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Enhancing Operational Efficiency in Hydrocarbon Supply Chains through Engineering Methods: A Case Study in Fuel Dispatch Optimization

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Abstract

In the context of the hydrocarbon sector, which is crucial for the global and regional economies of Latin America, significant issues were identified in the operational efficiency of fuel supply terminals. These challenges included deficiencies in machine maintenance, lack of process standardization, and congestion in dispatch areas, negatively impacting productivity and increasing operational costs. This situation highlighted the need to apply method engineering techniques to optimize processes and improve operational efficiency. The contribution of this research consisted of developing and implementing a process improvement model based on method engineering to increase productivity in the dispatch area of a fuel supply terminal. The proposed model included stages of process selection, detailed diagramming, analysis and development of a new method, implementation, and control. These stages allowed for the identification and elimination of redundant activities, optimization of loading times, and improved resource utilization. The most outstanding results of implementing the new method included: a reduction in total process time from 77 to 62 minutes, representing a 19.48% improvement; an increase in the man-machine utilization percentage from 85% to 91%; a significant decrease in the waiting times for tanker trucks; and an improvement in operational efficiency, reaching a maximum efficiency of 98% on high productivity days. These indicators demonstrated that the application of method engineering effectively resolved the identified problems, increasing the productivity and efficiency of the fuel dispatch area.

Keywords
Engineering methods, productivity, dispatch, cisterns, supply.

1. Introduction
The hydrocarbon industry is a key sector for the global economy, especially in regions with high levels of energy consumption. Globally, this industry is characterized by its crucial role in power generation, transport and manufacturing, being a primary source of fuel for various productive sectors (Tamayo et al., 2015). In Latin America, the hydrocarbon sector has had a significant influence on economic and social development, providing employment and generating significant income for producing countries (Palma, 2022). Peru is no exception, as its economy is heavily dependent on the production and marketing of hydrocarbons. The country has seen a growth in demand for

fuels, reflected in an increase of 21.4% in sales in 2021, which underscores the importance of the sector in the post-pandemic economic reactivation (Osinergmin, 2021).

Despite its importance, the hydrocarbon supply sector faces several problems that negatively impact its operational efficiency. Deficiencies in the maintenance of machines are a recurring problem, causing interruptions in the production and dispatch of fuels (Fernández and Ramírez, 2017). In addition, the lack of standardization in operational processes leads to inconsistencies and errors that increase waiting times and operating costs (Cruz and Velásquez, 2020). Delays in the attention to tankers due to equipment failures and congestion in dispatch areas are other major causes of inefficiency in this sector (Doig and Ríos, 2021). These problems not only affect productivity, but can also have environmental and safety implications, increasing the risk of spills and accidents (Fonseca, 2021).

Solving these problems is crucial to improving the efficiency and sustainability of the hydrocarbon supply sector. The application of method engineering techniques can offer effective solutions by optimizing processes and reducing downtime (Tamayo et al., 2015). Improving machine maintenance and standardizing operating procedures can significantly reduce delays and increase productivity, benefiting both companies and end consumers (Loayza, 2016). In addition, greater efficiency in the hydrocarbon sector can contribute to reducing operating costs and minimizing environmental impacts, promoting a safer and sustainable operation (El Peruano, 2022). It is essential that companies in the sector adopt these improvements to remain competitive and adequately respond to the growing demand for fuels in the market.

In short, the hydrocarbon sector plays a crucial role in the global, Latin American and Peruvian economy. However, it faces significant challenges related to machine maintenance, process standardization and operational delays. Addressing these problems through the implementation of method engineering techniques is essential to improve the efficiency and sustainability of the sector. Companies that adopt these improvements will not only be able to increase their productivity and reduce costs, but will also contribute to safety and environmental sustainability. It is therefore imperative that organizations in the hydrocarbon sector consider these solutions to ensure their future success and competitiveness.

