Enhancing Port Performance in India: A Case of JNPT

A dissertation submitted to the School of Maritime Management, Indian Maritime University in partial fulfilment for the requirements for the award of degree in MBA- Port & Shipping Management

Submitted

by

AMAL JERRY GEORGE
(Reg. No. 2003305003)

Under the supervision of
Dr. B. SWAMINATHAN
Associate Professor

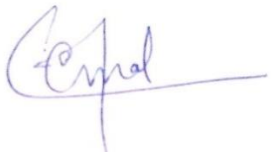
INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)
SCHOOL OF MARITIME MANAGEMENT
CHENNAI CAMPUS

DECLARATION

I, AMAL JERRY GEORGE **(Reg. No. 2003305003)**, student of School of Maritime Management, Indian Maritime University –Chennai Campus, hereby declare that this project report titled **Enhancing Port Performance in India: A case of Jawaharlal Nehru Port Trust** submitted in partial fulfilment of the requirement for the degree of **Master of Business Administration in International Transportation and Logistics Management** is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any Degree/Diploma of any University/Institution. The information submitted is true and original to the best of my knowledge.

w

AMAL JERRY GEORGE
(Reg. No. 2003305003)



Place: Chennai
Date: 00 June 2021

Supervised by

Dr. B. Swaminathan
Associate Professor

ACKNOWLEDGEMENT

It gives me immense pleasure to express my thanks to all those who helped in the successful completion of this project. First & foremost, I thank the God Almighty for his gracious guidance throughout the project work.

I would like to extend my sincere gratitude to my faculty **Dr. A Mourougane**, Associate professor and Head SMM Indian Maritime University, Chennai Campus for his support during my final project.

I would like to extend my sincere gratitude to my faculty **Dr. B Swaminathan**, Associate professor SMM, Indian Maritime University, Chennai Campus for giving me an opportunity to take up this project and for his guidance and support during my final project.

I am profoundly grateful to **Mr. T.S. Balasubramanian**, Member (Finance) of Tariff Authority for Major Ports for providing me with adequate information, ways and means by which I was able to complete the project.

Most importantly, I would like to express my heartfelt thanks to my beloved parents for their blessing, my friends and classmates for their help and wishes for the successful completion of this project.

EXECUTIVE SUMMARY

Title of Dissertation: **Enhancing Port Performance in India: A case of Jawaharlal Nehru Port Trust**

Degree: **Master of Business Administration, International Transportation and Logistics Management**

Ports are important to every country, but they are especially important to India, where ports handle around 95 percent of all international trade. Because of the benefits of standardization on trade costs, containers have become increasingly important among the cargo handled through ports. Jawaharlal Nehru Port Trust (JNPT) is India's principal government-owned container port, handling more than half of the country's total container traffic. However, it is currently under fierce competition from private ports, particularly on the West Coast, where it is losing market share. JNPT's market share of west coast freight has decreased by half in the last decade, from 66 percent in 2010 to 35 percent today. To cut India's trade expenses, all of the country's public ports must improve their operating efficiency as it pursues its goal of becoming a worldwide export hub. This was the reason for digging deeper into JNPT and exploring the port sector in India in general, as well as JNPT specifically, in order to uncover ways to improve its operating efficiency.

I have used a variety of data and reports collected from ports around the world and in India for our investigation. I attempted to chart a ship's travel from the time it enters JNPT seas till it loads/unloads cargo, as well as a container's journey from the time it is unloaded from the ship until it reaches an inland container depot or a container freight station. I have then compared JNPT's turnaround time to that of other major Indian and foreign ports to see where JNPT is falling behind.

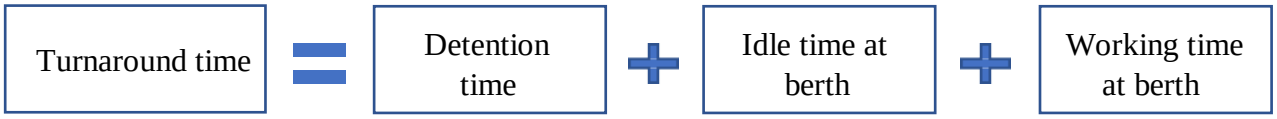
The journey of a container with a port begins months in advance, with freight forwarders preparing the bill of loading, calculating the ship's target port, and so on. The majority of the port's operational area, however, begins when the ship reaches the port's waters. The container is originally stored in the container yard once a vessel has been assigned a berth and the container has been loaded/unloaded using quay cranes. It subsequently passes through government customs and receives a bill of arrival. It can then be transported via a variety of modalities, including road, rail,

and inland waterways. Although JNPT has all three, a considerable portion is still transported by road and rail. The container can be delivered directly to the cargo owner via Direct Port Delivery (DPD), which saves time, or it can be delivered to intermediate facilities such as container freight stations (CFS) or inland container depots (ICD).

To examine the container's journey in further depth, I have divide it into two independent steps. The first is the voyage of the ship till it arrives at the yard. The second step is for it to be transported to the warehouse (CFS/ICD). Both of these procedures are examined in further depth in order to identify inefficiencies.

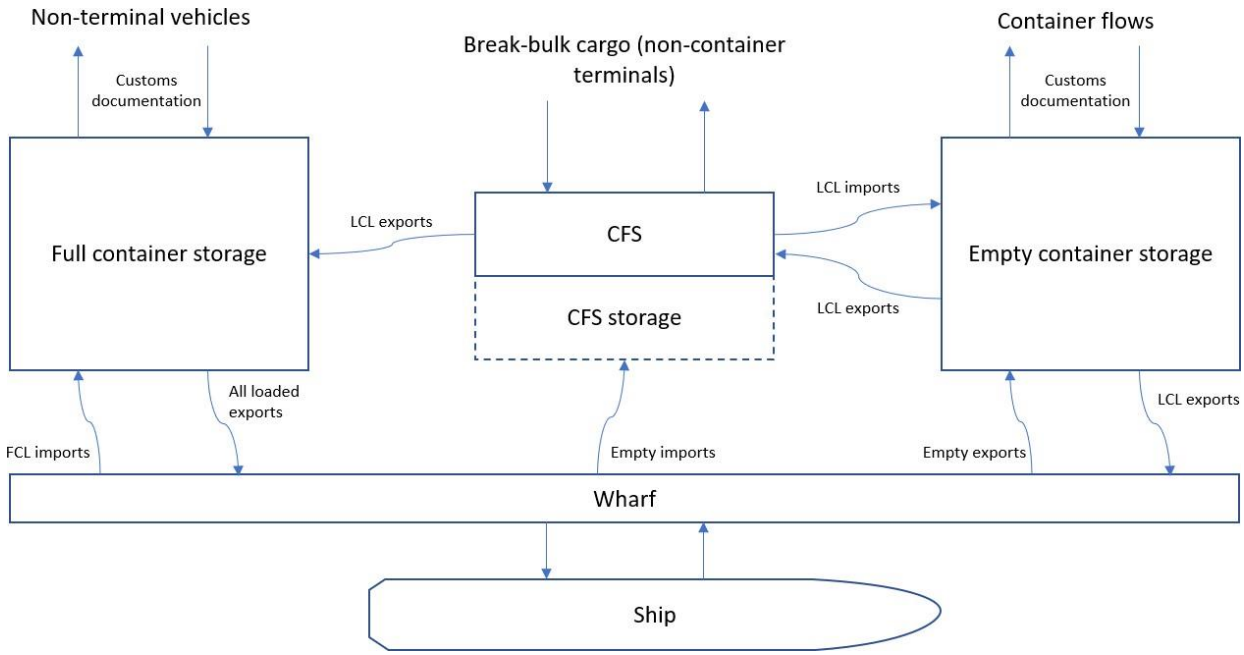
The ship's turnaround time after the containers have been loaded/unloaded can also be divided into three portions.

Turnaround time for ship = detention time + idle time at berth + waiting time at berth



The three elements of turnaround time are then assessed separately. The factors that influence each have been investigated in order to determine the fundamental cause of the time difference between JNPT and the world's leading ports. As new capacity is added and berth utilisation falls, the overall pre-berthing detention time for JNPT has been decreasing, especially in BMCT. The average number hides the discrepancies in two terminals - JNPT's own terminal JNPCT and the liquid terminal, both of which are nearing full capacity. While available capacity at JNPCT isn't an issue because demand has been declining in recent years due to competition (the problem is due to low equipment productivity, which will be addressed later), there is a pressing need for new capacity at the liquid terminal, which can be achieved by either extending the existing jetty or building a new coastal berth alongside BMCT. Because of BMCT's rapid expansion, new container terminals can be developed, with a viable location indicated in the study. Furthermore, the northern anchorage region can facilitate lighterage operations for moving cargo to the Mumbai port while also providing space for ships to wait. Idle time at berth is determined by the availability of labour and equipment. While there is already ample availability of quay cranes and trucks in JNPT's ports, the delay is due to low worker productivity at the equipment, which can be addressed by enhancing operator deployment planning. Working time at berth is determined by the productivity of terminal

equipment. At JNPT, there is a huge difference in productivity between terminals. In terms of crane productivity, they lag well behind private ports like Mundra and global best-in-class ports. Human resource improvements, such as implementing individual performance-based pay that varies with crane efficiency, or operational changes, such as raising the share of twin-lift movements through better planning, can increase this ratio. Equipment productivity at JNPCT might be improved by combining the terminal's import and export yards, which are now separate, resulting in long RTG movements.



Container movement can be made more efficient by making infrastructure improvements at the bottlenecks along the way. Constructing flyovers along the entrance route and allowing trucks inter-terminal access to pass through can help ease truck congestion at terminal gates. A large centralized parking plaza linked with a customs house will reduce the number of stationary trucks on the road and reduce documentation time. Instead of relying on manual inspection, there should be more stationary scanners at the gates for trucks entering and exiting the port. Container stacking can be sped up by having the ICDs deliver the containers color-coded with a little sticker on a terminal basis. JNPT's initiatives should be toward all-digital transactions and providing a one-stop website/app for all paperwork needs, from berthing and pilot services to customs and port billing, to decrease time and effort in the documentation.

Another difficulty JNPT is now dealing with is the low rate of container evacuation via rail, which is roughly 20% of total volume, substantially lower than Mundra's 40% and even lower than the national average of 22%. Because JNPT uses mixed-rail handling between terminals rather than individual trains, this ratio is lower, resulting in longer container wait times. After the DFC is established, it is possible to dramatically minimize travel time. Rail freight transport is substantially less expensive than automobile freight transport over long distances. Integrating the two distinct rail yards into one 1500m long rail yard with a huge container holding facility nearby would be one approach to boost the port's rail coefficient.

These ideas will undoubtedly enhance JNPT's efficiency, but only to the existing level of private ports in India or the mid-ranking global ports. However, in order for JNPT to become a globally competitive port and help India achieve its aim of being an export hub, it must also execute ground-breaking port-wide modifications on par with the top ports. JNPT could make a significant strategy shift in the area of digital enablement. I assessed the present level of technology implementation at JNPT and attempted to give a roadmap for developing its digital strategy in the study. Infrastructure, equipment, intermodal traffic, customs and clearances, and the environment are all areas where the port can collect data, according to the paper. It also employs a BCG report to determine the type of digital strategy JNPT should pursue, which differs depending on the port's goals (emerging port, local trade hub, intermodal gateway, or city-based port). It also lays out a plan for JNPT to develop its digital strategy, which will include tying the digital strategy to the overall port strategy, identifying process pain points that technology can alleviate, developing a portfolio of potential solutions, deciding between off-the-shelf and custom solutions, and managing risks.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BPCL – Bharat Petroleum Corporation Limited

GTIPL – Gateway Terminal India Private Limited

JNPT – Jawahar Lal Nehru Port Trust

MARPOL – The International Convention for the Prevention

MoPT - Mormugao Port Trust

MPRA – Major Port Regulatory Authority

NSICT – Nhava Sheva International Container Terminal

PPP – Public Private Partnership

SWPL – South-West Port Limited

TAMP – Tariff Authority for Major Port

TERI – The Energy and Resources Institute

TEU – Twenty-foot equivalents

CHAPTER - 1

INTRODUCTION

1.1. Background

For millennia, ports have been and continue to be the hubs of commercial activity. Cities have emerged as significant trade hubs around major ports both internationally and in India. Globally, London, Shanghai, Singapore, and Los Angeles are excellent examples, as are Mumbai, Chennai, Kolkata, Cochin, and Vishakhapatnam in India.

Even today, ships transport more than 90% of all international commerce. This figure is significantly greater in India, where it is close to 95%. 2021 (IBEF) Ports are vital to a country's development since trade growth is a key indicator of overall growth and economic condition. Ports are also critical to the present government's 'Make in India' initiative, which aims to increase India's exports to the rest of the globe.

