

**“Container Distribution System to Reduce Port Congestion”**

“A Case Study of MSC Agency India Pvt Ltd. Container Distribution Process”

Project Report submitted in partial fulfillment for the award of the degree of

**MASTER OF BUSINESS ADMINISTRATION**

**in**

**PORT AND SHIPPING MANAGEMENT**

by

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Under the guidance of

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**SCHOOL OF MARITIME MANAGEMENT**

**INDIAN MARITIME UNIVERSITY**

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## DECLARATION

I, **Pranav Prakash Patil** (Reg. No. 2103304017), hereby declare that the project research report on ‘**Container Distribution System to Reduce Port Congestion**’ submitted to **Indian Maritime University, School of Maritime Management, Chennai**, in partial fulfilment of the requirements for the award of degree **Master of Business Administration in Port and Shipping Management** under the supervision of Dr. **Lekha Ravi** Assistant Professor, School of Maritime Management, Indian Maritime University, Chennai.

This submission represents idea of mind in my own words and where ideas or words of other have been included. I have adequately and accurately cited and referred the original sources.

**Date: 05/05/2023**



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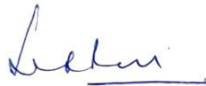
**(2021-2023)**

## CERTIFICATE

School of Maritime Management

Indian Maritime University, Chennai

This is to certify that this project research report entitled '**Container Distribution System to Reduce Port Congestion**' submitted to the School of Maritime Management, Indian Maritime University, Chennai Campus in partial fulfilment of the requirement for awarding the degree, MBA in Port and Shipping Management is a genuine work of **PRANAV PRAKASH PATIL (Reg no. 2103304017)**.



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## **EXECUTIVE SUMMARY**

This project is an attempt to study the issues arise due to container congestion at port and hinterland location and to implement the suitable solutions to help to reduce the container congestion and the management of container planning and distribution system and reports which are used to provide information to various stakeholders for different functions. Also, to comprehend the procedure container distribution to understand the working and methods of ports, ICD's, CFS's, Empty yard and logistics parks which are used to manage loaded and empty containers, loading and discharging of containers, stacking of various types of containers at yard and vessel planning and operations.

This study focuses on the function's container planning and handling and their goals to achieve for smooth and efficient work regarding handling of container, their stacking and proper distribution to various locations. I have studied the various reports which are maintained to analyse the efficiency and container handling procedure of shipping line. Also, how the various systems and data were used to carryout container handling and moving operations. The container distribution plays a vital role in the port and shipping industry, in which it occurs that the management of container distribution contributes to the competitive advantage to reduce cost and save time in operations and also it leads to sustainable development and to protect environment by implementation efficient container distribution to reduce the congestion which can cause the smooth and effective operations flow.

This research helps us to understand the solutions available to reduce container congestion and management of loaded and empty containers and their distribution. This project research study has taught me how to find solutions to reduce container congestion and any difficulties found in the distribution of containers. This project research was an excellent and rewarding experience of my academic life.

# CHAPTER I

## 1.1 Introduction - Preface

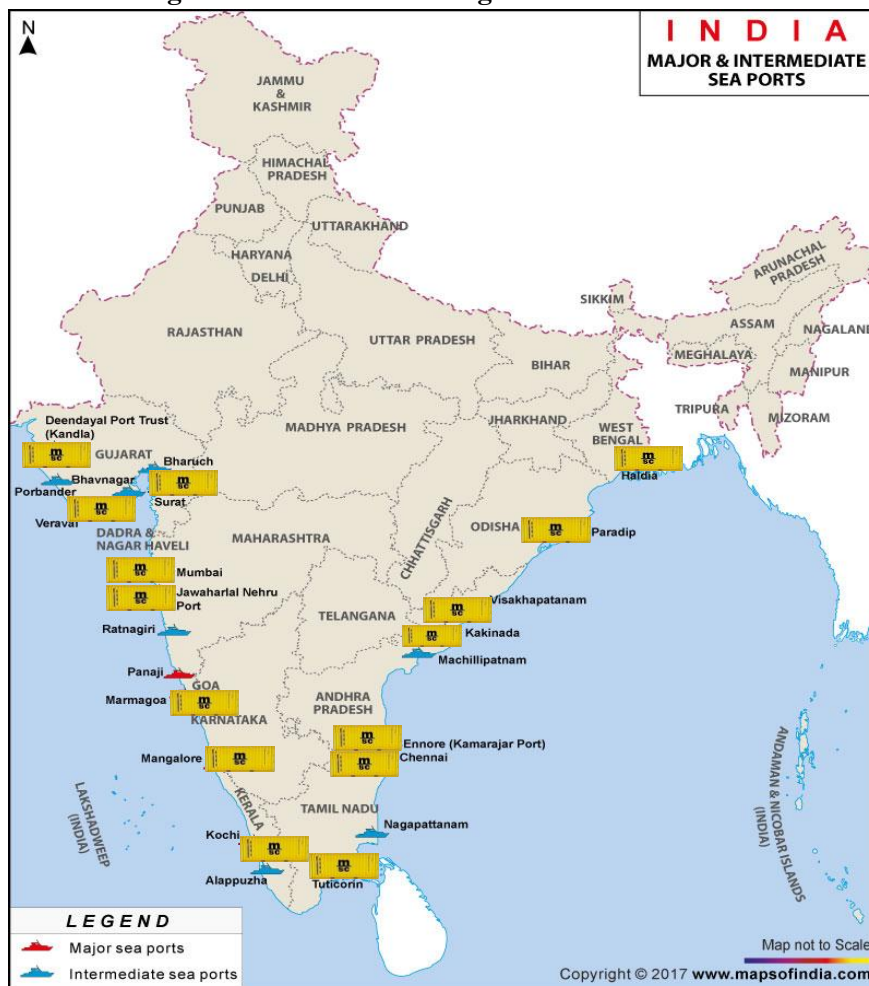
Every day, thousands of containers arrive at seaports from countries all around the world. They are carried aboard liner ships, which offer regularly scheduled service on fixed routes - much like a bus or train service does. Container transport is widely used for transporting various types and sizes of goods worldwide, and it is considered the most important method of transportation. The implementation of containerisation has improved productivity, reduced delivery time, and increased customer satisfaction.

This project study gives the details process of container distribution methods, process, challenges and solutions or suggestions to improve the container distribution process for efficient handling and management of containers. It also includes the details case study of container distribution system operated by 'MSC Agency India Pvt. Ltd.' which is world's largest container shipping organization and second in entire shipping sector. This projects study gives the detail explanation of how container shipping works, what are the various flows and processes involved in import and export trade of containers. The use of software and system to operate the container shipping to manage the large number of containers and the operational activates involved in container trade.

Freight can be transported by sea, road, rail, or a combination of these modes. According to research conducted by the Statista Research Department, the amount of cargo transported by sea in containers has increased substantially over the years, rising from 0.1 billion tons in 1980 to 1.85 billion tons in 2020. Understanding intermodal transportation and the different modes of transport is crucial. Often, goods are transported intermodally by utilizing various types of containers and multiple modes of transport within a single container throughout the entire journey. Intermodal transport of containers offers several benefits, including reducing delivery times and the risk of freight damage, providing flexibility, and ensuring the smooth flow of goods. For short distances, companies opt for intermodal road transport to deliver cargo quickly with the use of standard containers to its destination. For sea freight use of container transport, it is the most cost-effective way to transport large-scale cargo, even though it takes longer to transport. For short distances, companies also choose intermodal road transport of containers to ensure quick delivery to their destination.

Containerization is hailed as one of the greatest innovations in the goods transportation industry. Ever since the American entrepreneur Malcolm Maclean came up with the first container made of corrugated steel in 1955, the container has evolved from the humble corrugated steel box to the present-day super-efficient intermodal container. Containerized goods can be transported overland by standard trucks with trailer beds. Special temperature-controllable containers called refrigerated containers or reefers are used extensively to transport items that are temperature sensitive. Containerization is one of the most efficient methods of virtualization available to developers. Containers improve efficiency in two ways: they use all available resources, and they minimize overhead. When properly configured, containers allow a host to take advantage of virtually all available resources. Isolated containers can perform their operations without interfering with other containers, allowing a single host to perform many functions. Containers also remove the need for virtualized operating systems, hypervisors, and other bottlenecks that virtualization techniques introduce.

**Fig. 1.1 Container Handling Ports of India**



Source: [www.mapsofindia.com](http://www.mapsofindia.com), Major and Non-major sea ports of India

## **1.2 Research Question**

How to avoid container congestion in Indian Ports by effective container planning distribution and system?

## **1.3 Objectives of Research**

1. To study the methods to reduce container congestion at port.
2. To study the process of container planning and distribution at MSC and suggest solutions.
3. To analyse and identify the challenges, suggestions, and solutions available to reduce port congestion.

## **1.4 Research Methodology:**

The objective of this research is to analyse the current container distribution system in India and propose a new system to reduce port congestion. The research design is predominantly dependant on secondary data. Research papers, articles, reports, and data shared by MSC Agency India Pvt. Ltd. The study aims to evaluate the effectiveness of the proposed system and its potential impact on port congestion in India.

The research methodology for the study of Container distribution system in India will involve the following steps:

### **i. Literature review:**

The study will begin with a literature review of existing research on container distribution systems and port congestion in India. The literature review will provide a theoretical framework for the research and identify research gaps and potential research questions. A comprehensive review of relevant literature, including academic articles, reports, and policy documents, will be conducted to identify the regulatory and policy frameworks governing ports and container terminals in India.

### **ii. Case Studies:**

Case studies on the container planning and distribution system adopted by various shipping companies and difficulties occurred due to improper management and planning of containers and the used of latest system and technology to establish effective container distribution to reduce the container congestion at port and hinterland locations. The case studies involve the container yard visits, recent incidence happened in industry, hands-on work on container

planning software and EDI system. It also includes the solutions and suggestions for the effective and efficient container planning and management system which will contribute to reduction in port congestion.

Secondary data will be collected from various sources, including industry reports, government publications, and academic articles. The data will be analysed using content analysis to identify relevant information and themes.

### **iii. Industry Expert consultations:**

The industry expert's consultation is taken to understand the topic in deep and thoroughly, the technical terms and the flow of operations is guided by shipping line experts and the system working and explanation of the process of planning and distribution of containers is done with logistics expert's guidance and opinions.

## **1.5 Scope of Research**

1. The study is about the container handling and distribution techniques are used in India.
2. The study reviews the challenges faced by port industry due to improper container distribution at various locations.
3. The study focuses on the effective methods and solutions which can be implemented to reduce container congestion at port as well as hinterland locations.

## **1.6 Limitations of Research**

Since the study has been conducted through planned research, there are certain limitations, which are inherent in nature and are out of the researcher's control. The research work has been undertaken with almost accurate data but the following aspects can be termed as the limitations of the project work.

The limitations include:

1. During the period of analysis, the financial aspect is ignored.
2. The study is limited to process applicable in India for container movement and distribution.

## **1.7 Chapter Scheme:**

### **Chapter I – Introduction to Container Shipping**

First chapter is an introduction about the container shipping industry and research has been on the related field is mentioned along with the objectives of study, research methodology and limitations of research. The aim of research is to understand the causes due to container congestion and to provide effective solutions which leads to reduction in container congestion.

### **Chapter II – Review of Literature**

Second chapter is all about review of literature, consists of articles from different journals available in respect of container planning distribution system in shipping industry.

### **Chapter III – Container Distribution System**

Third chapter talks about analysis of study, which including details of container distribution system, tasks and procedure followed in shipping line for planning and distribution of containers.

### **Chapter IV – Case Study MSC Agency India Pvt. Ltd.**

Fourth chapter is consisting of detailed procedure and case study of a shipping line to analyse the causes of container congestion and need for effective container management system.

### **Chapter V – Summary**

Fifth chapter includes the findings of study, the solutions suggested to reduce the port congestion and conclusion of the project research.

## CHAPTER II

### Review of Literature:

#### **2.1 Article 01: A quantitative analysis of container vessel arrival planning strategies.**

The article discusses the challenges faced in maritime container transport due to the unpredictable nature of vessel arrivals and terminal service processes, resulting in handling delays and underutilization of resources. Arrival planning strategies (APS) are proposed as a solution to manage the variability of the terminal arrival process by considering various cost components and situational dynamics. To identify effective APS designs, the authors developed a simulation that quantitatively analysed different strategies. The study examined both central and decentral APS strategies under high and low fuel price conditions, resulting in significant differences between the two approaches in terms of both quantitative and qualitative outcomes. The article describes an analytical approach that was used to investigate the relationship between ship arrivals and terminal operations. The approach involved simulating ship arrivals and integrating this with an optimization routine that determines the optimal approach speed for the arriving vessels. The study compared the benefits of a centralized-information rich arrival planning strategy with a strategy where the speed of approaching vessels is not optimized. A generalized cost function that includes fuel costs and delay costs was used for the analysis.

The study also found that coordination has the potential to generate monetary and operational benefits for both shipping lines and terminal operators, even if it results in vessels having to speed up to make their time slot at the terminal. For terminal operators, managing congestion through coordination rather than facility investment has the added benefit of flexibility, allowing them to operate their facilities at a higher utilization level and increase returns on investments. For shipping lines, coordination could be a viable instrument to manage delays in structurally congested ports. The study suggests that the analysis could be extended in many ways, such as refining the cost and operation models, considering other costs beyond operational costs, and investigating alternative approaches to coordination. The scope of the study was limited to the coordination between shipping lines and a single terminal, being the first port of call. Future work could extend the ideas presented in the paper to research the impact of coordination in a cluster of terminals, and investigate whether the extra planning potential introduced by such a scope would justify the organizational costs of cluster-wide coordination.

## **2.2 Article 02: A study on the performance of Major ports in India.**

The article describes an analytical approach that, the maritime industry had been experiencing rapid growth, and plans were made to accommodate this growth. However, due to the global economic slowdown and recession, every sector, including shipping and ports, has been impacted negatively. As a result, the annual growth rate of cargo traffic, which was around 11%, has decreased. Despite the challenges, India has managed to survive the slowdown through its strong economy, effective systems, and policy measures. However, achieving the earlier growth rates is still a challenge. Although current economic indicators suggest a strong growth outlook for India.

Ports are very important for both economic and service-related reasons as they serve as a hub for different modes of transportation, including maritime and land, by rail or road. The key feature of ports is their ability to facilitate intermodal transportation. India has a coastline that spans approximately 7517 km, with 13 main ports and 176 non-major ports along the coast and sea islands. The growth potential and significance of ports is emphasized by the fact that cargo handled has grown at a compound annual growth rate (CAGR) of 8.6%, which is higher than the GDP growth rate of 7.6% CAGR. This suggests that there is a positive correlation between GDP growth and cargo volume growth handled by ports. It can be inferred that improving and expanding port infrastructure would be a critical factor in driving the growth of the Indian economy. The success of a port depends on its connectivity with the hinterland, which is crucial for cargo movement. In India, cargo transportation by road accounts for approximately 60% of the total cargo traffic, which is much higher than the global average. Rail transportation currently accounts for approximately 22% of containerized trade and 24% of overall cargo traffic, presenting a significant potential for growth in India. The delay in cargo movement from ports results in higher operational costs, which could be resolved by increasing the share of rail transportation.

## **2.3 Article 03: General Considerations on Container Terminal Planning**

The article discusses the different levels of planning involved in the operation of container terminals. The first level is the planning of terminal operations, which includes short-, medium-, and long-term planning of container handling, transport, and storage processes. These planning decisions can be further broken down into sub-levels. The short-term planning level involves decisions and measures related to day-to-day operations, while the medium-term planning level

includes tactical decisions and measures such as outsourcing activities or inter-organizational co-operations. The long-term planning level involves strategic decisions and measures, such as determining the range of terminal services and establishing long-term partnerships with shipowners. The article also explains, in recent decades, the increase in international container traffic has led to capacity problems, and various parties have been working on common strategies for growth to address this issue. This has included public and political entities, as well as companies in the container transport and handling industry, including logistics service providers such as shipping companies, terminal operators, and rail transportation and cargo forwarding companies. In the current decade, companies are also paying more attention to the environmental effects of their activities due to rising handling volumes and increasing environmental standards. Seaport container terminals are now more concerned with environmental issues such as air, noise, and light pollution, as well as the modal split of hinterland transports. Port authorities are also focusing on sustainable objectives in the context of seaport container terminal planning.

The recent crisis in the international container traffic has caused many logistics companies to shift their focus from capacity goals to cost-saving measures. This change in priorities has led to an emphasis on more economically efficient services with flexible capacity utilization to better meet dynamic market demands. As a result, seaport terminal operators have had to adapt their planning strategies to address these new challenges. The article proposes a level-model for container terminal planning, which divides the planning process into three levels: Planning of Terminal Operations, Planning of Terminal Superstructure, and Planning of Terminal Infrastructure. Each level focuses on planning activities related to different aspects of terminal operations, including the conception, construction, and operation of the terminal. Ultimately, the goal is to identify and prioritize planning alternatives that will lead to the most effective and efficient use of terminal resources.

