Indicators of Third-Party Logistics (3PL) Truck Haulage Companies for Fast-Moving Consumer Goods (FMCG) in Lagos

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ABSTRACT

Truck haulage 3PL firms in Lagos Nigeria play a very significant role in supporting the economy. The cost of movement of goods in Nigeria is five times higher than United States of America. This raises efficiency gap issues in truck haulage sector in Nigeria. The focus of this study was to investigate the impact of adoption of lean philosophy on performance indicators for truck haulage by looking at the role of technology and involvement in product design by 3PL with FMCG using selected 3PL firms based in Lagos. Lean philosophy has its origin in TPS and has also been extended to transport operations and have been seen to improve TOVE. The study adopted a mixed method approach which involved a quantitative survey and qualitative in-depth interview using convergent method approach. Therefore, Government and FMCG partners should collaborate with 3PL to create an enabling environment by providing good infrastructure and policies in place to encourage the set-up of Logistics clusters as this will improve efficiency in the truck haulage section in Nigeria. There is further study needed to look at what discourages freight sharing in Nigeria and fully integrated supply chain with multiple partners. The competition is not inside the truck but in the market place for FMCG firms as this is one opportunity area currently not being explored today resulting in empty miles in most movements thus raising the cost of operating truck haulage in Nigeria. Lean adoption alone can't close this gap so therefore there is urgent need for more collaboration, integration, freight sharing and resource sharing between all relevant stakeholders in the truck haulage transport chain.

INTRODUCTION

The truck haulage industry managed by third party logistics is very big in Lagos, Nigeria and supports most Fast-moving consumer good (FMCG) companies in transporting their raw materials from the port, and also assists in movement and distribution to the end customers across Nigeria. Lagos is the commercial nerve centre of Nigeria and it also has the main ports that serve as a gateway for all imports and exports in and out of the country. Most of the movement across the country is done by road with the use of trucks as the railway line network is not as developed and sophisticated as you see in other countries. There is also no major provision of movement of heavy goods on container by these trains for FMCG. Daramola (2022) found in his comparative study that road freight has a more competitive advantage than rail freight in Nigeria on key performance indicators parameters except for capacity and cost which is sacrificed on the altar of long delivery lead time, slow turnaround and poor customer service which is not good enough to support FMCG industry.

Giri and Sarker (2017) opined that companies that use third party logistics (3PL) alleviate the load of logistics processes and achieve better customer service which gives them a better competitive advantage. For FMCG that have made these choices to use 3PL it frees them ample time to focus on their core competencies of providing goods and services to their customers at the right quality, quantity, place and time. Ayantoyinbo and Gbadegesin (2021) in their study found that the overall logistics function has very huge impact on the financials in organizations, hence the need to take necessary steps to mitigate cost in the overall logistic process which involves truck haulage as well. Most FMCG in Nigeria outsource their truck haulage to 3PL as they are better placed to provide better service, efficiency and optimized cost. Nigeria is ranked 110 in the global logistics performance index and this is quite below acceptable standards to power the economy of the most populated nation in Africa. The logistics performance index (LPI) reflects a mean score per country of its logistics processes (Worldbank.org, 2018). Truck haulage is a critical component of the key deliverables for fast moving consumer goods in the various spheres of their operations. Unavailability of trucks for fast and efficient deliveries in Lagos, Nigeria is thus a major problem as it is the hub for most FMCG operations in Nigeria.

LITERATURE REVIEW

The COVID-19 pandemic has created major disruptions in global supply chains. Lead times are longer, the response to get spare parts to fix broken down trucks are also longer, and replacement lead time for trucks are also longer. The pandemic had knock on effect on overall road transportation in Lagos which in turn increased the inefficiency of trucks supply to FMCG in Lagos, Nigeria (Mogaji, 2020). Furthermore, there is a continuous increase in the price of gasoline for the trucks and an attendant paucity of road infrastructure across the country in Nigeria leading to overall increase in cost to FMCG and long delivery lead times. The World Bank in its Global Facility to Decarbonize Transport report (GFDT) stated that it costs 5.3 times to move goods in Nigeria

for same distance compared to the United States of America. This goes to show the lag in terms of efficiency for moving goods around in Nigeria through various transport modes (World Bank Group, 2021).

The problems highlighted above have necessitated the need to deeply examine how this negative trend can be reversed by the 3PL providers. This would call for smart solutions on ways to do things differently to optimize service delivery to FMCG organizations by the respective 3PL with minimal costs. This study aims at investigating how lean philosophies can impact on the key performance indicators with the goal of fixing the current challenges and problems using selected 3PL based in Lagos, Nigeria in this study. According to Ghosh 2012, lean operates at three different levels with lean philosophy which aims at elimination of unnecessary activities being the highest and the most impactful. Lean philosophy is an umbrella term for taking out waste in any organization.