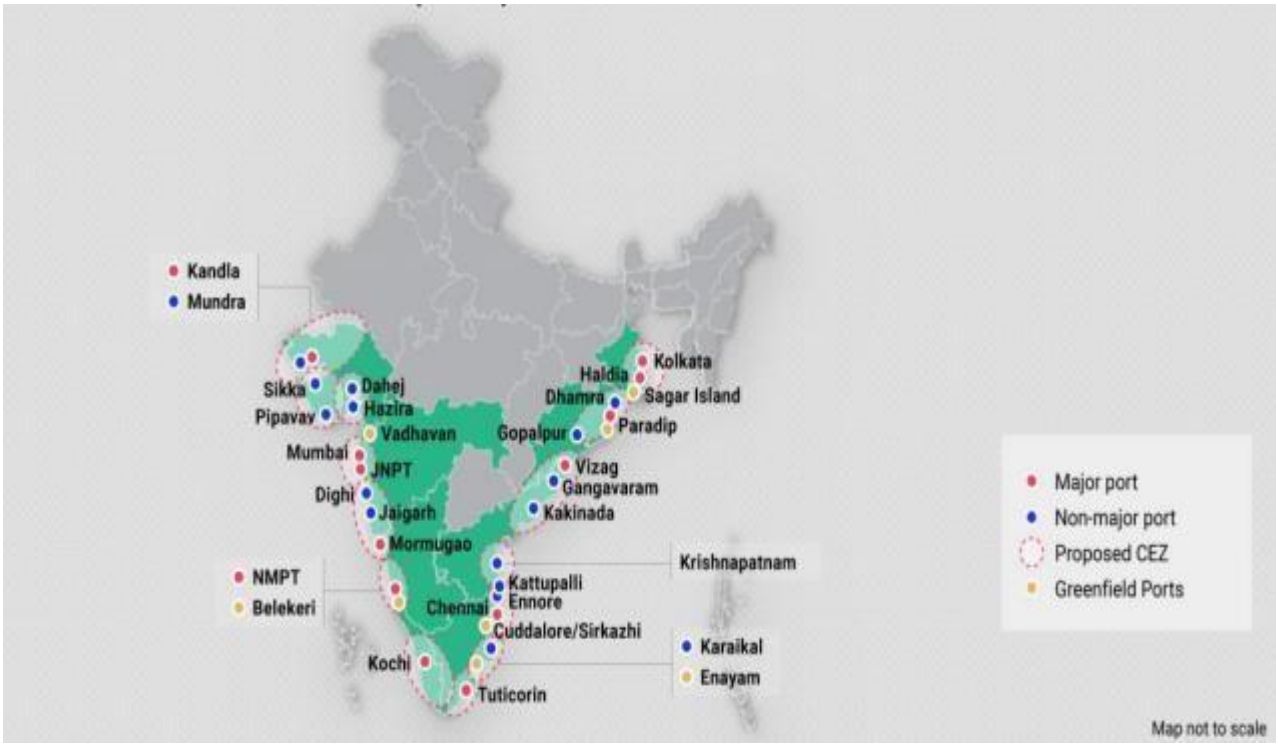


Figure 1: Major Ports in India[2]

With a coastline of more than 7,500 kilometres, India is one of the world's largest marine countries. It is also fortunate to be situated in the Indian Ocean region, which is home to one of the world's busiest trading routes, connecting East Asia with Africa and Europe. Nearly half of all marine and container trade, as well as 70% of all energy transport, passes through the Indian Ocean region. The ports of India are advantageously positioned to benefit from this commerce. (2020, Niti Aayog).

It has 12 major ports and 205 minor and notified ports, with six more mega ports planned as part of the Sagarmala3 plan. The Indian government will play a critical role in the development of the port sector. It has permitted up to 100% FDI in port and harbour building and maintenance projects under the automated method. It has also implemented a 10-year tax break for businesses that construct, maintain, and operate ports, inland waterways, and inland ports.

Solid (coal, iron ore, fertiliser), liquid (petroleum, oil & lubricants), and container traffic are the three types of cargo handled at India's major ports. Solid cargo accounts for the most traffic, accounting for 42 percent of total traffic. At 37%, liquid freight comes in second. Container traffic accounts for around 21% of the remaining traffic.

The capacity of India's major ports was 1,561 million tonnes per annum (MTPA) in FY21. All major Indian ports handled 650.52 million tonnes (MT) of cargo traffic in FY22 (through February) 2022.

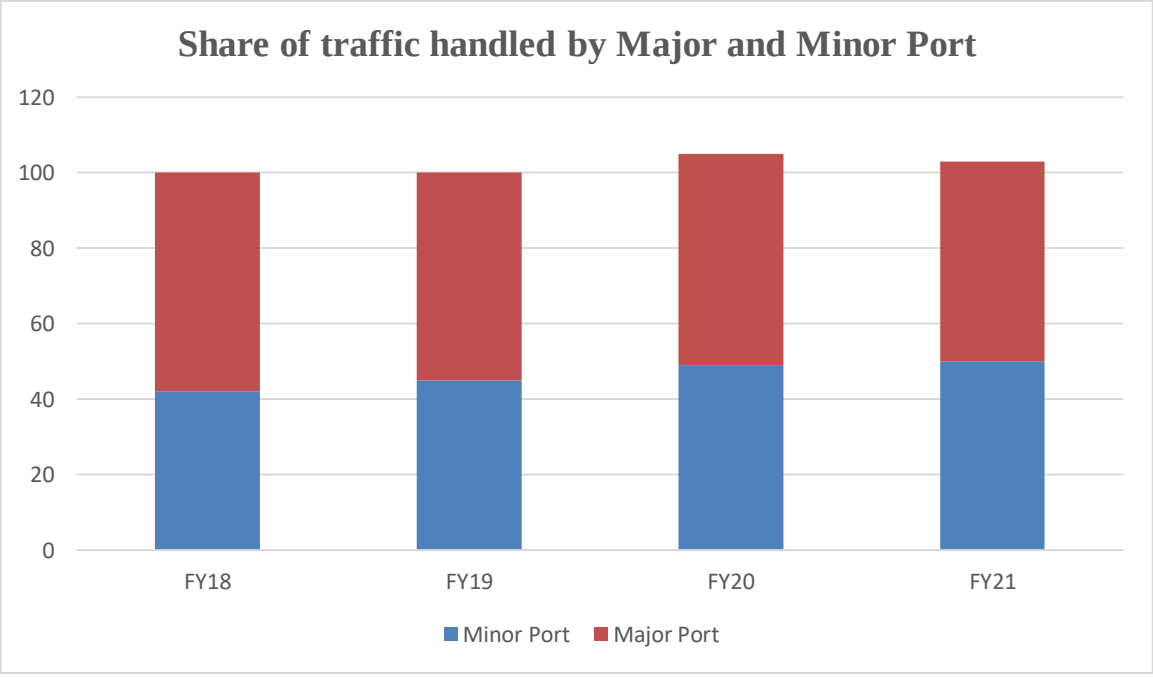


Figure 2: Share of Traffic handled by Major & Minor Ports in India

1.2 Port Performance Indicators

To construct a balanced scorecard, port performance can be measured across four strategic dimensions: finance, operations, human resources, and market. A scorecard like this can be a useful tool and a heuristic assessment for strategic planning. Cargo operators typically concentrate on the operational side of things in order to reduce turnaround time and maximise asset utilisation. This can also be a handy tool for breaking down a port system's complexity and delivering the project in distinct phases or blocks. It is also vital to build tools and define assumptions that allow for like-for-like comparisons in order to produce measurements that are useful to potential policy, research, and industry users. As a result, standard performance measurements may be used to compare many ports.

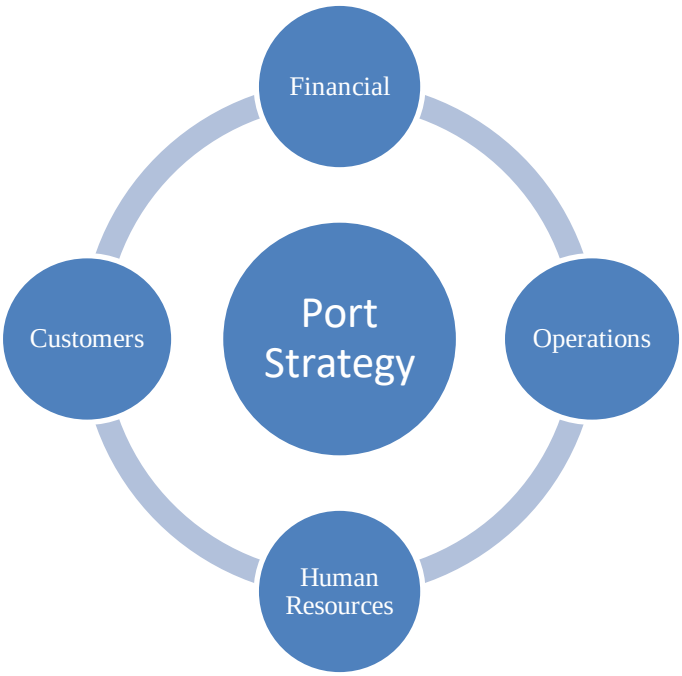


Figure 3: Dimensions of Port Performance Indicators

1.2.1 Operational Indicators

The most widely used metrics in port evaluation are operational indicators. They are used by every major port stakeholder.

Customers: Shipping companies and vessel operators need to know the time duration for whichtheir ships will be occupied on the route. They also decide which port to use in their route to minimize the amount of time their ships will be engaged. For example, a lower average pre- berthing delay will result in higher customer satisfaction.

Investors: The financial performance of a port is directly determined by operational metrics. Shorter turnaround times, for example, will result in more revenue.

Government: The operational efficiency of the ports of a country denotes the competitiveness of its economy since ports are the primary route of both inwards and outwards trade. More robustoperational parameters will signify the higher competitiveness of a country's trade markets.

Typically, operational indicators are classified into two groups: vessel indicators and cargo indicators.

From the time the vessel reaches the port until it leaves, vessel indicators establish the vessel's operational parameters. Cargo indicators show the operating parameters for cargo being imported or exported from a ship to a container depot, and vice versa.

- **Vessel Indicators**

Average turnaround time: Time spent by a ship from its arrival until its departure. i.e. the time it takes a ship to move from an anchorage to a berth and back after completing cargo handling activities.

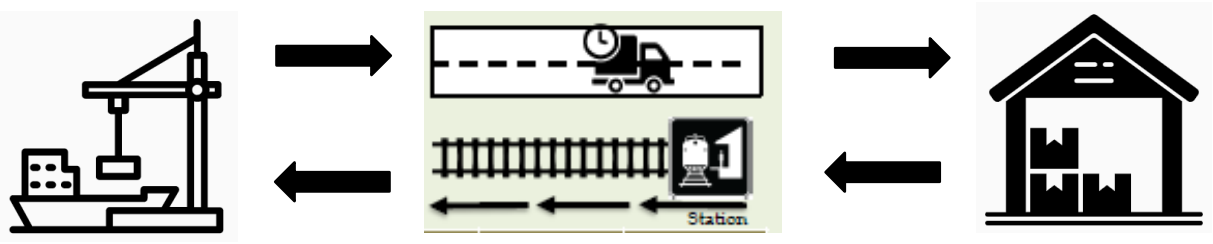
Average pre-berthing delay: The amount of time the vessel had to wait before entering the berth. The delay could be due to a variety of factors, including traffic congestion (non-availability of a berth, non-availability of tug, non- availability of a pilot, navigation restriction, etc.)

Percentage of idle time at berth to time at working berth: The ratio of the time spent idle at a berth to the time spent loading or unloading cargo.

Average output per ship berth day: The average output of a ship at a berth per day is measured in tonnes of cargo.

- ## Container Indicators

Due to its standard procedures and equipment, container traffic has been gaining traction with a global growth in quantities. Increased volumes and containerization of trades result from the ability to handle a wide variety of goods at lower prices and general acceptance. It also acts as a direct indicator of the amount of cargo handled at the port.



Container parameters in port operations are related to the time taken across different activities. Hence, we can divide the lifecycle of any container for import or export into different phases andmeasure each phase's parameter.

Port Dwell Time: The time an export spends on the terminal before being loaded into a vessel or the time an import spends on the terminal after being unloaded is referred to as dwell time.

Transit Time: The container's transit time is the amount of time it takes to get to a Container Freight Station (CFS) or an Inland Container Depot (ICD).

Warehouse Dwell Time: The container spends some time at the warehouse at CFS or ICD before being picked up for the next operation. Export containers come ready to be loaded onto the ship, while import containers await their purchasers. Depending on whether it's an ICD or a CFS, the dwell time differs.

- ## Other Operational Indicators

Aside from container and vessel operations, port-specific factors can be evaluated to determine operational efficiency. The following are some key metrics:

Port Congestion: The architecture of port infrastructure in terms of traffic congestion, inter-terminal movements, the number of vehicles on the road, and so on can help us understand the dynamics of commodities flow inside the port. Poor performance indicates that the current infrastructure needs to be updated to minimise bottlenecks and boost efficiency.

Communication System and the use of technology: Long operating delays might result from failures in the message exchange system, which can last anything from a few hours to an entire day. As a result, it's critical to keep track of how often such systems that facilitate communications and transactions at the port go down. Using technology to find your inventory can also help you reduce operating delays.

Toll Plazas: While this may not be part of the port infrastructure, measuring the average time spent by a container between two toll plazas is essential. This allows us to pinpoint the sites where delays are happening, resulting in long transit times.