#### **2.4 Article 04: Indian Ports Seeking Betterment for International Trade**

The transportation of cargo in standardized containers, which can be easily interchanged between ships, trains, and trucks, is known as containerization. Ports, railways, roads, warehouses, shipping, and logistics companies are the primary players that deal with containers, and the development of container trade and infrastructure depends on them. Containerization has brought many benefits to the overall trade, including reduced transport time, optimized storage, and warehousing capacity, minimal damage to goods, and the development of workers' skills.

However, the major problem faced by Indian ports is highly inadequate infrastructure, including overstaffing, low efficiency, frequent port congestion, and lack of skilled and professional workers. Indian ports are unable to handle modern vessels due to insufficient facilities, resulting in higher costs and transit times for cargo shipped from Indian ports. As a consequence, larger and cost-efficient vessels avoid Indian ports, leading to lower throughput performance, increased container handling costs, and port congestion. The government's bureaucratic attitude towards port management also contributes to the problem.

The shipping trade in India faces significant challenges due to inefficient port services and a lack of modernization in comparison to other ports worldwide. Long waiting times, high through port and transport costs, and limited capacity are the biggest handicaps logistics service providers have to deal with. To attract investment in the Indian ports sector and improve efficiency, value-added services should be provided, and port infrastructure should be expanded and modernized to meet international standards. This includes strengthening roads, dredging, updating equipment, and increasing containerization to handle smaller parcels of cargo. Additionally, reducing the turnaround time at ports would decrease transaction costs and increase capacity. India's ports are facing capacity constraints due to increasing cargo traffic, and if they continue to grow at a high rate, they may reach their capacity limit. To expand port capacity, it is necessary to improve operational efficiency, learn from international best practices, and adopt superior technology to achieve absolute capacity. Upgrading cargo handling equipment and infrastructure to meet international standards is also important to reduce dwell time. Developing the port infrastructure is crucial for India's trade and growth prospects, and there is a high need for capacity and investment in Indian ports. Therefore, India needs to focus on making its port system more efficient to boost its shipping trade and promote growth.

## **2.5 Article 05: Container Shipping Supply Chain; Planning Problems and Research Opportunities.**

The article describes, the effective management of container flows and storage in transport networks to meet customer demands and maximize the utilization of the container fleet is known as container logistics. Container fleet is the most significant asset of shipping companies after container vessels, and improving its utilization requires efficient management of both laden and empty containers. Container logistics includes planning problems such as container fleet sizing, container leasing, laden container canvassing, routing, and dispatching, and empty container repositioning (ECR). Container logistics involves managing the flows and storage of empty

containers, which is primarily driven by the imbalance of laden container movements. Existing solution models for ECR problems can be classified into two research streams: network flow models and inventory-control models.

The article discusses port and terminal logistics, which are important for transferring cargo and passengers from seagoing ships to other modes of transportation. Ports consist of various terminals, each specializing in specific types of commodities. Container terminals or ports facilitate the transfer of containers between ships and other modes of transport. The primary goal of port/terminal logistics is to improve the efficiency and productivity of port operations. The article discusses various planning issues associated with container port/terminal logistics such as quayside operations, yard-side operations, and landside operations. The planning problems are categorized based on the planning horizon and logistics process. The article also identifies research opportunities such as port disruption management, port congestion, integration of planning issues across logistics processes, and optimization problems. Lastly, the article highlights the need for joint efforts from terminal operators, shipping lines, and inland carriers to tackle port congestion problems. This paper provides an overview of the container shipping supply chain (CSSC) from a logistics perspective, including freight, container, vessel, port/terminal, and inland transport logistics. The article reviews and discusses the main planning problems and research opportunities in each logistics segment, as well as the challenges of digitalization and decarbonization facing the CSSC. The authors argue that CSSC digitalization requires the application of digital technologies across all five logistics segments and a change in behaviours and relationships in the supply chain.

They also suggest that shipping decarbonization is likely to take diverse pathways with different fuel/energy systems for ships and ports, and provide a range of research opportunities associated with shipping decarbonization. The study aims to stimulate interested researchers to tackle these challenging issues and push forward the knowledge frontier, and to bridge the gap between researchers who are experts in one or two segments of the CSSC. However, the paper has limitations and does not provide a guideline on how to tackle the identified research gaps. The authors suggest that further research could be pursued in directions such as multimodal transport and reverse logistics, and that empirical research such as questionnaire surveys would be helpful to evaluate and compare the relative importance of the identified research gaps.

## **2.6 Article 06: Performance Measure Evaluation of Port Truck Trip Reduction Strategies**

This article discusses the strategies evaluated in a study to reduce truck trips generated at the ports during weekdays, reduce the length of truck trips and reduce vehicle miles travelled (VMT) and emissions. The Virtual Container Yard (VCY) concept aims to reduce the movement of empty containers in and out of the port gates, with computerized "matching" systems for importers and exporters, thus reducing truck traffic. The Extended Gate Hours scenario, which shifts gate activity from daytime to off-peak periods and moves some weekday activity to weekends, aims to reduce traffic congestion. The On-Dock Rail scenario aims to increase on-dock rail use and reduce drayage truck trips. The study evaluates the impact of plausible scenarios of each strategy. To estimate the reduction in truck trips associated with the shuttle train, a model was developed that calculates the percentage of intermodal imports handled by the shuttle train and subtracts it from the local import percentage in the QuickTrip model. This reduction in local import percentage results in a decrease in truck trips that would have been made if the containers were delivered by truck. Similarly, a spreadsheet model was developed to calculate the inputs needed for Quick Trip to implement the increased on-dock rail scenario. The output from Quick Trip provides the number of truck trips associated with the increased on-dock rail scenario. The Port's travel demand model was then used to develop a trip length distribution for all trips arriving and departing the Port, and this was used to calculate a weighted average trip length multiplied by the number of trips generated to estimate total port truck VMT. The local shuttle train is expected to reduce port truck VMT, but there would be additional vehicle miles travelled between the shuttle terminal location and local destinations assumed to be within a 20-mile radius. If information on local destinations is absent, trips are assumed to be distributed among traffic analysis zones based on the share of "other" employment in these zones obtained from the Southern California Association of Governments regional travel demand model.

### **2.7 Article 07: Weaknesses in the supply chain.**

The Council of Supply Chain Management Professionals provides a comprehensive definition of supply chain management as involving the management of all activities related to sourcing, conversion, logistics, and collaboration with channel partners such as suppliers, intermediaries, third-party service providers, and customers. However, modern-day supply chain management is a complex subject that also includes documentary and electronic message handling, risk management, and compliance with legislation related to trade, customs, health, safety, security, transport, contracts, and liability. Supply chain management involves planning, estimating, sourcing, manufacturing, delivering, relationship building, contract negotiation, finance, risk management, data management, commercial and regulatory compliance, and systems

development. Real-time data management or feedback loops are crucial for reducing uncertainty and delays in the supply chain. The physical movement of goods involves a series of contracts of carriage between the carrier and the buyer and/or seller, and documents such as bills of lading are important for proving ownership of the goods. The international trade supply chain is not necessarily linear and involves physical, information, and financial flows along the supply chain, which are categorized into the Logistics Layer, the Transaction Layer, and the Governance Layer. Customs have historically used data in the Logistics Layer for risk assessment, but the Transaction Layer provides more accurate commercial data. The current management of international trade supply chains is inefficient and complex, leading to unknown true costs and inflated estimates that are ultimately passed on to consumers. Export systems have been neglected, leading to misdescriptions of goods and self-regulation that is ineffective. The solution lies in national legislation within a multilateral, international legal framework that ensures real-time, accurate data is shared in a risk-based, layered approach. Customs will use automated targeting tools to identify high-risk shipments early in the supply chain. The aim is to increase efficiency and security using parallel logistics and data pipelines that eliminate redundancies and provide real-time visibility. The emphasis needs to shift from limiting carrier liability and outdated paper trails to supply chain visibility and predictability through accurate data provision and management. International law provides a uniform approach, but the process of negotiation and political lobbying can be frustrating. The role of the consignor is critical, and there is a need to create an international legal obligation that reflects that responsibility along with the need for timely and accurate data.

### **2.8 Article 08: Decentralised Rotation Planning for Container Barges.**

This article discusses the port of Rotterdam, which has 18-24 terminals where sea vessels and barges unload and load containers. The rotation scheduling problem involves assigning rotations to barges over a number of terminals they have to visit. The problem is caused by statistics that show that the average rotation time is around 22.5 hours, of which only 7.5 hours are spent on loading and unloading. The remaining time is spent sailing and waiting. The article describes a planning tool called APPROACH that has been developed to partially automate rotation planning for terminal and barge operators. The tool uses a decentralized planning system that allows for the exchange of information between parties and synchronizes planning between barge operators and terminal operators. The objective of the project is to provide insights into the effects of decentralized planning on the reliability of barge handling in the harbour and to consider the applicability of multi-agent technology for modelling and realizing a decentralized

planning system. The article concludes by stating that the development of the approach tool is a first step in a longer-term tool development process. Barge operators are responsible for handling cargo and coordinating transportation activities between ports and inland areas. They determine the order of calling at terminals in consultation with the captain and make capacity reservations in advance, especially for larger terminals. They aim to achieve rapid and reliable barge handling. Terminal operators are responsible for transshipping containers from seagoing vessels to other means of transportation. To schedule transshipment activities, they require information in advance on the number of containers to be loaded/unloaded and at what time. Terminal operators want to maximize the use of scheduled transshipment capacity. Seagoing vessels take priority in scheduling terminal activities, and barges are scheduled after them.

Barge operators must inform large terminals of the number of barges calling and activities required at least 24 hours in advance. Requests are collected and included in terminal schedules, and barge operators receive a confirmation of scheduled times. Currently, only the barge operator works to harmonize various terminal schedules, but they have no say in final schedules, which are determined unilaterally by terminal operators. The aim of this paper is to present a decentralized planning system called APPROACH, which has been developed to efficiently and effectively plan the terminal visits of barges in the port of Rotterdam. The paper discusses how a distributed multi-agent planning system can be used to create efficient and realistic barge rotations, while still allowing competitive parties to maintain their autonomy and confidentiality. The Agent-Group-Role (AGR) model was used to set up a correct AGR model, which required an analysis of the domain and insights from all parties involved in the design process. The AGR model was also used to analyse the requirements of the APPROACH software tool and gain insights into its actual application. The paper concludes with two possible future research tracks: exploring the possibilities of more dynamic planning and setting up a detailed verification model for the rotation scheduling process.

## **2.9 Article 09: Principles of Combinatorial Optimization Applied to Container-Ship Stowage Planning**

The container stowage problem is a complex issue that depends on the capacity of the ship and the container supply and demand at each port. Even for small vessels, stowage planning is a large-scale problem due to the large number of variables that need to be considered, and the problem has been described as NP-Hard, which means that finding an optimal solution in a reasonable time is not possible. Automation through the application of Artificial Intelligence can

assist with short-term stowage planning, but little work has been done in the area of full automation of stowage planning. Attempts to automate the planning procedure have failed because they concentrate on specific placements of containers and ignore the abstraction processes used by human planners to determine commercially viable solutions. Several decision support systems have been developed to augment paper-based stowage planning systems, but they do not fully automate stowage planning. Mathematical models have been developed to solve the problem, but they ignore important features such as non-standard dimension containers, hazardous cargo, and specials. The authors propose a new approach that builds on the grouping and abstraction processes used by human planners to better model the problem. The authors suggest that the stowage problem can be broken down into two sub-processes to overcome computational difficulties. The first process is a strategic planning phase in which generalized containers are assigned to a blocked cargo space. The hatch-lids are grouped together and above-deck cargo can be placed across two sections of the lid. This reduces the number of options available for specifying container placements at any stage of the planning process, while retaining the inherent characteristics of the problem. The stress and stability can then be calculated for the abstract model. In the second process, specific containers are assigned to specific slots within the blocks determined in the strategic planning phase. This phase determines the exact slot occupied by each container at the current point of departure. The moves within the same block of the container ship are considered to avoid the combinatorial difficulties associated with attempting to make specific placements within the entire cargo space.

This procedure models the human planner's conceptual approach in their use of the Bay Plans. This article discusses the use of heuristic methods for solving the deep-sea container-ship stowage problem. The heuristics were used to evaluate the effectiveness of solutions during both the long-term decision-making process and the generation of stowage plans at an individual port of call. The authors used a hybrid of traditional (Branch and Bound) and modern (Tabu Search) search techniques to develop prototype software that could generate stowage plans that reflected the expertise of human planners. By limiting the size of the neighbourhood under consideration during the stowage optimization phase, the authors were able to propose a solution to the stowage planning problem that was based on an understanding of the conceptual processes employed by human planners. This approach was more efficient than other methods, allowing commercially viable solutions to be produced in a reasonable amount of time. The authors hope that their proposed hybrid approach will encourage further research in the application of search techniques to exploit the conceptual model developed.

### **2.10 Article 10: Planning decision alterations and Container Terminal Efficiency.**

This paper examines the challenges that arise from making changes to the original operational plan in container terminals. The discussion focuses on three areas: integrated planning functions, the role of planners, and uncertainty due to crane breakdowns. System Dynamics (SD) is used to model, test, and evaluate planning changes. The model demonstrates how the feedback loop between actual and expected terminal productivity affects planning outcomes. The research findings indicate that crane breakdowns necessitate adjustments to the plan, and yard planners bear a heavier workload than vessel planners. A successful plan is achieved when planners activate the balancing loop, which improves the productivity of remaining moves. When one berth operates more efficiently than expected, it can negatively impact the other berths, highlighting the importance of integrated planning. Future research directions include expanding the time horizon of the model, exploring new methods to evaluate planners, and applying SD to better understand practical problems in port operations. The SD model has two types of loops - reinforcement and balancing loops - which are divided based on the polarity of hourly alterations. Twelve loops were identified, with three critical points.

The first point is the aggregation of the time factor, while the second point is whether there is a planner contribution or not. The third point is when positive or negative move changes occur, which activates balancing and reinforcement loops, respectively. A scenario analysis was conducted to observe the impact of crane breakdowns versus planner involvement and the impact of other berths on a considered berth. The workload at other berths affected the productivity of the considered berth, with the yard planner having a higher impact compared to the vessel planner. The study highlights the importance of dynamic approaches within the quay-to-yard interface to identify real causes beyond a task.

## **CHAPTER III**

### **3.1 Introduction to Container Distribution System:**

The purpose of this Container Distribution procedure is to define and to harmonise the methodology to ensure the Logistics Functions of containers which includes, container tracking and monitoring, intermodal transportation, container imbalance and empty container planning, container cost control, vendor management (Empty yards, CFS, ICD), revenue and cost analysis and reports are done to maintain a unique system to control the distribution system of all types of containers. The logistics department from shipping lines or agency office is responsible to perform the container control and logistics functions as per the timeliness and quality guidelines given by respective heads from principal carrier's headquarters. Since the logistics department is responsible to provide the regular and Ad hoc analysis head office on time-to-time basis, the reports must be accurate and completely matching the requirements to solve the purpose of container distribution system.

#### **3.1.1 Issues arises due to container congestion in port as well as in hinterland areas:**

Container congestion in ports and hinterland areas can cause a range of issues that can have a significant impact on the efficiency and reliability of global supply chains. Some of the key issues that arise due to container congestion are:

##### **1. Delays:**

Container congestion can lead to significant delays in the movement of cargo, both in the port and the hinterland areas. This can result in higher costs for businesses due to the additional storage and handling charges incurred during the delays.

##### **2. Increased costs:**

Container congestion can also increase the costs of transportation and logistics, as businesses may need to use more expensive modes of transportation or pay higher fees to expedite the movement of their cargo.

### **3. Decreased productivity:**

Container congestion can reduce the productivity of ports and other logistical hubs, as it can lead to increased waiting times for cargo and longer turnaround times for ships and other transport vehicles.

### **4. Environmental impact:**

Container congestion can also have a negative impact on the environment, as ships and other transport vehicles may need to idle or operate at reduced speeds, leading to increased emissions and pollution.

### **5. Safety concerns:**

Container congestion can also pose safety risks, particularly in ports where there is limited space for container storage and handling. This can lead to accidents, equipment damage, and injuries to workers.

To address these issues, various measures can be taken to alleviate container congestion, such as investing in additional infrastructure and equipment, implementing better planning and management systems, and improving communication and coordination among stakeholders in the supply chain. Additionally, adopting digital solutions such as blockchain and other data sharing technologies can help to increase transparency and efficiency in the movement of cargo, reducing the likelihood of container congestion and its associated issues.

## **3.1.2 Methodology to be adopted to perform the container distribution and logistics functions:**

### **1) Container Tracking:**

#### **I. EDI Quality & Timeliness**

- Sourcing of container activities from Custodians.
- Update of container moves with specific move codes in system.
- Final load and discharge move update process of containers.

### **2) Container Control:**

#### **I. Maintaining Stock & Gate In/Out Activities of containers**

- Daily Container stock report (Loaded and Empty).

- Gate In/ Gate Out report of containers.

## **II. Imbalance Analysis & Container Repositioning**

- Container planning procedure – short term and long-term plan
- Maintaining historic Gate events and analysis to current trend
- Expected Surplus and Deficit scenario location wise
- Transport cost analysis, monitoring rate fluctuation of containers as per tariff.