2. Literature Review

2.1 Application of Method Engineering in Fuel Dispatch Processes

Method engineering has been widely used in optimizing fuel dispatch processes, with the aim of improving efficiency and reducing operating costs. For example, a study by Silva et al. (2019) implemented method engineering techniques to restructure operations at a fuel dispatch plant, resulting in a 15% reduction in loading time. Likewise, Martínez and López (2020) applied analysis of methods in a service station, achieving a 20% improvement in productivity by eliminating unnecessary steps and reconfiguring the layout. In another study, García et al. (2021) used engineering methods to redesign the fuel distribution process, implementing changes that increased dispatch capacity by 25%, demonstrating the effectiveness of these techniques in similar contexts. These studies highlight the relevance of method engineering in process optimization, not only in the fuel sector, but also in other industrial areas where operational efficiency is crucial (Silva et al., 2019; Martínez & López, 2020; García et al., 2021).

2.2 Implementation of the Study of Work in Fuel Dispatch Processes

The study of work is another crucial tool in the improvement of fuel dispatch processes, focusing on the optimization of tasks and the efficient use of human resources. For example, Rodríguez and Pérez (2018) conducted a study of the work in a refinery, identifying and eliminating bottlenecks in the dispatch process, which resulted in a 10% reduction in total operating time. Similarly, Hernández and Colón (2019) used work study techniques to analyze and improve the activities of operators in a fuel distribution plant, achieving a significant reduction in waiting times and better utilization of the workforce. In addition, a study by Navarro et al. (2020) implemented the study of work to reconfigure dispatch tasks at a service station, obtaining a 15% improvement in operational efficiency. These examples underline the importance of the study of the work in identifying inefficiencies and implementing improvements that increase productivity in fuel dispatch processes (Rodríguez & Pérez, 2018; Hernández & Colón, 2019; Navarro et al., 2020).

2.3 Application of the Route Diagram in Fuel Dispatch Processes

The flowchart is a visual tool used to map and analyze workflows and movements in fuel dispatch processes. A study by Jiménez and Torres (2017) applied the routing diagram to optimize the layout of a service station, resulting in a 12% reduction in operator travel time. Similarly, Morales and Sánchez (2018) used this technique to analyze and restructure the flow of materials in a fuel distribution plant, which led to an 18% improvement in the efficiency of the process. In addition, a study by Ortiz et al. (2019) applied the route diagram in a refinery, identifying opportunities to reduce internal transport times and improving coordination between different operational areas. These studies demonstrate how the use of the route diagram can facilitate the identification of inefficiencies and the implementation of changes that optimize fuel dispatch processes, contributing to continuous improvement and operational efficiency (Jiménez & Torres, 2017; Morales & Sánchez, 2018; Ortiz et al., 2019).

2.4 Use of Multiple Activity Diagrams in Fuel Dispatch Processes

The multi-activity diagram is an effective tool for analysing and coordinating simultaneous activities in fuel dispatch processes. For example, a study by Ramírez and Gómez (2018) used this diagram to coordinate loading and unloading activities in a dispatch plant, resulting in improved synchronization and a 10% reduction in waiting times. Also, Vargas and Rojas (2019) applied the diagram of multiple activities in a service station to optimize the assignment of tasks among operators, achieving a 12% improvement in operational efficiency. Another study by Castro et al. (2020) used this tool to analyze concurrent activities in a refinery, identifying opportunities to reduce overall process time through better coordination of tasks. These examples demonstrate the usefulness of the multi-activity diagram to improve efficiency and synchronization of operations in fuel dispatch processes, contributing to more effective management of resources and operational times (Ramírez & Gómez, 2018; Vargas & Rojas, 2019; Castro et al., 2020).

2.5 Application of the Systematic Interrogation Technique in Fuel Dispatch Processes

The technique of systematic questioning has been applied in the field of fuel dispatch processes to identify and solve operational problems efficiently. A study by Ramírez and Gómez (2018) used this technique to analyze loading and unloading procedures in a fuel distribution plant. Through a series of structured questions, they were able to identify key inefficiencies, such as excessive waiting times and workflow redundancies, implementing improvements that reduced cycle time by 15%. Similarly, Vargas and Rojas (2019) applied systematic interrogation at a gas station, focusing on optimizing the fuel supply process. Their analysis revealed opportunities to simplify operator tasks and improve internal logistics, resulting in a 20% decrease in customer service time. Another study by Castro et al. (2020) implemented this technique in a refinery, evaluating each stage of the dispatch process through detailed questions that helped identify and eliminate activities that did not add value, achieving an 18% improvement in operational efficiency. These examples highlight the effectiveness of the systematic interrogation technique to improve productivity and efficiency in fuel dispatch processes, demonstrating its applicability in various industrial scenarios (Ramírez & Gómez, 2018; Vargas & Rojas, 2019; Castro et al., 2020).