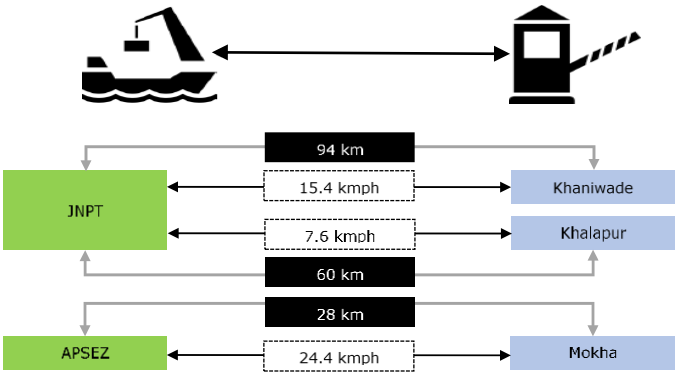


Figure 4: Average Speed taken by truck to cover the distance between Port terminals to nearest TollPlaza

- **Other Indicators**

  - **Financial Indicators**

Ports are an infrastructure-intensive industry with a significant capital investment need. Because of the various economic structures used in Public-Private Partnerships, measuring a port's overall financial performance is difficult. By viewing the ports as a single entity, attention may be focused on critical criteria. As a result, a clear image of income streams and activity costs is required to carry out this exercise. Also important are assessments of asset and investment quality, utilisation rate, cash flow, and so on.

Revenue streams are simple to calculate depending on the operational type, such as leasing, volume-based, and so on. Terminal operations and linked activities are the two primary categories of revenue. The majority of terminal services comprise vessel and container operations, stevedoring, and other related activities, such as warehousing and land-based activities. Because of the lack of suitable accounting measures, analysing costs in a port is more difficult. To identify the profit and loss-making segments, proper management accounting is required to allocate and apportion income and expenses for distinct segments.

The key revenue heads and their variation over time are one of the most basic and first topics of comparison. Port and non-port dues are the main sources of revenue. Revenue items relating to cargo and marine operations include port dues. Fees and licences, rental income, and other sources make up non-port dues. This simple accounting activity can offer significant fundamental numbers for industry comparison.

  - **Human Resource Indicators**

Human resource performance metrics are more standard and have less to do with port operations. Tonnage measures and the extent of automation can be utilised to identify the indications from a performance standpoint. Two critical performance indicators are listed below, in addition to revenue and margins per employee:

Training/wages: For port-to-port comparisons, this is critical. The amount of money spent on training per unit of revenue is usually measured in industries. As a result, it is a non-standard metric that is particularly useful in port management studies since it can account for variances in port income profiles dependent on cargo volume.

Wages/revenue: This metric of measuring the cost of labor per unit of revenue vary based on how port operations are managed. An increase in licensing to private players reduces the number of laborers in the space. Furthermore, labor costs are decreasing with an increase in automation and modernization of ports. However, it is an important metric to compare across similar seaports and with the national average to comply with the labor laws.

1.3 Objective of the study

- The main objective of this study is to identify,
    1. The essential parameter of operational efficiency in any port
    2. To evaluate the key performance indicators of JNPT
    3. Identifying areas for development in order to enhance overall port performance

1.4 Scope of Study

The present study has been made to evaluate the performance indicators of ports by taking JNPT in the background. As we know Ports are vital infrastructure that play an important role in international trade. They are critical in connecting emerging countries to the global market, as well as boosting corporate and economic growth. This infrastructure is increasing in size and complexity. As a result, performance indicators are in high demand for measuring competitiveness and strategic planning to improve it. Internal strategic management and benchmarking solutions for port performance can be used throughout a network of ports. As a result, a set of measures linked to vessel stay at port, cargo loading/unloading rate, and quality storage/inland movement are required to assess port performance. There is a strong connection between this set of indicators and other port performance indicators.

1.2. Dissertation Structure

- Chapter One: Gives an overview of the port industry importance of the study and various other details about the project.
- Chapter Two: This chapter presents a brief introduction about the port management structure, role of various entities, function of port, port model and need of PPP in Indian port.
- Chapter Three: This chapter present types of research design, methods of qualitative study quantitative study, data interpretation and data analysis procedure. It also involves methodological limitations.
- Chapter Four: This chapter brings out the interfirm comparison and inter period comparison between the port operators, port authority and lenders.
- Chapter Five: This chapter deals with the current regulatory issues prevailing in the sector, discussion, recommendations, and conclusion of the study.

CHAPTER – 2

Literature Review

2.1 Review of Literature

2.1.1

2.1. Role of Ports in National Economy

Ports produce a combination of public and private goods. Public goods include those that are inherently non-divisible and non-consumable, such as public safety, security, and a healthy environment on the one hand, and coastal protection works necessary to create port basins on the other hand. Private goods are both consumable and divisible and their use entails a minimum of economic externalities.

Most of the value of private goods can be captured in market transactions between private parties. However, a substantial portion of the value of public goods cannot be captured in arms-length transactions. Consequently, private firms have little incentive to produce them. Public goods create positive externalities when they are used; the social benefits they generate are greater than the price that private parties can charge for them. Thus, some form of public intervention is appropriate in their production to make certain that an adequate level of public goods is maintained.

Ports represent a mix of public and private goods. They generate direct economic benefits (private goods) through their operations, as well as additional indirect benefits (public goods) in the form of trade enhancement, second order increases in production volumes, and collateral increases in trade-related services. These economic multiplier effects have been used by many ports to justify direct public sector investment. It is in this dual production of both public and private goods that complexities arise, which makes defining roles for and boundaries between the public and private sectors challenging in the ports industry. This is particularly the case in the fields of marine and port safety, port security, and the protection of the marine environment.

Both through targeted development policies and the unplanned growth of interrelated industries, many ports have become the location for industrial clusters. Industrial clusters are geographic concentrations of private companies that may compete with one another or complement each other as customers and suppliers in specialized areas of production and distribution. Industrial clusters represent a kind of value chain, a web of interrelated activities that are mutually

supportive and continuously growing. Clustering of related activities improves the competitive advantage of cluster participants by increasing their productivity, reducing transaction costs among them, driving technological innovation, and stimulating the formation of new business spin-offs.

As a matter of strategic development policy, many ports encourage the co-development of various value-added services through franchising, licensing, and incentive leasing. Today, ports seek to attract enterprises that extend their logistics chains or provide them with specialized capabilities to add value to cargoes that are stored and handled in the port. General services that many ports attempt to develop include chandlering, ship repair, container maintenance, marine appraisals, insurance claims inspections, and banking.

Many governments are directly or indirectly involved in port development. They often use a growth pole argument to justify the direct financing of basic port infrastructure. This growth pole rationale derives from the belief that investments in port assets have strong direct and indirect multiplier effects on the entire national economy and, further, that the commitment of public resources is necessary to encourage co-investment by the commercial and industrial sectors. However, determining causal links between public investment and specific commercial activities and investments is difficult and at times speculative. Still, it is important that governments envision and articulate future development scenarios, maintain frequent consultation with the private sector, and implement public policies that are applied consistently and that enable the private sector to invest with confidence in projects that support the stated public policy objectives.

On the other hand, port operations are businesses and should be managed to achieve optimal utilization of capital. Investments in port assets are affected by risk, competition for land and capital, or other factors in the competitive business environment.

The alignment of public and private interests in recent years has resulted in a diminishing role for governments in the port industry. The total absence of public involvement in the port sector, however, remains an exception, limited primarily to specialized ports and terminals.

When governments attempt to increase national economic welfare through port development, they may choose to apply one of two distinct normative frameworks: the market surrogate framework or the public interest framework.

The one of the objectives of public policy should be to create contestable market structures for port services and to manage competitive behaviour. This might be accomplished through licensing, leasing, concession, or other methods designed to bring about an efficient allocation of resources. The market surrogate view is followed with market-oriented economic policies. The need for some form of government intervention in markets for port services is related to the unique economic characteristics of seaports, some of which tend to make them natural monopolies:

- The provision of port services entails large, fixed costs and low marginal costs. The marginal benefits associated with using port services exceed the marginal costs of providing these services.
- A relatively large, minimum initial capacity of basic infrastructure is required for technical reasons.
- The infrastructure is frequently indivisible and, as a result, increases in infrastructure capacity can only be realized in quantum chunks.
- Both initial construction and port expansion require large amounts of capital. As a result, the need to develop basic port infrastructure (for example, sea locks, breakwaters, quay walls, and main roads) all at one time creates large capital operating losses and foregone investment opportunities because of underused capacity during the earlier phases of a projects life cycle.
- The life span of port infrastructure projects often exceeds the time horizon acceptable for private investors and commercial banks.
- Basic port infrastructure is immobile and has few alternative uses.

This set of characteristics is the main reason for financial involvement of governments in port construction and expansion projects.

2.2. Role of a Port Authority

Ports usually have a governing body referred to as the port authority, port management, or port administration. Port authority is used widely to indicate any of these three terms.

The term port authority has been defined in various ways. In 1977, a commission of the European Union (EU) defined a port authority as a State, Municipal, public, or private body, which is largely responsible for the tasks of construction, administration and sometimes the operation of port facilities and, in certain circumstances, for security. Port's authorities may be

established at all levels of government: national, regional, provincial, or local. The most common form is a local port authority, an authority administering only one port area.

The statutory powers of a national port authority are:

- **Investment:** Power to approve proposals for port investments in amounts above a certain figure. The criterion for approval would be that the proposal was broadly in accordance with a national plan, which the authority would maintain.
- **Financial policy:** Power to set common financial objectives for ports (for example, required return on investment defined on a common basis), with a common policy on what infrastructure will be funded centrally versus locally, and advising the government on loan applications.
- **Tariff policy:** Power to regulate rates and charges as required to protect the public interest.
- **Labor policy:** Power to set common recruitment standards, a common wage structure, and common qualifications for promotion; and the power to approve common labor union procedures.
- **Licensing:** When appropriate, power to establish principles for licensing of port employees or agents.
- **Information and research:** Power to collect, collate, analyze, and disseminate statistical information on port activity for general use, and to sponsor research into port matters as required.
- **Legal:** Power to act as legal advisor to local port authorities.

Increasingly, central governments implement seaport policies through the allocation of resources rather than through the exercise of wide-ranging regulatory powers. While central governments should pursue macroeconomic objectives through an active seaport policy, port authority objectives should be more narrowly focused on port finances and operations. It is a widely accepted opinion among port specialists that a port authority should have as a principal objective the full recovery of all port-related costs, including capital costs, plus an adequate return on capital. The full recovery of costs will help a port authority to:

- Maintain internal cost discipline.
- Attract outside investment and establish secure long-term cash flows.

- Stimulate innovation in the various functional areas to guarantee a long-term balance between costs and revenues, especially when faced with innovations by terminal operators, port users, rival ports, and hinterland operators.
- Generate internal cash flows needed to replace and expand port infrastructure and superstructure.
- Compete according to the rules of the market system, without excessive distortions of competition.
- Put limits on cross-subsidization, which may be rational from a marketing point of view (market penetration, traffic attraction), but which can undermine financial performance.
- Avoid dissipation of the port authority asset base to satisfy objectives of third parties (for example, port users demanding the use of land in the port area without regard to the lands most economic use or port and city administrations using port authority assets to pursue general city goals).

Full cost recovery should be viewed as a minimum port authority objective; once this objective has been achieved, however, the port authority can pursue other-than-financial objectives considered desirable by the government or by itself.

2.3. Role of Terminal operators

Private port operators (such as stevedoring firms, cargo handling companies, and terminal operators). Port operators typically pursue conventional microeconomic objectives, such as profit maximization, growth, and additional market share. Only if port operators are free to pursue such objectives can the benefits of a market-oriented system be achieved.

2.4. Role of Transport Ministry

The ministry of transport typically performs a variety of functions at a national level. With respect to coastline and port issues, the main tasks and responsibilities of the ministry can be summarized as follows:

- **Legislation:** The ministry drafts and implements transport and port laws, national regulations, and decrees. It is responsible for incorporating relevant elements of international conventions (for example, the International Convention of Safety for Life at Sea [SOLAS],

United Nations Convention on the Law of the Sea, the International Convention for the Prevention of Pollution from Ships [MARPOL]) into national legislation for signature members.

- **Policy making**: The ministry develops transport and port policies related to:
  - Planning and development of a basic maritime infrastructure, including coastline defences (shore protection), port entrances, lighthouses and aids to navigation, and navigable sea routes and canals.
  - Planning and development of existing and new port areas (location, function, or type of management).
  - Planning and development of port hinterland connections (roads, railways, territorial waterways, and pipelines).
- **International relations**: Specialized departments of the ministry represent the country in bilateral and multilateral port and shipping forums. The ministry may also negotiate agreements with neighboring countries relating to water-borne or intermodal transit privileges.
- **Financial and economic affairs**: A ministerial department is usually responsible for planning and financing national projects. In many countries, a ministry of transport also finances basic port infrastructure as well as roads, waterways, and railways connecting ports with their hinterland. It should be able to carry out financial and economic analyses and assess the socioeconomic and financial feasibility of projects in the context of national policies and priorities.
- **Auditing:** These functions should be performed independently from the affected line organization and are usually included in a staff office. The auditors should report directly to the minister.