## **III. Container Activity Follow up**

- Visit to Empty Depot, Port, Terminal, CFS and ICDs.
- Release of Empty Container.
- Mis-released containers.
- Special placement of empty containers.
- On-Hire and Off-Hire of container.
- Long stay follow-up with consignee and Shipper.
- Long stay follow-up with Terminal, Depots, CFS and ICDs for Laden and Empties.
- Handling of Reefer containers.
- Handling of smart containers (Traxen).

## **IV. Maintenance & Repair of Containers**

- Repair & Cleaning of containers – Dry and Reefers
- Conducting PTI (Pre-Tip Inspection) and monitoring the same
- Checking the Booking trend for cargo, upgradation of containers to CW standards
- Collection of Repair cost from consignees for heavy damaged units
- Under warranty repairs on Reefers

### **3) Vendor Management**

- Vendor qualification, Quotation
- Vendor performance review
- Vendor Payments/Bills Checking

### **4) Container Reports**

- Weekly Events.
- Turn- Time analysis.

### **5) Cost Control & Value-Added Services**

- Empty container drop-off/ pick up fee

- Reuse of import container for exports.
- Last mile business.
- First mile business.

#### **6) Detention Analysis & Follow up**

- Import detention analysis & follow up.
- Export detention analysis & follow up.

### **3.1.3 Logistics Functions used in Container Distribution Analysis:**

#### **1. EDI Quality and Timeliness:**

Container movements which are denoted by specific move codes should be updated in a logical sequence and hence if there is an illogical container move then the EDI system will throw an error and will not allow to update a move. Due to this container movement updation is incomplete and it creates delay in process, the errors in the system have to get minimised for the efficient planning of container distribution and allocation to specific locations.

EDI files are to be obtained from the various concerned entities in order to update the latest container moves. Terminal sends the edit files on the designated email ids created by IT department of respective shipping line where IT team has set a rule for receiving all EDI files vendors through email. Container moves should be updated in a logical sequence and hence if there is an illogical container move the IBOX system will throw an error and will not allow to update a move. The CODECO and COARRI are UN EDI standard format files and are used by Ports globally. COARRI gives the load and discharge moves of a container while CODECO gives the gate-in and gate-out moves of the container at the port. If a port is not equipped to send CODECO/COARRI files then locations are to obtain the container moves in EDI format from designated vendors at the port. Container moves should be up to date as this helps with the container tracking. Hence the logistics department should ensure container moves are updated in the system as soon as the EDI files are received.

#### **Brief explanation how the process for container moves is updated in the system:**

- 1) EDI files are to be obtained from various concerned entities in order to update the latest container moves.

- 2) Terminals / CFS / Empty yards & Master Mariner send the container move files to be updated in the system.
- 3) Shipping lines' IT team has set a rule for receiving all EDI files from ICD/CFS/Empty depot vendors through specific email ( e.g. **IN363-eirv.<Location Name>@msc.com**)
- 4) The files (CODECO / CORRARI) are received from Terminal through email.  
Where, **CODECO** - gate-in, gate-out movements of containers from terminal and  
**CORRARI** - load and discharge movements of container from the vessel.
- 5) IT Team have scheduled Attachment Stripping Script which runs every 10 mins on the server where these mails are received. It checks for new emails in Inbox and once it finds new emails it copies attachments from emails to Cyclone Server.
- 6) Once the file is moved to Cyclone rest other process is been managed by IBOX which is the EDI software of shipping line.

Logistics department has to ensure that, all load and discharge moves are updated in the EDI system as much as possible on a real-time basis. Generate a file of discharged & loaded containers with their next port of discharge and final destination and upload the file on Intranet website where the headquarters can plan the container distribution accordingly. Once file is uploaded on Intranet website, the shipping lines' headquarters will accordingly update the load & discharge list for the particular vessel against the port of call in Live Schedules.

## **2. Maintaining Stock & Gate In/Out Activities of containers:**

The Daily stock monitoring is get done on an all-India basis where the daily stock of containers from EDI system is generated the daily stock of each location is checked and compared through the file which is shared by locations from PAN India.

Daily Equipment stock reports are maintained for all India locations, these reports give visibility of existing empty stock, import laden units, past two weeks performance, forecast for 3 weeks. After analysing the scenario, further supply/ evacuation plans are made to match the forecast. The reports also have the visibility of UAC (Uncleared / Abundant cargo) and other special type of units, the report is daily transmitted to various location offices of shipping line for the efficient management of containers. The aim of this procedure is to ensure the container control functions like maintaining the stock, analysing the imbalance, equipment repositioning, maintenance and repairs are done to make an effective container distribution system.

The Gate-In and Gate-Out movements are helpful to understand the flow containers where the gated-out containers can be identified as loaded out, empty out for export and gated in containers are identified as empty in for stock purpose, destuffing of loaded container, damaged containers for repair. Since with the help of gate report the allocation of containers to specific locations can be managed properly, the data is accurate due to which the future planning is done accordingly.

**Fig. 3.1 Daily Stock Report Format Location wise to ensure the Available Stock of Containers**

Daily of:	Nhava Sheva								DEPOTS AND PORTS	Date	31/08/2016	
	20DV	20OT	20FL	20RE	40DV	40OT	40FL	45HC	40HR	40HC	UNITS	TEUS
FULL import terminal	83				70			22		117	292	501
FULL import off dock												
FULL import with consignee	135	1		2	164	8	2	16	31	283	642	1,146
UAC ( uncleared & abandoned cargo)												
<b>Total FULL</b>	<b>218</b>	<b>1</b>	<b>2</b>	<b>234</b>	<b>8</b>	<b>2</b>	<b>38</b>	<b>31</b>	<b>400</b>		<b>934</b>	<b>1,647</b>
MTY'S @ ports	311				208		3		344	826	1,692	3,073
MTY'S @ depots												
MTY'S minor damaged	2				1					3	6	10
MTY'S major damaged	19				10				8	32	69	119
<b>SUB TOTAL AVAILABLE STOCK 1</b>	<b>332</b>			<b>219</b>	<b>3</b>	<b>352</b>	<b>861</b>				<b>1,767</b>	<b>3,202</b>
ON-HIRE pending to be picked up												
<b>SUB TOTAL AVAILABLE STOCK 2</b>	<b>332</b>			<b>219</b>	<b>3</b>	<b>352</b>	<b>861</b>				<b>1,767</b>	<b>3,202</b>
Nominated for OFF-HIRE												
OFF-HIRE to be picked up												
Nominated for SALE												
SALE to be picked up												
Blocked for CLAIM												
Blocked for SPECIAL CASES												
<b>SUB TOTAL BLOCKED STOCK</b>												
<b>GRAND TOTAL STOCK</b>	<b>332</b>			<b>219</b>	<b>3</b>	<b>352</b>	<b>861</b>				<b>1,767</b>	<b>3,202</b>
Last week Gates										Week N: 34		
IN	586				349				238	773	1,946	3,306
OUT	553				334				237	630	1,754	2,955
Difference	33				15				1	143	192	351
2 weeks ago Gates										Week N: 33		
IN	524				388	1		91	737		1,741	2,958
OUT	29				9			2	162		202	375
Difference	495				379	1		89	575		1,539	2,583
AVG last 2 wks difference	264				197	1		45	359		966	1,467
AVG last 2 wks daily Gate IN	111				74	0		33	151		369	626

### 3. Container Planning Procedure – Short-term and Long-term:

Parameters to be considered for planning empty containers are very dynamic and have to be based on experience and through knowledge of the import-export dynamics of the location.

The following should be taken into consideration while planning for empty containers:

- Containers to be picked against valid booking Dos (Delivery Order)
- Turnaround time of Import containers
- Expected import arrivals loaded and empty

- Empties repositioned into India by headquarters
- Gate-in/out report to check the import-export imbalance
- Future growth/decline projection
- Time lag between various stages and current position of individual containers
- Damaged containers and their estimated repair time
- For accurately forecasting the time taken for the above activities and the requirement for empties at various locations, statistical models can be used.

For the imbalance analysis and container repositioning the container planning procedure is very much important as per this data we can make the long-term and short-term planning of container and which will result into efficient container distribution system.

**Following are the Steps to Prepare an Imbalance Analysis and Container Repositioning:**

Step 01: Obtain 3-week export-import projections for the future vessels from sales team of every location.

Step 02: Calculate and estimate the expected empties from the previous weeks import arrivals based on import container turn time.

Step 03: Calculate the number of empties planned for repositioning at various locations around India.

Step 04: Consider the time taken for repositioning or evacuating empties by various modes of transportation.

Step 05: Based on the above figures calculate the empty requirement for the future weeks.

Step 06: Inform empty requirement forecast to headquarters.

Every day container moves from terminals, Empty yards and CFS across PAN India shipping line offices are being updated into our EDI system on real time basis. On a daily basis, each location pulls & prepares the report of their own location and sends to Logistics team every day. The container control team monitors All India location reports. Similarly, the Logistic team also prepares a Pan India report by move code based on which All India Stock. The logistics team then checks & compares the stock report sent by individual location with the All-India stock report pulled by their team. Only if there is major difference in the stock details, they check with respective branches/location and rectify. Once the stock report is updated, they then compare with locations stock to check if empties is required for location. If yes, then the tariffs by rail & road is compared to that particular location and accordingly call is taken for supply of Empties.

#### **4. Maintaining Historic Gate Events and Analysis to Current Trend:**

Maintaining historic gate events is the most important aspect to analyse the past trend, which helps to forecast and plan for the upcoming weeks.

The following should be taken into consideration while maintaining historic gate events and doing the forecast.

- Events should be recorded within 5 hours of its occurrence.
- The data is to be maintained on a weekly basis.
- Forecast and planning will be done by taking reference of the trend of the previous year.
- Comparison and trend analysis become a tool for the team which is used for forecasting and planning.

#### **Following are the steps to maintaining historic gate events and analysis to current trend:**

Step 01: Gate In/Out events are extracted from EDI system on weekly basis, those are compared with the weekly performance of previous years for same location and container type.

Step 02: Based on the trend of previous year and expected imports in future weeks (imports on water) the forecast is done for future weeks.

Step 03: Any major addition/elimination of any Port/Region in MSC Mainline services may affect the further in/out flow of containers. Accordingly forecast is done.

Step 04: The observations & plans are transmitted to headquarters & concerned departments in other offices in India.

#### **5. Expected Surplus and Deficit scenario location wise:**

The past few weeks pattern and the upcoming weeks forecast is important to anticipate the location as Surplus or Deficit. Logistics department has to ensure the containers are planned in right quantity at right place in right conditions to suit the EXIM needs.

#### **Following are the steps to generate Expected Surplus and Deficit scenario location wise:**

Step 01: Observe the Gate In/Out trend of the past few weeks, location, and container type wise.

Step 02: The Imports which is in pipeline (on water, on the way) is taken into consideration.

Step 03: Forecast is received from the Import/Export Trade desk which is also taken into consideration to define a location Surplus/Deficit.

Step 04: Necessary actions & Planning are done based on the state of a location for different container types.

### **3.2 Container Shipping Industry - Overview**

Container shipping has been around for over 50 years, and its standardisation started shortly after, led by the International Organization for Standardization (ISO). Shipping containers are strong metal boxes that are used to transport goods from place to place. They are generally made of steel and designed to be robust enough to handle long shipments. Standardised containers have transformed the shipping and transport industry, allowing the transport of goods by rail, road and ship easily, as the containers can fit onto different forms of transport with ease.

The standardisation of containers has helped increase efficiency and economies of scale. There are two ways to pack containers: Full Container Load (FCL) and Less-than-container Load (LCL), which is also known as break bulk shipments. If you only need to import a small amount of goods that do not require a full container, you may want to consider an LCL shipment. In this type of shipment, a shipping broker or freight forwarder combines your supplier's goods with others to create a full shipment. Although the unit cost per kg is higher than that of an FCL shipment, the total delivery cost will be lower. Containers are packed using various materials such as pallets (or skids), which are usually wooden or plastic supports for the load, shrink wrap, slip sheets made of plastic, or crates. These packaging materials are used to transport goods in and out of containers.

### **3.2.1 There are six types of Shipping Containers:**

#### **i. Dry storage containers:**

These are the standard previously mentioned shipping containers, which are used to ship dry materials. They are normally 10ft, 20ft, or 40ft in length.

#### **ii. Flat rack containers:**

These contain collapsible sides that fold. They are ideal for shipping boats, equipment, and cars.

#### **iii. Open side containers:**

On this style, the doors to the containers can be opened completely on the side, which allows for wider loading of materials. This structure makes them ideal for shipping vegetables.

#### **iv. Open top containers:**

As per the title, these containers have no roof, which enables goods of any height to be shipped. This makes them ideal for items such as logs or machinery

#### **v. Refrigerated containers:**

These are containers that are refrigerated. they are ideal for food stock or pharmaceutical goods

**vi. Tanks:**

These are designed to retain liquids (including fuels).

**3.2.2 Container Types and Specifications:**

**Fig. 3.2 Container Types and Specifications**



**20 FT Dry Container**



**40 FT Dry Container**



**40 FT Dry High Cube Container**



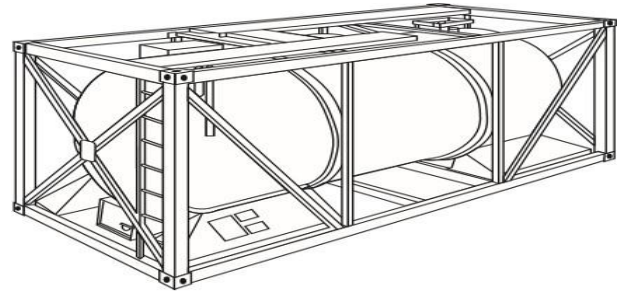
**20 FT Flat Rack Container**



**40 FT Open Top Container**



**20 FT Reefer Container**



**40 FT Reefer Container**

**20 FT Tank Container**

### **3.3 Shipping Container Conditions:**

Shipping container conditions can be a determining factor in choosing the right container type for your cargo. Since, it is necessary to keep the cargo safe and it must reach the final destination safely. The containers are made of Corten steel. This is the major material that creates all metal shipping containers. All the parts of the container: the corrugated wall panels, cargo doors, cross members, and frames, are made using Corten steel. The reason for this is that Corten steel is rust-resistant requires no painting. And is also weldable. This makes it the top pick for container manufacturers.

Containers may suffer from wear and tear, caused by several factors like harsh weather, improper stowage, pest infestation, odour contamination, and mishandling during loading and unloading, despite their sturdy structure. The condition of containers is affected by these factors, and their quality deteriorates over time due to the number of journeys they have undertaken. While a new container will always be in top condition, frequent use will lead to wear and tear. To maintain and monitor the condition of containers, it is recommended to have regular surveys conducted by professional container surveyors. These surveys provide important information on maintenance and repairs, ensuring that containers are kept in good condition.

**Fig. 3.3 Standardised Containers used in Shipping**





Container operations require many skills, one of which is to ensure the right container, is at the right place, at the right time to meet the shipper's ever more demanding needs. For the container operator it means the constant repositioning of containers, this arises from the imbalance of trade. Container grade in container conditions is very important, as per the type and quality of cargo the grade of container is required. The specific grade container is required for a specific type of cargo and it is necessary to carry out the trade with the help of same grade container. The reason conditions matter is goods safety, whether it's needed to be transported or stored as inventory. And goods can only stay secure if the box is equipped enough to safeguard them. Hence, the better the condition, the better the cargo safety.

### **3.3.1 Types of container conditions which used in container shipping industry:**

#### **i. F – Food Grade Containers / New:**

The transport of food needs certain requirements for the shipping container, such as that it has never carried any toxic chemicals or products before. And even though your food is packed in bags and hence is not in direct contact with the container, the mode of transportation still has to be in food-grade containers to avoid unnecessary contamination risks.

- The structural condition of your box for this grade is an IICL 5 with valid a CSC Plate.
- There is high internal cleanliness with scratches not exceeding 2mm in depth.
- Your box is waterproof and with zero-daylight visibility from inside of the box when closed.
- Your box has not carried any toxic chemicals or products before.
- Meets the standard for food grade quality/ import mostly ruled by governments.

**Fig. 3.4 'Garde F' – Food Grade Container**



**ii. ‘Grade A’ Containers:**

These are new, refurbished or used containers. They have only minimal rust and dents and are Wind and Water-Tight (WWT).

- The container doors, floor, and seals will be in great condition.
- The structural condition is IICL5 with valid a CSC Plate.
- The interior of container is mark-free.
- There is minimal surface rust.

**Fig. 3.5 ‘Grade A’ Container**



**iii. ‘Grade B’ Cargo worthy containers:**

‘Cargo Worthy’ (CW) is considered in an acceptable condition for transporting cargo. This means that if you need to transport goods, this container will suffice. In addition, this designation indicates that the container meets all the standards outlined in its original specifications. Generally, it also means that the container possesses a valid CSC plate, which is a safety approval label that all containers used for international transport must have.

