Waste in the Transportation Process Dedicated to the Offshore Chain in an Oil and Gas Company

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Abstract

Implementing Lean system tools in the road transportation process is a way to make the process happen with less human effort, equipment, time, and space, allowing for planned transportation logistics. The limited use of Lean thinking in the trucking industry and the paucity of practical studies suggest that there is no clear understanding of the benefits of how Lean thinking can support improved operations in this industry. Thus, this study aims to identify the waste in the transportation process dedicated to the offshore chain in a company in the oil and gas sector, through a real case study, adding guidance on the limited research conducted in this field. This is a complex process where possibilities for competitive improvement lie for the internal logistics area of the company under analysis. The offshore supply chain case study was composed of multiple theoretical and empirical data collection methods, such as scoping review, focus groups, and participant observation. The field analysis allowed us to clearly identify the waste existing in the process in the studied area. We conclude that this work explored the applicability of Lean tools to reduce waste in road transport through a real case of intervention, resulting in the identification of waste present in the process and in a concrete action plan for the implementation of automation of activities and treatment of the points identified with a minimum estimate of reduction of downtime in monetary value of R$ 128,477.17 in two weeks of operation.

Keywords
Road Transportation; Logistic; Lean Transport; Waste Elimination; Muda.

1. Introduction
The impact of supply chain, logistics and transportation on the economy is an issue that has received and is attracting increasing scientific and political attention (CSCMP, 2013). Logistics is defined by the Council of Supply Chain Management Professionals (CSCMP, 2013) as the part of the supply chain that is responsible for planning, implementing, and controlling the efficient and effective forward and reverse flow. And it defines transportation as the composition of various methods to move products. A supply chain is often seen as a network of critical links that connects organizations (stakeholders and partners) and links the inputs of each organization to its outputs. Managing this network generally involves the set of activities and relationships that contribute to customer value and achieve a sustainable competitive advantage (Sartori, 2021; Al-Aomar, 2018). Adopting this premise and knowing that logistics incorporates all the details concerning a given operation, process or activity and that transportation management is

known to be complex and fundamental, holding most of the logistics costs, since it corresponds from one to two thirds of a company's total costs (Sternberg et al, 2012; Gibbons et al., 2012; Ballou, 2004) this research studies the use of Lean tools because of the empirical need for more studies to reduce waste in transportation operations, deriving new theories from both empirical data from transportation operations and existing theories on Lean applications.

The Lean management philosophy and tools initially came from manufacturing and were pioneered by Toyota. In the last two decades, lean has already had tremendous success in improving quality and efficiency in various applications and its scope has extended to cover industry supply chains. Lean has also migrated to the service industry and service supply chains such as healthcare, food, retail, and the public sector and the lean concept of "waste minimization" for process improvement is no longer limited to manufacturing companies. Lean management is an approach where value is created by reducing waste, the focus of research within the field of application of Lean tools in transportation has been on activities related to quality improvement, search for increased efficiency, reduction of waste or losses along the process (Sartori, 2021; Alieva & Haarman, 2020; Al-Aomar, 2018, Garza-Reyes et al., 2016, Villarreal et al. 2016, Villarreal et al. 2017, Ribeiro et al. 2012, Villarreal 2012 and Sternberg et al., 2012).

Villarreal et al. (2017) address that the focus of the so-called Lean Road transportation movement, lies in identifying and eliminating non-value-added activities specifically relevant to transportation operations in order to improve the overall productivity and efficiency of a company's logistics operations. It accentuates along with Garza-Reyes et al., (2016); Villarreal et al., (2016); Ribeiro et al., (2012); Sternberg et al., (2012) and Villarreal, (2012); that the limited use of Lean thinking in the logistics and transportation sector may suggest that there is no clear understanding of the benefits of how Lean thinking can support improved operations in this sector, suggesting that future research should be conducted to test the method in different industrial sets, institutions and organizations. This will further validate the effectiveness and applicability of the method in different industrial situations.

1.1 Objectives

This work aims to identify the waste in the transportation process dedicated to the offshore Supply Chain of a large company in the oil and gas sector, through a real case study, contributing to the scarce studies related to the Lean Road transportation movement, using Lean system tools in a complex transportation process to provide optimization and organization of resources, increased productivity, employee efficiency, increased profits, and higher quality customer service. And as a secondary objective, to propose actions that enable waste reduction and value increase, resulting in gains for the transportation operational process. This work is justified by studying a complex process where possibilities for competitive improvement reside for the internal logistics area of the company, allowing a planned logistics with a level of service adequate to the customer's needs. In addition, it adds guidance on the limited research conducted in this field and to the literature of process mapping using Lean tools in transportation logistics such as those conducted by Garza-Reyes et al., (2016), Villarreal et al. (2016), Villarreal et al. (2017), Ribeiro et al. (2012) and Sternberg et al., (2012). This article is organized into five axes of reflection: introduction, theoretical framework, methodology, results/discussions, and conclusions.

2. Literature Review

The transportation sector is being treated as a strategic factor for Brazil's economic turnaround, including a new study by Fundação Dom Cabral (FDC) conducted by the Transport Infrastructure and Logistics Platform (Pilt) concludes the urgent need for a minimum investment of 2% of national GDP in transportation and logistics by 2035. This would generate a reduction in logistics costs for companies from 12.37% of sales to 8% (Resende, 2018).