2.5. Port Function

Within the port system, one or more organizations fill the following roles:

- Landlord for private entities offering a variety of services.
- Regulator of economic activity and operations.
- Regulator of marine safety, security, and environmental control.
- Planning for future operations and capital investments.

- Operator of nautical services and facilities.
- Marketer and promoter of port services and economic development.
- Cargo handler and storer.
- Provider of ancillary activities.

In view of the strategic significance of land, port property is rarely sold outright to private parties because of its direct and indirect effects on regional and often national economy and public welfare, its intrinsic value, and possible scarcity. Therefore, a key role for many port authorities is that of the landlord with the responsibility to manage the real estate within the port area. This management includes the economic exploitation, the long-term development, and the upkeep of basic port infrastructure, such as fairways, berths, access roads, and tunnels.

Port authorities often have broad regulatory powers relating to both shipping and port operations. The authority is responsible for applying conventions, laws, rules, and regulations. Generally, as a public organ it is responsible for observance of conventions and laws regarding public safety and security, environment, navigation, and health care.

2.6. Port Administration Model

The number of factors influence the way ports are organized, structured, and managed, including:

- The socioeconomic structure of a country (market economy, open borders).
- Historical developments (for example, former colonial structure).
- Location of the port (urban area or in isolated regions).
- Types of cargoes handled (liquid and dry bulk, general cargo, or containers).

Four main categories of ports have emerged over time, and they can be classified into four main models: the public service port, the tool port, the landlord port, and the fully privatized port or private service port.

These models are distinguished by how they differ with respect for such characteristics as:

- Public, private, or mixed provision of service.

- Local, regional, or global orientation.
- Ownership of infrastructure (including port land).
- Ownership of superstructure and equipment (particularly ship-to-shore handling equipment, sheds, and warehouses).
- Status of dock labor and management.

Service and tool ports mainly focus on the realization of public interests. Landlord ports have a mixed character and aim to strike a balance between public (port authority) and private (port industry) interests. Fully privatized ports focus on private (shareholder) interests.

2.7. Type of Port Model

- **Service Ports**

Service ports have a predominantly public character. The number of service ports is declining. Many former service ports are in transition toward a landlord port structure, such as Colombo Nhava Sheva (India), and Dar es Salaam (Tanzania). However, some ports in developing countries are still managed according to the service model. Under it, the port authority offers the complete range of services required for the functioning of the seaport system. The port owns, maintains, and operates every available asset (fixed and mobile), and cargo handling activities are executed by labor employed directly by the port authority. Service ports are usually controlled by (or even part of) the ministry of transport (or communications) and the chairman (or director general) is a civil servant appointed by, or directly reporting to, the minister concerned.

Among the main functions of a service port are cargo handling activities. In some developing country ports, the cargo handling activities are executed by a separate public entity, often referred to as the cargo handling company. Such public companies usually report to the same ministry as the port authority. To have public entities with different and sometimes conflicting interests reporting to the same ministry, and forced to cooperate in the same operational environment, constitutes a serious management challenge.

- **Tool Port**

In the tool port model, the port authority owns, develops, and maintains the port infrastructure as well as the superstructure, including cargo handling equipment such as quay cranes and forklift trucks. Port authority staff usually operates all equipment owned by the port authority. Other cargo handling on board vessels as well as on the apron and on the quay is usually carried out by private cargo handling firms contracted by the shipping agents or other principals licensed by the port authority. The tool port has several similarities to the service port, both in terms of its public orientation and the way the port is financed.

Under a tool port model, the port authority makes land and superstructures available to cargo handling companies. In the past, these companies tended to be small, with few capital assets. Their costs were almost entirely variable. The cost of underuse of port facilities was usually absorbed by the port authority, which minimized risk for the cargo handling companies.

A tool port does have its advantages, particularly when it is used as a means of transition to a landlord port. Using the tool port model as a catalyst for transition can be an attractive option in cases where the confidence of the private sector is not fully established, and the investment risk is considered high. A tool port may mitigate this by reducing initial capital investment requirements.

- **Landlord Ports**

The landlord port is characterized by its mixed public-private orientation. Under this model, the port authority acts as regulatory body and as landlord, while port operations (especially cargo handling) are carried out by private companies. Today, the landlord port is the dominant port model in larger and medium sized ports.

In the landlord port model, infrastructure is leased to private operating companies or to industries such as refineries, tank terminals, and chemical plants. The lease to be paid to the port authority is usually a fixed sum per square meter per year, typically indexed to some measure of inflation. The level of the lease amount is related to the initial preparation and construction costs.

The private port operators provide and maintain their own superstructure including buildings (offices, sheds, warehouses, container freight stations, workshops). They also purchase and install their own equipment on the terminal grounds as required by their business. In landlord

ports, dock labour is employed by private terminal operators, although in some ports part of the labour may be provided through a port wide labour pool system.

- **Fully Privatised Port**

Fully privatized ports which often take the form of a private service port are few. Full privatization is considered by many as an extreme form of port reform. It suggests that the state no longer has any meaningful involvement or public policy interest in the port sector. In fully privatized ports, port land is privately owned, unlike the situation in other port management models. This requires the transfer of ownership of such land from the public to the private sector. In addition, along with the sale of port land to private interests, some governments may simultaneously transfer the regulatory functions to private successor companies. In the absence of a port regulator, privatized ports are essentially self-regulating. The risk in this type of arrangement is that port land can be sold or resold for non-port activities, thereby making it impossible to reclaim for its original maritime use. Moreover, there is also the possibility of land speculation, especially when port land is in or near a major city. Furthermore, sale of land to private ports may also sometimes raise a national security issue.

The reason to move to full privatization are:

- To modernize institutions and installations, both of which often dated back to the early years of the industrial revolution, to make them more responsive to the needs and wishes of the users.
- To achieve financial stability and financial targets, with an increasing proportion of the financing coming from private sources.
- To achieve labor stability and a degree of rationalization, followed by a greater degree of labor participation in the new port enterprises.

2.8. Need of PPP in Ports

Public-private partnerships (PPPs) are increasingly being used by governments and public sector authorities throughout the world as a way of increasing access to infrastructure services for their citizenry and economies at a reduced cost. Physical infrastructure like port, involve large investments that can put a strain on the public purse. This strain is especially great for countries,

such as India, whose economies are undergoing rapid development and urbanisation and have a great need for expanded infrastructure.

Port infrastructure contributes to a country's economic development by reducing shipping time and costs, and by providing access to foreign and domestic markets. As global trade volumes increase, and transnational/global players emerge in certain parts of the shipping market, the demand for sufficient hinterland and port infrastructure increases.

The latter is endorsed by the recent initiation of numerous large port infrastructure projects worldwide. Such projects require large capital expenditures, often forcing public sector actors to search for sources of funding outside the public sphere.

Governments, governmental entities, and public enterprises have therefore started to look for private capital to implement infrastructure projects, and to provide services previously situated within the scope of the public sector.

This shift towards public-private arrangements for infrastructure provision, are part of a larger cyclical evolution within which the funding and procurement of transport infrastructure shifts from more, to less private involvement. Yet, in addition to raising traditional critical and recurrent questions on the need for large up-front investments required in such projects, the longevity of the infrastructure assets, and their sunk cost characteristic; there are also more tacit elements involved. These tacit elements are the division of risks and responsibilities amongst public and private partners, issues pertaining to the project's ecology, and the project success as perceived by different stakeholders involved. With most of the global trade carried by sea, developing strong, well-functioning maritime transport infrastructure is a key element of economic growth for many developing and emerging countries.

Public-private partnerships (PPPs) in ports have become a means to manage port operations more effectively, traditionally an exclusively government function.

Different port management structures are used worldwide but in most large and medium sized ports the landlord port model is used. In this model management responsibilities are delegated to the private sector, while the title in the land and assets remains with the government.

CHAPTER – 3

Jawaharlal Nehru Port Trust

The Jawaharlal Nehru Port Trust, or JNPT for short, is India's largest container port. JNPT was established on May 26, 1989, and is located east of Mumbai. The port was designed to relieve congestion at Mumbai's existing port and function as a container trade centre. Today, JNPT is India's No. 1 container port, handling more than half of all container freight across all major ports in the country. In the world ranking of container ports, JNPT is ranked 28th.

3.1 History

Mumbai Port used to have a lot of problems, such as channel shallowness, road and rail congestion, labour challenges, and so on. As a result, the Major Ports Trusts Act of 1963 established JNPT as an autonomous agency. A total of INR 1,109 crore was invested across 2,584 hectares. JNPT has enhanced its operational capacity in order to become a port that meets international standards. The following table depicts JNPT's history and progress (Jawaharlal Nehru Port Trust, 2020).

Year	Development
1986	The construction work at JN Port commenced
1989	Inauguration
1997	Second Container Terminal led by a consortium of P&O Ports, Australia
1999	NSICT[20] – India's first privatized container terminal commissioned
2001	JNPT becomes first Indian port to handle more than 1 million TEUs[21]
2002	The bulk terminal rendered to be the container terminal
2002	Twin-berth Liquid Cargo Terminal, jointly developed by BPCL & IOC on BOT basis commissioned
2006	GTICT[22] – third container terminal led by Gateway Terminals of India Pvt. Ltd. commissioned
2007	JNPT crosses 3 million TEUs in container handling
2010	JNPT crosses 4 million TEUs in container handling
2012	Widening and deepening of channels by Boskalis International
2013	Concession agreement for 330-metre quay extension signed with DP World
2016	NSIGT[23] – fourth container terminal commissioned
2018	BMCT[24] – fifth container terminal commissioned
2019	Additional liquid berth for liquid cargo to be developed

Table 1: History & Development of JNPT

JNPT now boasts a full-service customs house, 30 Container Freight Stations, and connections to 52 inland container depots throughout the country. To increase train capacity at the port, the link is extended and enhanced via the Dedicated Freight Corridor (DFC). The Port's proximity to the cities of Mumbai, Navi Mumbai, and Pune offers it a competitive advantage in efficiently meeting the needs of shippers.

3.2 Organizational Structure

JNPT is overseen by a Board of Trustees made up of various stakeholders. The Port Trusts are supposed to advance public interests while running operations profitably. The following is a breakdown of JNPT's organisational structure:

- The Board of Trustees is made up of a Chairman, a Deputy Chairman, and up to 17 people nominated by the Central Government as needed. The Board of Trustees is made up of a Chairman, a Deputy Chairman, and up to 17 people nominated by the Central Government as needed.
- • There are five departments, each with many sub-sections, led by a Head of Department, or Chief Manager.

Department	Sub-sections
Operations	• Bulk Terminal • Container Terminal • Engineering Services • Projects & CFS Section
Port Planning &Development	• Major Ports & Dredging Division • Port Area (Maintenance & Project) Division • Township (Maintenance & Project) & Environment Management Division • BOT Projects Section
Finance	• Revenue • Cash & Bank • Projects • Bills

Table 2: Departments & Sub-sections at JNPT

Department	Sub-sections
	• Procurement & Stores • Establishment • Internal Audit • Financial Accounting • Costing & Budgeting • Loans
Marine	• Marine Conservancy & Pollution Control • Fire and safety • Marine Operations (including pilotage & port signal station) • Marine Engineering • Safety
Administration	• Personnel and IR • Legal and Estate • General and Administration • Hospital • Marketing

JNPT's organizational structure is a mix of hierarchy, bureaucracy, and departmentalization with a common aim in mind.

Hierarchy: The organization is divided into a hierarchical structure with diversity in people and their credentials.

Bureaucracy: As a government-owned company, strict adherence to the government's rules is critical.

