MASTER PLAN FOR MUMBAI PORT

Master Plan for Mumbai Port

Prepared for

Ministry of Shipping
Government of India

Ministry of Shipping/ Indian Ports Association

Transport Bhawan,
Sansad Marg,
New Delhi,110001
www.shipping.nic.in

1st Floor, South Tower, NBCC Place
B. P Marg, Lodi Road
New Delhi - 110 003
www.ipa.nic.in

Prepared by

AECOM

AECOM India Private Limited,
9th Floor, Infinity Tower C, DLF Cyber City,
DLF Phase II, Gurgaon, Haryana,
India, Pin 122002, India
Telephone: +91 124 4830100,
Fax: +91 124 4830108
www.aecom.com

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important and strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming larger drivers of economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

	Details	Description
Why is Sagarmala needed?	1 Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2 Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3 Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1 Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2 Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3 Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

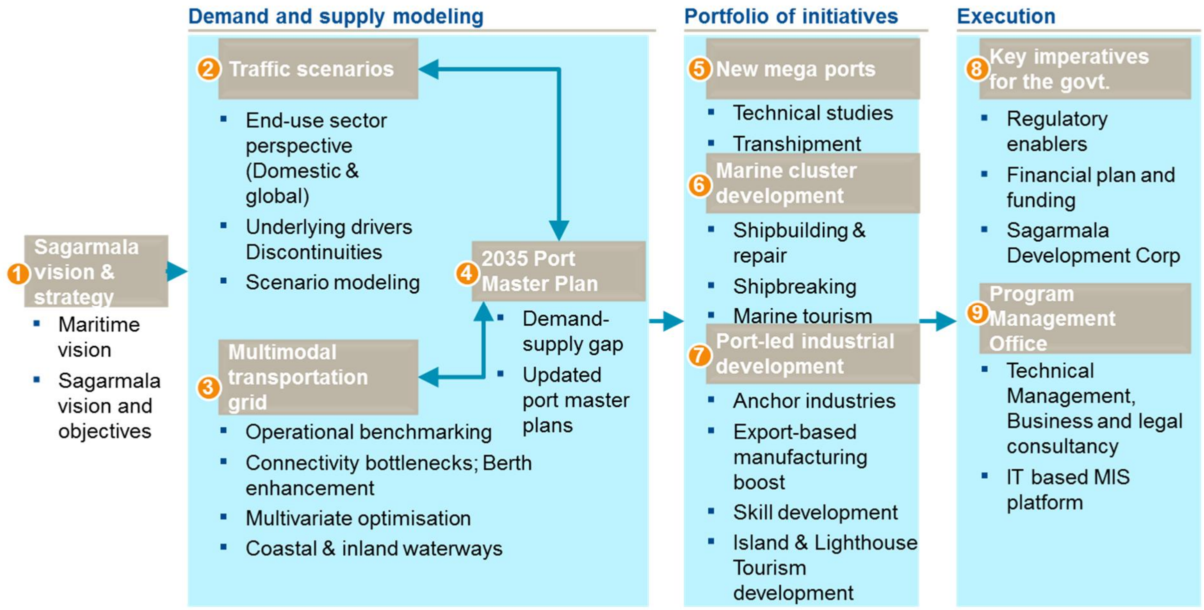


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

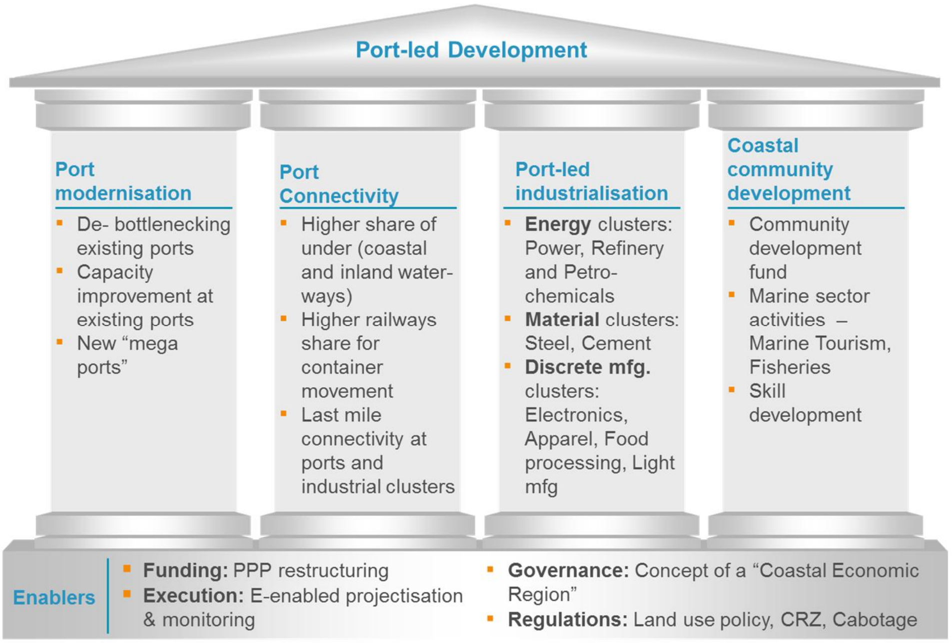


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on “Benchmarking Operational Improvement Roadmap for Major Ports in India” study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final Report for Development of Master Plan for Mumbai Port as part of Sagarmala assignment. This report is organised in the following sections:

Section 1 : Introduction

Section 2 : The Port and Site Conditions

Section 3 : Details of Existing Facilities

Section 4 : Performance, Options for Debottlenecking & Capacity Assessment

Section 5 : Details of Ongoing & Planned Developments

Section 6 : Traffic Projections

Section 7 : Capacity Augmentation Requirements and Proposals

Section 8 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Mumbai Port