A growth of about 40.5% in cargo volume is estimated by 2035, which will represent an increase in transportation expenses from the current R$166 billion to R$233 billion. The total cost of transportation will increase by about 40% by 2035 (Resende, 2018). The adoption of the Lean approach in business operations has reduced waste and improved efficiency in several industries as evidenced by studies that have been conducted, including transportation. Identifying waste in order to reduce costs in finished goods inventory (Sehnem et al., 2020), in construction (Mussolini et al., 2019), in the metalworking industry (Lima and Loss, 2017), in ice manufacturing (Santos et al, 2019), in manufacturing environment (Mostafaa, X. & Dumrakb, J.; 2015), in tubular machining facility (Xia et al., 2013), in transportation (Evangelista et al., 2013; Fernandes et al., 2012; Vilarreal, 2012, Vilarreal et al., 2016, Vilarreal et al., 2017; Garza-Reyes et al.; 2016; Sternberg et al., 2012). Table 1 presents some of the waste found in the literature.

Table 1. The types of waste

Types of Waste	Definitions	Autores
Overproduction (Overproduction)	Overproduce or overproduce too early, resulting in poor flow of parts and information or excess inventory.	Cifone *et al.,* (2021), Junior et al., (2021), Santos et al., (2019), Xia et al., (2013), Sternberg et al., (2012)
Waiting	Periods of waiting for something, result in considerable idleness periods, such as lost operator time and non-operation time.	Cifone *et al.,* (2021), Junior et al., (2021), Sehnem et al., (2020), Lima & Loss, (2017), Villarreal et al., (2017), Villarreal, (2012), Fernandes et al., (2012), Evangelista et al., (2013), Sternberg et al., (2012)
Transport	The unnecessary movement of parts, materials, people, or information is understood, resulting in unnecessary capital, time and energy expenditure.	Cifone *et al.,* (2021), Junior et al., (2021), Mussolini et al., (2019), Lima & Loss, (2017), Villarreal et al., (2017), Reyes et al., (2016), Xia et al., (2013), Evangelista et al., (2013), Villarreal, (2012)
Excessive processing	Inefficient activities that, are extra steps in the process that have unnecessary execution or are implemented in appropriately, not adding value to the organization/production.	Cifone *et al.,* (2021), Junior et al., (2021), Sehnem et al., (2020), Mussolini et al., (2019), Villarreal et al., (2017), Reyes et al., (2016), Xia et al., (2013), Evangelista et al., (2013), Sternberg et al., (2012)
Inventory	Excessive storage, increasing storage and depreciation costs.	Cifone *et al*., (2021), Junior et al., (2021), Mussolini et al., (2019), Santos et al., (2019), Lima & Loss, (2017)
Moving	Disorganization of the work environment, leads to poor performance of ergonomic aspects and frequent loss of items.	Cifone *et al.,* (2021), Junior et al., (2021), Sehnem et al., (2020), Mussolini et al., (2019), Santos et al., (2019), Lima & Loss, (2017), Villarreal et al., (2017), Xia et al., (2013), Sternberg et al., (2012), Villarreal, (2012)
Defects (Rework)	Direct relationship to failures in product quality, process charts, or poor delivery performance.	Cifone *et al.,* (2021), Junior et al., (2021), Mussolini et al., (2019), Villarreal et al., (2017), Reyes et al., (2016), Evangelista et al., (2013), Cifone et al., (2021), Sternberg et al., (2012), Villarreal, (2012)
Human Effort	Employees are doing work below their skill level, a business environment that does not allow employees to develop their performances and implementations.	Cifone *et al*., (2021), Junior et al., (2021), Alieva & Haarman, (2020), Malladi et al.,(2011), Damrath, (2012), Robinson et al., (2012), Sternberg et al., (2012)
Environmental	It includes any activities that cause harm to human health and/or the environment, such as excessive substances released into the air, water, or land.	Mostafaa & Dumrak, (2015)

Source: Authors' elaboration

Sehnem et al., (2020) report in their study to identify waste in finished product inventory losses by handling for adequacy of product organization; by waiting in the preparation of material for shipment and by processing in processes that may not be really necessary. Mussolini et al., (2019) report the identification of 5 types of losses in the manufacture of concrete pipes in their study for waste analysis in a company in the construction sector, they are: transport, inadequate processes, unnecessary inventory, unnecessary handling and defects. Lima & Loss, (2017) report losses such as waiting, transportation, unnecessary inventory and unnecessary movement in their analysis work to increase productivity and reduce lead time in a metallurgical industry.

Santos et al., (2019) in his research using process mapping to identify waste in the production process of a gypsum manufacturing company identified waste of the type of overproduction, unnecessary inventory and unnecessary movement and Xia et al., (2013) in a case study of a tubular machining facility found losses of overproduction, transportation, inadequate processes and unnecessary movement.

Villarreal et al., (2017) brought a case study suggesting that Lean thinking is an alternative for improvements in trucking operations by using Lean-based principles, identifying waste such as waiting, transportation, inadequate processes, unnecessary movement, and defects. Garza-Reyes et al., (2016) analyzed through a case study conducted at a world-leading logistics organization in the Monterrey metropolitan area in Mexico that the implementation of the Value Stream Mapping tool improved the operational efficiency of the trucking operations by identifying transportation-type waste, inadequate processes, and defects.