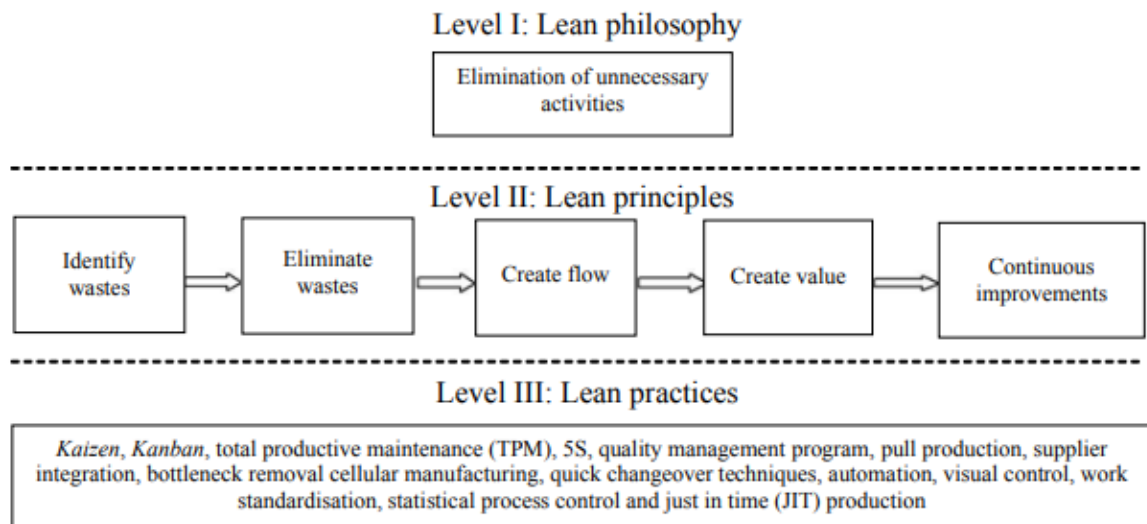


Figure 1. Three Levels of lean Production. Source (Ghosh, 2012)

Lean philosophies have been used as tools to identify waste and examine the value stream mapping of processes both in manufacturing, processing and service industries. This has been known to drive improvement in efficiencies mainly in manufacturing companies but philosophically lean can be applied to all type of industries and organizations (Panwar, Jain and Rathore, 2015). In view of this advantage, lot of studies have been conducted on lean and its impact on transport performance indicators generally however, truck haulage has not enjoyed necessary attention. Therefore, this study will thus focus on how adoption of lean philosophy would drive overall improvement in truck haulage supply to FMCG in Lagos Nigeria.

Research Questions

This study examined how lean philosophies impact performance indicators using the following research questions:

1. How does technology and analytics support in improving performance indicators?

2. How does synergy with FMCG from product design impact on truck capacity utilization?
3. How does sharing forecast of truck requirement schedule improve visibility and truck availability to FMCG?
4. How does the 3PL truck providers in Lagos partner FMCG to reduce empty mile?

METHODOLOGY

A mixed method research (MMR) design was adopted for this study. The MMR was used to answer the research and objectives to ensure a full grasp of the knowledge from the participating 3PL firms based in Lagos Nigeria. MMR is a combination of qualitative and quantitative method to address research problems and objectives and it provide the researcher with more in-depth insight to solve research problems and questions (Creswell, 2012; Frels & Onwuegbuzie, 2013; Hong & Espelage, 2011). Preliminary information was obtained from both external and internal sources as part of secondary research to support this study. External information will be gathered from existing literature on the topics of lean philosophies and their impact on performance indicators. Internal information will be sourced from within the selected 3PL firms and this will form the basics of the primary research method. The survey questions and interview questions were framed in line with the information gathered from the secondary research to support this investigation and study. The number of participants in the survey was 120 participants that are staff working in the 3PL truck haulage section (15 per company). The expected response rate to the survey is between 50% - 60%. An in-depth interview was conducted for 7 senior staff member managing truck haulage across seven different companies. The companies selected all had their head offices based in Lagos, Nigeria, with a blend of both local 3PL and multinational companies which is a current representation of the market. The instruments for data collection were online survey for the quantitative research, and structured interview for the qualitative research. In order to gain additional insights and knowledge about the unknown, convergent mixed research method was implored for the study. For analysis of the data collected, descriptive statistics with use of percentages was implored for the quantitative data while, thematic analysis was adopted for the qualitative data.

RESULT AND DISCUSSION

The findings of this study which assessed the impact that the adoption of lean philosophies have on performance indicators for truck haulage for 3PL firm based in Lagos is presented below following sequence in line with the research questions that guided the study. The result is also presented based on findings from the quantitative study and then qualitative study. From the data collected, the demographic distribution shows that 32 (48%) of the respondent of the 67 professionals working in 3PL firms that took the survey were working in Multinationals 3PL firms, while 35 (58%) of the respondents were working in

local 3PL firms. Below is the chart that describes the demographic distribution of the respondents.

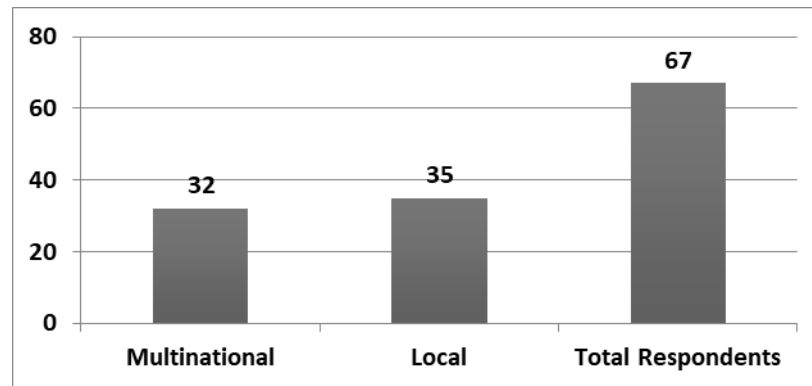


Figure 2. Demographic Distribution Chart

Quantitative Phase of Research Study

1. Role of Technology and Analytics Support in Improving Performance Indicators

Table 1. Survey Questions on Technology and Analytics Impact on Truck Haulage PI

Survey Questions	S A	A	N	D A	SD A	Total Count	SA	A	N	DA	SD A	Total 1 %
8. Technology and analytics have aided your abilities to monitor your truck haulage activities	46	17	4	0	0	67	69 %	25 %	6 %	0 %	0 %	100 %
9. An integrated transport management system is critical in coordinating truck haulage activities	54	10	2	1	0	67	81 %	15 %	3 %	1 %	0 %	100 %
10. Technology and analytics improve the visibility to key stakeholders integrates the network	41	25	1	0	0	67	61 %	37 %	1 %	0 %	0 %	100 %