3. Methods

3.1 Proposed basis and model

The process improvement model based on Method Engineering focused on increasing the productivity of the fuel dispatch area of a fueling terminal. This model addressed the selection of the current process, followed by detailed diagramming using tools such as the operations diagram, the route diagram and the multiple activity diagrams. Subsequently, the current method was examined, and a new method was developed to be implemented. Finally, the process implemented was monitored to ensure its effectiveness. The philosophy of the model was a continuous and systematic improvement of productivity through detailed analysis and redesign of methods. These steps are visually represented in **Figure 1**.

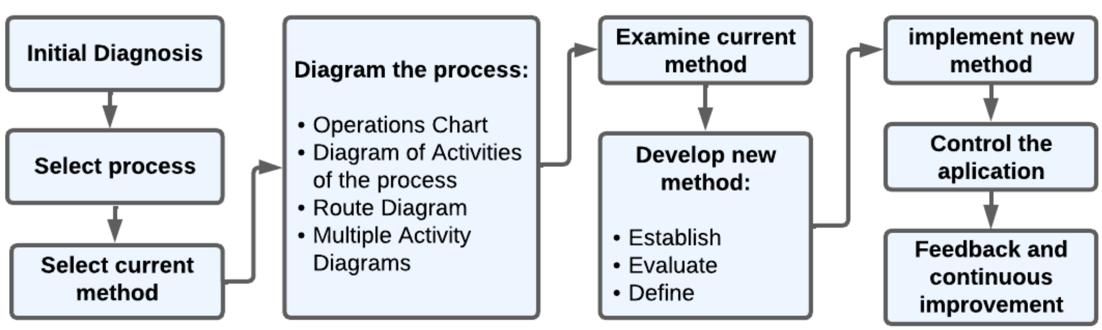


Figure 1. Proposed Model

3.2 Description of the model components

The process improvement model illustrated in the Figure 2 is a systematic approach to analysing and improving the methods used in an organization. This model consists of several key stages: process selection, selection of the current method, process diagramming, examination of the current method, development of a new method, implementation of the new method and control. Each of these stages is described in detail below.

Process Selection

The first stage in the process improvement model is the selection of the process to be improved. At this stage, critical processes that significantly impact the efficiency and effectiveness of the organization were identified. The selection of the right process is crucial, as it focused on those processes that presented the greatest opportunities for improvement and that, when optimized, could bring substantial value to the organization (Hammer & Champy, 1993; Harrington, 1991).

Selection of the Current Method

Once the process was selected, the current method used to execute the process was identified and documented. This phase involved a detailed analysis of current practices and procedures, collecting data on how tasks and activities were carried out. Understanding the current method provided a baseline against which improvements could be measured (Davenport, 1993; Rummler & Brache, 1990).

Process Layout

At this stage, the process was plotted using specific tools such as the operations diagram, the route diagram and the multiple activity diagrams. These tools allowed us to visualize the workflow and interactions between different activities and actors involved in the process. The process layout facilitated the identification of bottlenecks, redundancies and opportunities to simplify workflow (Gilbreth, 1911; Shingo, 1989).

Review of the Current Method

The next step was to examine the current method. This review included a critical assessment of each step of the process to identify inefficiencies, waste and activities that did not add value. Various analytical techniques, such as value-added analysis and root cause analysis, were used to understand the underlying causes of the problems identified (Imai, 1986; Juran, 1988).

Development of a New Method

Based on the findings of the review of the current method, a new method was developed that promised to be more efficient and effective. This development included generating ideas, prototyping and testing new solutions. Creative and collaborative approaches were used to design a method to eliminate inefficiencies and improve process performance (Deming, 1986; Ishikawa, 1985).

Implementation of the New Method

After developing the new method, it was implemented. This phase involved the planning and implementation of a change plan, including staff training, communication of changes and the implementation of new tools and technologies, if necessary. Implementation was carried out in a controlled and gradual manner to minimize interruptions and ensure a smooth transition (Kotter, 1996; Lewin, 1951).