In the company under study, transportation is characterized by two modalities. In the first section, the material is collected in a road vehicle belonging to the contract with dedicated service level up to the ports, and in the second section the material is shipped to the destination (platforms, ships, etc.). Therefore, the logistical challenges of integrated fulfillment are increasing and require optimization, meeting deadlines, and synchronism (Nicoletti et al, 2020).

3. Methods

The article starts from the need for methods to reduce waste in transportation operations, and for this a real case study with a qualitative approach was chosen. The analysis site studied is the logistics area of an oil and gas company responsible for road transportation of materials, where the transportation process family dedicated to serve the bimodal mode (road + maritime) was evaluated. The research involves data collection through three methods: Scoping Review, participant observation, and focus group.

3.1 Scoping Review

The present study used the Scoping Review methodology to identify and map the available evidence on the topic pointed out in the literature (Munn et al., 2018), focusing on various issues related to inefficiency in transportation operations, as waste is associated with inefficient operations with the aim of investigating the 9 wastes of a Lean with an approach adapted for transportation operations and was guided by the 5 steps proposed by Arksey et al. (2005). In Step 1, for the definition of the research question, we started by reading articles related to the topic to define the research problem as mentioned in the Introduction. Step 2, search for relevant studies, consisted of investigating which studies would be used to identify gaps, deficiencies, and trends in the current evidence and help sustain and inform research in the field. This search was conducted in the electronic databases Scopus and Scielo (Scavarda et al., 2020). The parameters chosen were lean manufacturing, lean production, lean principles, lean practices, lean tools, lean techniques, lean management, lean transport, 7 waste, Value Stream Mapping, kaizen, melhoria contínua, transporte, waste ou muda. In step 3, study selection, we sought to define which studies were relevant according to inclusion criteria and exclusion parameters. The abstracts of the documents found were read, and this consultation allowed the identification of 23 relevant articles for a full reading. In step 4, data mapping, the collected information was interpreted by searching and organizing the relevant points. And, in step 5, collection, summary, and organization of the results. It is evident that it is not the objective of this study to evaluate the quality and generalization capacity of the analyzed materials.

3.2 Participant Observation

The data collection method in participant observation consists of the researcher participating in everyday activities in order to observe events in their contexts. The researcher, in participant observation, collects data through participation in the daily life of the activities studied. The approach is in everyday interaction involving conversations to discover the participants' interpretations of the situations they are involved in (Mónico, 2017). The process analysis stage was carried out in the field (Scavarda et al., 2009), evaluating all the stages of the process and the use of the equipment, that is, the transportation vehicles (fleet) belonging to the contract that provides the service under study. In the study at hand, according to, technique mentioned by Mónico (2017) the notes taken were reviewed and expanded immediately after leaving the field for proper analyses.

3.3 Focus Group

The focus group planning should consider a set of elements to ensure its full development, namely: necessary resources, especially the group moderators; definition of the number of participants and groups to be held; participant profile; selection process and duration (Pizzol, 2004; Morgan, 1997; Trad, 2009). Regarding the necessary resources, the discussion process occurred with a researcher moderator's participation after clarifying the purpose of the meetings. The groups were mediated face-to-face in proper and comfortable meeting rooms in the bases located in Rio de Janeiro-RJ and Macaé-RJ and/or via the Microsoft Teams virtual room. The moderator emphasized to the group that there are no right or wrong answers; observed the participants, encouraging each one to speak; sought the participants' "cues" to build relationships with the experts to individually deepen answers and comments considered relevant by the group and/or for research.

The number of participants per group varied from 8 to 13 specialists, totaling 11 focus groups. All participants are active in the process activities and/or experts in the target process of the research analysis, possessing a vast knowledge of the factors discussed. The groups had meetings ranging from 90 minutes (min) to 120 minutes (max). After clarifying the objective to be achieved, the group was encouraged to answer the question: What are the causes that increase the total service time of the dedicated transportation process? Then all ideas were put on the table, the uncommon ones appreciated, and the possibilities combined.

The deepening of the process to be analyzed, the mapping of the target process of study, the analysis, the validation of the current process mapping, and the definition of actions to improve the operational process were developed through the 11 focus groups. Still, with the focus groups, brainstorming was applied to raise the root causes that originate the high service time of the dedicated transportation process.

5. Results and Discussion

The map of the current state of the dedicated transportation process was elaborated and corroborated in the identification of the presence of waste and where it was concentrated, in the signaling of possible limiting factors in the process, and of activities that add or do not add value. Table 2 presents the description of the eleven main stages of the process referenced in the mapping performed, explaining in detail the main activities involved in the study's analysis.

Table 2. Process Stages

Stages	Breakdown (Work Element)
RT Released	The Load Preparation activity starts the process with the Release of the RT (Transport Request).
Programming of the Sea leg	The Management responsible for integrating the logistics chain with the customer schedules the sea leg according to the customer's needs.
Request of Invoice (NF)	The Contract for Scheduling, Movement, and Invoice Request performs the NF request.
Invoice Issuing	The contract with the company contracted to issue the NFs issues the note.
Programming and allocation of resources	The PMNF contract schedules RT allocates vehicle and informs the fleet team of the Dedicated contract that plans the service at INFOPAE and schedules delivery at the Port. The fleet team starts the trip for service with an estimated start time of 30 min.
Arrival at origin	Upon arrival at Origin the Fleet monitoring team updates the planner, moving the attendance card to the Origin (loading) column.
Loading	The Fleet team carries out the loading of the Material at the Origin. The deadline for loading at the origin is 3 hours. If the loading period exceeds 3 hours, the own operational supervision and monitoring desks must be activated via email.

