A Study on Yard Opeeration at Allcargo Terminal, Chennai.

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ABSTRACT

This article presents the results of an empirical study on the efficiency of yard operations at a major Container Freight Station (CFS) in the vicinity of Chennai Port. Structured questionnaire was administered to 55 employees at managerial, supervisory and operational levels. Dimensions analyzed were yard layout, equipment management, workforce competency, IT integration, gate operations and storage capacity. There is a positive sentiment of approximately 82% overall, confirming the operational maturity of the facility. However, four big vulnerabilities were identified: equipment reliability, gaps in digital adoption, inconsistency in container placement and shortage of resources during peak hours. Recommendations to stay competitive in the growing trade volume include predictive maintenance, AI based yard management, digital upskilling and gate automation

Key words

Container Freight Station (CFS), Yard Operation Efficiency, Logistics Equipment Control Workforce Competency

1. INTRODUCTION

The Container Freight Station (CFS) is an essential link in global containerised trade, managing the receipt, storage, consolidation, deconsolidation, customs inspection and dispatch of cargo. CFS facilities are crucial for Less-than-Container-Load (LCL) shipments where multiple consignments are combined into one Full-Container-Load (FCL) in order to optimise shipping economics. The operational backbone of any CFS is the Yard Operations, which covers everything from container stacking and stuffing and destuffing, customs coordination, equipment deployment and inventory control from gate arrival to departure. Inefficiencies in this chain result in increased dwell time, operational costs and customer dissatisfaction.

India's CFS market is valued at about USD 9.5 billion and is projected to grow at 10– 12% annually on account of increasing trade in FMCG, engineering and pharmaceutical sectors and Government's 'Make in India' initiative. The Chennai corridor contributes to 8-10% of the total EXIM container traffic in India. The facility under study is located on 23 acres, 9 km from Chennai port and has a capacity of over 10,000 TEUs per month. It provides LCL consolidation, bonded warehousing, customs clearance, ODC handling, reefer services and digital documentation through an in-house platform and is C-TPAT, AEO, ISO and OHSAS 18000 certified. The global CFS market is growing at a CAGR of 5%, but is challenged by Direct Port Delivery (DPD), increasing demands for real-time visibility, digital documentation and sustainability compliance, making internal efficiency optimisation a strategic imperative.

1.1. NEED FOR THE STUDY

Chennai Port is seeing increasing container volumes, which adds pressure on CFS infrastructure, equipment and operations. Yard inefficiencies such as congestion, equipment breakdowns, poor placement of containers and inadequate staffing have increased dwell time and negatively impacted customer satisfaction. Empirical research on internal CFS yard efficiency specific to India is scarce. Also, this work is motivated. The competitive threat from Direct Port Delivery (DPD) forces CFS operators to demonstrate operational excellence.Rapid adoption of IoT, AI and Terminal OperatingSystems (TOS) across the industry creating urgency to understand digital readiness. Global container trade to approach 1.1 billion TEUs by 2027, adding to throughput pressures on South Indian gateways. The need to provide evidence-based, actionable recommendations to allow the facility to improve productivity and quality of service in a sustainable way. Yard inefficiencies including congestion, equipment failures, poor container placements and staffing issues increase dwell time and decrease customer satisfaction. Further, there is limited empirical work on internal efficiency of CFS yards in India. This study also is important because: Competition from Direct Port Delivery (DPD) putting pressure on CFS operators to demonstrate operational superiority.

1.2 SCOPE OF THE STUDY

The study is limited to the internal yard operations of the CFS facility. The scope includes yard layout and space utilisation, equipment deployment and management, container storage and inventory control, stuffing and destuffing processes, gate management, IT system integration and workforce capability. The study does not cover portside operations, inter-facility transportation, financial or commercial performance, external supply chain activities or multi-facility benchmarking. It consists of yard layout and space utilization, equipment deployment and management, container storage and inventory control, stuffing and destuffing processes, gate management, IT system integration and workforce capability. The scope excludes portside operations, interfacility transportation, financial or commercial performance, external supply chain activities, or multi-facility benchmarking.

1.3 OBJECTIVES OF THE STUDY

The main objective of the study is to evaluate the overall efficiency of yard operations at the CFS facility in Chennai. Other objectives of the study are to analyse the effectiveness of container storage and handling practices. Assess utilisation of equipment and workforce in day-to-day yard operations. Identify challenges — congestion, delays, and environmental constraints — affecting yard performance. Examine how planning and coordination contribute to improved yard efficiency. Recommend measures to optimise yard operations and reduce container turnaround time.