Departmentalization: Multiple departments executing a range of duties

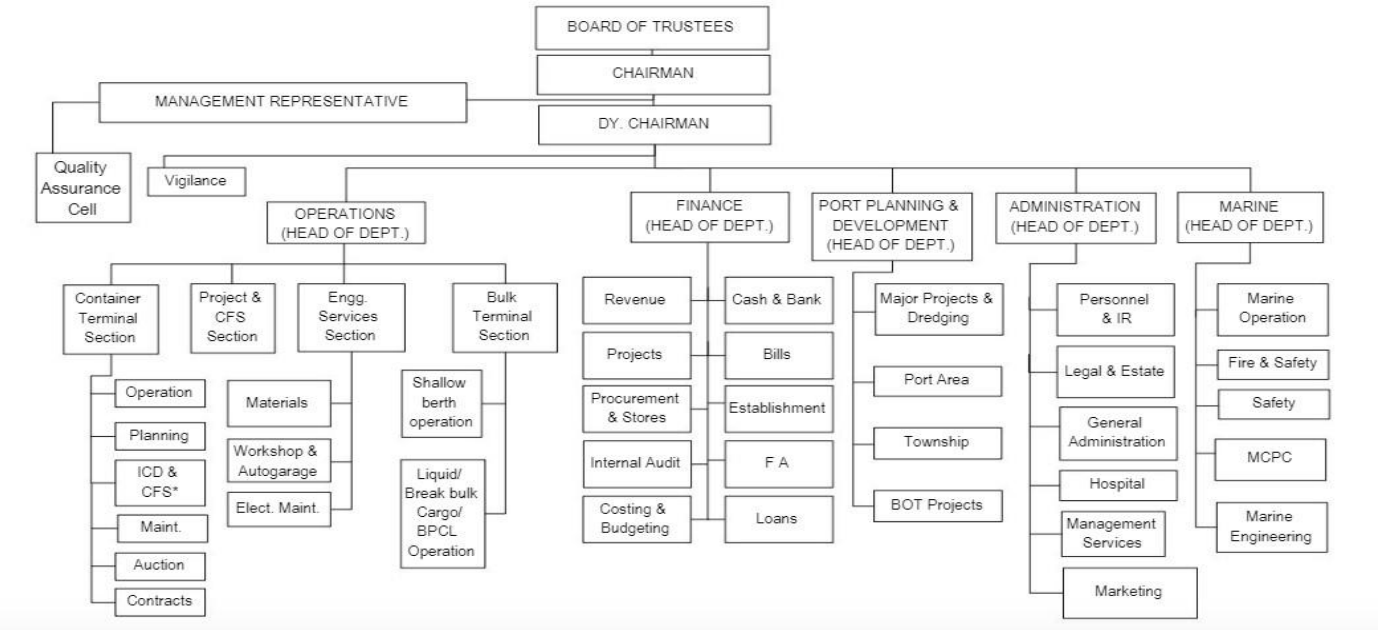


Figure : Organogram of JNPT

3.4 Terminals at JNPT

The Port has five terminals and one liquid terminal operated by different entities, making it the largest container port in the country.

Terminal	CommissioningDate	Capacity (in TEUs)	Quay Length	Container Yard
JNPCT – Jawaharlal Nehru Port Container Terminal	26th May 1989	1.5 MM	680 m	61.89 Ha
NSICT-DP World – Nhava Sheva International Container Terminal	April 1999	1.2 MM	600 m	25.84 Ha
BPCL and IOC Liquid Terminal	Oct 2002	7.2 MM tons	300	-
GTI-APM – Gateway Terminals India	March 2006	1.8 MM	712 m	54.57 Ha
NSIGT-DP World – Nhava Sheva (India) Gateway Terminal Pvt. Ltd.	July 2016	0.8 MM	330 m	27 Ha
BMCT – Bharat Mumbai Container Terminal	Feb 2018	4.8 MM	2000 m	200 Ha

Figure 21: Existing Facilities at JNPT (retrieved from Google Maps)

Figure 21: Existing Facilities at JNPT (retrieved from Google Maps)

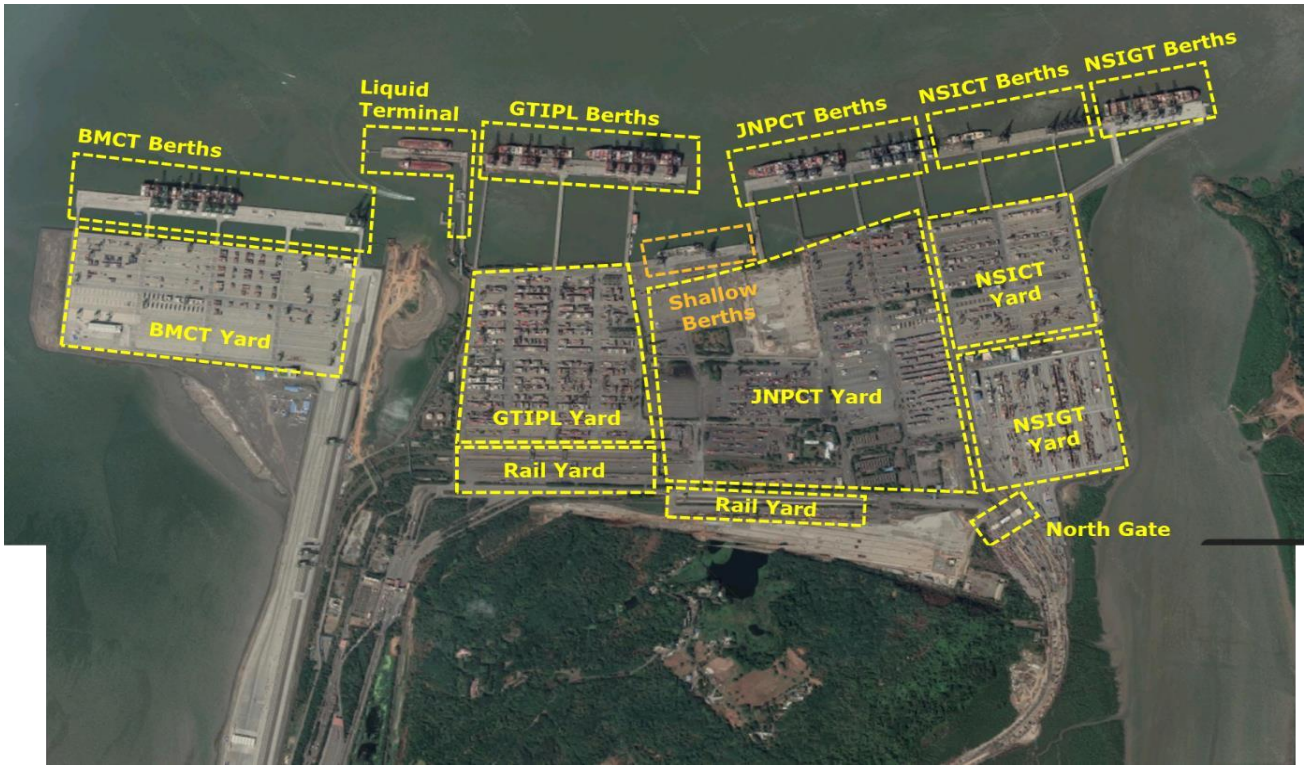


Figure : Existing Facilities at JNPT (retrieved from Google Maps)

1. JNPCT – Jawaharlal Nehru Port Container Terminal

JNPCT is JNPT's own container terminal, with contemporary, international-standard facilities. It has three berths with a total quay length of 680 metres that can handle vessels with a draught of 14 metres. With a container yard covering 62 hectares, the terminal has a capacity of 1.5 million TEUs. It also features a shallow terminal with a quay length of 445 metres and a draught of 10 metres, with a total capacity of 0.15 million TEUs and 4.5 million tonnes per year of other goods.

Figure 22: JNPCT Container Terminal (retrieved from Google Maps)

2. NSICT-DP World – Nhava Sheva International Container Terminal

NSICT-DP World was established to fulfill the growing need for container trade activities around the world. P&O Ports, an Australian firm, built the two-berth container terminal on a 30-year BOT basis. The project entails the building of a 600-meter dock, the reclamation of 25.84 hectares of land for container yards, as well as the necessary container handling equipment and other amenities. The terminal's current capacity is at 1.2 million TEUs per year

Figure 23: NSICT Container Terminal (retrieved from Google Maps

3. BPCL and IOC Liquid Terminal

A twin-berth liquid cargo jetty for handling liquid goods, including POL, developed by BPCL and IOCL on a BOT model for a 30-year lease tenure. The terminal, which has a 300-meter quay, can accommodate 7.2 million tonnes per year. The dual loading/unloading facility can handle two ships at once: 120,000 DWT in the seashore berth and 45,000 DWT in the shoreside berth.

Figure 24: BPCL Liquid Terminal (retrieved from Google Maps)

4. GTI-APM – Gateway Terminals India

Since 2006, GTI, a joint venture between APM Terminals and CONCOR, has operated JNPT's third terminal on a BOT basis for a 30-year lease tenure. The port has a capacity of 1.8 million TEUs with a quay length of 712 metres and a container yard of 54.57 hectares. It can handle vessels with a draught of 14 metres.

Figure 25: GTIPL Container Terminal (retrieved from Google Maps)

5. NSIGT-DP World – Nhava Sheva (India) Gateway Terminal Pvt. Ltd.

NSIGT was completed in 2016 and features a 330-meter quay, 27-hectare area backup for container yards, and a capacity of 0.8 million TEUs per year. The maximum vessel draught at the terminal is 15 metres. The terminal was built in response to increased demand and to increase private sector participation in ports.

Figure 26: NSIGT Container Terminal (retrieved from Google Maps)

6. BMCT – Bharat Mumbai Container Terminal

This is the latest container port built under the Design, Build, Fund, Operate, and Transfer (DBFOT) model for a 30-year concession. The contract has been granted to Bharat Mumbai Container Terminals Pvt. Ltd., a subsidiary of the Port of Singapore Authority, at an estimated cost of INR 7,915 Cr. With a capacity expansion of 4.8 million TEUs, this terminal will nearly quadruple JNPT's capacity (2.4 MM TEUs in two phases). Following the commissioning of this terminal, JNPT exceeded the yearly 5 million TEUs mark for the second straight financial year in FY19-20.

Figure 27: BMCT Container Terminal (retrieved from Google Maps)

Figure 27: BMCT Container Terminal (retrieved from Google Maps)

- **Technological Upgradation at JNPT**

JNPT aims to increase its innovation quotient by using various technologies aimed at improving port operations efficiency. It wants to increase automation by using digitalization and data-driven processes. Among its notable initiatives are:

1. **Gate automation systems**

The process was started by DP World, one of the world's leading port terminal operators, in 2005, when it installed a paperless gate module called Smart Gate. In all terminals, the port now has computerised, RFID gate operating processes with readers and cameras at checks. This greatly automates entry and exit, decreasing personnel requirements from an average of four to one.

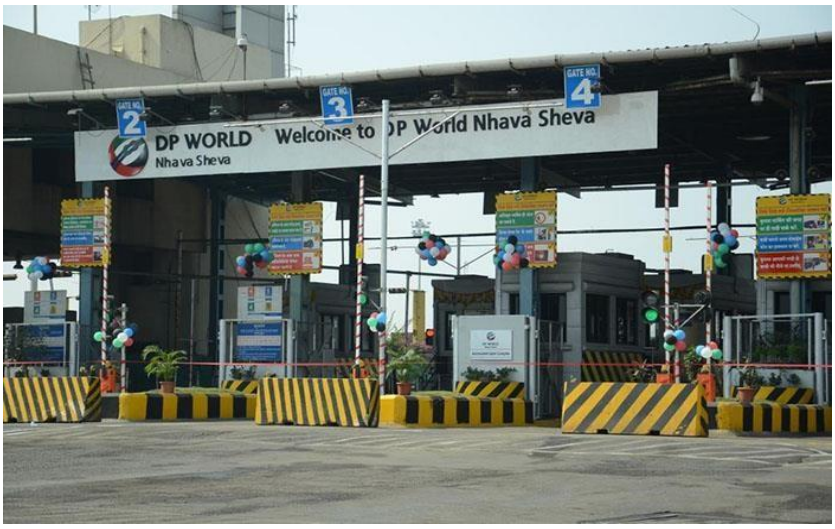


Figure 28: Automated gates at the NSICT terminal in JNPT

2. Container traceability

In the port, using RFID chips for container tracking has become widespread. Inventory management has become easier, faster, and less manual as a result of this. Container owners and port operators can now track their containers in real time across the whole logistics chain (from ship to the container freight station)

3. Monitoring activity & movement

Cameras have been deployed at the port and CFS to monitor personnel and equipment movement and activities. These can be found throughout the port, terminals, and warehouse facilities.

4. Rubber tyred gantry (RTG) cranes

These are self-driving or semi-autonomous vehicles that can lift and stack containers from ships to trucks or trains and vice versa. JNPT has purchased a fleet of electrically powered RTG cranes for usage in various terminals for cargo stacking. These trucks can manage loads ranging from 10 to 50 tonnes and can be controlled by a single person, as opposed to the ten operators necessary previously.

Figure 29: RTG cranes in BMCT, JN Port

5. **Vehicle management system**

Vehicle Miles Travelled (VMT) screens installed in trucks provide GPS-enabled navigation in a terminal via a centralised system for a work assignment. This enables the system to assign tasks to truck drivers as well as offer a route and detailed directions for picking up and dropping off cargo at the port. This was previously accomplished by manual intervention at each level, but it is now a fully automated process.

3.6 Ongoing Projects at JNPT

JNPT has been focusing on infrastructure development in recent years, with the goal of increasing capacity and improving surrounding facilities. The following are some of the main projects underway in and around the port:

1. **Development of the Bharat Mumbai Container Terminal in the port**

The second phase of BMCT's terminal construction will include an additional 1 km of quay length, 16.5m of berth depth, 12 quay cranes, 46 RTG Yard cranes, and 4 RKGC cranes for its rail yard, with a capacity of 2.4 million TEU (total 4.8 MTEU). The addition of this terminal will increase the port's overall handling capacity to 10 million TEUs, solidifying JNPT's position as India's leading container port.

2. **Infrastructure development works of SEZ Phase 1**

JNPT has proposed a Special Economic Zone (SEZ) project as part of the Government of India's port-led industrialization agenda. It would be built on 277.38 hectares of land with a JNPT investment of Rs. 500 million. Automobile, Electrical, Electronic, Engineering, Food Processing, and Pharma sectors are all planned for the SEZ.