Arrival at destination	When arriving at the Destination, the Fleet monitoring team updates the planner, moving the attendance card to the Destination (unloading) column.
Unloading	After unloading, the fleet team updates the planner, moving the schedule card to the Monitoring Table Conference column, which will evaluate the service performed.
Evaluation of the service	The Monitoring Desk team evaluates the attendance when it arrives at the Monitoring Desk Conference column. All RTs must have Status 07 noted (Completed). For services with pending proof of delivery or failure to note the 07 status, the monitoring desk must seek treatment with operational supervision and treat the refusals and deviations.
Monitoring of the Process	The monitoring and inspection desk accompany the entire process, from the programming of the M stretch until the delivery at the port and note of the Status 07. In case of refusal, the monitoring and inspection desk of the TT (Ground Transportation) expedites the unloading of the cargo and suspension of the refused items.

Source: Authors' elaboration

In the field, the use of the equipment was evaluated, i.e., the transportation vehicles (fleet) belonging to the contract that serves the service under study (Figures 1 and 2). Figure 1 shows the number of days of service by equipment.

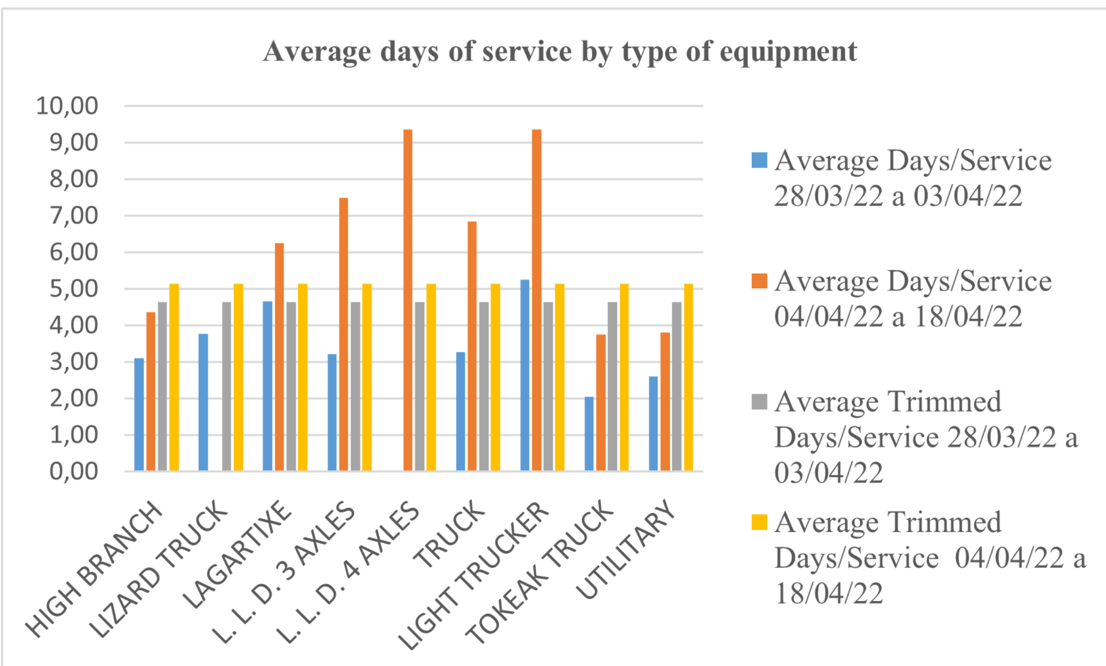
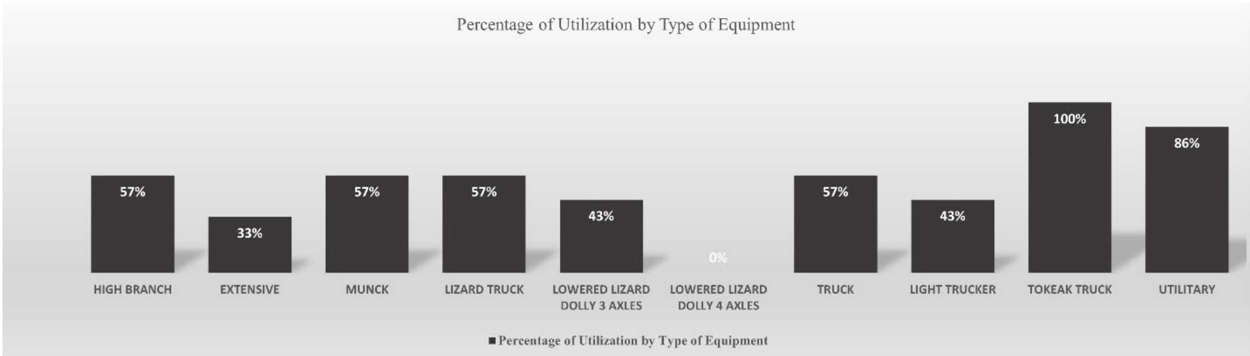


Figure 1. Average days of service per type of equipment
Source: Authors' elaboration

In alignment with the management and those involved in the area, an average of 2 days per trip was considered to be an adequate occupation, that is, it is understood that each type of equipment should be occupied with a demand for a maximum of 2 days. And that each piece of equipment should perform an average of 3.5 visits per week. The analysis made shows that the average time of use of the equipment is above what is operationally expected (4.64 - 5.15 days) and that the percentage of use per type of equipment is below 90% in almost all types of equipment (Figure 2).