Mumbai Port is one of the major ports located on the west coast of India, commissioned more than a century ago is a natural harbour, situated at latitude 18° 54’ N and longitude 72° 49’ E, protected on the east by mainland and sheltered by Mumbai Peninsula on the west. The location of the port is shown in the **Figure 2.1**.

Figure 2.1 Location Plan of Mumbai Port

The bay nearly rectangular in shape, measures about 36 km north to south and about 15 km east to west. The entrance to the harbour is from the southwest between Pong’s reef at the southernmost tip of Mumbai and Thal Reef lying off the mainland to the southwest. The distance between these reefs is about 11 km. The main harbour channel is, for the greater part, a natural channel following the longitudinal axis of the harbour approaching to the docks. The main harbour accommodates the Indira Dock and the Ballard Pier. Further northeast of the harbour is located Jawahar Dweep accommodating the POL berths. The Pir Pau chemical berth is at the northern extremity of the harbour’s deep water. In addition, there are 63 general ship anchorages straddling the main harbour channel from south Karanja buoy northwards as far as the Indira Dock approach channel.

Crude and POL products are handled from the jetties at Jawahar Deep and chemicals are handled at Pir Pau. Dry bulk, break bulk, automobiles and passengers are handled at Indira dock and Ballard Pier.

2.2 Rail and Road Connectivity

2.2.1 Road Connectivity

Mumbai Port is well connected to the hinterland through major arterial road network of suburbs of Mumbai city. The main road networks connecting the hinterland to Mumbai Port are as follows:

- **NH-8 connecting Delhi – Jaipur – Gandhi Nagar – Surat – Mumbai**

  This is a six lane road network connecting cargo generation clusters in the North to JNPT port. It is a part of the golden quadrilateral project. The majority of the cargo from Gujarat and Rajasthan hinterland will utilize this route.

- **NH-3 connecting Delhi – Agra – Bhopal – Nashik – Panvel**

  This is a four lane road network connecting cargo generation clusters in UP and MP via Agra. This road will serve the requirement of Central Maharashtra and part of Northern Cluster.

