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OPTIMISING TRUCK TURNAROUND TIME (TAT) USING SIX SIGMA METHODOLOGY (DMAIC) AN ANALYTICAL APPROACH WITH REFERENCE TO DP WORLD MULTIMODEL LOGISTICS PVT LTD

Rahul A[1], Dr. R. Raajalakshmi[2], L. Balaji[3], Mr Rahul A[4], Dr R Raajalakshmi[5]

[1,2,3,4]Student, Department of Management Studies, School of Management Studies, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.

[5]Assistant Professor and Research Supervisor, Department of Management Studies, School of Management Studies, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.

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ABSTRACT

Operational efficiency is an important factor to both the competitiveness of an organization as well as the level of customer satisfaction in today's logistics environment. A major Key Performance Indicator (KPI) used in measuring logistics operations is Truck Turnaround Time (TAT). TAT is defined as the time taken from a truck's arrival at a logistics facility until it leaves the facility after completing all entry, processing and exit requirements. High TAT creates congestion and delays, increases operational costs, wastes resources and ultimately destroys efficiency. The primary focus of this study is to analyze and reduce TAT at DP World Multimodal Logistics Pvt Ltd through the use of the structured problem-solving process known as Six Sigma. This research uses the DMAIC (Define, Measure, Analyze, Improve, Control) approach to identify bottlenecks, measure performance gaps and make recommendations for corrective action. The research utilizes both primary and secondary data to analyze the current logistical processes, identify inefficiencies, and develop recommendations for improvement through process standardization, automation, and improved coordination. The results indicate that application of the Six Sigma methodology will result in significant reductions in TAT and will improve operational flow and overall productivity. The study concludes with practical recommendations for each aspect of the study, which can be implemented to achieve sustained operational excellence.

1. INTRODUCTION

The logistics sector is crucial for global trade, and its continuous growth necessitates that firms streamline operations. A key metric is Truck Turnaround Time (TAT), the total duration from a truck's arrival to its departure, which indicates operational efficiency. High TAT at facilities, such as the DP World Multimodal Logistics Private Limited Container Freight Station (CFS) in Redhills, Chennai, signals issues like paperwork delays and congestion, which are compounded by increasing cargo volume. To address these challenges and improve truck movement and overall operational efficiency at the CFS, this case study will apply the structured process excellence methodology of Six Sigma, which focuses on reducing variability and inefficiencies.

OBJECTIVES OF THE STUDY

Primary Objective:

To improve and/or improve the Six Sigma methodology for truck turnaround time (TAT)

Secondary Objectives:

- To learn more about the current truck transportation process
- To find the bottlenecks causing delays in this transportation process
- To determine what the current performance of TAT is
- To increase operational effectiveness
- To provide better use of all resources

To offer recommendations for process improvements

NEED FOR THE STUDY

Due to growing inefficiencies in logistics operations, there is a requirement for this research. High TAT negatively impacts both operational performance, customer satisfaction and profitability.

Key reasons for high TAT include:

- Increased traffic congestion in logistics facilities
- Increasingly high costs associated with delays in the supply chain
- Inefficient use of trucks and labour resources
- Increased demand for faster logistical services

Reducing TAT will provide organisations better operational efficiency and service quality, while also reducing overall logistics costs for firms.

SCOPE OF THE STUDY

The Study focuses on the operations carried out at DP World Multimodal Logistics Pvt Ltd.

In terms of research scope the following will be included as part of the overall study;

- Truck entry/exit.
- Loading/unloading.
- Documentation procedures.
- Queue/yards management.

Limitations to the above scope will be;

- Only the Redhills Facililty
- Data only available up to October 2023
- Does not include any external logistics aspect

STATEMENT OF THE PROBLEM

Regarding the project statement, DP World Multimodal Logistics Pvt. Ltd. has been able to purchase great infrastructure; however, they are still faced with a number of challenges related to truck turnaround time.

The following challenges were identified:

- Delays at the gate entry and exit
- Poor Documentation Practices
- Congestion within the yard area
- Lack of coordination between departments

These problem areas contribute to higher operational costs and decreased efficiency.

2. REVIEW OF LITERATURE

1. Tamalika et al. (2025)

The study by Unpacking Lean Six Sigma Practice: A Systematic Literature Review (2020–2025) provides a comprehensive analysis of Lean Six Sigma applications across industries between 2020 and 2025. This research highlights that Lean Six Sigma consistently improves quality, productivity, cost efficiency, and lead time reduction.