Control

Finally, the control stage focused on monitoring and evaluating the performance of the new implemented method. Metrics were established and data were collected to measure the effectiveness of change. This continuous monitoring allowed for further adjustments and improvements as needed, ensuring that the benefits of the new method were sustained over time (Shewhart, 1931; Crosby, 1979).

4. Validation

4.1 Initial Diagnosis

The initial diagnosis included a thorough analysis of the fuel release process at the fueling terminal. It was observed that the average care capacity was 11 tanks per hour, with an efficiency of 68%. However, on certain days the productivity fell to 7 tanks per hour, with an efficiency of 43%, evidencing variability and problems in the operation.

Bottlenecks were identified, especially in the fuel load, which marked the pace of the process and caused accumulations in the parking area. The average charging time was increased from 53 to 77 minutes, which reduced the terminal's response capacity. In addition, the use of inspection and order generation activities was found to be low, with rates of 6 per cent and 29 per cent, respectively. These findings indicated the need to improve the standardization and monitoring of processes to increase the productivity and efficiency of the terminal (Table 1 and 2).

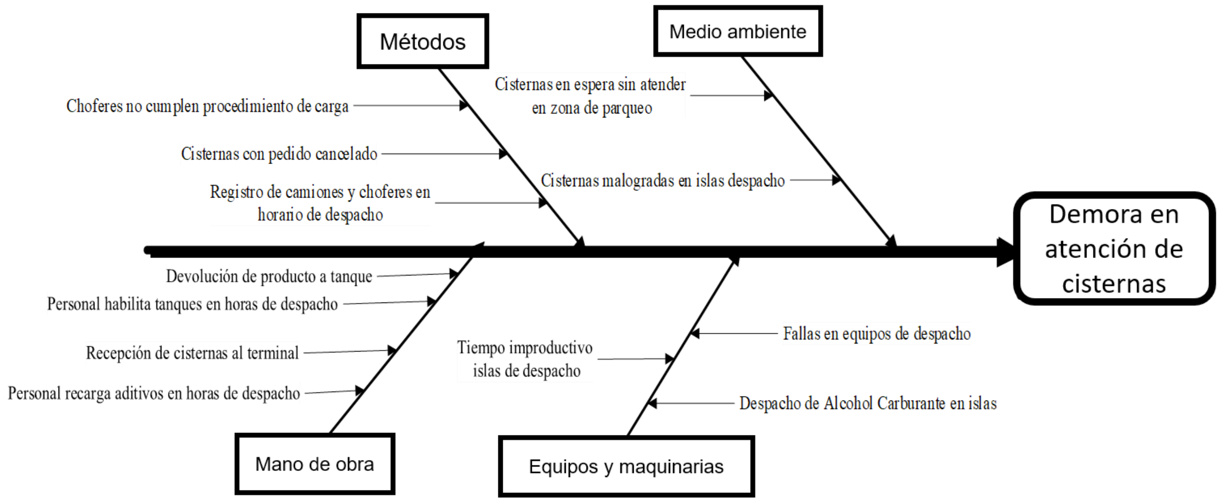


Figure 2. Ishikawa Diagram

Table 1. Activities of the dispatch process

Activities of the dispatch process	**Time (min)**	Available (min x day)	Capacity (Tanks x day)	**Utilization (%)**
Tank inspection	3	1,320	440	6%
Order generation	15	1,320	88	29%
Fuel loading on dispatch island	51	1,320	26	100%
Inspection-Sealing and exit	8	1,320	165	16%

Table 2. Comparative results 2022 vs 2023

Activities of the dispatch process	**Average time 2022 (minutes)**	**Average time 2023 (minutes)**	**Difference (minutes)**	**Increase (%)**
Tank inspection	2	3	1	50%
Order generation	15	15	0	0%
Fuel loading on dispatch island	29	51	22	76%
Inspection-Sealing and exit	7	8	1	14%
Total	**53**	**77**	**24**	**45%**

4.2 Process Selection

At this stage, dispatch processes were selected to optimize by reducing service times and delays at the terminal. Bottlenecks were identified, such as waiting tanks, which experienced waiting times ranging from 7 to 36 minutes, with some extreme cases reaching up to 181 minutes. This analysis reduced maximum waiting times and improved the efficiency of the dispatch process (Figure 3, 4).