2. REVIEW OF LITERATURE

Ramírez-Nafarrate et al .(2017)

Truck Appointment Systems (TAS) were introduced at the Port of Arica, Chile, to regulate truck traffic and alleviate congestion. The system worked in reducing the truck waiting time and the container rehandling and improving the efficiency of the yard operations.

Sitompul, Deliana & Sabila. (2024)

The study explains transportation, the role of Sea Cargo Expedition (EMKL) companies in handling cargo movement, documentation, port charges and container transfers between ports, container yards and storage facilities

Subrahmanyan & Subhashini (2018)

Container Freight Stations (CFS) are a relief to the ports by reducing congestion and improving the handling of cargo. With the growth of trade and containerization in India, the CFS has gained increased importance in port operations

Koech, (2018)

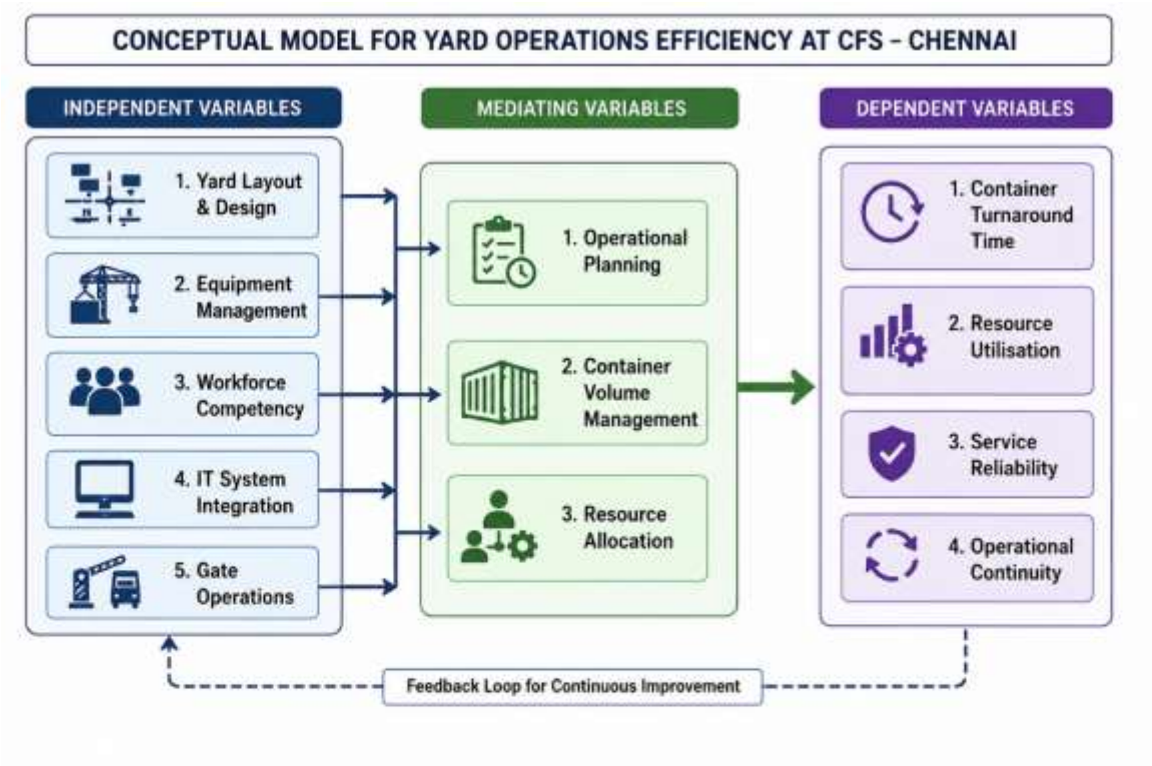
The study highlights Mombasa Port congestion and storage problems due to rising cargo imports and poor handling of cargo. “These challenges impact trade efficiency and port performance in East Africa.”

Musyoka (2018)

The study examines the effect of Container Freight Stations (CFS) on operations of Mombasa Port. CFS was introduced to reduce inefficiencies and congestion but had limited success in improving port performance in general .

CONCEPTUAL FRAMEWORK

The conceptual framework for this study is structured around five independent operational variables that are hypothesised to influence overall yard efficiency (the dependent variable), mediated by planning and coordination processes.



3. RESEARCH METHODOLOGY

The research design was descriptive type. Primary data was collected through administration of structured questionnaires to 55 employees (Managers, Supervisors and Operations Staff) on a five-point Likert scale. Because of the constraints of access to facilities, convenience and purposive sampling were used. Data analysis was done using descriptive statistics and frequency distributions. Secondary sources included CFS industry reports, logistics literature and academic research. The study is limited to the internal yard operations.