The authors emphasize that one of the most significant outcomes of Lean Six Sigma implementation is the reduction in process lead time, which directly relates to operational metrics like Truck Turnaround Time (TAT). The study also introduces the concept of Digital Lean Six Sigma (DLSS), which integrates modern technologies such as data analytics and automation into traditional process improvement frameworks. This integration enhances real-time decision-making and process visibility.

Another important contribution of this study is the identification of implementation challenges, including resistance to change, lack of training, and poor data management. Despite these challenges, the research concludes that organizations that successfully adopt Lean Six Sigma achieve sustainable operational excellence and improved customer satisfaction.

https://jurnal.ukdc.ac.id/index.php/isejou/article/view/860

2. Gomaa (2024)

The research by Boosting Supply Chain Effectiveness with Lean Six Sigma focuses on the integration of Lean Six Sigma with supply chain management to enhance operational performance. The study explains that supply chain efficiency depends on the coordination of procurement, production, and delivery processes, and any inefficiency in these stages leads to increased delays and costs.

The study presents a structured Lean Six Sigma framework that improves performance through waste elimination, process standardization, and continuous improvement. One of the key findings is the significant reduction in processing lead time—from 645 hours to 370 hours per ton—after implementing Lean Six Sigma practices.

Additionally, the research highlights that improved coordination among departments leads to better synchronization of activities, reducing bottlenecks and enhancing throughput. It also emphasizes the role of data-driven decision-making in improving transparency and operational control.

The study concludes that Lean Six Sigma not only improves efficiency but also increases customer satisfaction and overall system reliability.

https://www.sciencepg.com/article/10.11648/j.ajmse.20240906.14

3. Rizkiyah et al. (2024)

The study by Waste Analysis of International Delivery Service Process Using Lean Six Sigma focuses on identifying inefficiencies in logistics operations using Lean Six Sigma tools. The research highlights that logistics systems often suffer from delays due to **customs clearance issues, slow processing, and operational bottlenecks**, which increase turnaround time and operational costs.

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Using tools such as Failure Mode and Effects Analysis (FMEA), Pareto charts, and 5 Whys analysis, the study identifies four major types of waste in logistics operations:

- Delay
- Duplication
- Unnecessary movement
- Errors

The research emphasizes that waiting time and unnecessary movement are the most critical factors contributing to inefficiencies. It suggests that eliminating these wastes through process optimization and automation can significantly improve operational performance.

Furthermore, the study highlights the importance of continuous monitoring and process control to sustain improvements over time. The findings demonstrate that Lean Six Sigma is highly effective in improving logistics efficiency and reducing turnaround time.