11. Technology and analytics give visibility to your FMCG partners.	40	2 4	3	0	0	67	60 %	36 %	4%	0%	0%	100 %
12. Technology and analytics trigger alerts and response actions that help in driving efficiency and improvements.	38	2 4	4	1	0	67	57 %	36 %	6%	1%	0%	100 %
13. Technology and analytics aid quick decisions leading to drop in truck cost.	24	2 8	7	7	1	67	36 %	42 %	10 %	10 %	1%	100 %
14. Technology and analytics help in connecting partners to support in multi-drop locations.	29	3 1	7	0	0	67	43 %	46 %	10 %	0%	0%	100 %
15. Technology and analytics improve communication and collaboration with clients	41	2 5	1	0	0	67	61 %	37 %	1%	0%	0%	100 %
16. Technology and analytics help in improving truck availability.	23	3 3	8	2	1	67	34 %	49 %	12 %	3%	1%	100 %
17. Technology and analytics help in improving truck capacity utilization.	25	3 0	1 1	1	0	67	37 %	45 %	16 %	1%	0%	100 %

From the table above most of the questions had > 75% of a combination of the strongly agree and agree options chosen which is quite significant that technology and analytics have a big role on influencing performance indicators

for haulage truck and also help in improving efficiency. In order words technology play a key role in truck monitoring, coordination, improved visibility, alert management, decision support system, improved service delivery and improve TOVE.

2. Collaboration with FMCG from Product Design on Truck Haulage Efficiency

Table 2. Q18 - Do You Participate with New Product Design Phase with Your Respective FMCG Client?

Category of Firm	Frequency		Total Frequency	Percentage	
	Y	N		Y	N
Multinational	15	17	32	43%	53%
Local	20	15	35	57%	47%
Total	35	32	67	100%	100%
% of Total	52%	48%			

Dichotomous question was asked with Y and N response to check collaboration of 3PL firms with FMCG from product design. 35 (52%) of the respondent said Yes (Y) while 32 (48%) said No (N). This indicates that there is no clear-cut alignment on the collaboration of Truck haulage firms with FMCG on involvement in their product design.

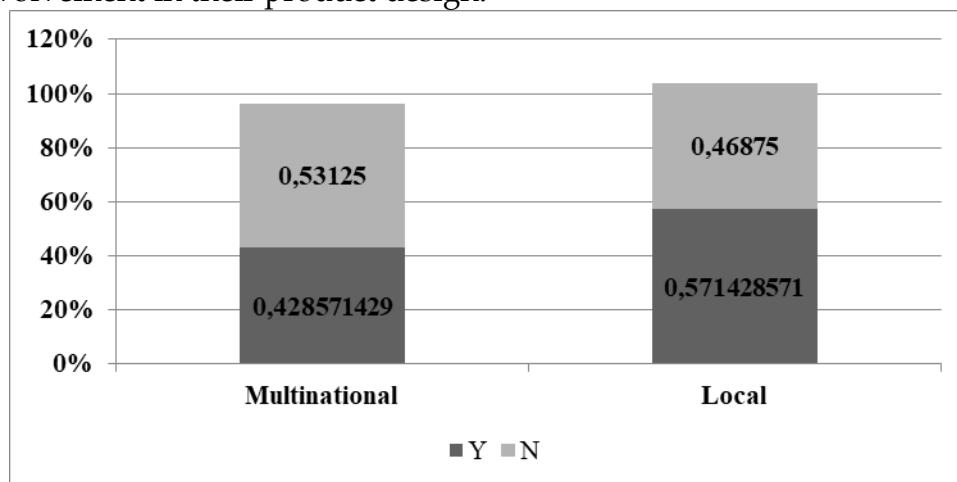


Figure 3. Collaboration of 3PL on Product Design for FMCG at Detailed level

From Figure 3 above, 43% of respondents from multinationals said YES while 57% from local said YES, 53% and 47% said NO respectively.

Table 3. Survey Questions on Impact of Synergy with FMCG by 3PL Firms

	S A	A	N	D A	SD A	Total Count	SA	A	N	DA	SD A	Total %
19. Synergy with FMCG helps to increase truck utilization	24	36	7	0	0	67	36%	54%	10%	0%	0%	100%
20. Working closely with the clients on order maximization improves truck utilization	29	35	2	1	0	67	43%	52%	3%	1%	0%	100%
21. Advising clients to partner on return trips with other firms minimizes idle time	30	26	8	3	0	67	45%	39%	12%	4%	0%	100%
22. Collaboration on freight sharing improves on overall trip cost	16	28	17	6	0	67	24%	42%	25%	9%	0%	100%
23. Collaboration on freight sharing impacts the quality of goods delivery to clients	10	17	21	18	1	67	15%	25%	31%	27%	1%	100%
24. Collaboration on freight sharing reduces overall turnaround time	8	15	17	19	7	66	12%	23%	26%	29%	11%	100%

On impact of synergy with FMCG by 3PL firms 36% SA while 54 agrees that it helps in truck utilization. It was also indicated that cooperation on size of

orders improve close truck utilization where 43% SA and 52% A. Partnering on return trip and freight sharing was noted to minimize idle time and capacity where 45% SA and 39% A for the former and 24% SA and 42% A for the latter. There was no position on impact of freight sharing on quality of goods and reduction in turn-around time.

Lean Culture and Its Impact on Truck Performance Indicators

Q25. Do you use lean philosophy (removal of non-value adding activities) in your firms?

Table 4. Survey Questions on Technology and Analytics Impact on Truck Haulage PI

Category of Firm	Frequency		Total Frequency	Percentage	
	Y	N		Y	N
Multinational	26	6	32	48%	46%
Local	28	7	35	52%	54%
Total	54	13	67	100%	100%
% of Total Freight	81%	19%			

Dichotomous question was asked on use of lean philosophy in the selected 3PL firms with Y and N response. 54 (81%) of the respondent said Yes (Y) while 13 (19%) said No (N). This indicates that most of the respondents believe that lean philosophy is used in their firms. From Fig 12 below 48% of respondents from multinationals said Yes while 52% from local said Yes, 46% respondents working in multinational 3PL firms and 47% working in local 3PL firms said NO respectively.