4. DATA ANALYSIS AND INTERPRETATION

The responses of 55 respondents are tabulated below. For each of the dimensions the table consolidates all the items in the Likert scale and reports the percentage of Strongly Agree (SA%), Agree (A%), Neutral (N%) and Disagree/Strongly Disagree (D%) with a short key insight per statement. This allows rapid comparison across items in the respective operational dimension. Each dimension table presents all Likert-scale items, including the distributions of Strongly Agree (SA%), Agree (A%), Neutral (N%), and Disagree/Strongly Disagree (D%), along with a brief key insight for each statement. The format enables rapid comparisons across items for each operational dimension.

In the analysis for yard layout and design, it was identified that 81.9% positive; congestion well managed. 92.7% positive — highest layout score. 27.3% neutral signals placement inconsistency. 81.8% positive; zoning is effective. 80% positive; 5.5% disagree in specific bays

In the analysis for the equipment management , it was identified that 89.1% positive — strong fleet availability. 78.2% confirm disruption — critical reliability gap. 78.2% positive; 5.5% risk at peak surge. 78.2% positive; 18.2% neutral. flags inconsistency.
In the analysis for the workforce competency , it was identified that 85.5% positive — strong cross- skilling culture. 80% positive; adaptability is a workforce strength. 81.8% positive; 49.1% strongly agree with training. 83.7% positive; 56.4% SA — highest workforce score.

In the analysis for the IT system integration, it was identified that 85.5% positive — strong cross- skilling culture. 80% positive; adaptability is a workforce strength. 81.8% positive; 49.1% strongly agree with training. 83.7% positive; 56.4% SA — highest workforce score.
In the analysis for the gate operations, it was identified that 85.5% positive — strong cross- skilling culture. 80% positive; adaptability is a workforce strength. 81.8% positive; 49.1% strongly agree with training. 83.7% positive; 56.4% SA — highest workforce score.
In the analysis for the storage capacity and strategic planning, it was identified that 72.8% positive; 25.5% neutral flags capacity concern. 81.8% positive; 52.7% SA — highest single response. 89% positive; 0% disagree — unanimous sentiment. 74.5% positive; 9.1% disagree —? re-handling risk. 70.9% positive; lowest SA (21.8%) in study.

ANOVA Test 1

To study the impact of Designation on Operational Efficiency, a One-Way ANOVA was conducted. and the null hypothesis for Anova test for the variables designation and operational is that there is no significant difference in Operational Efficiency across different Designation groups. Designation was the independent variable with four levels: Manager, Operations Staff, Supervisor, and Other. Operational Efficiency was the dependent variable. Operational Efficiency was assessed by 5 point Likert scale. The test was performed in SPSS software with a significance level of 0.05.

ANOVA Summary Table

Table 1: One-Way ANOVA Results — Operational Efficiency by Designation

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.052	3	0.017	0.073	0.974
Within Groups	12.497	51	0.245	—	—
Total	**12.549**	**54**	—	—	—

Inference

The One-Way ANOVA gave a value of F-statistics as 0.073 and the p-value as 0.974 . The p-value is far greater than the significance level $\alpha = 0.05$. The Between-Groups Sum of Squares is negligible (0.052) compared to the Within-Groups Sum of Squares (12.497) indicating that the variation in Operational Efficiency is attributable to differences at the individual level rather than designation based group membership.
For p=0.974 > 0.05 H 0 is accepted. Operational Efficiency does not significantly differ across Designation groups. The results suggest that operational efficiency is perceived to be at a similarly high level (mean ≈ 4.10 on a 5 point scale) by employees in the yard at all levels of the hierarchy, from managers to operational staff. This would show the consistent application of CFS operational standards to positions.

ANOVA Test 2

To study the Impact of experience in CFS vs operational efficiency a One-Way ANOVA was performed with Experience in CFS as the independent variable and the null hypothesis for the variables is that there is no significant difference in Operational Efficiency across different Experience in CFS groups.

ANOVA Summary Table

Table 2: One-Way ANOVA Results — Operational Efficiency by Experience in CFS

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.869	4	0.217	0.873	0.487
Within Groups	11.680	50	0.234	—	—
Total	**12.549**	**54**	—	—	—

Inference

The One-Way ANOVA test gave an F-statistic of 0.873 and a p-value of 0.487, which is greater than the threshold α = 0.05. The Between Groups Sum of Squares (0.869) is still far less than the Within Groups Sum of Squares (11.680) meaning the small difference seen in the mean score of the 5-8 years group is not large enough to be a statistically significant group effect.
The p value was greater than 0.05 (p = 0.487) and the null hypothesis (H0) was accepted. No significant difference in Operational Efficiency is found between Experience in CFS group. The average score for the 5–8 years group was slightly lower. However, the difference between groups is not statistically significant. This means that the length of experience of CFS does not have a significant impact on employees' perceptions of operational efficiency.