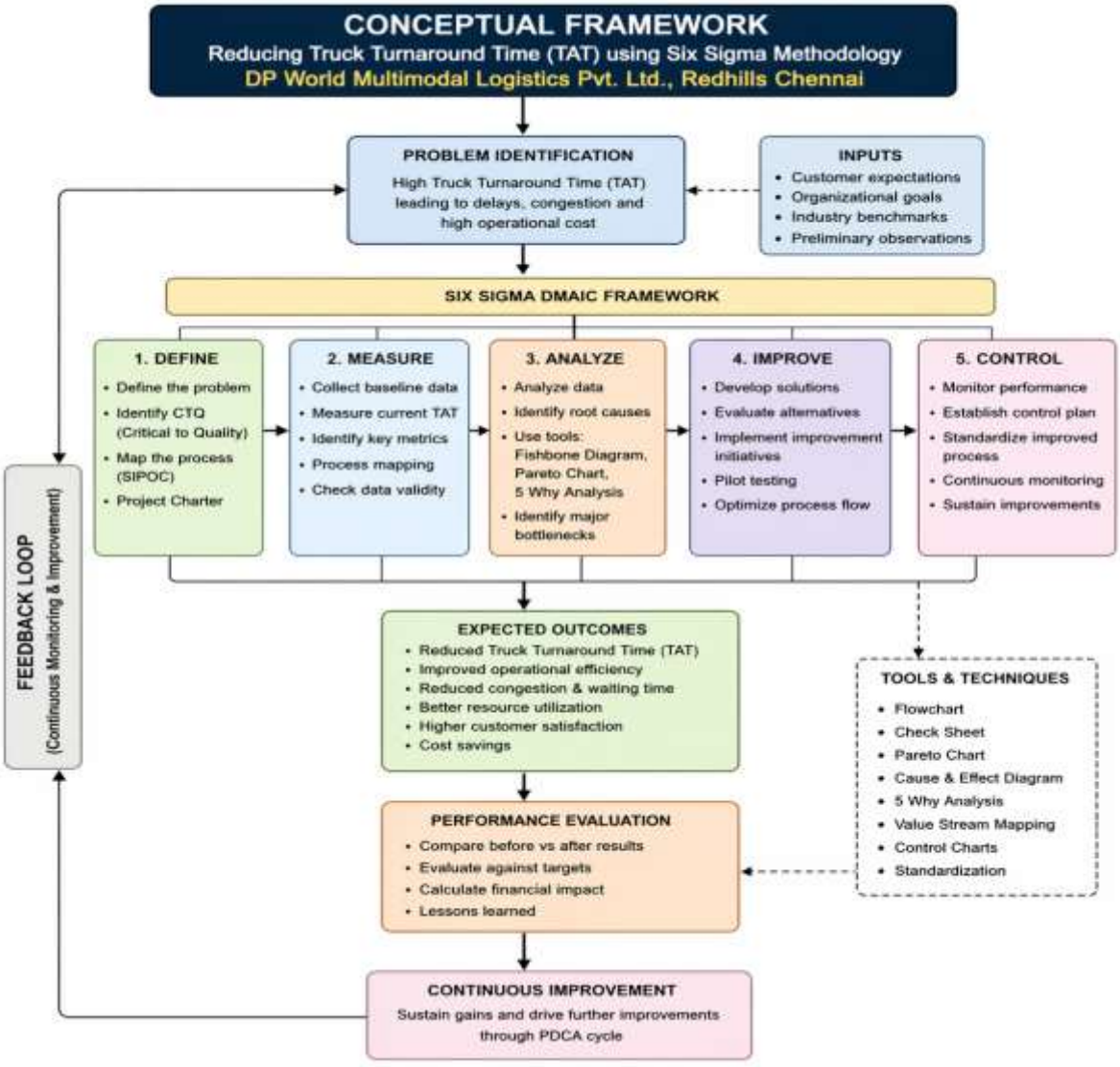
https://journal.yrpipku.com/index.php/jaets/article/view/5792

Primary Data & Secondary Data

Primary Data: Collected through Observation of truck movement, Interaction with employees, Time measurement of processes.

Secondary Data: Collected from Company reports,Industry journals,Research papers, Online resources.

Conceptual Framework



The study is based on the DMAIC framework of Six Sigma.

Define

Identify the problem of high TAT.

Measure

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Collect data on truck processing time.

Analyze

Identify root causes of delays.