- CW container, is guaranteed an IICL 5 with a valid CSC Plate.
- Used containers fall into this category.
- Container interior will be a minimum of 50% mark free, with some scuffing or scratching and minor surface rust.
- The floor of container will be stained or marked and may have minor delamination.
- The exterior may have more prevalent corrossions and dents.
- The container may have a small number of previous repairs.

**Fig. 3.6 ‘Grade B’ – Cargo Worthy (CW) Container**



#### **iv. Grade C (WWT, Wind and Water Tight):**

A container is wind and water-tight if no wind or water can penetrate the container. These containers are suitable for the cargo transportation under the TIR/UIC/CSC criteria. Typically, it also implies that your container has a valid CSC plate.

- These containers are good for storing and transporting your goods and are also called cargo worthy 2 containers.
- There will be some extensive markings, corrosion, and scratches on the containers.
- The floor of container will be marked and may also have moderate delamination.
- It would have undergone several previous repairs.
- Container is said to be the most common and the cheapest.
- The Container WWT box will show wear and tear.
- These containers are often used as storage containers.

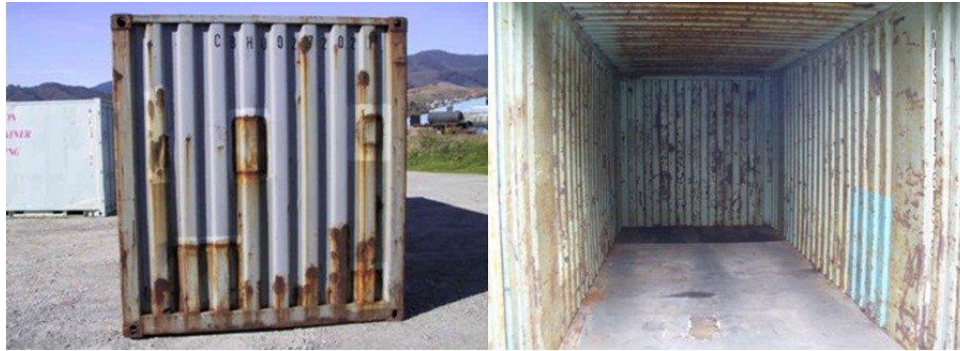
**Fig. 3.7 'Grade C' Container**



#### **v. Aged Containers:**

The aged container is manufactured very long time as 19 years and above, these are damaged containers that have been taken out of commission in the shipping industry and are sometimes not even usable for storage. They could have majority damage on the roof or walls, damaged floors, bad seals, doors that are difficult to open, or structural damage. If you are looking for a box for other purposes such as office spaces, swimming pools, etc, and ready to spend money on its entire repair, they can be ideal.

**Fig. 3.8 Aged Container**

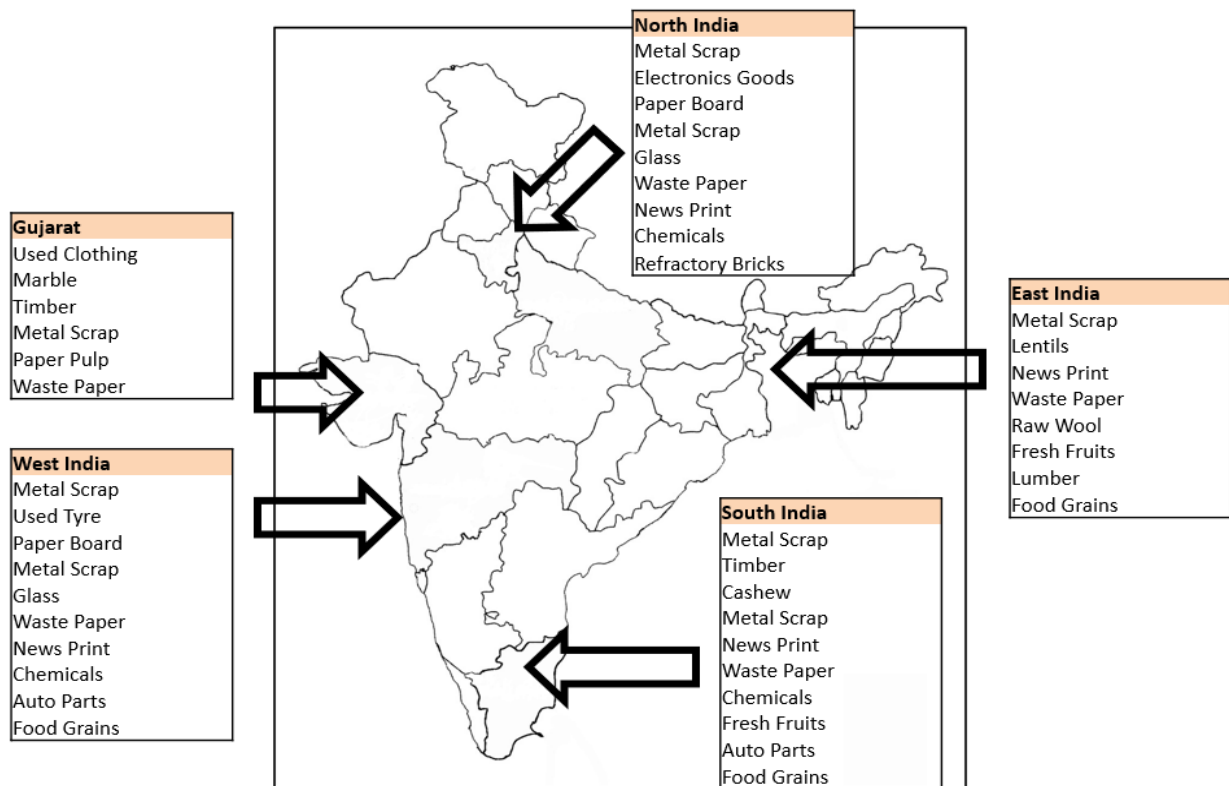


Since the container distribution can be plan as per the demand of types of container conditions, the right number of containers must be kept ready in container stocks at empty yard. Most of the time Cargo Worthy (CW) containers have huge demand rather than food grade containers, hence we can keep adequate number of 'F-Grade' containers and a greater number of CW containers. Due to this the proper number of containers can be distributed to the right locations and hence by implementing this strategy the container congestion can be reduced in various areas of port.

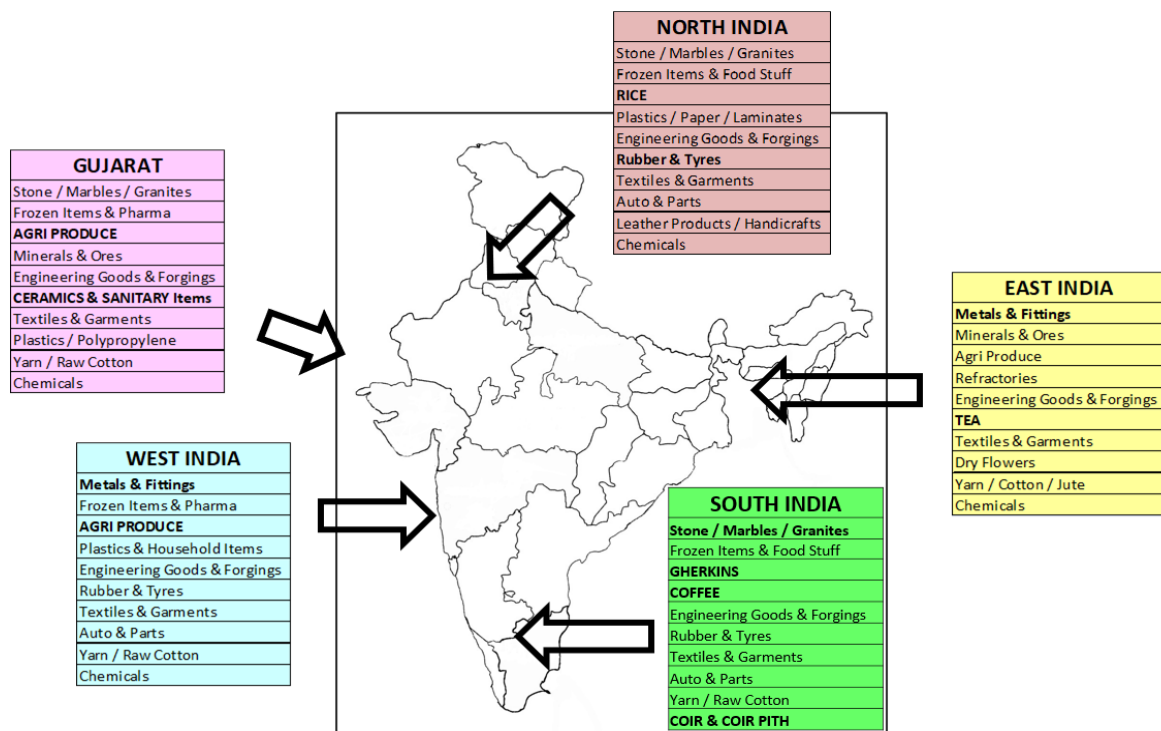
### 3.4 Commodities Transported through Containers:

The location wise container handling commodities which include the various types of cargo and specific commodities.

**Fig. 3.9 Regional Imports Commodities**



**Fig. 3.10 Regional Exports Commodities**



Commodities transported through cargo containers are diverse and encompass a wide range of products, from raw materials to finished goods. The containerization of cargo has revolutionized the transportation industry, making it more efficient and cost-effective. Commodities transported through cargo containers include consumer goods, electronics, textiles, machinery, food products, chemicals, and pharmaceuticals, among others. The use of cargo containers has enabled businesses to streamline their supply chains and reduce transportation costs by utilizing intermodal transport, which involves the use of multiple modes of transportation, such as ships, trucks, and trains. This abstract provides an overview of the commodities transported through cargo containers and the benefits of containerization for businesses and the global economy.

Commodities transported through cargo containers are diverse and include, but are not limited to, Consumer goods such as clothing, footwear, and household items, Electronics such as computers, smartphones, and televisions, Food products such as fruits, vegetables, and processed foods, Raw materials such as metals, minerals, and lumber, Chemicals such as industrial and agricultural chemicals, Pharmaceuticals and medical supplies, Machinery and equipment such as industrial machinery and heavy construction equipment, Automotive products such as vehicles, parts, and accessories, Textiles such as fabrics and clothing, Plastics and rubber products. These commodities are transported via cargo containers using intermodal transportation, which involves the use of multiple modes of transport, including ships, trucks, and trains.

## **CHAPTER IV**

### **Case Study on MSC Agency India Pvt Ltd. Container Distribution Process**

#### **4.1 Introduction to MSC Mediterranean Shipping Company:**

**Mediterranean Shipping Company S.A. (MSC)** is a Swiss-Italian international shipping line. The company operates in all major ports of the world. It is the world's second-largest shipping line in terms of container vessel capacity. MSC Mediterranean Shipping Company is a global business engaged in the shipping and logistics sector. Present in 155 countries, MSC facilitates international trade between the world's major economies, and among emerging markets across all continents.



Founded in 1970 and headquartered in Geneva, Switzerland, since 1978, MSC is a privately-owned organisation driven by the Aponte family. A world leader in container shipping, MSC has evolved from a one vessel operation into a globally-respected business with a fleet of 730 vessels and more than 1,50,000 staff. MSC delivers goods and services to local communities, customers and international business partners. With access to an integrated global network of road, rail and sea transport resources, the company prides itself on delivering global service with local knowledge. Through a network of 675 offices, MSC ensures that shippers can talk directly to our representatives, as well as using a variety of e-business solutions for digitalized cargo bookings.

Responding to the needs of our customers, MSC is a major driving force behind the evolution of smart containers in our industry, helping to set the standards for digital shipping. MSC calls at 520 ports on 260 trade routes, carrying some 23 million TEU annually, via a modern fleet, equipped with the latest green technologies.

**MSC Mainline Services for India:**

**Table 4.1 MSC Mainline Services for India**

Sr. No.	Service Name	Service Route
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1.	<b>IPAK</b>	Nhava Sheva – Hazira – Mundra – Gioia Tauro – Valencia – Rotterdam, Antwerp – Felixstowe – King Abdullah – Salalah – Port Qasim – Nhava Sheva.
2.	<b>Himalaya</b>	Colombo – Nhava Sheva – Mundra – King Abdulla – Gioia Tauro – Felixstowe – Hamburg – Antwerp – Le Havre – Sines – Gioia Tauro – King Abdullah – Colombo.
3.	<b>New Falcon</b>	Mundra – Singapore – Shanghai – Ningbo – Chiwan – Singapore – Colombo – Salalah – Bandar Abbas – Jebel Ali – Dammam – Jubail – Mundra.
4.	<b>Indus Service</b>	Jebel Ali – Port Qasim – Mundra – Nhava Sheva – Haifa – Valencia – New York – Norfolk – Charleston – Savannah – Freeport – King Abdullah – Jebel Ali.
5.	<b>Australia Express</b>	Colombo – Salalah – Djibouti – King Abdullah – Valencia – London Gateway – Antwerp – Le Havre – Fos – La Spezia – Naples – Gioia Tauro – Pointe – Port Louis – Des Galet – Sydney – Melbourne – Adelaide – Fremantle – Singapore – Colombo.
6.	<b>S. Africa</b>	Mundra – Nhava Sheva – Hazira – Colombo – Port Louis – Coega – Durban – Port Louis – Salalah – Jebel Ali – Port Qasim – Mundra.

According to the mainline services the container arrival, repositioning, evacuation, and overall container distribution planning is get done. By following the route, the containers are planned to load and discharge from specific ports. The number containers are loaded from earlier port of loading and discharges to next port of discharge and as the demand arises of specific containers the right number of containers of right type, at right location, at right time are get planned to avoid the future deficiency of container in particular location. As per the surplus and deficit data report the container movements are planned and on the vessel the containers get loaded or discharge to maintain the imbalance of container through every location.

### **MSC Logistics and Equipment Control Department**

The logistics department is responsible to perform the equipment control and logistics functions as per the timeliness and quality guidelines given by respective in-charge from MSC Geneva Logistics Department. Responsible to provide the regular and ad-hoc analysis asked by MSC Geneva from time-to-time basis, the reports must be accurate and completely matching the requirements to solve the purpose explained by MSC Geneva.

**Fig. 4.2 Double container placed vehicle**



### **General Procedures:**

MSC Logistics and Equipment Control department performs the logistics functions which includes,

- Equipment Tracking and Monitoring
- Intermodal functions
- Equipment imbalance and empty planning
- Equipment cost control
- Vendor management and revenue
- Cost analysis and reports

These are the functions carried out by logistics department as per the guidelines of MSC Geneva

### **Responsibilities:**

- The logistics department is responsible to perform the equipment control and logistics functions as per the timelines and quality guidelines given by respective in-charge from MSC Geneva Logistics Department.
- Responsible to provide the regular and Ad-hoc analysis asked by MSC Geneva from time-to-time basis, the reports must be accurate and completely matching the requirements to solve the purpose explained by MSC Geneva.

### **4.2 Container Planning and Distribution Process adopted by MSC:**

MSC has implemented a comprehensive container planning and distribution process that involves several stages, to ensure the efficient and timely movement of cargo. The first stage of the container planning and distribution process is to identify the cargo requirements of customers

and determine the most appropriate shipping route. MSC has an extensive network of shipping routes that cover all major ports and cities worldwide, allowing customers to choose the most convenient and cost-effective option. Once the shipping route has been determined, the next stage is to plan the container loadings. MSC has a dedicated team of container planners who work closely with customers to ensure that containers are loaded efficiently and safely. The container planners consider several factors, including the weight and dimensions of the cargo, the type of container required, and the specific handling requirements of the cargo. After the container loadings have been planned, the containers are then distributed to the designated ports for loading onto the ships. MSC uses a fleet of modern and reliable vessels that are equipped with the latest technologies for efficient loading and unloading of containers.

Throughout the entire container planning and distribution process, MSC employs a range of sophisticated technologies and systems to monitor and track the cargo, ensuring that it is delivered safely and on time. MSC also provides customers with real-time visibility of their cargo through its advanced online tracking system, which allows them to monitor the progress of their shipments at any time. In conclusion, MSC's container planning and distribution process is a comprehensive and well-planned approach that ensures the efficient and timely movement of cargo worldwide. By utilizing advanced technologies and systems, MSC provides customers with a high level of visibility and control over their shipments, which is critical for successful supply chain management.

**Process of Container planning and Distribution adopted by MSC in India:**

- The import containers arrived on port through vessel are discharged in the container terminal according to their locations, CFS, ICD, Direct Port Delivery (DPD) order and specific area is allotted in container yard of port to import container. Hence the import loaded containers are sent to their respective named place of unloading after discharge.
- The empty import containers arrived on port through vessel are kept in specific empty yard of port till when the shipping line sent the vehicles to gate-out from terminal. The empty containers are arranged as per their empty yard locations outside the port area.