The One-Way ANOVA analyses validate the common understanding of Operational Efficiency in CFS yard operations by different employee groups. The null hypotheses for both tests are accepted that there are no statistically significant differences due to Designation (F=0.073, p=0.974) and Experience in CFS (F=0.873, p=0.487). The results indicate a need for operational standards at the organisational level and Allcargo Terminals has successfully imbibed efficiency practices across workforce demographics. Future studies may consider qualitative aspects or other variables such as timing of shifts, level of technology adoption or particular sub-departments to find out latent sources of variation in efficiency.

5. FINDINGS RECOMMENDATIONS

5.1 KEY FINDINGS

The consolidated analysis across all six dimensions reveals an overall positive sentiment of ~82% in an operationally mature facility. The table below gives a summary of performance and highlights four key gaps that require strategic action:

The four most critical findings are:

Equipment reliability gap: 89.1% confirm availability but 78.2% report breakdowns disrupt operations – revealing a reactive maintenance model that is not likely to meet the throughput growth challenges. • Digital adoption deficit: 32.7% of staff are neutral on IT system comfort – the highest neutral rate in the study – limiting the full productivity result from the facility's digital infrastructure. Container placement inconsistency: 27.3% neutral on handling time minimisation – indicating container slotting is not optimised consistently, generating avoidable rehandling costs . Persistent delay patterns: Only 21.8% strongly agree delays are minimal – the weakest 'Strongly Agree' score in the study – suggesting delays are normalised rather than systematically eliminated.. Digital adoption deficit: 32.7% of staff are neutral on their comfort with the IT system the highest neutral rate in the study, limiting full productivity yield from the digital infrastructure of the facility.. Container placement inconsistency: 27.3% neutral on handling time minimisation points to container slotting not being consistently optimised, creating avoidable re-handling costs. Persistent delay patterns: Only 21.8% strongly agree that delays are minimal (lowest "Strongly Agree" score in the study), indicating that delays are normalised rather than systematically eliminated

5.2 RECOMMENDATIONS

Predictive Maintenance Deploy IoT sensors on all critical handling equipment for AI-driven failure prediction. This directly addresses the 78.2% breakdown disruption discovery and can reduce unplanned downtime by 30-50% based on industry benchmarks — the single highest return intervention available. Dynamic Peak-Period Resource Allocation Schedule your workforce to demand using historical volume and vessel arrival schedules. Establish a pre-positioned pool of backup equipment to accommodate the 9% peak resource shortage reported by respondents .

Medium Priority Digital Literacy Programme Provide hands-on role specific IT training to all operational staff especially those reporting low confidence with systems. Better data quality, accuracy in documentation and ROI of the system will directly bridge the 32.7% digital proficiency gap. AI-Driven Yard Management System (YMS) Use AI to slot containers based on the departure schedule, cargo weight and access frequency – addressing the 27.3% neutral score on minimizing handling time and avoiding unnecessary re-handling costs. RFID and OCR Gate Automation: Identify Vehicles and Verify Containers at Entry and Exit Gate. This resolves the gate bottleneck (5.4% disagree on processing speed) and 9.1% divide in gate-yard coordination. Provide hands-on, job-specific IT training to all ops staff, particularly those who have indicated low comfort with the system. Greater digital fluency that closes the 32.7% adoption gap can improve data quality, documentation accuracy, and system ROI.

Long-Term Sustainability and BenchmarkingMove to electric handling equipment and solar powered operations consistent with industry carbon neutrality targets for 2040. Research should be broadened to a number of CFS facilities nationally to allow systematic benchmarking and best practice dissemination across the network.

CONCLUSION

This paper presents an evidence based assessment of the efficiency of the yard operations of a leading CFS facility at Chennai, South India. Yard layout, workforce capability, IT infrastructure, storage capacity and strategic planning are the fundamentals of a mature well-managed logistics facility with an overall positive sentiment of ~82% across six operational dimensions.

As containerised trade volumes grow and our industry's standards are raised, we will need to remain competitive by addressing four targeted vulnerabilities: equipment reliability, digital adoption, container placement practices and delay persistence. The recommendations on predictive maintenance, digital upskilling, AI-based YMS and gate automation provide a clear and evidence-based way forward to address the gaps. With the growth in India's EXIM trade and rapid technology change in the CFS industry, facilities that take a proactive approach to operational improvements will be best placed to maintain a competitive advantage and deliver high quality logistics services throughout the supply chain.

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