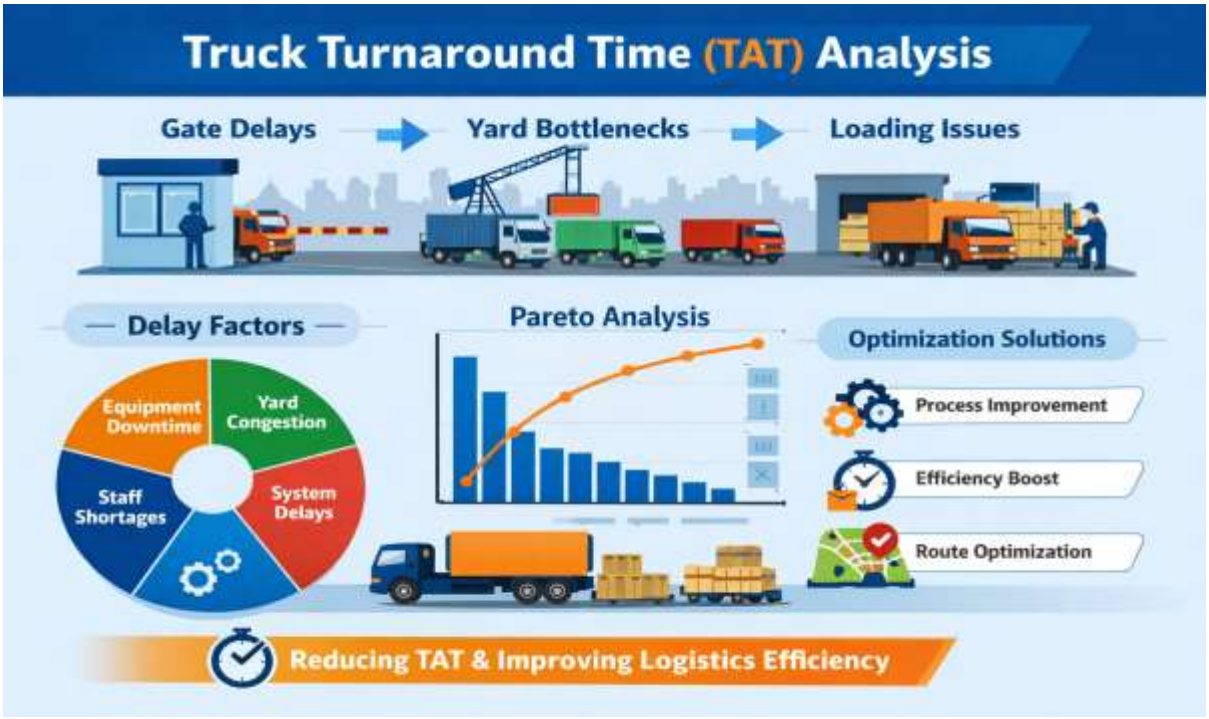
Improve

Implement solutions to reduce TAT.

Control

Monitor performance to sustain improvements.

DATA ANALYSIS AND INTERPRETATION



Truck movement analysis showed a number of operational inefficiencies:

- High entry gate wait time
- Document delays
- Yard congestion
- Poor unloading/loading efficiency

Explanation

- Delays were primarily created by lack of coordination.
- Manual processing requires longer times to complete freight processing.
- Uncoordinated scheduling causes yard congestion.

The analysis shows that process optimizations may be necessary.

SOLUTIONS FOR THE PROBLEM

Process Standardization: To establish consistency and lower variability in processing trucks' operation activities, standardizing the operational procedures will assist in achieving this goal. By developing and implementing defined workflows for gate entry; documentation; unloading/loading; exit, etc., opens up the opportunity to eliminate potential delays. The development of Standard Operating Procedures (SOPs) creates an opportunity for employees to perform their tasks with more efficiency and with less reliance on individual decision-making.

Automation: Automation of critical areas within the operation will reduce the amount of manual errors made while processing documents and speed up processing times. With the document being digitally documented rather than written on paper, you can verify and approve the documents at a much quicker rate than if they were written by hand. Automated gate systems based on RFID technology provide more streamlined operation of trucks entering and leaving the facility, which reduces wait times and provides better tracking of truck traffic flow.

Queue Management: Utilizing a well-organized system to schedule trucks and manage wait times will improve control of traffic into your facility through assigned time slots for all trucks which will reduce congestion at the entrance gates and within the yard. It will help facilitate smoother operations, optimize your use of available space, and provide trucks with less wait time.

Training and Skill Development: When companies offer regular employee training to develop skills it enhances overall operation performance level. Employees receiving training for improvement on process efficiency, how to use technology (digital) systems, how to work together (coordination practice) improves execution time and decreases errors made by employees. Skilled employees are critical to maintaining consistent performance levels.

Real-Time Monitoring: Tracking and Monitoring Systems in Real Time Provide Greater Visibility Into Your Operations. By Using Dashboards And Tracking Tools, Management Can Monitor The Movement Of Trucks, Instantly Identify Delays, As Well As Implement Corrective Measures. This Will Create Better Coordination Between Departments With Improved Decision-Making Efficiency.

Infrastructure Optimization: Improving the layout of the yard area and traffic patterns through the facility will help lessen congestion and delays. Properly managed lanes with assigned spaces and properly configured load/unload zones will allow for better vehicle flow. Efficiently designed infrastructure has a direct effect on how long a vehicle spends doing its work (turnaround time) and how many loads a particular piece of equipment or the facility will be able to process (throughput).

3. CONCLUSION

It was found that one of the biggest problems for logistics operations at DP World Multimodal Logistics Pvt. Ltd. was that Truck Turnaround Time (TAT) was too high and therefore resulted in slow and unproductive operations. In order to address the challenges mentioned above, the study was conducted using the Six Sigma methodology to identify any potential "bottlenecks." Providing pragmatic solutions to resolve these bottlenecks were the key outcomes of this report. In conclusion, a commitment from both management and staff at DP World Multimodal Logistics Pvt Ltd, to use a systematic, data-driven process to increase operational excellence is paramount. The implementation of these practical recommendations will not only create operational efficiencies but will also enhance customer satisfaction and competitiveness.

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