Formula for calculation = Number of calls made for each equipment model within the analyzed weeks / 3.5 * Number of equipment per model.

Figure 2. Percentage of use per type of equipment
Source: Authors' elaboration

The study allowed us to clearly identify and analyze in the studied area the wastes in waiting, overproduction, overprocessing, and human effort (Table 3) through focus groups 9, 10, and 11. Waiting waste, the most mentioned, was identified at various times when the service is performed: during loading, unloading, and scheduling/resource allocation. In the calls analyzed it was found that 76% of the calls of the verified sample (37 calls) took 3 days or more (Figure 3), totaling 138 days of stopped equipment in two weeks of analysis and monetarily corresponding to the average value of R$ 128,477.17 paid by the truck and driver per day of operation on hold without effective use and that the loading or unloading stages take 1 day or more to be completed.

Table 3. Identified waste

Waste	Description	Where found	Time	Suggested actions	Articles
Wait	Equipment downtime	Loading	1.0 day	Process automation; Alignment with interfaces; Daily demand planning;	Cifone *et al.*, (2021), Alieva & Haarman, (2020), Garza-Reyes *et al.*, (2016), Villarreal *et al.*, (2017), Villarreal *et al.*, (2016), Villarreal, (2012), Sternberg *et al.*, (2012)
		Offloading (destinations)	1.5 days	Structure KPIs;	
	Scheduled delivery in Porto	Scheduling and Resource Allocation	1.5 hours	Mechanism to stimulate productivity.	
Overproduction	Multi-channel demand input - excess information / information noise	Process Start (RT released)	2 hours	Digitization;	Alieva & Haarman, (2020), Garza-Reyes *et al.*, (2016)
				Digital transmission of the documents.	Villarreal *et al.*, (2017), Villarreal *et al.*, (2016), Villarreal, (2012)
Overprocessing	Printouts/contract signatures	Scheduling and allocation of resources	3 hours	Process automation; Debureaucratization..	Alieva & Haarman, (2020)
Human Efforts	Employees doing work below their skill level because they are dealing with glitches or correcting disorganized	In the stages of service evaluation and process follow-up	Average of 2 to 4 days	Update work instructions; Stipulate performance evaluation factors; Training; Analyze factors that influence turnover; Debureaucratization.	Cifone *et al.*, (2021), Alieva & Haarman, (2020), Garza-Reyes *et al.*, (2016), Villarreal *et al.*, (2017), Villarreal *et al.*, (2016), Villarreal, (2012), Sternberg *et al.*, (2012),

Source: Authors' elaboration

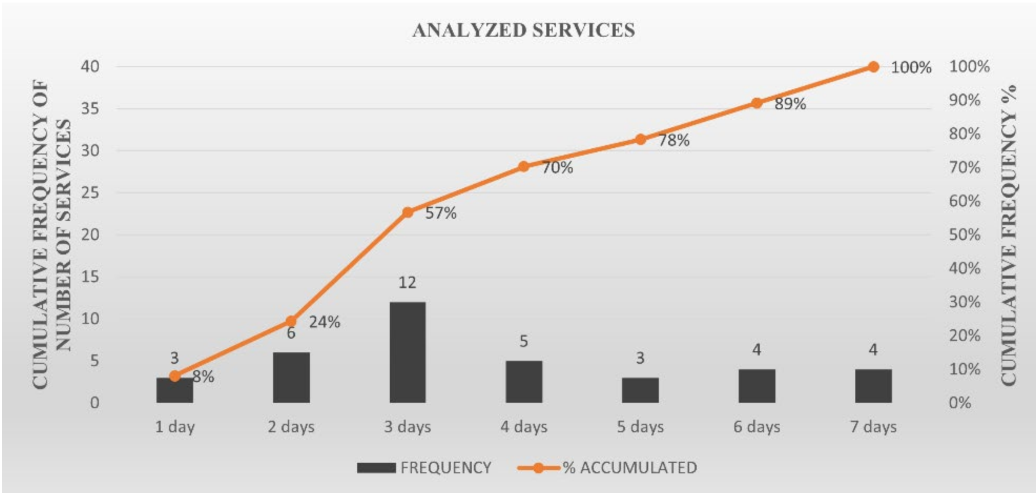


Figure 3. Analyzed services (time between demand processing and delivery) - Dedicated Transportation.
Source: Authors' elaboration

Another point classified as waste waiting is that the current traceability software developed and maintained by the company's IT (Information Technology) area has suffered constant inoperability and falls short of what is necessary for the monitoring and data extraction process. It was also verified that the quality of the data present in the spreadsheet used by the monitoring team makes the process vulnerable in terms of identifying the progress of the trip, delivery, delays, and unsigned pending items that prevent services from being concluded burdening mainly the loading and unloading stages, culminating in the precariousness of fleet management. And in the programming/resource allocation stage, there is the creation of a virtual service (prior processing of the demand) before the allocation of the vehicle that will effectively do the collection, and in the cases analyzed it was found that there was equipment available, but the virtual service was converted into real late.

The waste of Overproduction was identified in the demand input flow. In the analysis performed it was verified that the demand has arrived for treatment through several channels such as e-mails sent directly by the client, by the management responsible for the integration of the logistics chain with the client, by the leadership, by the inspection and by the filter in SAP increasing the demand processing and screening time to be part of the treatment.