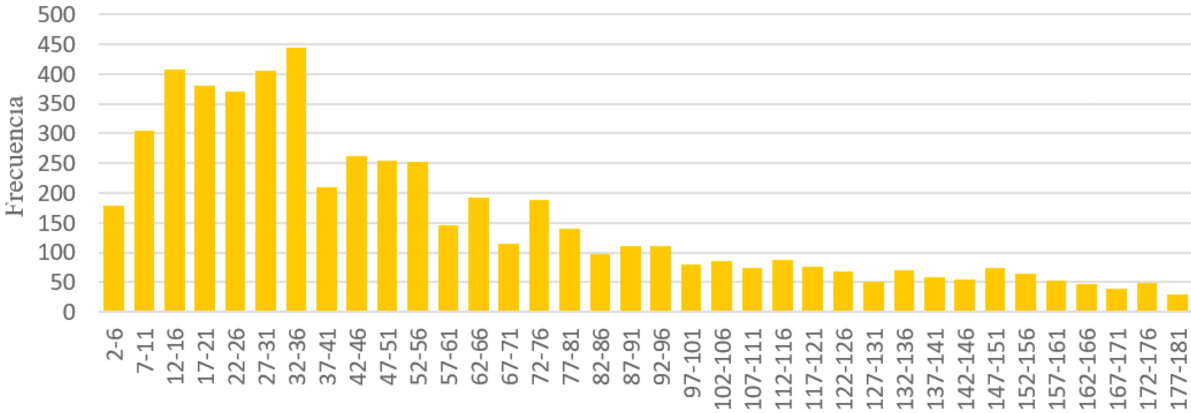
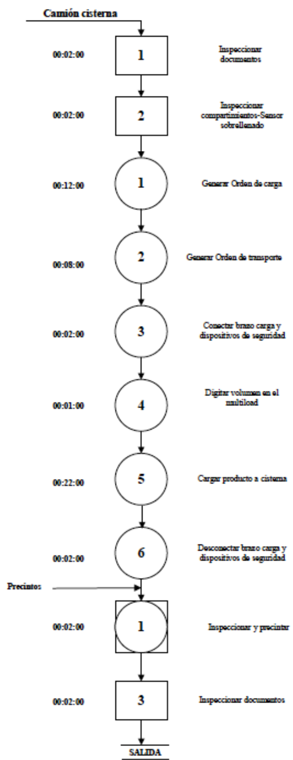


Figure 3. Tank waiting time on request (time in minutes)

Figure 4. Congestion in terminal parking area

4.3 Selection of the Current Method

At the registration stage, details of the implementation of the process were identified mainly through the observation method. This information made it possible to determine whether tasks could be divided into smaller activities, as well as to define the place of performance, the resources and the people required. The dispatch process was analyzed, recording current information through flow diagrams, route diagrams, process analysis and man-machine diagrams, with the aim of improving service times and increasing the productivity of the company. The areas of Operations, Maintenance, Safety, Quality and Billing participated in the dispatch operations. For the execution of the activities in two operating shifts from Monday to Saturday, a total of six people were counted, accumulating 144 man-hours per week. Activities included tank inspection, order generation, fuel loading and sealing, with a dedicated staff of one or two operators per activity (Figure 5, 6, 7).



RESUMEN	CANT.	TIEMPO min
Operaciones	6	47
Inspecciones	3	6
Combinadas	1	2
Total	10	55

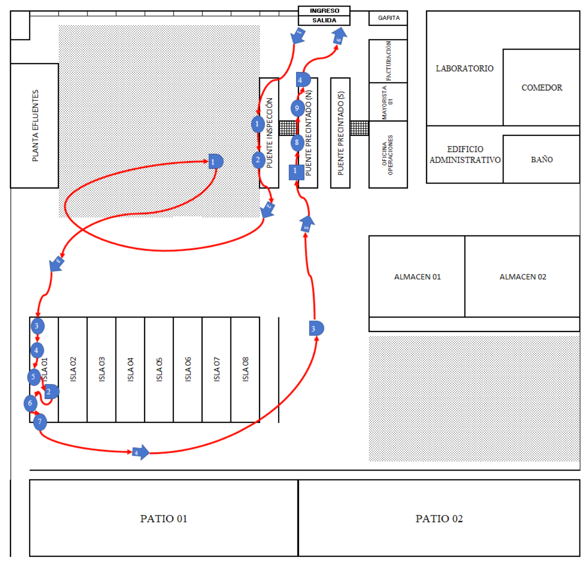


Figure 6. Actual Route Diagram

Figure 5. Fuel dispatch process operation diagram.