3. **Construction of a dry port at Wardha, Nashik, Jalna, Sangli**

A dry port is an intermodal terminal in a remote location that serves a region connected by rail or road to one or more ports. Between the dry port and the overseas ports, it provides specialised services. It is mostly used for container cargo and provides logistics and value-added services to shipping and forwarding firms.

The dry ports of JNPT will be built in Maharashtra's Wardha, Jalna, Nashik, and Sangli districts. These ports will aid container movement to India's inland areas by reducing logistics costs and time.

4. Additional Liquid Cargo Jetty

JNPT is investing INR 309 crores in the construction of a 4.5 MTPA liquid jetty. The jetty will feature two berths, one for 35,000 DWT vessels and the other for 25,000 DWT vessels, allowing it to accommodate two large vessels at the same time. Construction on this project began in February 2020.

5. Coastal berth construction

To speed up coastal shipping in India, the Indian government is building a coastal vessel berth at each major port, which will be positioned in the port's shallow areas. These docks will not be accessible to large international ships.

JNPT is building a 250-meter-long coastal dock with two 94-meter-long trestles and an 11-hectare backup reclamation area to meet this need. The berth's capacity will be 1.5 MTPA for liquid cargo and 1 MTPA for general coastal freight. As of July 2020, most of the construction on this berth has been completed.

CHAPTER – 4

ANALYSIS and DISCUSSION

The country's ports have become the backbone of international trade. Furthermore, with greater containerized movement and JNPT handling over half of the volume, it is critical to assess port performance in order to detect faults and bottlenecks. Increased turnaround time is required for infrastructure-heavy assets in order to increase available capacity and lower utilisation rates. JNPT is already using more resources than the global average, leaving less space for other activities.

4.1 Competitive Landscape: Comparing Port Performance (Global)

Despite the projects undertaken, JNPT trails other significant ports globally on key performance parameters. For a port's shipping customers, factors like a ship's turnaround time are crucial. Shipping corporations assess a port's service quality based on two factors: time and cost. The time cost of the vessel is used by shipping corporations to assess a port's service efficiency. The turnaround time of the ship is the most important factor to consider when evaluating this measure. This comprises pre-berthing detention, unloading, inspection, documentation, and other aspects of a ship's journey between arrival and departure. It is mostly divided into the following categories:

Turnaround time = pre-berthing detention + working time at berth + idle time at berth

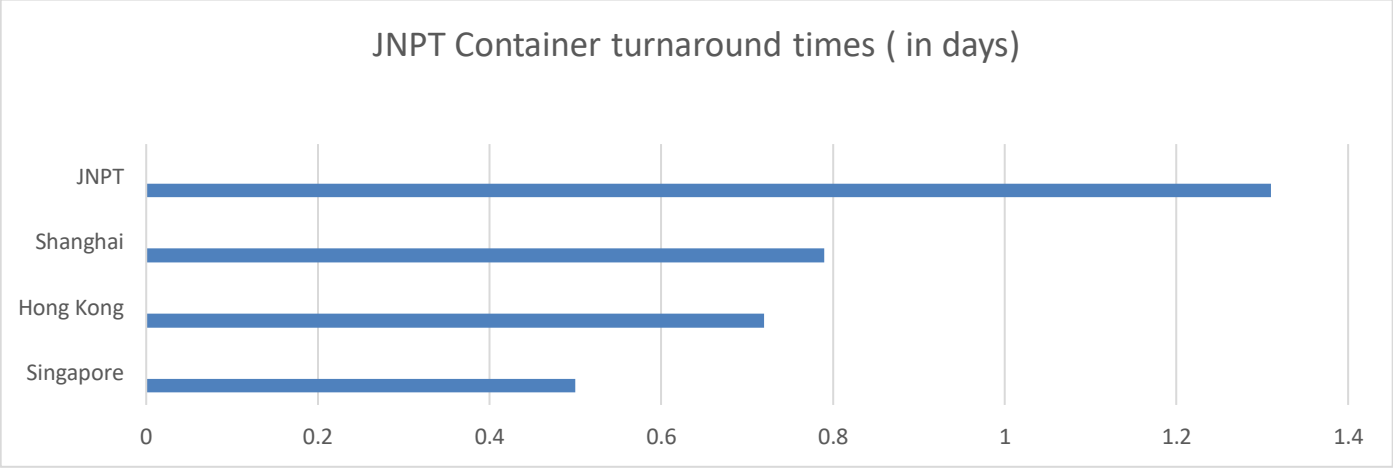


Figure 31: Global Benchmarking of Turnaround Time

The major part of the turnarounds time comprises of pre-birthing detention where the vessel needs to wait before entering the berth.

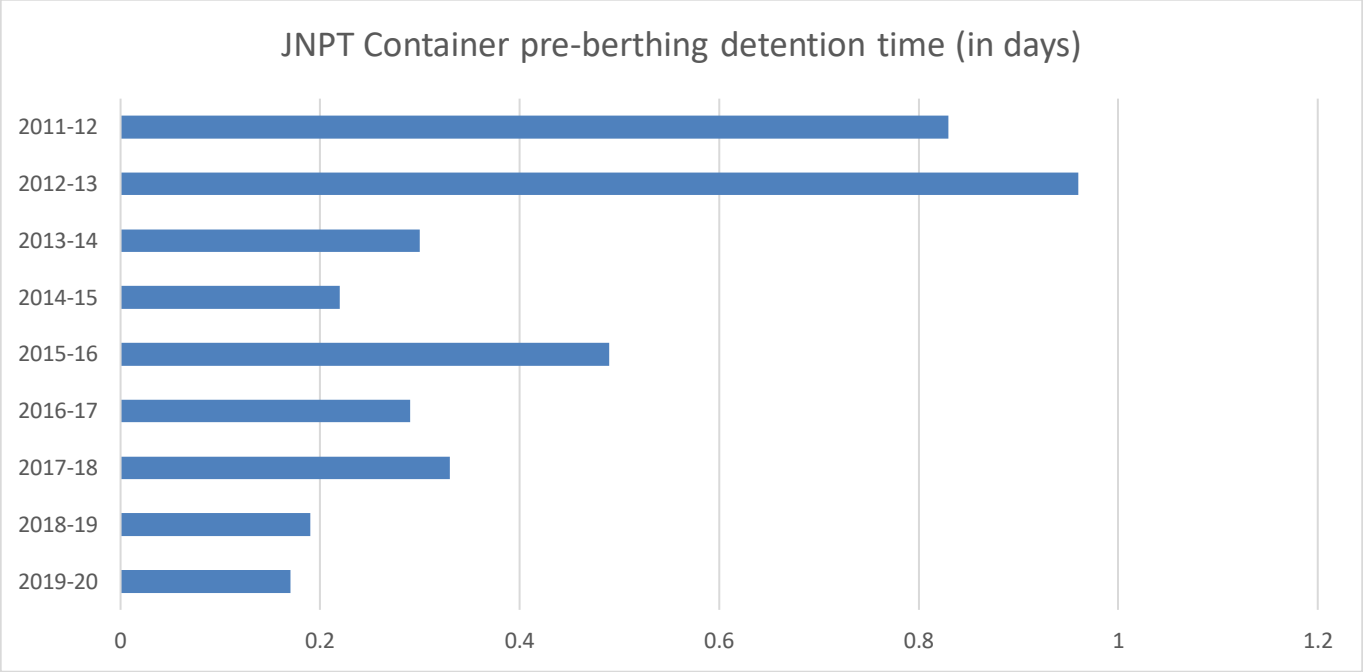


Figure 32: JNPT Pre-berthing Detention Time Trend Analysis

For container ships, the percentage of idle time at berth to time at working berth can be used to determine idle time at berth.

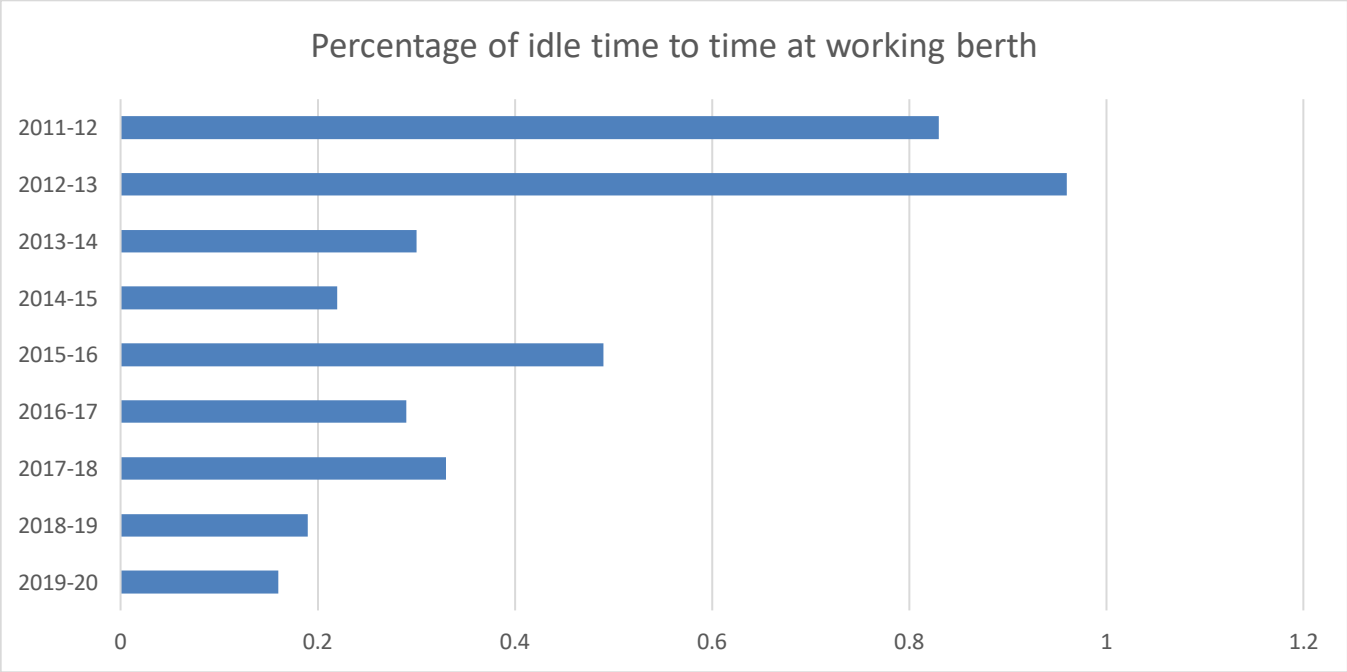


Figure 33: Percentage of idle time to time at working berth

In the last decade, this metric has been quite steady. This implies that ships are still spending a lot of time on the berth waiting for loading and unloading to start. There could be a variety of causes for this, including crane shortages, crane operator shortages, truck shortages, and so on.

Thus, in this equation,

Turnaround time = pre-berthing detention + working time at berth + idle time at berth

We have seen that the pre-berthing detention time has decreased in the past decade, but the working time at berth and idle time at berth is still high.

4.2 Competitive Landscape: Comparing Port Performance (Local)

The major ports in the three directions were taken and compared on numerous characteristics relating to available infrastructure and operations for competitive landscaping globally.

- **Dwell Time**

When comparing the pan-India scenario for the month of August 20, JNPT performed best in terms of overall import and export operations. JNPT has the shortest dwell time for export containers and the second shortest for import containers. Below is a trend study of the dwell time performance throughout the three regions.