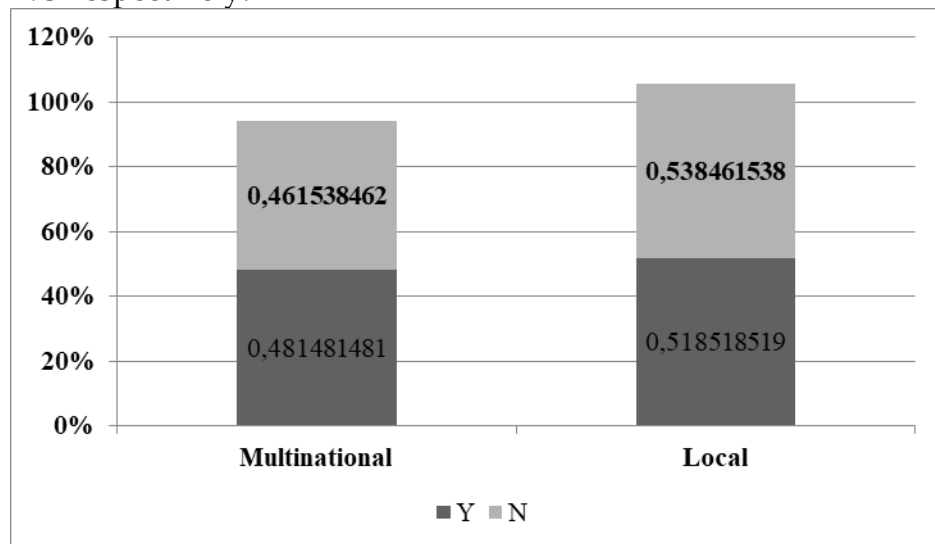


Figure 4. Adoption of Lean Philosophy for Selected 3PL

Q29. Do you have a strong lean culture in your organization?

Table 5. Lean Culture at Detailed Level by Firm Type

	Frequency		Total Frequency	Percentage	
Category of Firm	Y	N		Y	N
Multinational	26	6	32	48%	46%
Local	28	7	35	52%	54%
Total	54	13	67	100%	100%
% of Total Freight	81%	19%			

Dichotomous question was asked on the existence of lean culture the selected 3PL firms with Y and N response. 54(81%) of the respondent said Yes (Y) while 13 (19%) said No (N). This indicates that there most of the respondents believes that there is implementation of strong lean culture in their 3PL firms. From Fig 13 below 48% of respondents from multinationals said Yes while 52% from local said Yes, 46% respondents working in multinational 3PL firms and 47% working in local 3PL firms said NO respectively.

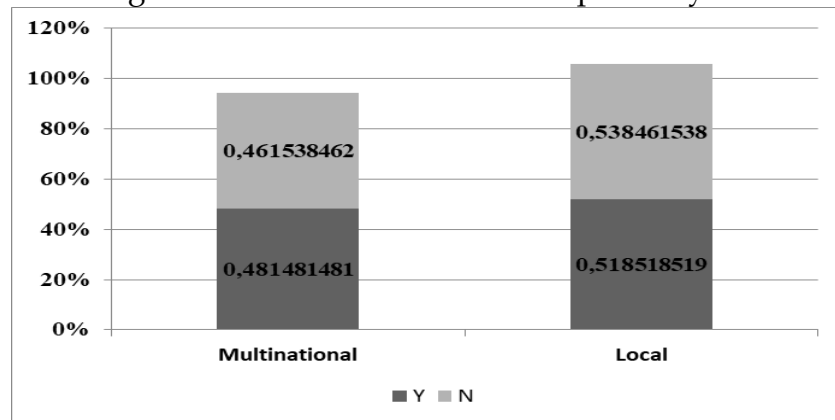


Figure 5. Lean Culture at Detailed Level by Firm

Table 6. Table on the Impact of Lean Principles and Practices

Survey question	SA	A	N	DA	SDA	Total Count	SA	A	N	DA	SDA	Total %
26. Total preventive maintenance helps in improve truck availability.	40	25	1	1	0	67	60%	37%	1%	1%	0%	100%
28. Total Productive Maintenance improves lead time and turnaround time	26	38	2	1	0	67	39%	57%	3%	1%	0%	100%
30. Continuous improvement culture is embedded in your organization	33	25	6	3	0	67	49%	37%	9%	4%	0%	100%

31. Commitment to the continuous improvement culture is from top down to bottom in your organization	27	29	8	2	1	67	40%	43%	12%	3%	1%	100%
33. JIT helps in improving your truck trip cost.	11	32	22	2	0	67	16%	48%	33%	3%	0%	100%
35. Automation in truck routing expedites delivery time.	23	30	14	0	0	67	34%	45%	21%	0%	0%	100%
37. Automation use for multiple drops lead to drop in freight cost.	10	24	27	5	1	67	15%	36%	40%	7%	1%	100%

Q27. Lean philosophy minimizes and reduces break down and improves cost efficiency

Table 7. Lean Philosophy Minimizes and Reduces Break Down

	Frequency		Total Frequency	Percentage	
Category of Firm	T	F		T	F
Multinational	30	2	32	48%	50%
Local	33	2	35	52%	50%
Total	63	4	67	100%	100%
% of Total Freight	94%	6%			

A choice question was asked on whether lean philosophy reduces break down and ultimately improve cost efficiency in the selected 3PL firms with T (True) and F (False) response. 63 (94%) of the respondent said True (T) while 4 (6%) said false (F). This indicates that there most of the respondents believes that lean philosophy minimizes truck breakdown and improves cost efficiency. From Fig 14 below 48% of respondents from multinationals said T while 52% from local said Yes, 50% respondents working in multinational 3PL firms and 50% working in local 3PL firms said F respectively.