- **NH-4 connecting Thane – Pune – Belgaum – Bangalore – Ranipet - Chennai**

  This is a four lane network connecting 3 main industrial networks at Pune, Chennai and Bangalore. NH9 merges into NH4 at Pune.

- **NH-17 connecting Cochin – Mangalore - Goa - Panvel**

  This is a road connecting Cochin to Panvel via Goa. The south bound cargo utilizes this route. NH 17 is a four lane road and part of the stretch is two lane roads which are being widened to 4 lane with a provision to expand to six lanes to accommodate future expansions.

The NH-8 from North & Gujarat, NH-3 from Central part and Nashik, NH-4, Mumbai – Pune Expressway and NH-17 from Southern Part of country bring the traffic to Mumbai port.

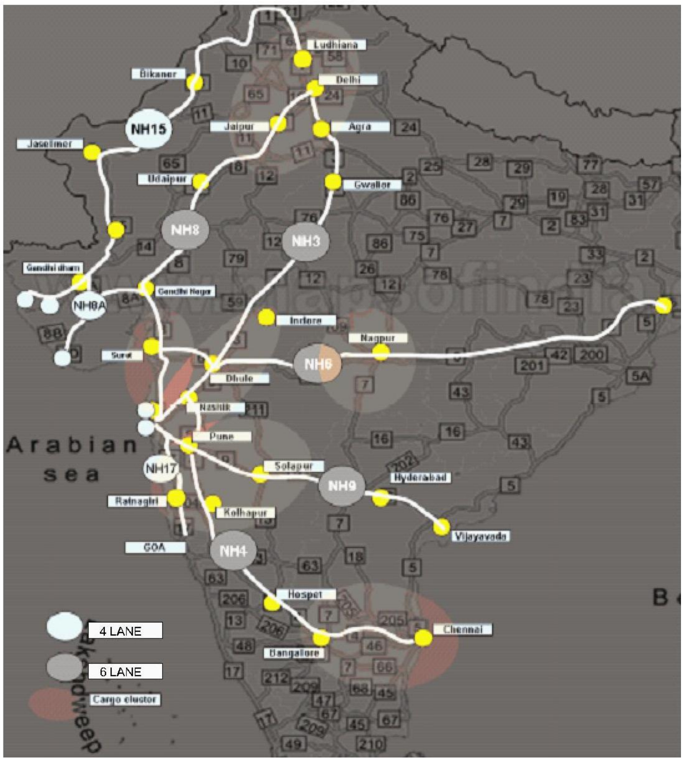


Figure 2.2 Existing Road Connectivity to Mumbai Port

2.2.2 Rail Connectivity

MbPT railway system is connected to Indian Railways at Raoli Junction, Wadala for receiving and dispatching the traffic generated from and to hinterland.