- The available stock of empty containers is kept in respective empty yards of shipping line where the empty yards acts as a vendor to shipping line, which takes care of container storage, repairing, cleaning and arrangement of containers.
- As per the analysing of deficit and surplus stock of each location within India the empty containers are allotted to their respective locations.
- The details report of deficit and surplus location is taken from the respective location offices, whereas the demand of various types of containers the reports are been generated and then these get send to head regional office of shipping line and the allocation of container is done by logistics team.
- The right number of containers are planned to the right location at the right time, the balance of containers is maintained in respective locations. Sometimes the containers are moved from surplus location to deficit to maintain the adequate number of containers in respective location as the demand of stakeholders is get fulfilled.
- In a particular country the demand of empty container is high and they are deficit in their stock then from the headquarters of shipping line the planning of voyage of empty containers is get done and as per the mainline services of shipping line the empty containers are get loaded on the vessel and sent to that country through sea.
- Repairing and maintenance of containers – the advice is the repairing activities of dry container has to be done by 10<sup>th</sup> day after entering into repair yard. And For reefer container as per the availability of party the repairing has to get done fast the allocation of slots is managed by FIFO (First In First Out) basis.
- The PTI, Washing and cleaning of containers must be done in minimum time the container should be ready for next loading in quick time.

### **4.3 Adoption of EDI system for efficient planning of containers:**

#### **Electronic Data Interchange (EDI) System:**

Electronic Data Interchange (EDI) is the electronic interchange of business information using a standardized format; a process which allows one company to send information to another company electronically rather than with paper. In the EDI system there are two software's on which the work is carried out and the systems are,

- 1. IBOX Location**
- 2. IBOX India**

With the help of these software's, we can find out the current status of each equipment and minimize the errors which are found in the system. The EDI files are obtained from the concerned entities to update the latest container moves. The Logistics Executive checks for errors if any, these errors are resolved by taking the appropriate action, and the moves are updated in the IBOX System. Container moves should be up to date as this helps with the container tracking. Hence the logistics department should ensure container moves are updated in the system as soon as the EDI files are received.



Fig. 4.3 EDI System Flow

**Flow of Operations:**

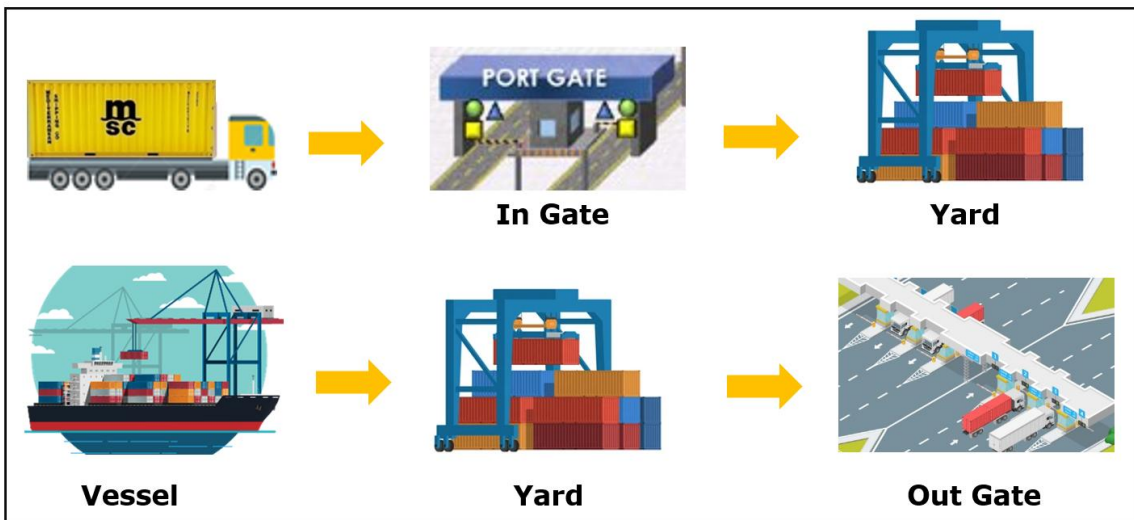
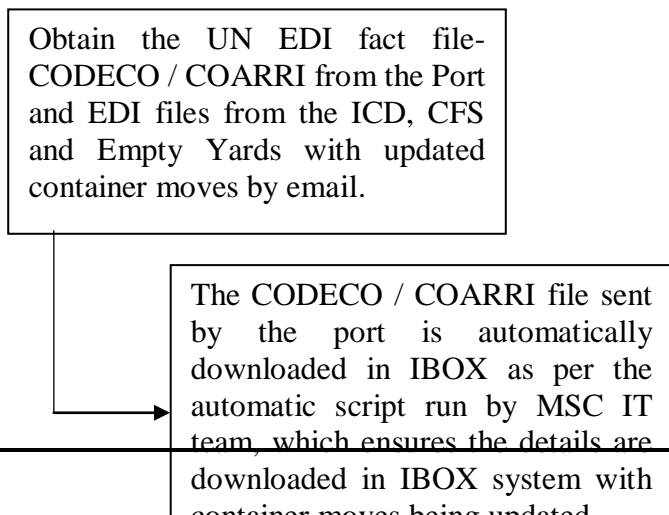
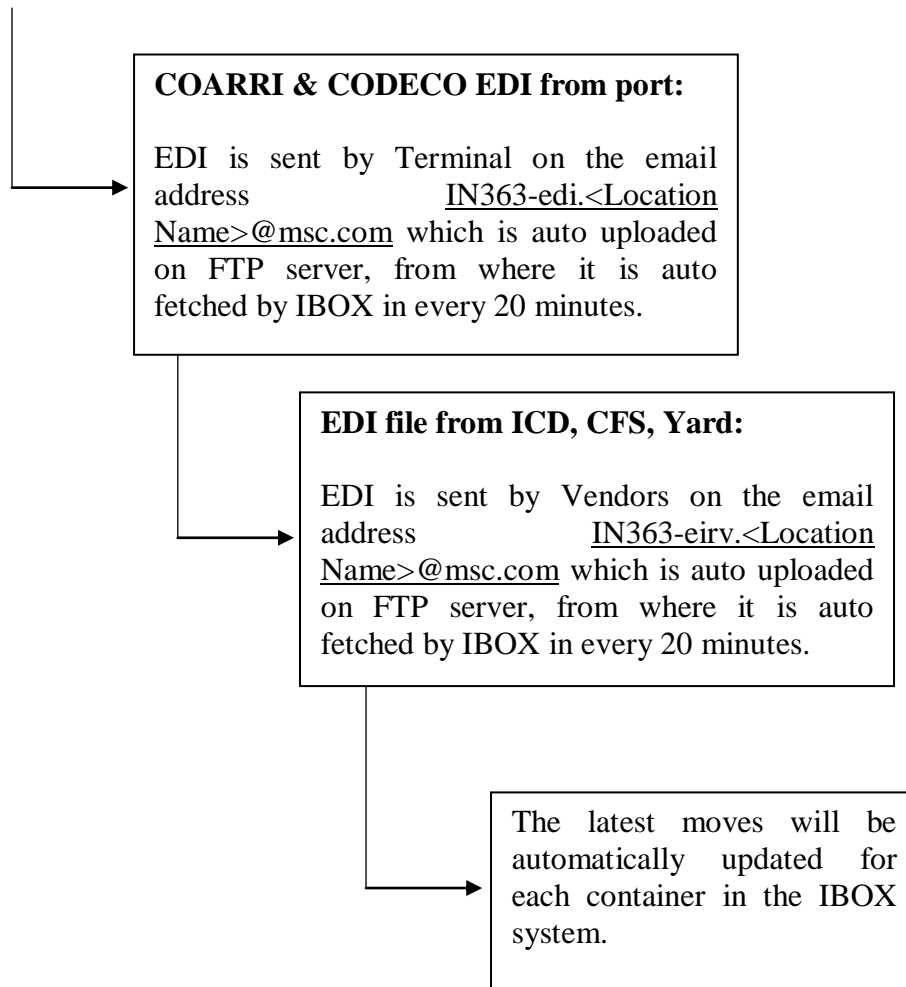


Fig. 4.4 Flow of Operations

**4.3.1 Updation Process of Container EDI moves:**





#### 4.3.2 Import and Export Flow Chart: with EDI Move Codes

Fig. 4.5 Import Flow Chart with Container EDI Move Codes

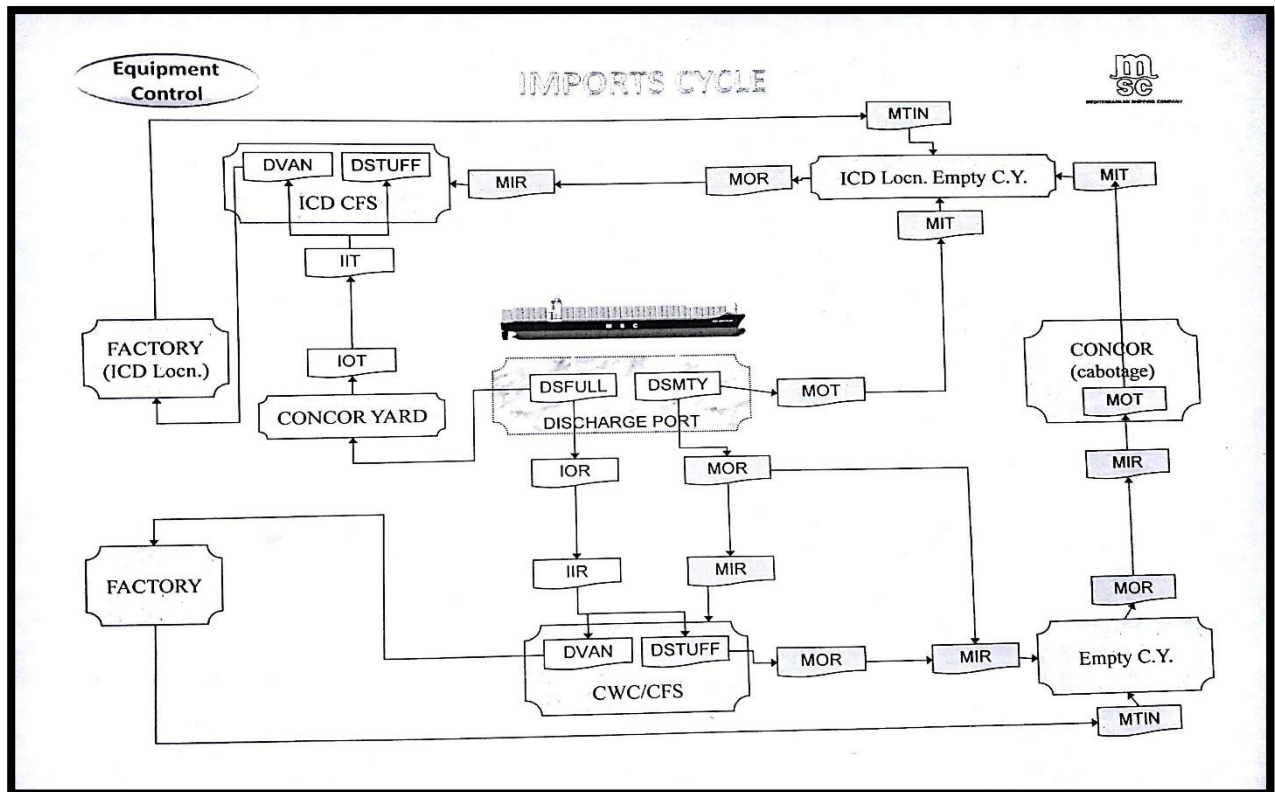


Fig. 4.6 Export Flow Chart with Container EDI Move Codes



**Description of Moves:**

- **DSFULL** – Import FCL container discharge from vessel.
- **DSMTY** – Empty container discharge from vessel.

- **DSFTSP** – FULL TSP container discharge from vessel.
- **DSMTSP** – EMPTY TSP container discharge from vessel.
- **IOR** – Full container get out on Road.
- **FL\_OUT** – Full Out.
- **FL\_IN** – Full In.
- **IIR** – Full container get in via Road.
- **IOT** – Full container gate out on Train.
- **IIT** - Full container gate in via Train.
- **DVAN** – Full container for Devanning.
- **MTIN** – Empty container after Devanning.
- **DSTUFF** – Full container to CFS for destuffing.
- **CSTUFF** – Empty container to CFS for stuffing.
- **MOR** – Empty container gate out on Road.
- **MIR** - Empty container gate in on Road.
- **MOT** – Empty container gate out on train.
- **MIT** – Empty container gate in on train.
- **VAN** – Empty container on vanning.
- **EXPIN** – Full container after vanning.
- **EOR** – Full container gate out on Road.
- **EIR** – Full container gate in on Road.
- **EOT** – Full container gate out on Train.
- **EIT** – Full container gate in on train.
- **LDFULL** – Full container loaded on vessel.
- **LDMTY** – Empty container loaded on vessel.
- **LDFTSP** – Full TSP container loaded on vessel.
- **LDMTSP** – Empty TSP container loaded on vessel.
- **RET** – Return Empty from Shipper.
- **RET\_MT** – Return Empty after Rework.
- **XSTUFF** – Cross Stuffing.

### **4.3.3 Import Flow Chart Description:**

1. Post vessel berthing, when the container discharges from the vessel, the terminal records this event by using COARRI. COARRI is the report message for the discharge and loading of containers on and off from the vessel, respectively. DSFULL is reflected in IBOX system.
2. Similarly, CODECO is used for recording the movement of containers in & out of the gate from the terminal. IOR is reflected in IBOX system.
3. Loaded container is sent to the one of the CFS from the panel, and a surveyor is appointed. Loaded container can also be taken by customer to his nominated CFS.
4. From the CFS, either the container is sent to the importer's factory for destuffing, or it is destuffed in the CFS itself.
5. DVAN container is cleared at the CFS, customs issues Out Of Charge. The importer approaches DO team with Out of Charge after which DO is issued. The container is then taken by the importer to the factory under his custody. The importer is responsible to send the container to the empty depot, after destuffing. At the empty depot, the DO validity is checked. The container is also checked for damages. Only after both these checks, the empty depot accepts this container and this event is recorded as MTIN by the Empty Depot.
6. DSTUFF container moves out for the empty depot. The CFS records gate out movement of the container as MOR. When this empty container reaches the empty depot, same checks are done, after which this event is recorded as MIR.
7. Empty containers discharged from the vessel, are sent to the empty depot. COARRI & CODECO is again used by the terminal to record, DSMTY & MOR respectively. This container is then moved to the empty depot, and this event is recorded by the Empty depot as MIR.

**Fig. 4.7 Container Placing on Rail Wagons**



#### 4.3.4 Export Flow Chart Description:

1. Exporter books container with MSC. He is given a booking number. A container is then allotted from an empty depot, against the booking number.
2. Exporter picks the container from the empty depot under his custody after showing the booking id. This event is recorded by the depot as VAN.
3. The empty container is stuffed at his factory, and the container is sent to the port.
4. Gate-in at the port is recorded by the terminal under CODECO and the loading of the container is recorded under COARRI. These events are reflected in the EDI system as EXPIN & LDFULL, respectively.
5. Some empty containers are moved to the CFS for stuffing. Out-gate movement from the empty depot is reflected as MOR, and gate-in at the CFS is reflected as MIR.
6. Stuffing of these containers is reflected as CSTUFF/VAN in the EDI system. These containers are then moved towards the port for loading. Out-gate from the CFS is reflected as EOR.
7. CODECO & COARRI come into use again to report the in-gate at the port, and the loading of the container on the ship. These events are reflected as EIR & LDFULL respectively.
8. Some empty containers are also exported from the empty depot. Empty depot records the out-gate movement from their facility as MOR. CODECO & COARRI report the container gate-in and empty container loading on the ship, and these events are reflected as MIR & LDMTY, respectively.

EDI files are to be obtained from the various concerned entities in order to update the latest container moves. Terminal sends the edit files on the designated email ids created by MSC IT Team. MSC IT team has set a rule for receiving all EDI files vendors through email. Container moves should be updated in a logical sequence and hence if there is an illogical container move the IBOX system will throw an error and will not allow to update a move.

- The CODECO and COARRI are UN EDI standard format files and are used by Ports globally.
- **COARRI** gives the load and discharge moves of a container at the port.
- **CODECO** gives the gate-in and gate-out moves of the container at the port.

If a port is not equipped to send CODECO/COARRI files then locations are to obtain the container moves in EDI format from designated vendors at the port e.g., Master Marine. Container moves should be up to date as this helps with the container tracking. Hence the

logistics exec should ensure container moves are updated in the system as soon as the EDI files are received.