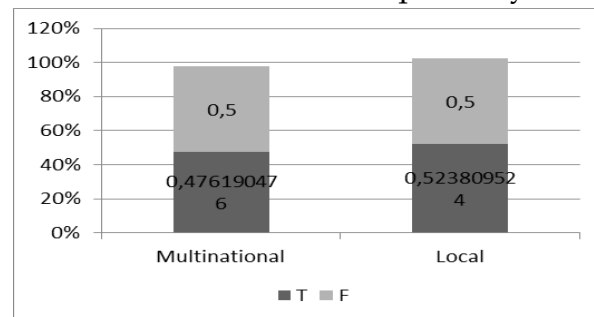


Figure 6. Lean Philosophy impact on cost efficiency and breakdown minimization

Table 8. Table Confirming Usage of JIT and Automation

Survey question	Y	N	Total Count	Y (%)	N (%)	Total %
32. Do you practice just in time delivery?	53	14	67	79%	21%	100%
34. Do you use automation to manage your truck routing?	38	29	67	57%	43%	100%
36. Do you use automation for multiple drops for FMCG firms?	39	28	67	58%	42%	100%

The following Y and N questions were asked for practice of JIT and automation which are lean practices. For JIT delivery 53 (79%) indicated Y while 21% indicated N, this points to a large percentage of respondents practice JIT delivery. For automation to manage truck routing and multiple drops for FMCG firms, 57% indicated Y for truck routing 58% for multiple pick up and drops while 43% and 42% indicated N.

Implications of Improved Visibility, Consolidation, Integration and Communications

Table 9. Table on Impact of Improved Visibility, Consolidation, Integration and Communication

Question items	SA	A	N	DA	SDA	Total Count	SA	A	N	DA	SDA	Total %
39. FMCG client forecast aids in proactive planning and improves overall turn around	4	25	9	4	25	67	6%	37%	13%	6%	37%	100%
40. This approach above leads to improved trip cost.	23	26	16	2	0	67	34%	39%	24%	3%	0%	100%
42. The priority list based on forecast received helps in achieving high truck delivery to FMCG	21	38	7	1	0	67	31%	57%	10%	1%	0%	100%
48. Freight sharing leads to additional lead-times	9	26	24	8	0	67	13%	39%	36%	12%	0%	100%
49. Working in a logistics cluster with other firms is beneficial based on the sharing of resources.	11	35	16	5	0	67	16%	52%	24%	7%	0%	100%
50. Working in a logistics cluster leads to a reduction in empty mile	4	19	17	11	16	67	6%	28%	25%	16%	24%	100%

Only 6% SA, 37% A that forecast sharing aids planning however the importance of clear priority list was obvious as over 80% either SA or A. On freight sharing about 50% believes it leads to additional lead time. Working in Clusters seems good idea from a resource point of view as 68% both SA and A but however only 6% SA agrees that it will lead to eliminating empty mile.

Table 10. Impact of Information Sharing and Collaboration on Performance Indicators

Survey question	Y	N	Total Count	Y (%)	N (%)	Total %
38. Do you demand for forecast from FMCG client?	55	12	67	82%	18%	100%
41. Do you draw up a priority list based on forecast received?	59	8	67	88%	12%	100%
43. Do you use this forecast to plan for additional resources there by improving your overall capacity?	56	11	67	84%	16%	100%
44. Does this support in your building-in needed redundancy and flexibility into your fleet?	52	14	66	79%	21%	100%
45. Do you use this forecast to do freight sharing and partnering with other FMCG in the chain?	41	26	67	61%	39%	100%
46. Does this lead to improvement in cost per trip?	54	13	67	81%	19%	100%
47. Is this cost shared with respective FMCG companies?	38	29	67	57%	43%	100%

Qualitative Phase of Research Study

Table 11. Demography of Interview Participants

Code	Category	Gender of interviewee	Years of Experience	Age of 3PL firm in Nigeria
S1	Multinational	Male	11 to 20 Years	More than 20 Years
S2	Multinational	Male	11 to 20 Years	0 to 10 Years
S3	Multinational	Male	More than 20 Years	More than 20 Years
S4	Local	Female	11 to 20 years	11 to 20 years
S5	Local	Male	11 to 20 years	More than 20 Years
S6	Local	Male	6 to 10 Years	11 to 20 Years
S7	Local	Male	6 to 10 years	0 to 10 Years

Table 11 above shows the demographic distribution of the staff interviewed. Out of the seven interviewed; three were of multinational firm while four were of local firm, majority were male as there was only one female, three indicated that their firms had existed in Lagos, Nigeria for more than 20 years while two each of the remaining four firms indicated they had been around the study location for less than 10 years, and above 10 years but less than 20 years respectively. Four of the staff had more than 10 years but less than 20 years of experience, two had between 6 to 10 years of experience while one had over 20 years of experience.

Transcriptions by Firms In-Depth Interview Questions

Nine (9) questions were transcribed based on responses by senior staff working in the 3PL firms. For the first question of Do you adopt Lean (waste

elimination) in your 3PL operations, S1, S2, S3 responded Yes and were all working for Multinational firms while S4, S7 responded no both working in local 3PL firms. S5 and S6 said Yes but their concept of lean is about spare parts management basically. Then next question was asked to those that responded Yes to adoption of lean. What is the adoption of lean impact on performance indicators SI responded on truck utilization, cost reduction, pay per case and per lane, S2 responded it impacts transit time, offloading, remove wastage along process, fuelling, truck mileage, and next trips, S3 responded Yes it does, impacts customer satisfaction, review of processes, ensure money is not wasted. S5 responded Yes, profit making which emphasizes on reduction in truck overall cost S6 mentioned Yes it impacts on performance indicators (improve customer service, give value to customers, they don't lose money, save cost for them, operate within budget).