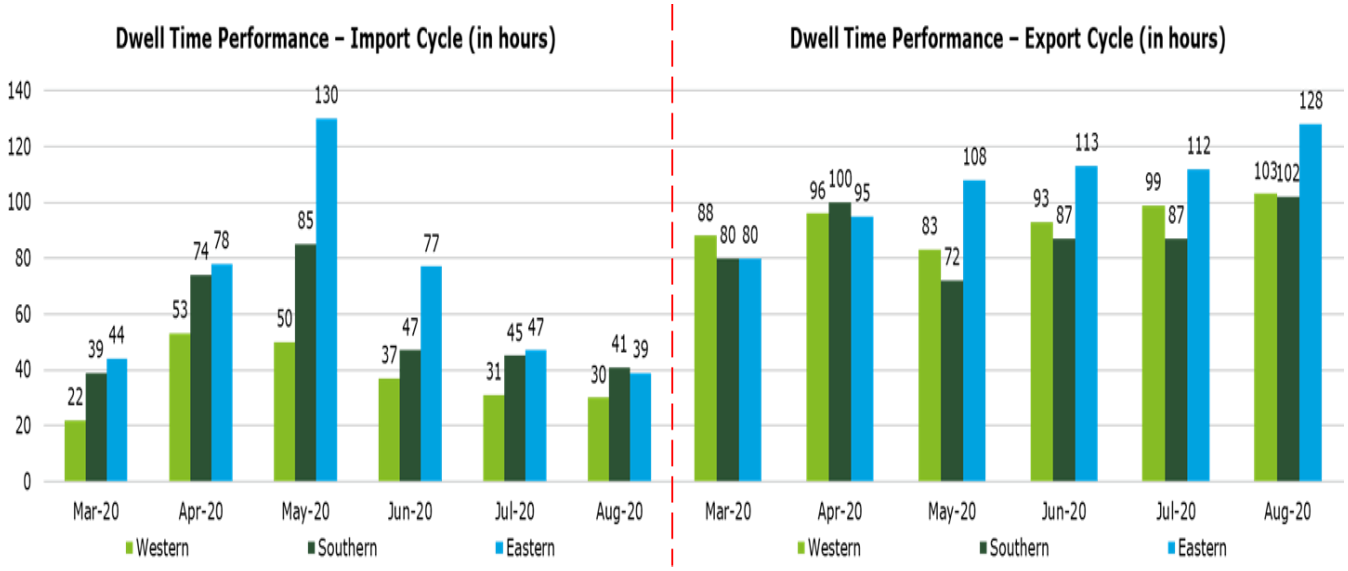


Figure 34: Dwell Time Performance of Ports: Trend Analysis

Figure 35: Pan India Performance Snapshot for Dwell Time (Aug-20)

4.3 Performance Benchmarking of Port

I am here using a framework developed by DLDS - DMICDC Logistics Data Services, a joint venture between the Government of India represented by the National Industrial Corridor Development and Implementation Trust (NICDIT) and Japanese IT company NEC Corp, which is entrusted with collating data across operational parameters on many ports in India, to compare the performance of JNPT terminals to other ports on the western coast of India. Their flagship product, Logistics Databank System, gives container visibility and comparative performance data across India's western corridor. (DLDC, 2020)

Terminals are plotted on a graph that measures container volume handled and container dwell time. The terminals are classified into one of four quadrants based on these metrics: slow bulk movers, star performers, high potential, and laggards. These are described as follows:

- Slow bulk performers

Terminals with a high container volume but a long dwell period. Due to locational or heritage advantages, these terminals typically have high volumes that would not have been sustained in a more competitive market.

- Star performers

Terminals that have handled relatively high container volumes with a shorter stay time. These are the grid's best-located terminals, with high volumes and excellent efficiency. However, given the lower benchmarks at Indian ports, they continue to lag behind their worldwide counterparts. As a result, they must continue to discover ways to improve operational efficiency while increasing container quantities.

- High potential

Terminals that have served relatively small container volumes with shorter dwell times. As terminal demand rises, these have the potential to move into the Star performers quadrant. Low container quantities and high capacity, on the other hand, improve operating efficiency. Instead of idle capacity, efficiency should ideally come from technical advantages and productivity. As a result, the reason for the high potential must be determined.

- Laggards

Terminals that have generally catered to smaller container volumes and longer dwell durations. These must improve their dwell times as well as try to increase their demand. While increased dwell time may be one of the reasons for low demand, it must be determined if there are any other locational drawbacks that cannot be overcome. Ports, for example, cannot attract larger ships or enhance their throughput per ship without a natural draught or the ability to dredge.

The categorization as of July’21 is ,

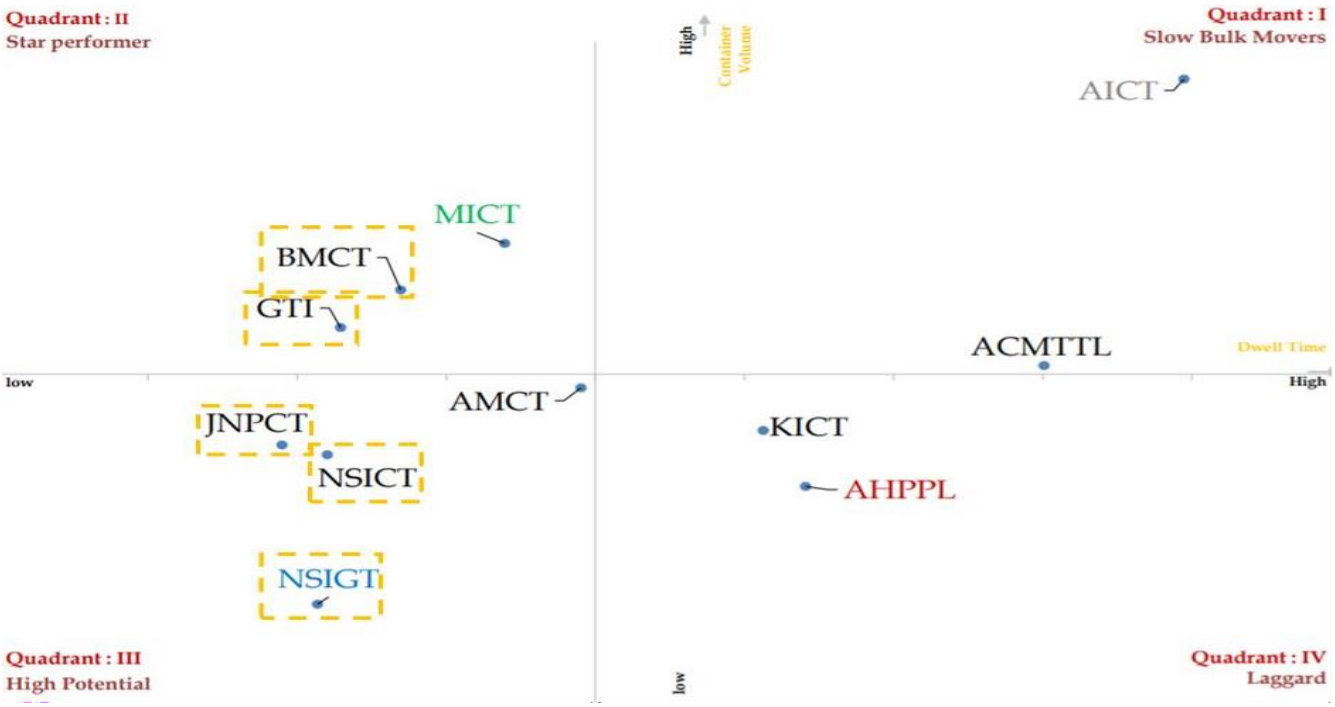


Figure 44: Port Terminal Performance Index - July'*21*

The five JNPT terminals – JNPCT, NSICT, NSIGT, GTI, and BMCT (boxed in yellow) – are all in the high potential or star performer quadrants, as seen on the chart. If demand increases, the high potential terminals can migrate into the star performer quadrants. However, their dwell periods are already shorter than those of other western ports. However, in order to compete with world-leading ports, it must lower its dwell time even further. Furthermore, the reason for the short stay duration must be investigated. It could be due to a combination of high efficiency and low utilisation. For example, throughput at JNPT's own terminal JNPCT has been declining in recent years.

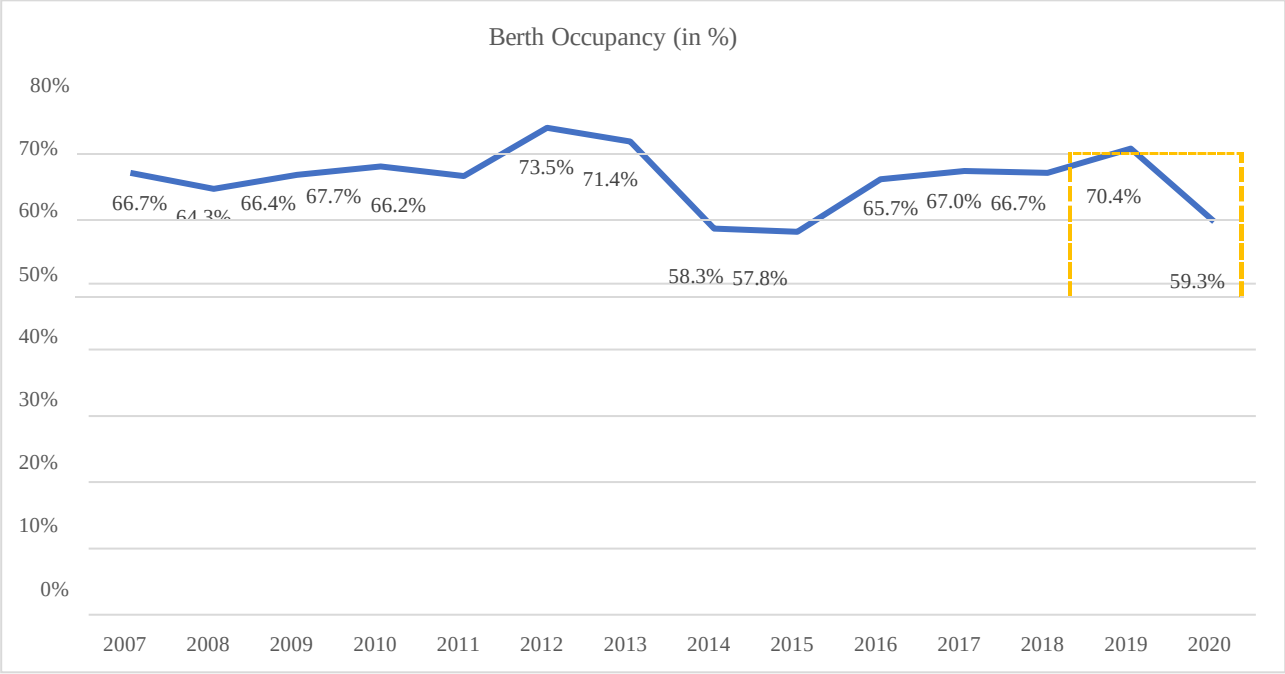
The Mundra International Container Terminal (MICT) in the Mundra port, owned and operated by global port terminal operator DP World, is India's best-performing terminal. MICT has the highest container volume and the shortest dwell time. It has been able to grab market share from JNPCT due to its operating efficiency and proximity to the JNPCT . The JNPT terminals, on the other hand, have shorter dwell durations and a lower container volume than MICT.

4.4 Capacity Assessment of Existing Berths

A terminal's and port's container and cargo handling capacity is determined by a variety of criteria, including berth capacity usage, stackyard capacity, equipment provided, handling rates, and so on.

The berth occupancy factor is an important parameter to consider when determining a port's or terminal's berth capacity. This is the ratio of the total number of days a berth is occupied to the total number of operational days in a year for the port. This ratio must be kept low to avoid vessel bunching and berthing delays, whether there are fewer berths or ships arrive at random. The following are the recommended berth occupancy factors:

Number of berths	Recommended berth occupancy factor
1	60%
2	65%
3 or more	70%



As can be seen, by 2018, JNPT's overall berth occupancy was quite close to the criterion of 70%. The port would have exceeded the benchmark occupancy ratio if demand continued to rise. The overall occupancy factor has decreased after installing the BMCT terminal's 2.4 MTPA capacity. However, the new port is already seeing tremendous demand and is swiftly ramping up. After debuting in February of that year, it reached the millionth container milestone in October of that year. As the terminal's demand

grows, the port's overall berth occupancy percentage will increase yet again.

Individual terminal occupancy, however, remains very high. The GTI terminal has a near-100 percent occupancy rate. The NSIGT port is functioning at greater than 100% capacity. Due to strategic reasons, its secondary port is only 44.2 percent utilised by its operator, DP World. DP World has a commissioning agreement with the Indian government that requires it to pay a very high concessional rate for throughput greater than 0.6 TEU and to sustain a demand of at least 0.6 TEU. As a result, it is limiting the NSICT terminal's throughput to 44% utilisation and transferring the remaining demand to its other terminal, NSIGT.

- Liquid cargo handling facility

The berth occupancy at the liquid freight handling facility is over 80%. The waiting period for vessels can sometimes exceed 5-6 days, with 2-3 days attributed to the port and 3-5 days due to other factors. While the JN Port has plans to build a second liquid terminal, it will be some time before that happens. As a result, it is critical for the port to analyse the various options for reducing the port's waiting time.

Furthermore, if an LPG vessel is berthed on the front side with this facility, a Crude or Petroleum Oil Lubricant (POL) ship cannot berth on the opposite side. It can only be used by chemical or edible oil tankers.

4.5 Container Transportation

Container cargos are transhipped from/to the vessel to/from ICDs/CFS in container transportation. The transport might be done by train or by road. Both rail and road transit are available at JNPT. In the import cycle, vehicles are typically employed to transport containers from the vessel to the CFS and vice versa. Long-distance transportation to ICDs across the country is provided by trains. In the case of imports, direct port delivery containers take longer than containers going for CFS. Exports, on the other hand, are equivalent but more expensive than import activities. The laden containers, which require better handling, have lower dwell time in imports than the exports. Further, their time is significantly lower than empty containers. In this scenario as well, the export time is higher than import time.

4.6 Yard Operations

The yard area of JN Port is broken up, and the import and export zones are separated. This causes operational delays and limits the transportation of equipment, specifically RTGs.