The waste of Excessive Processing was verified in the assembly of the documental process at the moment of printing the documents that physically follow along with the driver in the transporting equipment, besides noticing a significant volume of documents that must be printed, on average each service generates around 150 printed sheets.

The waste of Human Effort was identified mainly in the activities of the professionals allocated to the operational management of the target process, who stop performing priority activities of solution development to spend energy treating problems in a palliative way, leaving insufficient time to act in the effective improvement of the process. This waste was also identified in the performance of the contracted teams due to a lack of procedural orderliness.

After the identification and analysis of the waste, the following were developed: Ishikawa Diagram, 5W2H, and PDCA. The application of Brainstorming made it possible to determine the leading causes that culminate in the inactivity of the transportation equipment concerning the dedicated transportation process with the involvement of the participating experts. Figure 4 shows through the Ishikawa diagram the reported causes that lead to the aforementioned downtime.

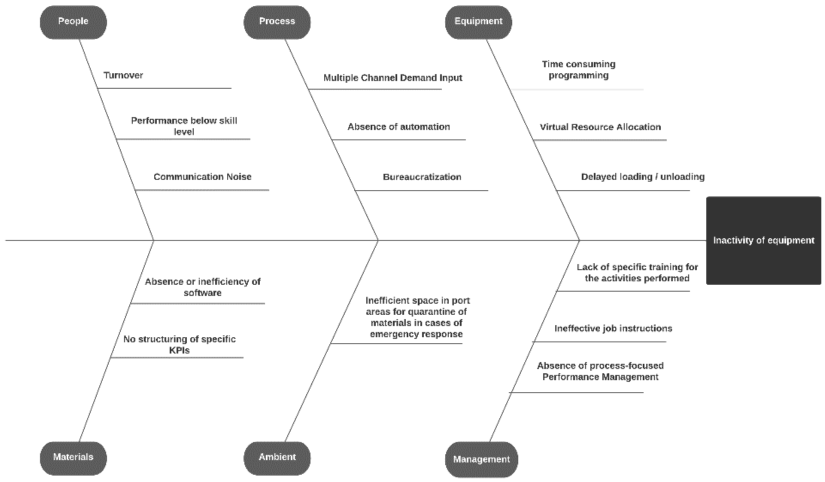


Figure 4. Ishikawa Diagram
Source: Authors' elaboration

With the use of the 5W2H tool, it was possible to make records in an organized and planned way to be put into practice in the development and implementation of the referenced improvements. Specifically, in the focus group 11 the action plan was validated - part of it is presented in Table 4.

Table 4. Action Plan

Action Plan

What?	Why?	Where?	When?	Who?	How?	How much?
Measure the studied process	Evaluate the data collected by comparing the results achieved with the pre-established goals, guiding the decision making process.	Land Transportation Resource Distribution Management	2022-June	Production Engineer	Create specific indicators for the Dedicated Transportation process	No additional costs for study management
Outline daily demand planning	Sanitize excessive demand input channels, communication noise, and reduce the time to start the process.	Land Transport Management for Offshore Operations	2022-June	Manager	Agree with the management responsible for the integration of the logistics chain with the customer the input of the daily demand and visualization through the Service Now - Integration of Operations tool.	No additional costs for study management
Perform alignment with the interfaces	Reduce equipment downtime with material under cart.	Land Transportation Resource Distribution Management and Land Transportation Management for Offshore Operations	2022-June	Production Engineer Manager	Hold Critical Analysis Meetings with the customer units to divulge the services provided and their nuances, especially about the treatment of pending items, and meetings with the destinations to verify the problems of refusal of material and delays in receipt.	No additional costs for study management

Source: Authors' elaboration

A partial implementation of the PDCA cycle (Figure 5) was carried out for future use in the dedicated transportation logistics process as a parameter to foster follow-up and continuous cycle meetings.

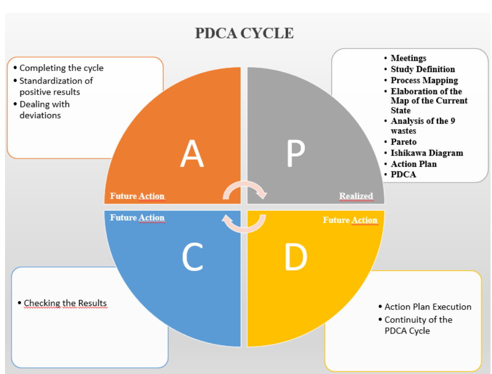


Figure 5. PDCA
Source: Authors' elaboration

5.3 Proposed Improvements

As a suggestion for improvement, after meetings with those involved in the process, for the treatment of Waiting waste it is suggested to involve the company's technology area to adjust the system so that all loading and unloading operations are centralized and there is no need to use a parallel spreadsheet, improving the efficiency of the monitoring team, fleet, and data reliability. Alignment with destinations is also guided through analyzing local delays, especially in the Docks port and in areas that the company has no management over teams, as well as structuring KPIs to support the measurement of carrier operations and equipment utilization, according to Sternberg et al., (2012).

It was also suggested the implementation of the planning of the daily demand of operations for the use of cargo moving equipment (forklifts, cranes) and the team that is used in the processing and unloading stages. And guarantee of mechanisms to stimulate productivity (the contracted company has to be stimulated to make the vehicle "run", otherwise it will be more advantageous for the company to have the vehicle stopped, delaying the operations). To deal with the excessive processing it is suggested to deburocratize, digitize the documents and analyze the sending of accessory documentations (cargo manifest, transport requisitions, invoices) via system to the destination (Nascimento et al., 2018), emphasizing the need to use technology, according to Alieva & Haarman, (2020).