The next question was on lean culture embedded in your organization and was asked to S1, S2, S3, S4 and S6. They all said Yes but only S1 emphasized that this cut across the organization both technical, management and operational workers. S3 mentioned they have people trained that are lean champions and have 6 sigma belt and have received training on lean. The next question was if they practice CI, S1, S2, S3, S4, S5 and S6 all said Yes. The connotes that despite they don't all adopt lean philosophy but all continuously drive to improve their processes and better their overall cost and efficiency.

The next question was "Do you practice the following lean tools in your organization TPM and Automation" S1 responded no for TPM but mentioned YES for automation. They have SAP, Instantaner workshop management, Carlo Solo plan, S2 said yes to TPM and automation but didn't disclose the names of software due to confidentiality issues, and S3 responded they use automation and TPM very well. S4 responded yes for TPM and No for automation due to software not working when they tried hence it was abandoned due to lack of experts to operate it, S5, S6 and S7 no automation but YES to TPM. They use manual records to track maintenance. How does sharing forecast of truck requirement schedule improve visibility and truck availability to FMCG? S1 said they do receive forecast in advance that helps their planning and truck supply to their clients. S2 responded that these aids planning and make equipment properly manned, also impact on truck availability to FMCG clients. S3 said yes to receipt of forecast to FMCG. S4 said Yes, it helps better availability of trucks to clients. S5 said Yes and it help a lot, help your planning and improve service delivery, strong partnership and drive efficiencies. S6 said Yes to receipt of forecast, helps ensure safe trucks are delivered to clients and no delays to availability, share visibility ahead to clients to make a call of truck type and standard being provided. S7 don't receive forecast from FMCG client. How does synergy with FMCG from product design impact on truck capacity utilization? S1 said yes but only cited one example of implementation with one FMCG company meaning this is not fully embedded already. S2, S3, S4, S5, and S7 don't participate in product design with FMCG. S6 answered Yes but Yes, dependent on the tonnage dependent on the state of the road How does technology and analytics to support in improving performance indicators? SI

responded that they use the following TMS, WMS and SAP. TMS used to track from end to end, historical data help in their forecasting and it helps in proof of delivery (POD) remission, truck transit time management and availability calculation. It helps with real time tracking with telematics; you can the truck position at any point in time S2 said they Software like Power BI that gives visibility and analytics and impacts on cost, and drives improvement. And it also improves company visibility and ensures firm is not run blindly. S3 said automation of report ease decision making. S4 said it helps you in terms of visibility, total management of assets and overhauling and management of truck fleet management. S5 said Yes it does, driver management ease communications, customer feedback, ensures safety speed limit are adhered to improve turnaround time. Telematics and fleet management systems support truck tracking and efficient fuel management (technology that tracks fuel). S6, they don't use technology and analytics. S7 mentioned visibility and maintenance of assets, telematics is in use and use a fleet management. S1 responded that they don't do JIT, is in the evolving state in Africa due to our road network. RFID is not in common use in Nigeria. Push demand is common in the market for most FMCG difficult to implement JIT. On the question of operating in Logistic Cluster, S1 responded yes, freight sharing yes, movement of mast of two of the biggest telecoms in in Nigeria MTN and Glo. S2 (No consolidation, left for FMCG customer lead-time impact and add to some cost, do freight sharing among FMCG NO and implement JIT in your operations OK for Customers from Dc from the port to factory line. S3 Yes to fright sharing and Logistic cluster YES On the question Do you operate in Logistic Cluster S4 responded No, also responded no on freight sharing among FMCG and said YES implementation of JIT in some operations. S5responded NO for Do you operate in Logistic Cluster, no also for do freight sharing and implement JIT. S6 said No to operating in a logistics cluster, JIT and freight sharing. S7 said no to operating in a logistics cluster, no to freight sharing among `FMCG yes to JIT.

The below is a summary of transcripts of the interview based on the following themes and its sub category as seen from the in-depth interview.

Table 12. Table Showing the Theme Category: Adoption of Lean

Code	Theme Category	Theme Sub Category	Theme Sub Category	Theme Sub Category
	Adoption of Lean	Lean Culture	Practice of CI	Lean Practices TPM & Automation, JIT.
S1	YES	YES	YES	Partial Implementation
S2	YES	YES	YES	Partial Implementation
S3	YES	YES	YES	Partial Implementation
S4	NO	NA	YES	Partial Implementation
S5	YES	NO	YES	Partial Implementation
S6	YES	YES	YES	Zero Implementation
S7	NO	NA	YES	Partial implementation

Table 13. Table Showing the Theme Category: Technology and Analytics Impact

Code	Theme Category	Theme Sub Category	Theme Sub Category	Theme Sub Category
	Tech and analytics improve efficiency in 3PL PI	improve visibility	improve Resource Utilization	Ease Decision making
S1	YES	YES	YES	YES
S2	YES	YES	YES	YES
S3	YES	YES	YES	YES
S4	YES	YES	YES	YES
S5	YES	YES	YES	YES
S6	NA	NA	NA	NA
S7	YES	YES	YES	YES

Table 14. Table Showing the Theme Category: Collaboration and Integration

Code	Theme Category	Sub Category	Sub Category	Sub Category	Sub Category
	Collaboration and Integration	Forecast sharing	Participation in Product Design	Logistic Cluster	Freight Sharing
S1	YES	YES	YES	YES	YES
S2	YES	YES	NO	NO	NO
S3	YES	YES	NO	YES	YES
S4	NO	YES	NO	NO	NO
S5	NO	YES	NO	NO	NO
S6	NO	YES	NO	NO	NO
S7	NO	YES	NO	NO	NO