DIAGRAMA DE ACTIVIDADES MULTIPLES ACTUAL

Diagrama N°: Proceso: Carga en isla de despacho Fecha: 22/08/2022

Elaborado por: Miguel Guanilo Operador: xxxxxx

Tiempo minutos	Operador Uso	Operador Actividad	Isla 01 Uso	Isla 01 Actividad	Chofer Uso	Chofer Actividad
1					X	Traslado a isla de despacho
2					X	Conecta cables y mangas de carga
3					X	Conecta mangas de vapores
4					X	Ingresa datos al Multiload
5					X	
6	X	Verifica carga	X			
7			X			
8			X			
9			X			
10			X			
11			X			
12			X	Carga compartimientos		
13			X			
14			X			
15			X			
16			X			
17			X			
18			X			
19					X	Conecta cables y mangas de carga
20					X	Ingresa datos en Multiload
21	X	Verifica carga	X			
22			X			
23			X			
24			X			
25			X			
26			X			
27			X			
28			X			
29			X			
30			X			
31			X			
32			X			
33					X	Conecta cables y mangas de carga
34					X	Ingresa datos en Multiload
35	X	Verifica carga	X			
36			X			
37			X			
38			X			
39			X			
40			X			
41			X			
42			X			
43			X			
44			X			
45			X			
46			X			
47			X			
48					X	Desconecta cables y manga Desconecta manga de vapores
49					X	Traslada a zona de precintos

Tipo	Tiempo de ciclo	Tiempo de accion	Tiempo Inactividad	% Utilización
Operario	49	3	46	6%
Chofer	49	11	38	22%
Isla 01	49	38	11	78%

Figure 7. Current Diagram of Multiple Activities

4.4 Development of a New Method

In the process of examining and establishing, each activity recorded in the diagrams was critically analyzed using the interrogation technique, using questions about purpose, place, succession, person and means. With the participation of various people involved in the dispatch process, several alternatives were generated to look for the best method. During the inspection of the overfill sensors, it was determined that such activity could be carried out in the island area instead of the inspection bridge, which would optimize the process. The systematic interrogation technique made it possible to identify redundant activities and areas for improvement, such as the inspection and sealing of compartments, proposing to transfer these operations to the dispatch area. Quantitative aspects were evaluated, such as the average time of the dispatch process, which showed an increase of 45% in 2022 compared to 2019, highlighting the need to optimize times and eliminate unnecessary activities to improve the productivity and efficiency of the process.

Table 3. Systematic interrogation technique of the data entry process.

Activity	Questions		Answers
Enter data in Multiload	Purposeful	What do you do?	Data of the volume to be loaded on the truck is entered
		Why is it done?	So that the load can be made
		What should be done?	Only data should be entered
	of place	Where is it done?	On the island of dispatch
		Why is it done there?	Because the controller (multiload) is installed in the zone
		Where else could it be done?	Can only be performed on island
	Of succession	When is it done?	Where previous work has been carried out on connecting cables and sleeves
		Why is it done then?	Because the driver has to finish the connections
		When could it be done?	When the truck parks on the island
	of people	Who does it, huh?	Island operator and driver when enabled
		Why does that person do it?	Because they are qualified and authorized
		Who else could do it?	The operator, when the driver is connecting cables and sleeves
	Procedural	How is it done?	Enter the loading order data
		Why is it done that way?	This information is needed to load
		How else could it be done?	Can only be done on island

According to the analysis in Table 3, it revealed that data entry could not be performed elsewhere due to infrastructure restrictions and the need for precision and control in the process. In addition, it was identified that this activity is performed after connecting the charging cables and sleeves, which ensures that all previous preparations are complete before entering the data. This approach ensures efficiency and accuracy in the loading process, minimizing errors and optimizing the workflow on the dispatch island.

Table 4. Systematic interrogation technique of Inspect quantity and quality of compartments.