To deal with the waste of human effort, mentioned by Malladi et al., (2011), Damrath (2012) and Robinson et al., (2012) in their studies, it was indicated the creation and/or improvement of work instructions, insertion of disruptive processes to overcome the barriers of bureaucratization, training, development of a goal for monitoring the process, turnover analysis and insertion in the GD (Performance Management) of the employees working in inspection.

6. Conclusion

Was observed that the Lean philosophy already has its place in the management of companies and, when applied, arises with possibilities to motivate new academic studies, as well as to generate work environments with leaner processes. This paper explored the applicability of Lean through a real intervention case, resulting in important identifications for noticeable improvements in the dedicated transportation process. It can be said that Lean is not easy to implement. However, the field research allowed us to anticipate benefits, to visualize important barriers to dealing with problems that would occur in the long term, and to help the operation's professionals recognize the need for a lean service structure suitable to implement in their processes. Finally, the study, by operationalizing the conceptual framework, presented a useful practical approach to reduce resource waste and increase operational value.

The treatment of the waste analyzed adds value by allowing contracted resources to be used in such a way that they can be dimensioned in critical and/or emergency demands and that they do not delay the delivery of essential materials for maritime activities, highlighting the company's end activities such as production and exploration of oil and gas, emphasizing that the non-delivery of transported materials can lead to extremely high economic losses for the company under study. It also improves the capacity gain and performance of the contractors involved in the process to perform the main activities with the desired quality and reduces contractual costs for the company.

In addition to discussing the application of lean thinking in the trucking industry, the paper also contributes to the lean and logistics literature by using principles of lean application in this industry. The limited research conducted in this area, as has been highlighted through this article, will hopefully inspire scholars to further study lean thinking in transportation operations and explore its compatibility with other traditional methods such as mathematical modeling, operations research, simulation, and Industry 4.0. By doing so, a better understanding of this area will also be achieved, from which more effective strategies for improving transportation operations can be formulated.

It is concluded that the process mapping technique was useful in identifying the waste and it is suggested that the process should continue to be monitored and that a lean "future state" resource matrix should be developed and implemented to improve the activities of the studied process and that in the authors' view the study performed highlights that this area is an important area for future research, and also suggests that a much more differentiated approach to understanding the role of digital technologies in operations and supply chain management is needed along with Lean philosophy.

References

Alieva, J. & Haartman, R.V., Digital Muda - The New Form of Waste by Industry 4.0., *Operations and Supply Chain Management*, v. 13, n.3, pp. 269 – 278, 2020.

Al-Aomar, R., Hussain, M., Exploration and prioritization of lean techniques in a hotel supply chain, *International Journal of Lean Six Sigma*, 2018.

Arksey, H. & O'malley, L., Scoping studies: towards a methodological framework, *International Journal of Social Research Methodology*, v. 8, n. 1, pp. 19–32, 2005.

Ballou, R. Business Logistics and Supply Chain Management (5th Editio), 2004.

CSCMP - Council of Supply Chain Management Professionals, Supply Chain Management Definitions and Glossary. Disponível em: < https://cscmp.org/CSCMP/Academia/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921>. Acesso em 23 set. 2021 às 03:22h, 2013.

Cifone F. D.; Hoberg, K.; Holweg, M.; Staudacher, A. P., Lean 4.0': How can digital technologies support lean practices? *International Journal of Production Economics*, v. 241, 2021.

Damrath, F., Increasing the Competitiveness of Service Firms: Developing Conceptual Models for Implementing Lean Management in Service Firms, No. l, Tese, Politecnico di Milano, 2012.

Evangelista, C. S.; Grossi, F. M.; Bagno, R. B. Lean Office - lean office: study of the applicability of the concept in a transportation company. *Electronic Journal Production and Engineering*, v. 5, n. 1, pp. 462-471, 2013.

Fernandes, S. T.; Marins, F. A. S., Applying Lean Six Sigma in Transportation Logistics, *Produção Online Journal*, v. 12, n. 2, pp. 297-327, 2012.

Garza-Reyes, J.A.; Villarreal, B.; Kumar, V.; Ruiz, P.M., Lean and green in the transport and logistics sector – a case study of simultaneous deployment, *Production Planning & Control*, v. 27 n. 15, pp. 1221-1232, 2016.

Gibbons, P. M.; Kennedy, C; Burgess, S. C.; Godfrey, P, the development of a lean resource mapping framework: introducing an 8th waste, *International Journal of Lean Six Sigma*, v. 3 n.1, pp.4-27, 2012. https://doi.org/10.1108/IJLSS-03-2016-0013.

Junior, L.G.V.; Venuto, T.C.G.; Santos, R.O.B, The Integration of Lean Tools and Industry 4.0: An Investigation and Analysis. *Brazilian Journals of Business*, v.3, n. 5, pp. 4151-4156, 2021.

Lima, P. A. M., and Loos, M. J., Application of continuous flow as a contribution to the increase of productivity and decrease of lead time in a Metallurgical Industry, *Industrial Management Journal*, v.13, n. 1, pp. 99-119, 2017.