Table 15. Comparative Analysis Table of Findings

Theme	Quantitative Results	Qualitative Results	Summary of Results	Literature
Technology and Analytics on PI	>75% responded that tech impacts on PI -improved PI -efficiency Gains -Monitoring, -improved visibility, -Alert management, -Decision support system - Improved	6 of the 7 firms (79%) Interviewed support Tech impact PI resulting - improved Visibility -Improved resource utilization -Ease Decision making	One commonality is tech improves visibility, ease decision, and ensure resources utilization to gain efficiency in PI thus delivering value to FMCG.	Orchestrator (Zacharia, Sanders and Nix, 2011) Efficiency, Value to Customer, flexibility, delivery, visibility Data analytics – Futuristic prediction (Kamble and Gunasekaran, 2019). GPS - Woxenius (2012)

	service delivery	- Futuristic prediction - Security of assets - Real time tracking GPS/Telematics	One divergent view from is tech assist in security of assets as well and prediction	
Impact of Adoption of Lean Philosophy on PI	94% said True that lean philosophy improves efficiency.	- improved PI - Productivity gains - Efficiency gains - Waste Elimination - Improved visibility - Customer service - Flexibility - Profit maximization - Value creation	Lean is seen to have impact on PI from both findings, value creation to customers, improve TOVE but is implementation is not fully embraced for local 3PL firms as seen in the in-depth interview due to resource constraints and wrong notion of lean but all practice CI	TOVE, waste reduction, Villarreal, Garza-Reyes and Kumar (2016) Pinho and Lobo (2019) lean is journey CI (Anvari et al., 2011; Aziz and Hafez, (2013). Dey and Cheffi, 2013; Cabral et al., (2012) Benefits of Lean, Melton, T. (2005). Advantage of Lean (Čiarnienė and Vienažindienė, 2012)
Acceptance of Lean Culture	Adoption of lean Philosophy- 81% said True CI is embedded in 3PL 49% SA and 37% A Lean practice -JIT 79% said Y -TPM improve availability 60% SA and 37% A -Automation 57% said Y	Adoption of lean Philosophy-71% of 3PL practice Lean culture – 57% of 3PL firm practice this CI 100% of 3PL practice this Lean practice partial implementation for -JIT -TPM -Automation	Lean culture is fully embedded from survey results but is not implemented in full in most cases for the in-depth interview but 3 Multinational had lean culture not fully matured but locals have little on lean culture due to cost concerns and skill gaps. Change management is also an issue	Resource constraints- Ledbetter (2018) Lean implementation varies (Leite and Vieira, 2015) Automation of metrics (Galvin, 2019). Sub optimization of some transport PI (Taylor and Martinchenko (2006) Leanlite (Chaplin,Heap and O'Rourke, 2016) Resilience, Agility and Flexibility (Ferguson, Frank and Poddar, 2022) Lean C management (Timmerman, 2019)
Collaboration, integration and information	-Forecast sharing (43%) said SA and A; this is not as important as	- Forecast sharing (29%) of Participants interviewed	Forecasting support availability and for trucks but	Collaboration (Okon 2018) Supplier Integration (Bento, Schuldt and

sharing	priority (>80%) list in ensuring availability -PD Participation 42% said Yes - Logistic Cluster 6% SA it will reduce empty mile - Freight sharing 50% both SA and A that it will lead to additional lead time.	- PD participation (14%) of Participants interviewed - Logistic cluster (29%) of Participants practices this. interviewed practice this - Freight sharing (29%) of Participants interviewed practices this	from the point priority list is more important involvement in PD participation, operations of LC and freight sharing low indication lack of integration and metric that track integrated PMS.	Carvalho, 2020). Integrated PMS - Irfani, Wibisono and Basri, 2019). Freight sharing – Kim 2022 Logistics Clustering Abushaikh, 2018
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Table 23 shows a comparative analysis for themes agreed upon for both the quantitative study and qualitative study, we employed convergent triangulation to look at divergence and commonality in terms of findings and connect to relevant theories from literature review. This will be used for basis of discussion below. This was done in line with 4 themes namely Tech and analytic impact on PI, lean philosophy impact on truck PI, embodiment of Lean culture and end to end collaboration integration and partnership.

The section focused on the main findings from results garnered from both the quantitative and qualitative study in line with the central research question of how lean philosophy impacts of PI for truck haulage manage by 3PL firms in Lagos for FMCG. This was done by interpreting the results and discussing and the main findings under 4 broad themes in line with agreed aims and objectives and was linked to relevant theories from literature review done in chapter 2.

1. Technology and Analytics Impact on PI for 3PL Firms Based in Lagos

One of the questions that was asked to participants during the survey and in-depth interview in this research was on the role of technology and how it impacts on performance indicators for their 3PL. It is reported the most commonly used metrics for measuring effectiveness of truck performance are cost, quality, delivery and flexibility (Dr. B. Vittaldas Prabhu and Mr. Aditya Kudva S, 2015). From the study one of the main findings is that technology plays a significant role in improving efficiency for the metrics mention above namely cost by reducing turnaround time, preventing losses due to theft or sabotage and managing detour from route by drivers. Tech provides visibility and close monitoring that ensures prompt delivery through the use of transport managements system. This lay credence to what Woxenius (2012) pushed that directness should be measured as KPI for truck haulage because there a lot of detours happening within transport chains triggered by certain factors which can grouped into commercial, political, operational, physical and unplanned events. He then proposed that one of the counter measures for this is by ensuring strict adherence to assigned routes through global positioning system

(GPS). It was also seen that Telematics supports in ensuring optimal utilization of trucks through fleet management system, the technology have advance to the extent of tracking fuel usage and ensuring losses are prevented. It was seen from this study that overall customer service was improved to FMCG firms due to strong decision support systems that enable 3PL to respond to changes in request and deliver accordingly.