Activity	Questions		Answers
Inspect quantity and quality of compartments	Purposeful	What do you do?	Product and appearance levels are inspected
		Why is it done?	To ensure the quantity and quality of the product
		What should be done?	Monitor island product quality and quantity with flow meter testing
	of place	Where is it done?	At the sealing bridge
		Why is it done there?	The infrastructure for the operation exists
		Where else could it be done?	On islands of random dispatch
	Of succession	When is it done?	When the load ends and is parked on the sealing bridge
		Why is it done then?	It is established in the procedure
		When could it be done?	At loading time (randomly)
	of people	Who does it, huh?	The sealing operator
		Why does that person do it?	It's part of their function
		Who else could do it?	Personnel in the quality area
	Procedural	How is it done?	Use a jug and check each compartment on top of the truck
		Why is it done that way?	To visualize the appearance
		How else could it be done?	Removing samples in lines (dispatch island)

According to the analysis in Table 4, it was suggested that this inspection could be moved to the islands of dispatch and carried out randomly, which would represent an opportunity for improvement. This relocation could optimize the process by reducing waiting and transportation times. It was noted that carrying out the inspection at the end of loading and at the sealing bridge, although established in the current procedure, might be unnecessary if quality and quantity tests were implemented during loading on dispatch islands. This change would not only improve the efficiency of the process but also ensure better utilization of available staff and resources, contributing to increased overall productivity at the supply terminal.

4.5 Implementation of the New Method

At the evaluation stage, existing processes were reviewed using methods engineering tools such as the Process Operations Diagram (PDO) and other specific diagrams. This analysis made it possible to identify inconsistencies and areas of improvement in the tanker truck dispatch process. For example, inspection of overfill sensors was found to be redundant, as during loading on the island, a team was already evaluating the condition of the sensors, making this repetitive inspection unnecessary. In addition, it was suggested to optimize load preparation times by involving the island operator in activities previously performed only by the driver, such as connecting the steam sleeve and recording data in the Multiload system.

The definition phase made it possible to implement the necessary changes to optimize the process. By applying the identified modifications, the total process time was significantly reduced from 77 minutes to 62 minutes. This reduction was achieved by eliminating redundant activities and relocating certain operations to optimize resources and lead times. For example, the sealing operation of the lower compartment was moved to the dispatch area, allowing it to be performed immediately after loading each compartment, which optimized resources and improved the efficiency of the process.

As for the quantitative results, the evaluation revealed that the optimization of the tanker truck dispatch process resulted in a significant reduction in times and an improvement in operational efficiency. Total process time was reduced by 15 minutes, representing an improvement of 19.48%. In addition, the elimination of unnecessary inspections and the redistribution of tasks contributed to minimizing bottlenecks and improving the use of human and material resources.

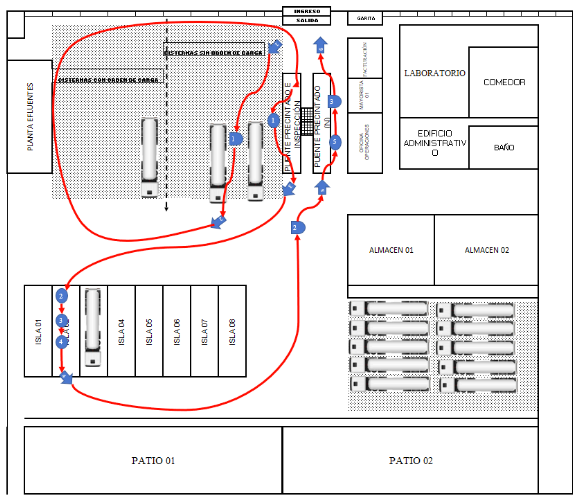


Figure 8. Proposed route diagram

Figure 8 illustrates the proposed route to optimize the process, highlighting suggested modifications and showing how the process flow was restructured to eliminate inefficiencies

4.6. Control

The implementation of the new processes in the organization was carried out after a detailed analysis of staff positions and roles. Six key activities were identified, such as tank inspection and fuel loading, involving a total of six people. The presentation of the project to the affected areas highlighted the standardization of processes and the elimination of redundancies as main benefits. To ensure effective adoption, a week of theoretical and practical training was conducted.

The control of the new processes was based on observations and measurements of productivity and efficiency. Daily data such as the number of tanks loaded and the capacity to care were recorded, with results ranging from 47% to 98% efficiency. For example, in one of the days, the productivity was 285 tanks loaded in 22 hours available, reaching an efficiency of 78%. This continuous control allowed to adjust and optimize the processes according to the observed results.