Malladi, S., Dominic, P.; Kamil, A., "Lean Principles in IT services: a case study on deployment and best practices", *International Journal of Business Information Systems*, v. 8 n. 3, pp. 247-268, 2011.

Mónico, L.S.; Alferes, V.R.; Castro, P.A.; Parreira, P.M., Participant Observation as a qualitative research methodology, *CIAIQ: Ibero-American Congress on Qualitative Research*, v. 3, 2017.

Morgan, D. L. Focus group as qualitative research. London: Sage, 1997.

Mostafaa, X. and Dumrak, J., Waste elimination for manufacturing sustainability, *Procedia Manufacturing*, v. 2, pp. 11-16, 2015.

Munn, Z.; Peters,M.D.J.; Stern, C.; Tufanaru, C.; McArthur, A.; Aromataris, E., Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach., *BMC Medical Research Methodology*, v.18, n.143, 2018.

Mussolini, T. P.; Gaudencio, J. H. D., Application of the idef-sim mapping technique for identification and analysis of waste in a company in the construction sector, *GEPROS. Production, Operations and Systems Management*, v. 14, n.3, pp. 14 – 28, 2019.

Nascimento, D., Caiado, R., Tortorella, G., Ivson, P., & Meiriño, M. (2018). Digital Obeya Room: Exploring the synergies between BIM and lean for visual construction management. Innovative infrastructure solutions, 3(1), 1-10. https://doi.org/10.1007/s41062-017-0125-02020

Pizzol, S. J. S. Combining focus groups and discriminant analysis: a method for typifying agricultural production systems, *Journal of Rural Economy and Sociology*, Brasília, v. 42, n. 3, pp. 451-468, 2004.

Resende, P., Conflitos entre o agora e o amanhã: um risco de ruptura na infraestrutura de transportes. Disponível em: <https://www.fdc.org.br/conhecimento/blog/postagem?ItemID=87&Cat=Log%C3%ADsticaCompetitividadeEconomiaGest%C3%A3o%20p%C3%BAblica>. Acesso em 07 out. 2021 às 18:52h, 2018.

Ribeiro, P.C.C; Ferreira, K.A., Logistics and Transportation: A discussion on transportation modals and the Brazilian panorama. *XXII National Meeting of Production Engineering – ENEGEP*, 2012.

Robinson, S., Radno, Z.J., Burgess, N. e Worthinfton, C., "SimLean: using simulation in the implementation of lean in healthcare", *European Journal of Operational Research*, vol. 219, n. 1, pp. 188-197, 2012.

Santos, P.V.S; Ferraz, A.V.; Silva, A. C. G. C., Using the Value Stream Mapping (VSM) tool to identify waste in the production process of a gypsum manufacturer, *Produção Online Journal*, v. 19, n. 4, pp. 1197-1230, 2019.

Sartori, A.; Oliveira, R.; Siqueira, R.N.; Boteho, M. P.; Vieira, A.N., Mapping and modeling processes of a distribution center using Lean philosophy. *Brazilian Journal of Development*, v.7, n.1, pp. 348-362, 2021.

Scavarda, A., Daú, G., Scavarda, L. F., Azevedo, B. D., & Korzenowski, A. L. (2020). Social and ecological approaches in urban interfaces: A sharing economy management framework. Science of The Total Environment, 713, 134407. https://doi.org/10.1016/j.scitotenv.2019.134407

Scavarda, L. F., Schaffer, J., Scavarda, A. J., da Cunha Reis, A., & Schleich, H. (2009). Product variety: an auto industry analysis and a benchmarking study. Benchmarking: An International Journal, 16 (3), 387-400. https://doi.org/10.1108/14635770910961399

Sehnem, E.H.; Kipper, L. M.; Silva, J. I.; Freitas, F.; Choaire, G. T., Using lean manufacturing principles and value stream mapping tool to identify waste in finished product inventory. *ExactaEP Journal*, v. 18 n.1, pp. 165-184, 2020.

Stenberg, H.; Stefansson, G.; Westernberg, E.; Gennäs, R.B.; Allenström, E.; Nauska, M.L., Applying a lean approach to identify waste in motor carrier operations *International Journal of Productivity and Performance Management*, vol. 62, pp. 47 – 65, 2012.

Thomé, A.M.T.; Oliveira, F.L.C.; Silva, D.L. (2016). Framework de Value Stream Mapping a partir de uma Revisão Sistemática da Literatura, *Produto & Produção*, vol. 17 n. 4, pp. 19-40, 2016.

Trad, L. A. B., Focus groups: concepts, procedures, and reflections based on experiences using the technique in health research. *Physis: Journal of Collective Health*, v. 19, n.3, pp.777-796, 2009.

Villarreal, B., The transportation value stream map (TVSM). *European J. Industrial Engineering*, vol. 6, n. 2, pp. 216-233, 2012.

Villarreal, B.; Reyes, J.A.G.; Kumar, V. (2016). Lean Road transportation – a systematic method for the improvement of road transport operations. *Production Planning & Control*, v.27 n.11, pp. 865-877, 2016.

Villarreal, B.; Reyes, J.A.G.; Kumar, V.; Lim, M.K., Improving Road transport operations through lean thinking: a case study, *International Journal of Logistics Research and Applications*, v. 20 n. 2, pp. 163-180, 2017.

Xia, W.; Sun, J., Simulation guided value stream mapping and lean improvement: A case study of a tubular machining facility. *Journal of Industrial Engineering and Management*, v. 6, n. 2, pp. 456-476, 2013.

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