#### 4.4 EDI Software Move Updation and Error Minimization:

Fig. 4.8 Moves Updation in EDI Move Validation

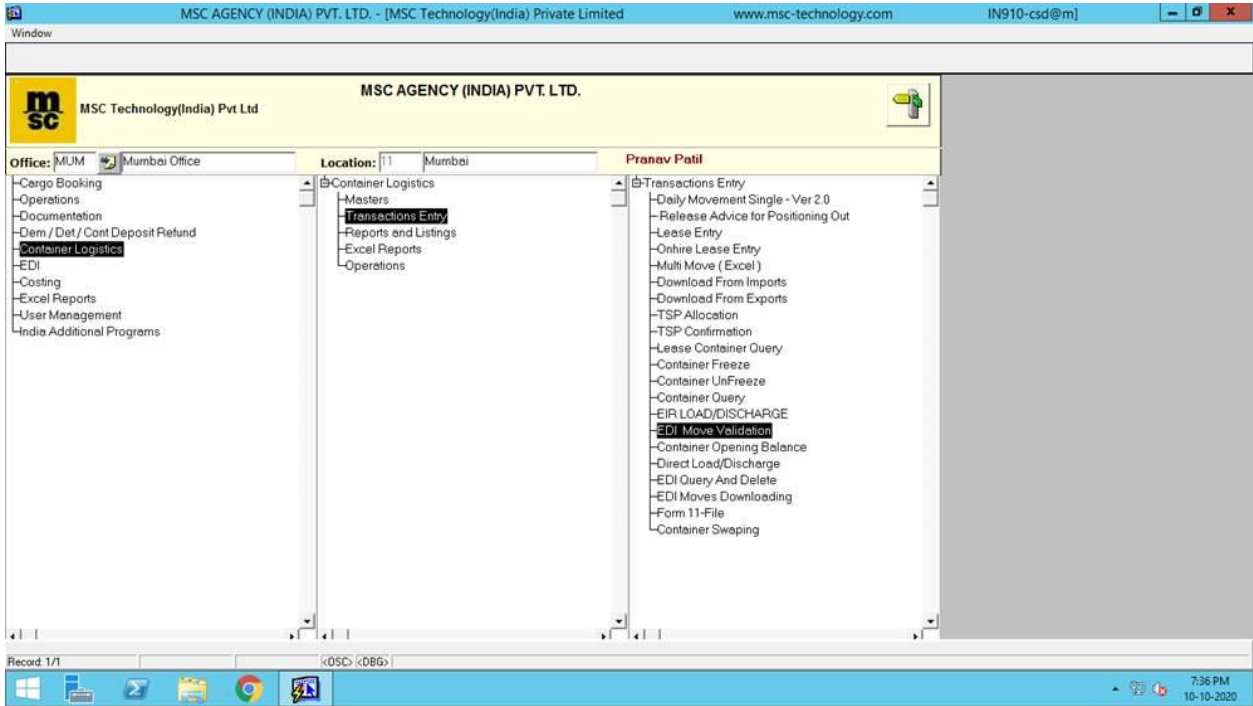
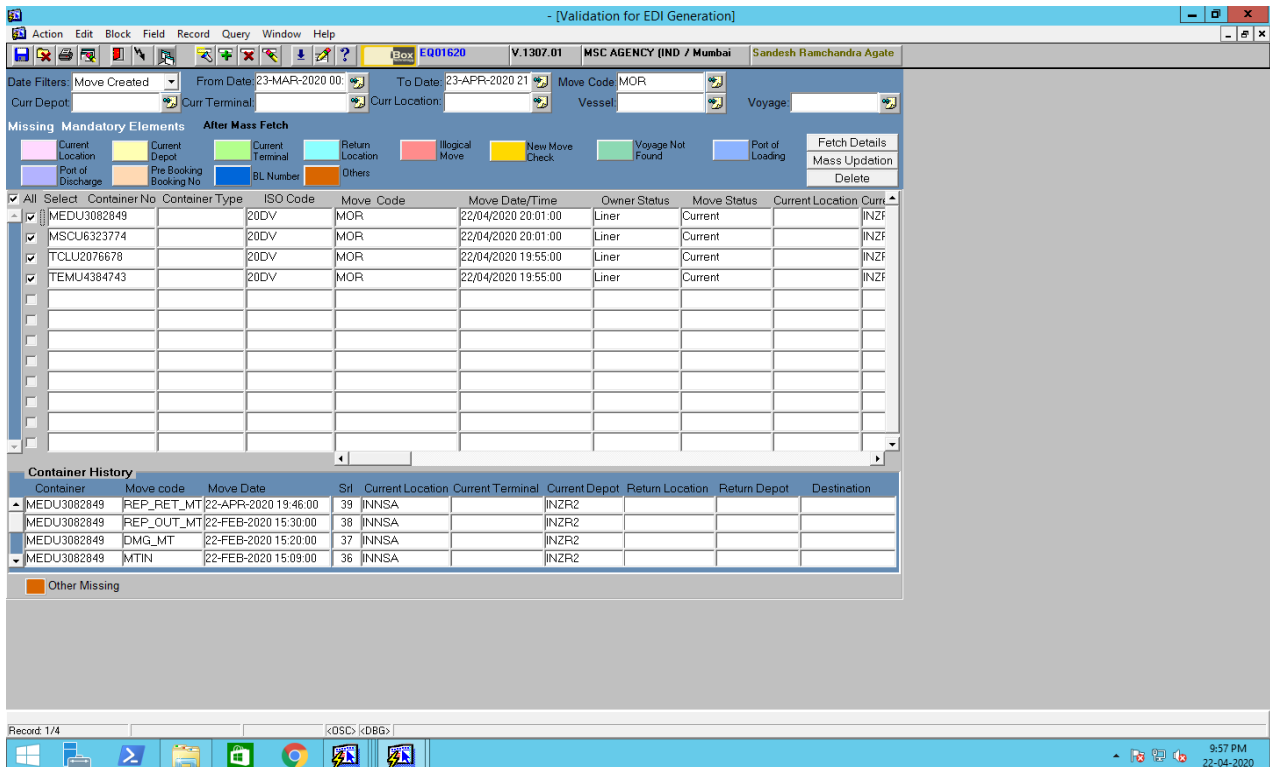
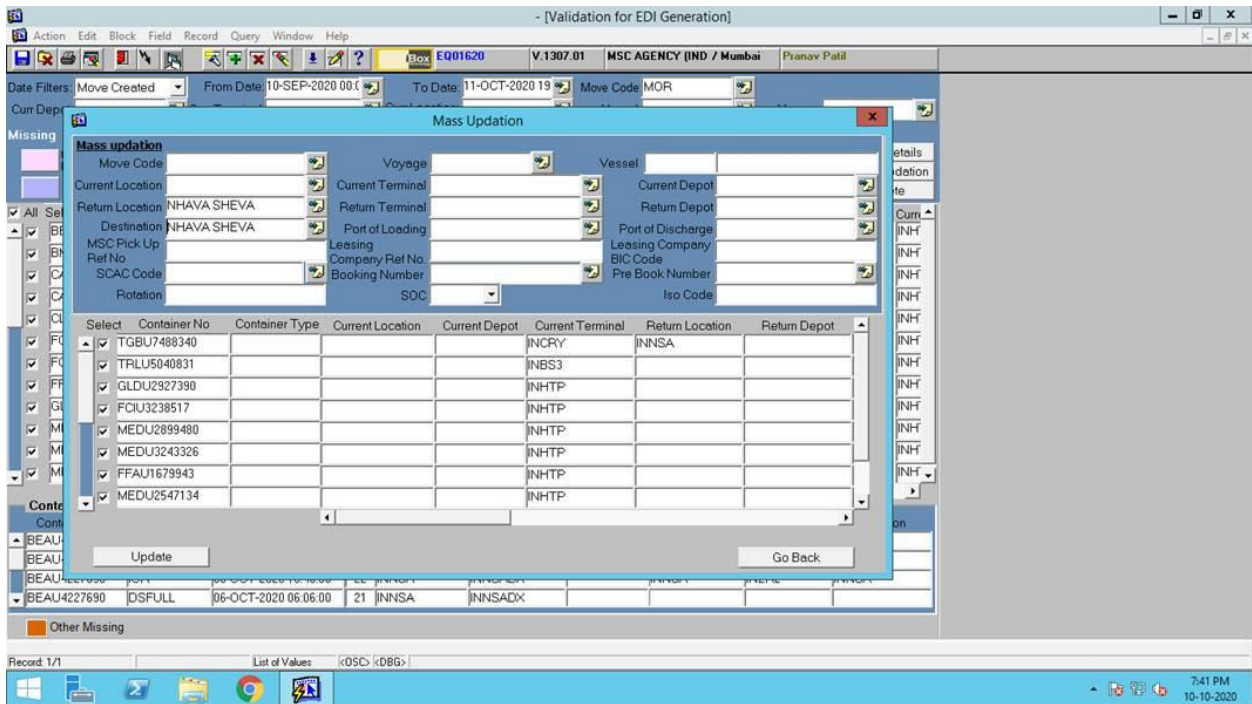


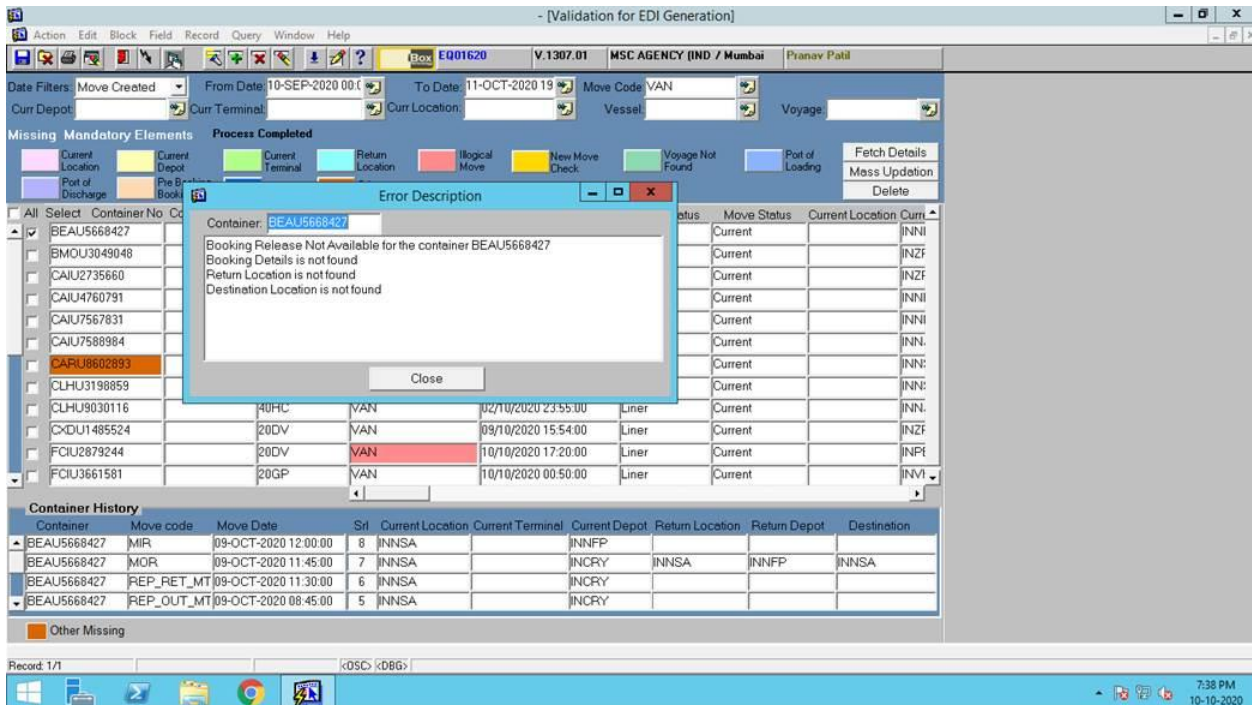
Fig. 4.9 Errors found in Move Code 'MOR'



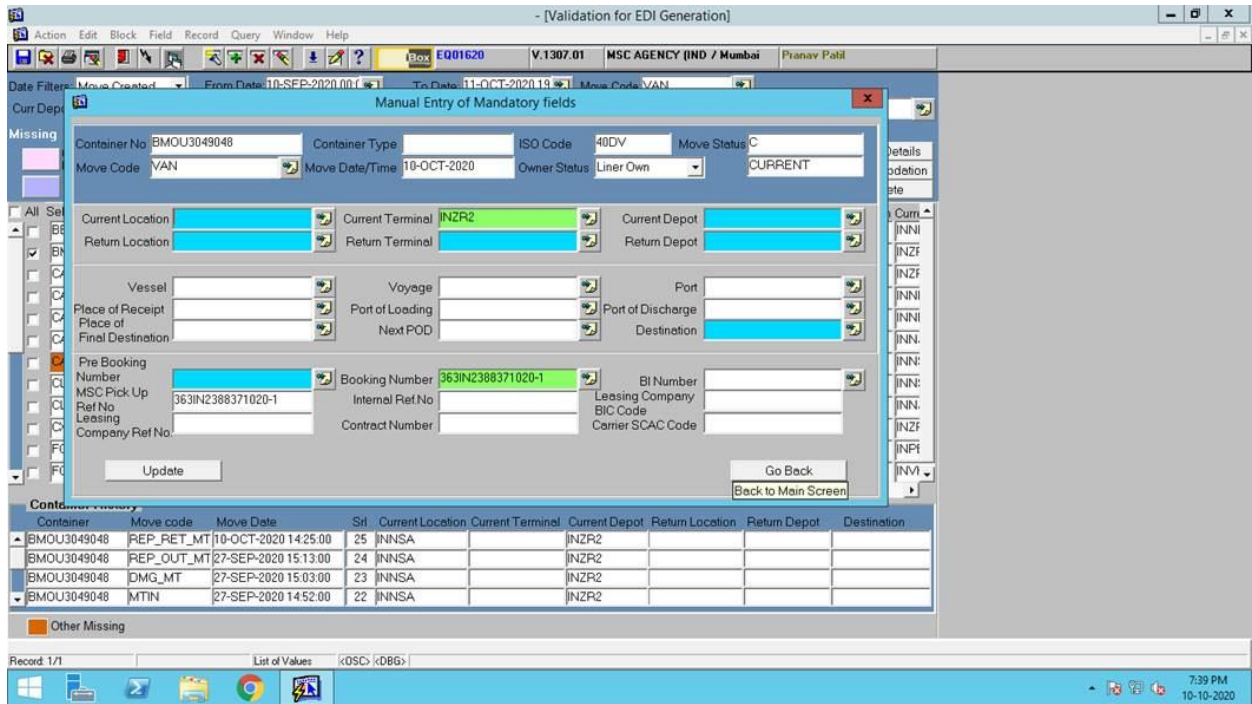
**Fig. 4.10 Updating Return Location & Destination**



**Fig. 4.11 Showing Error Description**



**Fig. 4.12 Manual Entry Window & Container History**



### 4.5 Technology Solutions of MSC Technology Cell:

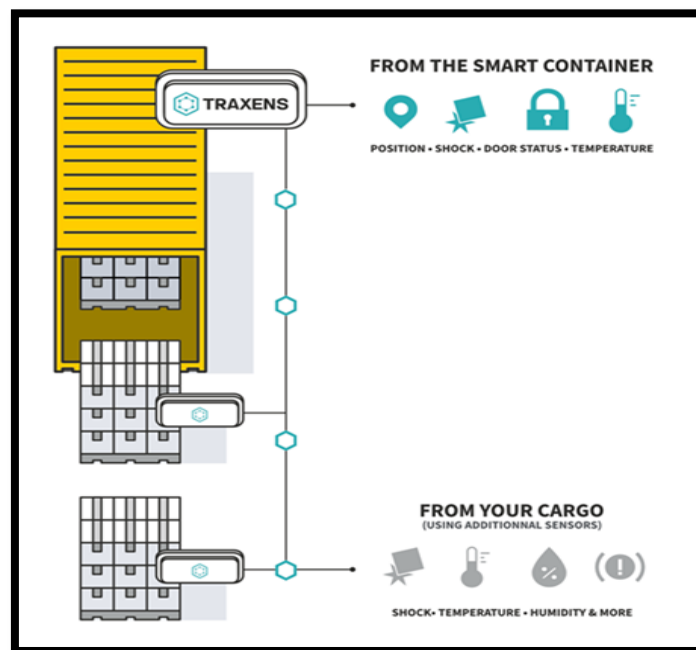


MSC Mediterranean Shipping Company (MSC) is increasingly introducing smart container solutions for customers at many locations around the world, using IoT solutions developed by its partner Traxens. The Traxens Smart Container system is the only system designed from day one

to deliver the benefits of IoT and Big Data to the whole container shipping ecosystem. Years of R&D have been spent developing breakthrough technology which drives down the total cost of operating Smart Container over time. The scalable data platform TRAXENS-HUB was built to manage millions of containers and is easily integrated into corporate IT systems.

Traxens generates, collects, consolidates, enriches and transforms logistics asset data into actionable insight. The breakthrough internet-of-big-things technology provides comprehensive, real-time information for managing logistics assets anywhere in the world. Traxens solutions digitally transform multi-modal supply chains, enabling customers to reduce costs, optimize investments, comply with environmental regulations and deliver premium services to their customers.

Receive reliable information throughout the journey of your cargo, helps you to optimize a large number of operations within your supply chain. This is the reason why, MSC partners with Traxens to give you 24/7 visibility and near real-time notifications on your containers' position and condition. Our smart containers allow you to keep an eye on your dry cargo door-to-door, on sea, rail, or road (position, temperature, movement, shocks, door opening, etc.).