This Table 4 shows the productivity and daily efficiency control data of the tanks loaded. It includes detailed information on the number of tanks loaded, the hours available, productivity in terms of tanks per hour, attention capacity and efficiency, with values ranging between 47% and 98%. This table is crucial to demonstrate the quantitative results of the control of the new process implemented.

Table 5. Control of dispatch indicators

Date	Number of tanks loaded	Day Hours/available	Productivity (Tanks/hours)	Capacity	Efficiency
1.0	285	22	12.9	364	78%
2.0	241	22	10.9	364	66%
3.0	230	22	10.5	364	63%
4.0	189	22	8.6	364	52%
5.0	351	22	16.0	364	97%
6.0	358	22	16.3	364	98%
7.0	335	22	15.2	364	92%
8.0	260	22	11.8	364	71%
9.0	228	22	10.4	364	63%
10.0	170	22	7.7	364	47%
11.0	264	22	12.0	364	72%
12.0	244	22	11.1	364	67%
13.0	328	22	14.9	364	90%
14.0	243	22	11.0	364	67%
15.0	239	22	10.9	364	66%
16.0	327	22	14.8	364	90%
17.0	222	22	10.1	364	61%
18.0	162	22	7.4	364	45%
19.0	240	22	10.9	364	66%
20.0	293	22	13.3	364	80%
21.0	308	22	14.0	364	85%
22.0	211	22	9.6	364	58%
23.0	350	22	15.9	364	96%
24.0	238	22	10.8	364	65%
25.0	331	22	15.0	364	91%
26.0	203	22	9.2	364	56%
27.0	268	22	12.2	364	74%
28.0	211	22	9.6	364	58%
29.0	349	22	15.9	364	96%
Total	**7,676**	**638**	**12.0**	**10556**	**73%**

Table 6. Results

Techniques	Indicator	Average time (minutes)	Pre-control	Average time (minutes)	Post-control	Variation (%)
Method study	Percentage of tanks served within the average	45.0	53%	41.9	57%	4%
Work measurement	Percentage of use Man-Machine		85%		91%	6%

Table 6 shows the results obtained in this improvement project. Regarding the study of methods, the initial average time was 45 minutes in the pre control and 41.9 minutes in the post control, resulting in an increase in the percentage of attention within the average time from 53% to 57%. In addition, work measurement indicated that the Man-Machine utilization percentage increased from 85% to 91%, reflecting a 6% improvement in operational efficiency.

6. Conclusions

The main findings of the study indicate that the application of engineering methods in the fuel dispatch area of a supply terminal significantly increased productivity. The implementation of operations diagrams, route diagrams, and multiple activity diagrams allowed for the identification and elimination of bottlenecks, reduction of waiting times, and improvement of the efficiency of the tanker loading process. Specifically, a 45% reduction in total dispatch times and a 19.48% improvement in operational efficiency were observed. Additionally, the redistribution of tasks and the elimination of redundant activities contributed to better utilization of human and material resources.

The importance of this research lies in its contribution to improving operational efficiency in a critical sector of the economy, such as hydrocarbons. In a context of growing fuel demand and the need to optimize resources, the findings of this study offer practical and effective solutions to increase productivity and reduce operational costs. Furthermore, by improving efficiency in fuel dispatch, the study promotes a more sustainable and safer operation, which is crucial for the long-term competitiveness and sustainability of the sector.

The contributions to the field of study are significant, as this work demonstrates the applicability and effectiveness of methods engineering techniques in a complex industrial environment. Implementing these methods not only improves specific processes of fuel dispatch but also establishes a reference framework that can be adapted and applied in other industrial sectors facing similar challenges. This methodological approach, supported by quantitative and qualitative data, reinforces the importance of efficient management of operational processes and the continuous pursuit of improvements.

Finally, some final observations and suggestions for future studies are offered. The research highlights the need for constant monitoring and periodic re-evaluation of the implemented methods to ensure their continuous effectiveness. It is recommended to apply emerging technologies, such as artificial intelligence and real-time data analysis, to identify new improvement opportunities and further optimize processes. Additionally, future studies could explore the integration of environmental sustainability practices in the fuel dispatch process and evaluate the long-term impacts of the implemented improvements in terms of safety and operational efficiency.

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Biographies

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