However, there is need to have integrated performance management system in the transport chain network and use the big data analytics to have a futuristic approach to efficiency improvements (Kamble and Gunasekaran, 2019). This is currently a gap in the current operating environment for both Local and Multinational 3PL working in Lagos. This is one area of improvement as there is currently no integrated performance management system power by tech that can ensure continuously improvement is driven across the Supply chains. There is also the issue of operating different soft wares which might lead to compatibility issues. This of course is a big show stopper in pushing for end-to-end efficiency in PI between FMCG and 3PL. The current situation in Lagos is far off from the role of 3PL acting as an orchestrator in supply chain by linking partners together through technology as proposed by (Zacharia, Sanders and Nix, 2011). It is recommended that 3PL should move away from the silo mode of operation with the use of tech and analytics and move more towards integration of the supply chain which will drive more efficiency gains.

2. Impact of Adoption of Lean Philosophy on 3PL Performance PI in Lagos

It was seen from this study that most 3PL multinationals use lean while some 3PL locals also adopt this but what was common was that lean have great impact on waste reduction, improve customer service, and improve profitability and TOVE. This is in support of the claims made by several authors that described lean as a theme that drives efficiency and process enhancement and delivers results in overall improvement in customer service to both internal and external stakeholders (Pinho and Lobo (2019), Čiarnienė and Vienažindienė, 2012, Melton, T. (2005). One common line that runs across both Multinational 3PL and Local 3PL firms from this research is they all embrace CI and believe that it is an ongoing process in their operations as they strive to look for better ways to improve the efficiency of their operations and deliver value to their customers. Though they don't all practice lean as defined by TPS templates but adopt part of its thinking in their day-to-day operations. It has been mentioned by several researchers that lean is a journey and not a destination. This implies that the status quo needed to be challenged all the time to identify new techniques for doing things better (Anvari et al., 2011; Aziz and Hafez, (2013). This position was also supported from a metric point of view by Dey and Cheffi, 2013; Cabral et al., (2012) that Lean performance measure is an ongoing continuous improvement initiative. In order to cope with current disruptions, it have become imperative that we need to strike a balance of how far you can go in terms of lean with respect to truck haulage in Lagos. There is has to be a balance between building redundancy to cope with current transport and supply chain disruptions; Just in case solutions is now replacing just in

time solutions (Ferguson, Frank and Poddar, 2022). It is recommended that while pushing for lean with all its benefits it is important to look at what works best for each firm in line with its environment. The reason why Taylor and Martinchenko (2006) challenged the notion of complete lean implementations in transport chain operations but focus should be to push for the concept of sub-optimization of some of the PI that will improve the overall system PI and value delivered to FMCG clients

3. Acceptance of Lean Culture by 3PL Firms in Lagos

The acceptance of lean culture is more evident among multinational 3PL firms; even for the locals 3PL firms the notion of Lean operations is far from the TPS template. Ledbetter (2018) noted that most companies invest a lot of resources to adopt lean philosophy and practices in their organization but often times achieve very little to no result and far off from the TPM template. Based on the evidence from Literature there is however no standard set of tools for applying lean philosophies in various organizations (Leite and Vieira, 2015). It was also seen that Lean application means different things to different firms but the culture was more embedded with the Multinational 3PL firms than Local 3PL firms. The role of proper change management is highly recommended as proposed by Timmerman 2019 that for lean cultures to be fully embedded there have to be transformation in the following 3 spaces namely: space for trust, space for change and finally space for CI. It is also strongly recommended that Locals can start with lean lite which is a concept lighter version of lean in line with their available resources (Chaplin, Heap and O'Rourke, 2016)

4. Collaboration, Integration and Information Sharing Among 3PL Firms and FMCG in Lagos

It was seen from this study that collaboration, integration and information play a big role in the implementation of lean but there is huge opportunity in the area of freight sharing and operating in logistics clusters which is resulting in trucks not fully utilize leading to emptier mile and increased cost of operations. This further support the position made by Okon (2018) that collaboration as a big challenge confronting supply chains in Nigeria. There are still big barriers like trust among partners, reluctance to share information and resource sharing. This was evidenced in the low participation in freight sharing. Which is a big opportunity that is recommended to be looking at serious for FMCG firms? The competition is in the market space not inside the trucks. Freight sharing was seen to increase by 20% for carriers in the USA (Kim 2022). This is already being done by Telecoms Company in Nigeria as shared by one of the interviewees from the in-depth interview. Ride sharing is also a common thing in Lagos for commuters with firms like Uber and Toxify. The other issue is lack of supplier integration as was seen in very low participation in product design by 3PL firms for FMCG, this means there is wastage as products are not designed with fitting into truck for maximum truck utilization in mind. This upholds the view that supplier

integration plays a key role in successful implementation of lean to drive efficiency in operation (Bento, Schuldt and Carvalho, 2020).

Truck performance indicators for different companies varies and sometimes even conflicts hence the need for specialized attention for each client but having an integrated dynamic performance management with solution solving toolkits (Irfani, Wibisono and Basri, 2019). Abushaikh, 2018 mentioned Logistics clustering plays a key role in driving efficiency through sharing of resources among FMCG partners and 3PL by collocating close to each other. The findings from this study indicated that only some few multinationals do this in silo. It is recommended that FMCG, Policy makers and 3PL need to work on plan to build and integrated hub with key partners for ensuring there is collaboration and resource sharing is done optimally.

CONCLUSIONS AND RECOMMENDATIONS

There is further study needed to look at what discourages freight sharing in Nigeria and fully integrated supply chain with multiple partners. The competition is not inside the truck but in the market place for FMCG firms as this is one opportunity area currently not being explored today resulting in empty mile in most movements thus raising the cost of operating truck haulage in Nigeria. Lean adoption alone can't close this gap so therefore there is urgent need for more collaboration, integration, freight sharing and resource sharing between all relevant stakeholders in the truck haulage transport chain.

ADVANCED RESEARCH

This research still has limitations so further research on this topic is still needed.

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