Traxens is directly integrated with MSC's information system and they combine data from the Smart Containers with our data to give you meaningful, contextualized, and timely information. It allows staff, suppliers and customers to have access to selected information, or to receive email alerts. Access all raw data through your TMS or ERP. Data from Smart Containers is

secure and reliable because it is created electronically and encrypted from end-to-end. On Time the routine information is updated at regular intervals each day; important alerts are sent as soon as possible. Customers can get the information which they need and stay in complete control of all their shipments and cargo, making the shipping process simpler and easier. Traxens generates, collects, consolidates, enriches and transforms logistics asset data into actionable insight. The breakthrough internet-of-big-things technology provides comprehensive, real-time information for managing logistics assets anywhere in the world.

Traxens solutions digitally transform multi-modal supply chains, enabling customers to reduce costs, optimize investments, comply with environmental regulations and deliver premium services to their customers. MSC is actively involved in digitalisation in the shipping and logistics sector, because MSC understands how valuable this is for their customers.

#### **4.6 Challenges faced due to container congestion at port and hinterland areas:**

Container shipping lines are facing a multitude of challenges due to container congestion at port and hinterland areas. These challenges have significant implications for the global supply chain and can result in significant delays, increased costs, and decreased efficiency. Below are some of the key challenges faced by container shipping lines:

##### **1. Limited availability of containers:**

The COVID-19 pandemic has caused a significant disruption to the supply chain, resulting in a shortage of containers in many regions. This limited supply of containers has led to a backlog of cargo at ports and hinterland areas, resulting in significant delays and additional costs.

##### **2. Port congestion:**

The lack of available space at ports to accommodate the growing number of containers is another significant challenge. Many ports are operating at or near capacity, and the congestion is leading to significant delays for vessels waiting to unload. This congestion is also leading to increased costs for shipping lines as they are forced to pay demurrage charges for delayed vessels.

##### **3. Inadequate infrastructure:**

The transportation infrastructure in many hinterland areas is inadequate to handle the growing volume of cargo. This is particularly true in developing countries, where the infrastructure may not be sufficient to handle the volume of cargo being transported. The lack of

infrastructure is leading to delays and additional costs for shipping lines as they are forced to use alternative modes of transportation, such as trucking or rail.

#### **4. Shortage of labour and equipment:**

The shortage of labour and equipment, particularly in the wake of the pandemic, is another significant challenge. Many ports are experiencing a shortage of dockworkers, truck drivers, and other essential workers needed to keep cargo moving efficiently. The shortage of equipment, including trucks and cranes, is also contributing to delays and congestion at ports and hinterland areas.

#### **5. Limited storage capacity:**

The limited storage capacity at ports and warehouses is another challenge. As containers pile up, it becomes increasingly difficult to find space to store them. This can result in delays and additional costs for shipping lines as they are forced to find alternative storage solutions.

#### **6. Trade imbalances:**

Trade imbalances between regions can also contribute to container congestion. For example, if there is a high demand for exports from a particular region but little demand for imports, containers can quickly pile up, leading to congestion and delays.

### **4.7 Case Study – Container Distribution Strategy**



#### **MSC Agency India Pvt. Ltd.**

Container Distribution Case – Date: March 2021

In month of March year 2021, there is demand occurred from MSC Delhi office, that there is urgent requirement for the 86 empty containers including 20 ft. DV, 40 ft. DV and 40 ft. HC containers. Delhi location is found deficit in stock. Since, the JNPA has the surplus stock of empty containers, MSC Nhava Sheva office planned to distribute containers to Delhi location. This operation should get done within 02 Weeks.

- The Empty containers received at JNPA port by foreign vessel.
- The route was JNPA to Nagpur and From Nagpur to Delhi.
- Rail facility is arranged to transport 32 containers from JNPA to Nagpur and after that, from Nagpur additional 54 containers will get transport to Delhi by other rail facility.
- **But in between, there is huge rail accident happened before reaching the Nagpur.**

- Due to track breakdown the railway wagons get slipped out from track and containers got heavily damaged.

**Fig. 4.12 MSC Rail Containers Accident – ‘JNPA – Nagpur – New Delhi’**



Most of the containers got heavily damaged and 09 containers declared as total loss.

- Due to this incidence, MSC team was not able to transport these containers to Delhi Location.
- The incidence is reported to MSC Nhava Sheva Head office as the Logistics and Equipment control operations are head by this office.
- Since, the new distribution plan was made after this incidence, the requirement must get filled and delivery containers should be made before time.

**Fig. 4.13 Total Loss containers found due to huge accident**

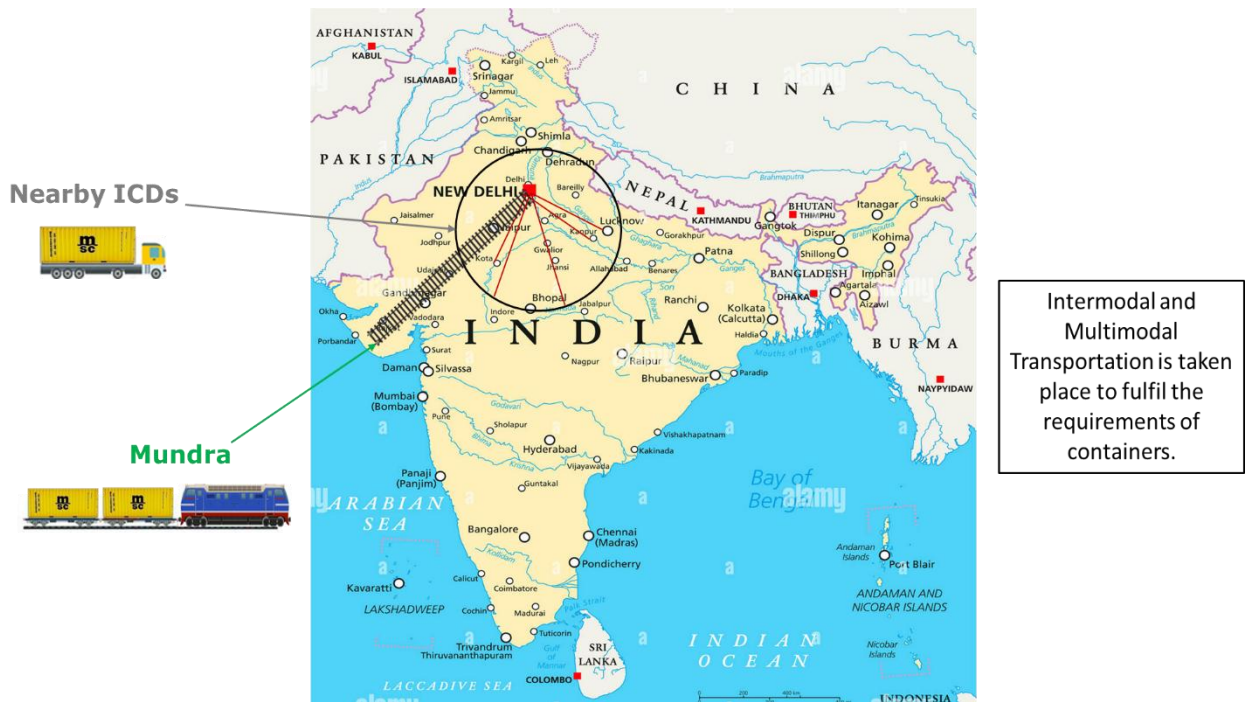


### **Solution – The New Container Distribution Plan**

- Required Quantity – 86 containers.
- MSC team pushed the nearby locations ICDs in Delhi to make the arrangements to transport empty containers to New Delhi.

- Empty containers are planned By Road Transport for New Delhi, due to adequate stock. ICD Palwal, ICD Tughlakabad, ICD Faridabad, ICD Rewari, ICD Moradabad, ICD Kanpur
- Since, Mundra location was in surplus condition many empty containers are planned from Mundra to Delhi by Rail Transport.
- From Jaipur Location Empty containers are planned By Road Transport for New Delhi.

**Fig. 4.14 New Container Distribution Plan**



**Fig. 4.15 New Container Distribution Process**



As per new container distribution plan, 58 empty containers were arranged from Mundra to transport by rail to Delhi location, 28 empty container was arranged from nearby ICDs where the adequate stock of container was available these are transported by road. Hence after the span of 03 weeks the demanded quantity of 86 containers were fulfilled at Delhi location successfully.

Also, the damaged containers in rail accident sent to respective container repair yard for repairing and keeping ready for future use and the total loss containers sent to ‘Gioia Tauro’ as per procedure.

**Fig. 4.16 Container Congestion and Traffic Volume at Port**



The main significant challenge for container shipping line is the lack of available space at ports to accommodate the growing number of containers. Many ports are operating at or near capacity, and the congestion is leading to significant delays for vessels waiting to unload. This congestion is also leading to increased costs for shipping lines as they are forced to pay demurrage charges for delayed vessels. Additionally, the transportation infrastructure in many hinterland areas is inadequate to handle the growing volume of cargo. This is particularly true in developing countries, where the infrastructure may not be sufficient to handle the volume of cargo being transported. The lack of infrastructure is leading to delays and additional costs for shipping lines as they are forced to use alternative modes of transportation, such as trucking or rail.

#### **4.8 Need of effective Container Distribution System:**

- To maintain the balance of container quantity at every location and reduce the storage cost of containers.
- To supply the right number of containers at right location to fulfill the requirement of shippers or exporters.
- To reduce the congestion at Port areas as well as in hinterland locations.
- To maintain flow of containers at all locations with supply of various types of containers.

- The limited availability of containers, port congestion, inadequate infrastructure, shortage of labour and equipment, limited storage capacity, and trade imbalances are all contributing to delays, increased costs, and decreased efficiency.
- Addressing these challenges will require a coordinated effort between shipping lines, ports, governments, and other stakeholders to ensure that the global supply chain can continue to operate efficiently and effectively.

## **CHAPTER V**

### **5.1 Solutions to reduce container congestion**

Container congestion at port and hinterland locations can be a major problem for shipping companies, freight forwarders, and other stakeholders in the supply chain. The following are some solutions that can help to avoid container congestion and improve the efficiency of the shipping industry:

#### **1. Improve port productivity:**

One of the primary causes of container congestion is the limited capacity of port terminals. Shipping companies can improve port productivity by investing in equipment and infrastructure that can handle larger volumes of containers. Additionally, they can implement advanced technologies like automation, artificial intelligence, and blockchain to optimize the entire supply chain.

#### **2. Increase transparency:**

Lack of transparency in the supply chain can lead to delays and confusion, which can contribute to container congestion. By implementing tracking systems and sharing data with stakeholders, shipping companies can improve visibility and coordination, which can help to prevent congestion.

#### **3. Increase collaboration:**

Collaboration between shipping lines, terminal operators, and other stakeholders is essential to avoid congestion. Shipping companies can work together to optimize vessel schedules, reduce turnaround times, and share resources like cranes and other equipment.

#### **4. Expand hinterland infrastructure:**

Hinterland infrastructure, such as road and rail networks, can have a significant impact on container congestion. Shipping companies can work with governments and other stakeholders

to invest in the expansion and improvement of these networks, which can reduce transit times and improve the overall efficiency of the supply chain.

**5. Develop alternative transport modes:**

Shipping companies can also consider alternative transport modes, such as inland waterways and short sea shipping, which can provide additional capacity and reduce the pressure on traditional port terminals.

**6. Implement container booking systems:**

Container booking systems can help to manage container flows and prevent congestion by providing a transparent and efficient way to schedule shipments and allocate capacity.

**7. Optimize container usage:**

Shipping companies can optimize container usage by improving cargo planning and reducing empty container moves. This can help to reduce the number of containers that are idle and waiting for shipment, which can contribute to congestion.

**8. Improve communication:**

Effective communication between stakeholders is critical to prevent container congestion. Shipping companies can implement communication protocols that ensure timely and accurate information sharing, which can help to prevent delays and improve efficiency.

By implementing these solutions, shipping companies can reduce container congestion and improve the efficiency of the supply chain. These efforts can lead to faster transit times, lower costs, and improved customer satisfaction, which can help to drive the growth of the global economy.

**5.2 Techniques to be adopt to Reduce Container Congestion at port and Implementations of Effective Container Distribution System:**

**1. Visit To Depot, Terminal, CFS And ICD:**

- Regular and Planned Visits to Depot/CFS/ICDs are required in order to ensure the defined process is followed and instructions are adhered.
- Regular visits are done to ensure the instructions are properly followed by the custodians, and they are properly guided in case of any difficulty or confusion.
- It's a method to ensure the FIFO is followed and Container Handling, Repairs, Washing & Stacking are done in proper manner.

- Details of Container's Age (no. of days lying in a facility) are referred in order to check and ensure the FIFO is followed.
- It is ensured the containers are properly stacked, have the proper access and are put on flat surface so that there is no damage to the containers. Guide the Depot and ensure proper estimation of damages and repair is done without any delay.
- Ensure the container handler (stackers) and other equipment's are working properly and ensure there is no delay in operation.

## **2. Reuse of Import Container for Exports:**

- When an Import customer also acts as an Exporter, and requests Shipping line grant permission to utilize the import container for exports purpose.
- Export Customer Service Desk to send every such Re-Use request to the Equipment Control Desk to seek approval.
- Once approval & charges received from Equipment Control Desk, customer to be advised on the Charges for same and their concurrence to abide by the SOP.
- Customer provides the all details to the Customer Service Desk as required by Equipment Control regarding the Destuffing Date of Import container, further Stuffing Date for next Shipment.
- Customer Service Desk provides details to Equipment Control Desk including the Export Booking number for further Shipment to get updated into the system.
- Sales and Customer Service Desk to ensure the collection is done (Reuse Fee) well on time for such Reuse requests.

Customer saves Transportation by doing Reuse of Import container for Exports. For providing this Value-Added Service to the customer, Shipping Line charges the Reuse fee to the customers. For such Reuse cases, Imports cycle ends as on Destuffing Date provided by the customer and further Exports Cycle starts from the same date. Accordingly Imports and Exports detentions are calculated, and collection is done from the customers.

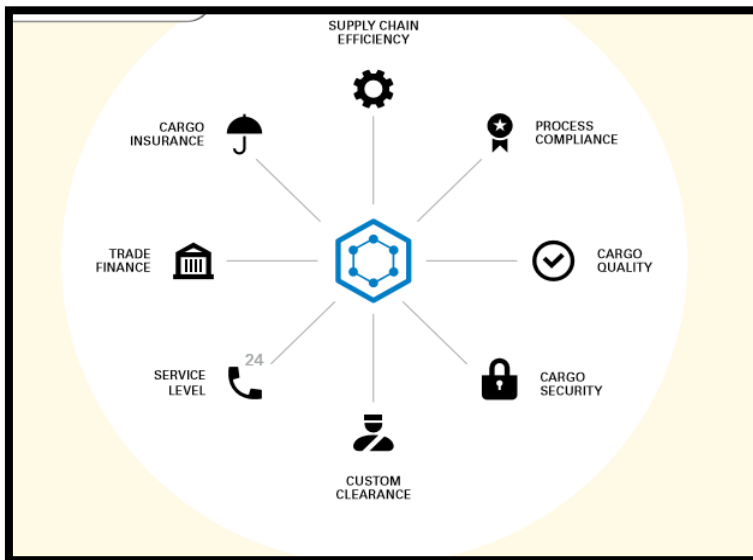
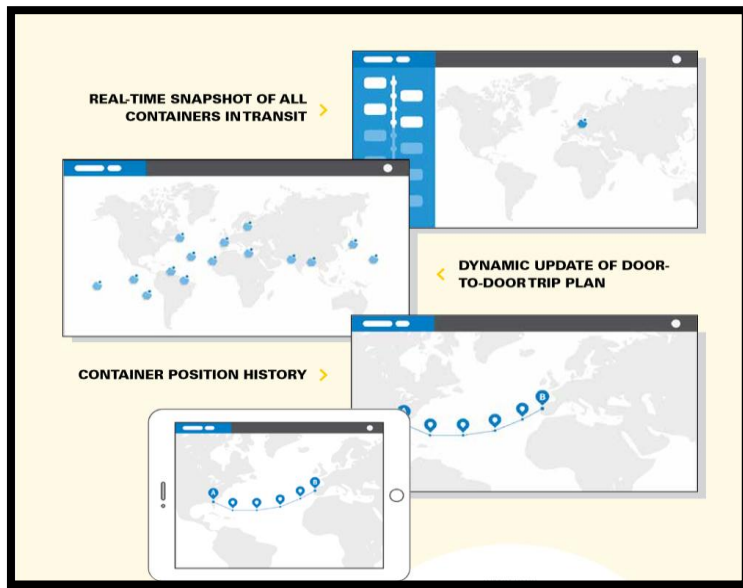
## **3. Handling of Smart Containers (Equipped with Traxens Device):**

### **What is a Smart Container?**

A Smart Container is a standard container permanently fitted with electronics which transmit data contains position, temperature, movement, shocks, door opening and near real-time events like Geofencing in/out site, late in/out site, door status. Customers or Staff can also know more

about the condition of your cargo by placing additional sensors for temperature, shocks, humidity and more, within your cargo. These sensors are like traditional data loggers but they can see the values in real-time as the cargo travels across the planet.