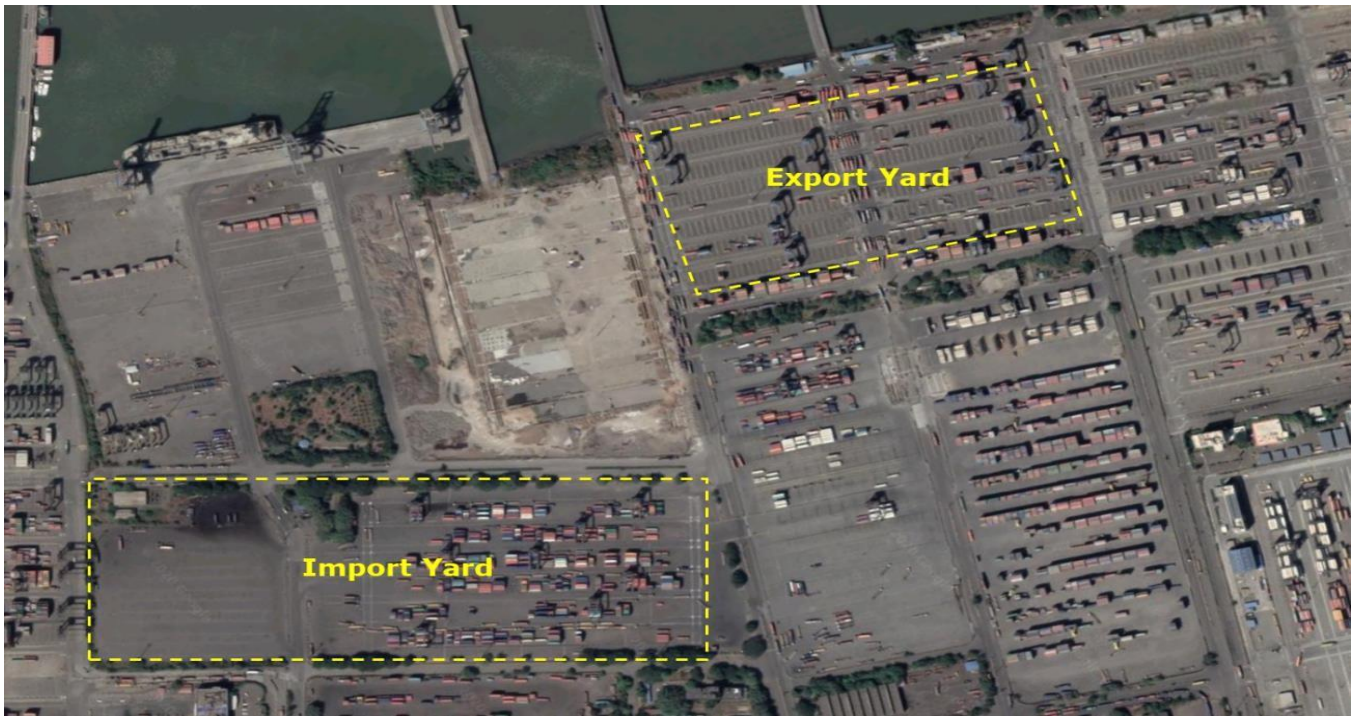


Figure 54: Discontinuous Yard for Import and Exports (retrieved from Google Maps)

4.7 Rail Operations

In comparison to other private ports in India, JNPT's present rail coefficient is quite low. This is problematic because, over longer distances, rail travel is both faster and less expensive than road transport. Although rail evacuation is not prominent at India's major container ports, the percentage of JNPT is also low when compared to the national average.

The use of "mixed-rail handling" instead of specialised trains for each terminal is one of the main reasons for the lower percentage of rail evacuation at JNPT. Another reason is the prolonged stay time of containers sent by rail, which is caused by India's slow freight rail traffic, especially over short distances. Because many JNPT containers are also sent to the nearby hinterland (including Maharashtra), JNPT has a low rail share, which raises its costs. Mundra has begun using its rail line to remove containers, significantly reducing the dwell time.

JNPT currently operates nine rail lines and has two separate rail yards. Both yards are 750 metres long and can carry up to 90 TEUs in 4-45 wagons

.

Figure 56: Rail Yard at JNPT (retrieved from Google Maps)

4.8 Equipment utilization & productivity at JNPCT

The levels of equipment utilisation at JNPCT and GTI are significantly different. Despite its high availability, JNPCT's RTGC (RT Gantry Crane) and quay crane utilisation is quite low. Even while overall terminal use remains high, this level has decreased in recent years. This results in a significant occupancy gap between the berth and the yard's equipment.

The equipment productivity at JNPCT is also quite low. The average RTGC productivity at JNPCT is six gross moves per hour (GMPH), whereas it is 12 GMPH at the neighbouring GTI terminal. By increasing the number of moves per hour, more efficient container stacking and moving activities can be achieved. The separation of import and export yards at JNPCT is one of the key causes for the low utilisation. As a result, RTGCs have lengthier trip times. The utilisation differs between import and export yards as well.

There are also issues with crane operators' responsibilities and incentive schemes. There are no specialised crane operators for dock cranes, RT gantry cranes, and other crane types. Quay cranes are more specialised and complicated, and their operation necessitates a higher level of skill. There is currently no such differentiation. Crane operators' incentives are similarly tied to total terminal productivity rather than their own. They have no incentive to enhance their skills and aim for a higher productivity rate as a result of this.

4.9 Technological challenges at JNPT

Despite technical advancements, JNPT falls behind its Indian and international counterparts in terms of technological innovation. Advanced technology have long been used in terminals in ports like Singapore and Rotterdam to boost automation and utilisation.

The Port of Rotterdam, for example, has lately enhanced production through expanding automation. This was the world's first port to use remotely controlled ship-to-shore gantry cranes, which were complemented by 54 Automated Rail-Mounted Gantry Cranes (ARMGs). The terminal is also powered by wind turbines rather than fossil fuels. These emit no CO2 and are far quieter than the diesel generators used at ports.

CHAPTER – 5

CONCLUSION & ISSUE RAISED

5.1 Issues at JNPT

The port's slow growth in traffic might be attributed to a number of difficulties. With worldwide containerization of port traffic rising, identifying and addressing concerns at one of the country's largest container ports is critical. Some important issues have been found and highlighted below based on the benchmarking and capability assessment of JNPT in the earlier sections.

5.1.1 Physical Infrastructure

- Terminal Draft

The volume of container/cargo handled is the main driving force of port operations. The size of the vessel that the port can accommodate determines this. The draft accessible at the terminals determines this. The maximum available draft at JNPT is 14 metres, which is lower than major ports like as Rotterdam (24 metres), Shanghai (20 metres), Singapore (16 metres), and others. As a result, JNPT has an inherent limit on the number of operations it can handle. Even in India, the draft is lower as compared to competitors in the container segment, Mundra and Pipavav.

The eastern corridor's Gangavaram Port has increased its capacity ahead of demand. It is more efficient than the other ports due to low utilisation, improved mechanisation, and large port infrastructure. Even for Ultra Large Crude Carriers (ULCC) and Very Large Ore Carriers (VLOC), the port's allowed draft of 19.5m is sufficient .

- Quay Length

Singapore's quay length is 15,500 metres, but JNPT's is only 680 metres. As a result, the port's capacity to handle multiple vessels at once is limited. If JNPT can handle ten ships at once, the Port of Singapore can handle even more and far larger cargo ships.

- Yard Area

JNPT has around 350 hectares of accessible yard space, whereas the Port of Singapore has 600 hectares. In addition, land acquisition constraints in India create a challenge with yard expansion. JNPT is reliant on land acquisition behind the terminal and is troubled with land acquisition and

resettlement/rehabilitation concerns rehabilitation concerns.

5.1.2 Operations

- Capacity Utilization

Although JNPT's overall berth occupancy is low, the port's capacity utilisation of different terminals is near to 100% . The use of the only private terminal, such as BMCT, is rapidly increasing. Forecasting port container demand seems to be important, as planning future capacity, as demand rises.

- Berthing Time

Due to equipment or manpower unavailability when the ship is berthed, JNPT's working time at berth and idle time is relatively high.

- Crane Utilization

Even with high availability, crane usage and productivity at JNPT (particularly at JNPCT) are quite poor compared to other private and government ports in India. Because of the high unavailability of either equipment or staff when the ship is berthed, this results in a high working time at berth and idle time for JNPT. The causes for this must be investigated further, as well as HR interventions to boost productivity.

- Technological Advancement

In comparison to global counterparts, JNPT's current technology level and number of digital interventions are low. Assume JNPT needs to reduce its operational time to match that of other international ports in order to improve customer satisfaction. In that situation, it will have to consider a major overhaul of its operations using cutting-edge port technology. There are numerous Asian and European ports that have attained this goal.

5.1.3 Port Area

- Yard Discontinuity at JNPCT

JNPCT has a discontinuous yard that separates imports and exports. As a result, overall efficiency declines, and equipment movement is hampered.

- Rail Yard Operations

The current rail yard operations of JNPT are inefficient due to the separated yards and mixed-rail handling practice. Although things should improve with the advent of the Western DFC, JNPT must explore other methods of enhancing the efficiency of rail operations at the port as well. It is important to note that JNPT has a significantly low rail coefficient. As a result, the traffic of northern hinterland is lost due to competition from Gujarat Port. The coverage area of JNPT is getting restricted to the central and western regions.

- Road Congestion

At JNPT, near the port gate, there is a Y-junction. Inter-terminal travel is restricted due to heavy congestion at the junction. With the building of a new terminal, the estimated traffic would climb even more. At the port, traffic bottlenecks of up to a kilometre have been seen, affecting turnaround times. This has an impact on the dealers' overall costs.

5.2 Conclusion

With the worldwide shift to containerized trade and high-volume container flows via JNPT, it's critical to address challenges and improve operations. While the port is in the process of expanding its handling capacity, it also requires its current facilities to run well in order to avoid operational bottlenecks that would cause users to abandon the port. JNPT also needs to look at some of the operational parameters to fasten the current process in place and augment effective port capacity. Adopting the state-of-the-art facilities used by the best ports in the world, there are several ways for JNPT to improve its scale of operations.

JNPT is working to increase operational efficiency by digitising activities and shifting to equipment-based initiatives where manual labour was previously used. These initiatives have resulted in some improvements in the company's operational metrics. The first-order effect is a reduction in ship turnaround time due to reduced berthing time, and the second-order effect is a reduction in ship pre-berthing detention time. It has fueled these efforts by increasing the usage of commonly used equipment such as electric RTGs, container traceability, and vehicle management systems, among other things. However, JNPT can only achieve the worldwide middle-order of advanced ports with these technological efforts.

Ports have evolved into complex partner-based systems with players from all parts of the value chain, including shipping lines, port authorities, terminals, logistics firms, and labour suppliers. To make any port technology successful, the technologies used by each of these entities and those adopted by the port must be carefully integrated. Through seamless information sharing, these technologies must enable the port to boost its efficiency. Furthermore, the stakeholders must implement the technology without making significant changes to their existing software or port equipment. As a result, the port requires a platform-based solution that can combine various port technologies.

Information from a variety of port equipment and machines must also be integrated into the system. It must rely on industrial internet-of-things (I-IoT)-based technology to collect data from across the port and smoothly transfer it to the platform for stakeholders to use.

- Infrastructure

Smart IoT sensors will assist ports and terminals in tracking, operating, and maintaining infrastructure. Embedded sensors in quay walls, railway tracks, highways, and other structures will relay real-time information on the port's status, eliminating the need to shut down the port for inspection or routine maintenance.

- Intermodal traffic

Ports & terminals need to implement solutions to reduce the lag time between dropping off and picking up cargo by coordinating with logistics providers (trucking & rail services). The Port of Singapore is experimenting with an automated traffic monitoring system that employs sensors at key areas to track truck & container movement and notify logistics operators where and how to reach to drop off or pick off cargo. As a future initiative, they’re also working on an autonomous driving technology for trucks.

- Customs & clearances

Customs is a crucial point where container flow is disrupted and dwell time is extended. In Indian ports, customs clearance has gone a long way. JNPT is transitioning to a paperless customs clearing system, which has reduced clearance times in the past. However, more modern ports are experimenting with block chain technologies to reduce customs processing times, such as in Europe, Singapore, and China. This will make record keeping more efficient, affordable, and transparent throughout the value chain.

JNPT must increase its technological capabilities in order to remain competitive. It serves as India's local commerce center. JNPT handles a large portion of India's container traffic, and the competitiveness of Indian exports is based in part on its operating efficiency. As a result, it must maintain an efficient relationship with the Indian hinterlands in order to keep import and export trade costs as low as feasible. At the same time, it is a huge multimodal gateway port. It has been integrated with several forms of freight transit - road, rail, and now inland waterways – as India's principal container port. It must strive to be as technologically advanced as the great ports in developed countries if it is to be a competitive global port in the South Asian region. As a result, JNPT must consider the technology requirements of each of these stages of development and design a digital strategy for itself.

BIBIOGRAPHY

http://jnport.gov.in/terminals

http://www.jnport.gov.in/projects_ongoing

http://jnport.gov.in/terminals

https://www.joc.com/port-news/asian-ports/port-singapore/singapore-port-pushes-automated-trucking_20170109.html

https://www.joc.com/port-news/asian-ports/india-making-progress-new-port-portal-after-rocky-rollout_20190514.html