**Fig. 5.2 Advantages of Traxen System**



**Think Big: 100% Smart Containers in Your Future Supply Chain**

The Smart Container represents a major transformation for Supply Chains. As for all major transformations, the “Think Big, Start Small, Build Quickly” rule applies; so, start building your future Container Supply Chain now.

### **Start Small: Container Supply Chain Diagnostic**

A Container Supply Chain Diagnostic is an easy way to start with Smart Containers. There is no long-term commitment, no system integration required, and as always, no installing or returning devices.

- Hard facts about a specific container route allowing you to streamline targeted operations.
- A better understanding of the potential of Smart Containers for your whole Supply Chain.

### **How It Works:**

The diagnostic should be made to include 50 or more container trips, over a three-month period, and from 3 origins maximum. Traxens will ensure with MSC that Smart Containers are made available for each trip instead of standard containers. There is no need to change any processes or to train any operational staff. MSC and Traxens will accompany you throughout so you can access the right data in real time, and Traxens will present a detailed analysis with actionable data at the end of the project.

- The List of Traxens Device fitted containers destined for India (Empty/Laden).
- The updated list of Traxens fitted units is forwarded on daily basis by equipment team to Booking confirmation team/Trade team/Compliance team and to Exports Customer service team.
- Traxens fitted containers needs to be exported to specific countries only as per guidelines given by Traxens team.

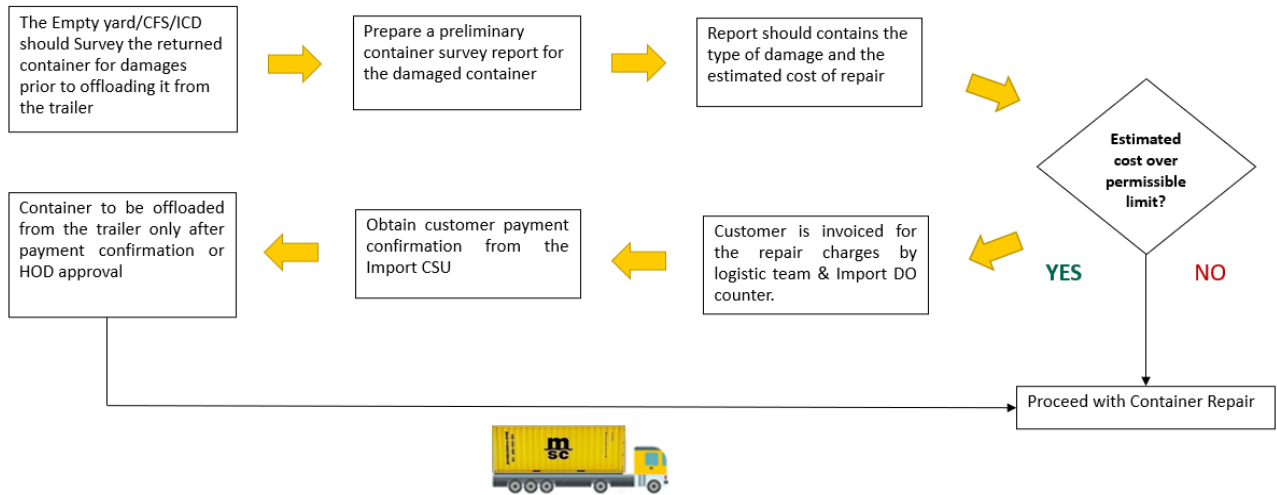
**Fig. 5.3 Installed Traxen Device**



#### 4. Repair And Cleaning of Containers – Dry and Reefers and Under Warranty:

- Each location to have a predefined permissible repair cost limit. If the damages exceed this limit, then the customer has to bear the cost of repair.
- Only machinery repair is cover under warranty and the warranty age is less than or equal to 05 years.
- If the container is in warranty age, repair vendor approaches to service vendor to attain repair job and provides all the details regarding the spare if any.
- After work done service vendor sends confirmation of same to respective yard and after survey, yard sends confirmation to shipping line.

**Fig. 5.4 Container Repairing Procedure**



**Damage Container Report & Collection of Repair Cost:**

- The container damage report received from the empty yard/CFS/ICD should be well documented in an excel sheet.
- The final survey report of the container should contain information such as type of damage, reason for damage and date of receipt of damaged container should be documented.
- The type of repair carried out, the name of the yard where repair was carried out and the cost associated for repair of damage should also be documented.
- The total cost and also the total charges recovered from the customer should also be documented.
- For reefer container the repair estimates are sent by the yard and after getting approval from shipping line the repairing operation get initiated. The container spare parts, machinery parts like compressor, plugs, power cable, display & keypad arranged for repairing of container.

**Fig. 5.5 Damaged Containers in Repair Yard**



**Conducting PTI and Monitoring the Same:**

- PTI (Pre-Trip Inspection) is the mandatory inspection which needs to be performed before allotting container for a Shipment.

- PTI consists of a total of 16 steps. These 16 steps consist only the checks related to machinery, hence require the Power Supply.
- Post Physical Survey, the container is offloaded in the yard, for the PTI. A PTI takes around 4-8 hours to complete. This includes 16 check steps.
- If PTI fails any of the steps, the screen displays the respective step as an error.
- The respective machinery is fixed only after approval from the logistics team. After necessary repairs, PTI is conducted once again.
- After passing all the checks, the container can be allotted for next Shipment.
- PTI is valid for 30 days. Within this time, if the container is not used for export, a RE-PTI check is mandatory.
- The empty depot is responsible to conduct and monitor the PTI.

#### **5. Release of Empty Containers:**

- Empty yard/CFS/ICD to ensure that containers are released against a valid booking DO/JOB ORDER and updated against a valid booking number.
- Shipper/Transporter approaches the empty yard /CFS /ICD with a valid booking DO /JOB ORDER for pickup of empty container.
- Empty yard /CFS/ICD to release container as per valid booking DO.
- Empty yard/CFS/ICD to survey the container for damage and conduct a PTI for reefer containers prior to release to the customer. Also, to note the booking number and container(s) released against the same.
- Empty yards on a daily basis in regular intervals keeps sending the updated EDI file with latest container moves to the assigned specific email address, through which the EDI file having latest container moves automatically gets downloaded in the IBOX system as per the rule set/ assigned by MSC team.
- The Logistic team needs to periodically keep checking and confirming the moves updated in system.

#### **The following should be taken into consideration while planning for empty containers:**

- ✓ Containers to be picked against valid booking DOs
- ✓ Turn time of Import containers
- ✓ Expected import arrivals full and empty
- ✓ Gate-in/out report to check the import-export imbalance
- ✓ Future growth/decline projection

- ✓ Time lag between various stages and current position of individual containers
- ✓ Damaged containers and estimated repair time
- ✓ For accurately forecasting the time taken for the above activities and the requirement for empties at various locations, statistical models can be used.

#### **6. Long Stay with Consignee and Shipper:**

- The purpose of monitoring the Long-standing containers is to ensure that the containers which are with the Consignees/Shippers for more than the approved free days are cleared on time and collection of detention amount against the containers are collected.
- Long staying container list to be generated from IBOX system → IBOX → Container Logistics → Report & Listing/List by Movement (Text)
- Forward the list to the various locations as reminders to follow-up with the Consignee/Shippers for long staying boxes beyond 14 days.
- Follow-up with Consignees/Shippers are done by Import customer service from respective location based on the Long-standing report sent by Logistics team.
- The details / comments are updated against each container follow-up done in the report. If the Consignee/Shipper has returned the container, the details of the Empty yard and time/date are confirmed.

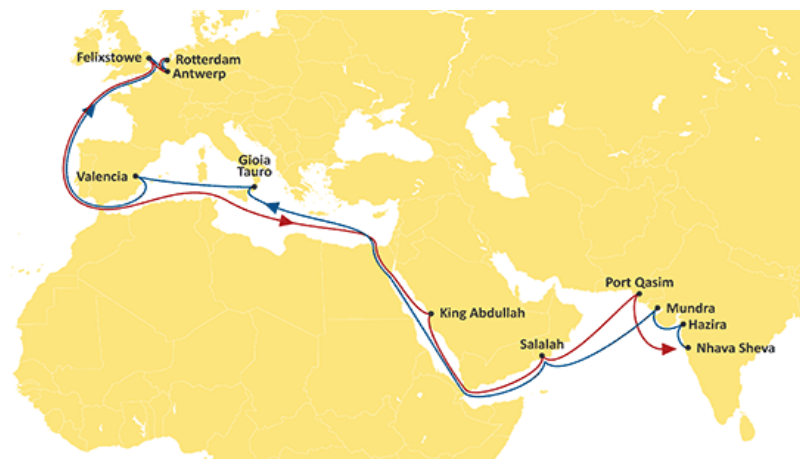
#### **Long Stay Follow-up with Depot/CFS/ICD/Terminal for Laden & Empty Containers:**

- The purpose of monitoring the Long-standing containers is to ensure that the containers which are with the Depots/CFS/ICD/Terminal for more than the approved free days are cleared on time and collection of detention amount against the containers are collected.
- Once the containers are cleared by Depots/CFS/ICD/Terminal, the MSC logistics team updates the same.
- Long staying container list to be generated from IBOX system → IBOX → Container Logistics → Report & Listing/List by Movement (Text)
- Forward the list to the various locations as reminders to follow-up with the Depots/CFS/ICD/Terminal for long staying boxes beyond 14 days.
- Each container is tracked with detailed comment and action plan with timeline, so that further action is taken accordingly to utilize/move the container on its earliest possibility.
- Depot visits are done to ensure the proper stacking is being done in order to access the containers without delay.

#### **The Operation Efficiency Objectives by implementing effective container distribution:**

- To reduce storage cost of containers at CFS, ICD, empty yards, and factory locations.
- Most cost-effective repositioning of containers to avoid congestion.
- To provide containers based on current supply and demand.
- To maximize vessels for the continuous supply of containers and effective evacuation and repositions of containers to various locations.
- To monitor containers in idle status to understand the real time tracking of containers to planning and distribution of containers accordingly.
- To ensure damage units get repaired and become available.
- The container distribution planning id depend of the mainline service route, the ports belong to specific service route the container are get loaded on the specific vessel which conducts their voyage through the same route. The containers are loaded on the vessel as per their type and discharges at respective locations port to maintain the adequate supply containers to that location.

**Fig. 5.6 IPAK Service by MSC**



## SUMMARY

Container distribution in port and hinterland areas is crucial for the efficient movement of goods between different locations. Containers are the backbone of global trade, and the effective management and distribution of these containers are essential to ensure that goods reach their intended destinations in a timely and cost-effective manner. An effective container distribution system in port and hinterland areas requires coordination between various stakeholders, such as port authorities, shipping lines, trucking companies, and freight forwarders. This coordination is necessary to ensure that containers are picked up and delivered to their intended destinations without delays or disruptions. Effective container distribution also requires the use of modern technologies and logistics management systems, such as real-time tracking and monitoring of

containers, automated scheduling and dispatching of trucks, and the use of data analytics to optimize container movements. Also, the operational benefits, effective container distribution systems can also have a significant economic impact. They can reduce transportation costs, improve supply chain efficiency, and enhance the competitiveness of businesses operating in port and hinterland areas. Since the effective container distribution in port and hinterland areas is critical in nature for global trade and economic growth. A well-designed container distribution system requires coordination, technology, and logistics management expertise to ensure that containers are moved efficiently and effectively between different locations.

### **6.1 Findings of Research:**

- Container congestion can lead to delays in shipping and receiving goods, which can disrupt supply chains and cause financial losses for businesses.
- When containers are stuck in congestion, they occupy valuable space and resources that could be used for other containers, which can lead to increased storage and handling costs.
- Container congestion can create safety hazards, such as accidents caused by toppling stacks of containers or congested areas blocking emergency access.
- Drivers may have to wait longer to pick up or drop off containers, which can lead to increased labour costs and inefficient use of resources.
- Container congestion can lead to shortages of equipment, such as cranes and trucks, which can further delay the movement of containers and cause additional costs.
- Container congestion can limit the capacity of ports and other handling facilities, which can lead to reduced efficiency and increased costs.
- Container congestion can highlight inadequate infrastructure, such as insufficient rail or road access to ports, which can create bottlenecks and further exacerbate congestion.
- Since, container congestion can have significant negative impacts on supply chains and the global economy. Addressing the underlying causes of congestion, such as improving infrastructure and optimizing container movement, can help mitigate these challenges.
- There are various solutions available to control and reduce the container congestion with the help of efficient container distribution process which can create a massive change in the container flow process and operations and may create a evolution in this industry.

### **Objectives of Container Logistics Functions to Reduction in Port Congestion:**

- a) To ensure the containers are tracked by updating the moves and events within 5 hours of any activity with 100% accuracy.
- b) To ensure the container control functions like maintaining the stock (empty containers), analysing the imbalance, container repositioning, maintenance and repairs are done.
- c) To ensure the Off-hire/On hire/ Sale/ Mis-release containers are tracked and reported.
- d) To ensure the vendor management for qualification, performance and payments are done as per the agreement.
- e) To analyse the deficit & surplus locations report for effective container distribution planning.

Due to adoption of these suggestions, shipping companies and other stakeholders in the supply chain can improve container distribution systems and prevent congestion at ports and hinterland locations. Through collaborative efforts and innovative solutions, we can ensure that the global shipping industry operates smoothly and efficiently, benefiting businesses and consumers.

## **6.2 Suggestions:**

Container distribution systems play a crucial role in preventing container congestion at ports and hinterland locations. Below are the suggestions for improving container distribution systems and avoiding congestion:

1. Use advanced analytics and predictive modelling to anticipate container flows and adjust shipping schedules and routes accordingly. This can help prevent container overflows and reduce the risk of congestion.
2. Establish a container booking system that enables shippers to reserve slots for their cargo in advance, helping to allocate capacity and manage container flows.

3. Improve communication and coordination between stakeholders in the supply chain, including shipping lines, terminal operators, customs agents, and transport companies, to prevent bottlenecks and delays.
4. Develop inland container depots and container freight stations that provide temporary storage and handling facilities for containers, helping to reduce the pressure on port terminals and minimize congestion.
5. Encourage the use of alternative transport modes, such as rail and barge, to move containers inland and reduce the reliance on trucking, which can be a significant contributor to congestion.
6. Implement real-time tracking and visibility systems to monitor container movements and identify potential bottlenecks, enabling proactive intervention to prevent congestion.
7. Establish container repositioning programs to optimize container usage and minimize the number of empty containers that need to be transported, reducing the risk of congestion and increasing efficiency.

## **PROJECT CONCLUSION**

Container congestion at port and hinterland locations is a significant challenge for the shipping industry, leading to delays, increased costs, and decreased customer satisfaction. However, by implementing solutions like improving port productivity, increasing transparency, expanding hinterland infrastructure, and optimizing container usage, shipping companies can avoid congestion and improve the efficiency of the supply chain. It is also important to emphasize that

collaboration and communication between all stakeholders in the supply chain are critical to prevent congestion. Shipping companies must work with terminal operators, governments, and other stakeholders to invest in infrastructure, optimize vessel schedules, and share resources. By working together and leveraging technology and data, the industry can create a more efficient and sustainable container distribution system.

Improving port productivity, increasing transparency, expanding hinterland infrastructure, developing alternative transport modes, implementing container booking systems, optimizing container usage, and improving communication are all key strategies that can be used to avoid container congestion. By working collaboratively with stakeholders across the supply chain, shipping companies can improve efficiency and streamline operations, ultimately leading to improved customer satisfaction and increased profitability.

In the face of the challenges posed by container congestion, it is clear that effective container distribution systems are crucial to the success of the shipping industry. In the long run, these efforts can lead to a more resilient and competitive shipping industry that can meet the growing demand for global trade. By prioritizing container distribution efficiency and addressing the challenges of congestion, the shipping industry can continue to play a vital role in driving economic growth and prosperity around the world.

## **ABBREVIATIONS**

- EDI – Electronic Data Interchange
- TEUs – Twenty Foot Equivalent Units
- APS – Arrival Planning Strategies
- ECR – Empty Container Repositioning
- CSSC – Container Shipping Supply Chain
- CFS – Container Freight Station

- ICD – Inland Container Depot
- EY – Empty Yard
- CW – Cargo Worthy
- UAC – Uncleared / Abundant Cargo
- DO – Delivery Order
- JO – Job Order
- MSC – Mediterranean Shipping Company
- EXIM – Export Import
- FCL – Full Container Load
- LCL – Less Than Container Load
- DV – Dry Van
- HC – High Cube
- IICL – Institute of International Container Lessors
- CSC – Convention for Safe Containers
- WWT – Wind Water Tight
- DPD – Direct Port Delivery
- FIFO – First In First Out
- PTI – Pre-Tip Inspection
- TMS – Terminal Management System
- ERP – Enterprise Resource Planning
- JNPA – Jawaharlal Nehru Port Authority
- CLP- Container Load Plan
- ODC – Over Dimensional Cargo
- POL – Port of Loading
- POD – Port of Discharge
- RFID – Radio Frequency Identification
- VMS – Vehicle Monitoring System
- VIA – Vessel Identification Advice
- TDR- Terminal Discharge Report
- RDT- Radio Data Transfer

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