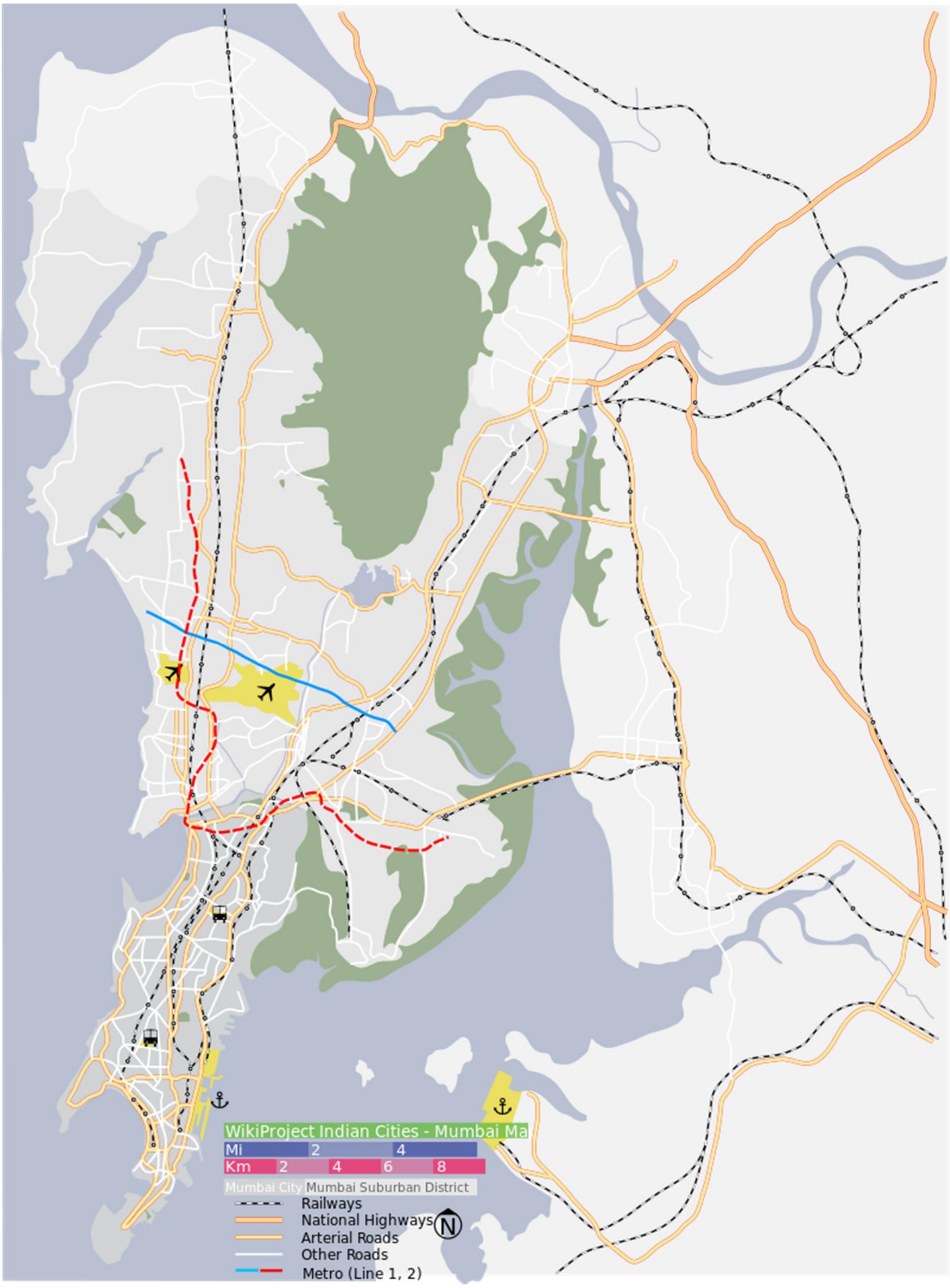


Figure 2.3 Rail Connectivity to Mumbai Port

2.3 Site Conditions

2.3.1 Meteorology

The climate of Mumbai generally shows a regular seasonal variation and the general character of the weather is more nearly related to the season. Mumbai is subject to the influence of both the SW and NE monsoon winds prevalent over the sub-continent. However, the former is more strongly marked along the west coast than the latter. The fair weather period is from October to June when it is generally sunny and dry. In the latter half of May, the weather becomes hot, sultry and humid as the conditions build up for the onset of SW monsoon. The “break” of the monsoon is accompanied by heavy rains, often lasting for several days. For the next two or three months there are periods of heavy rains interspersed with periods of less intensity. Towards the end of August, the monsoon begins to slacken and eventually recedes from Mumbai by the end of September.

2.3.1.1 Winds

During the fair weather period from October to June, the general wind direction is from the NW-NE quarter. Form June, for two or three months, the wind has an almost constant SW direction. The south-west monsoon winds are relatively stronger than the north-east winds. The maximum wind speed recorded is 150 kmph during the cyclonic storm of 1948.

2.3.1.2 Rainfall

The SW monsoon period starting about mid-May is the season for heavy rains. Nearly all the rainfall in Mumbai occurs during this period. The average yearly rainfall is about 2098 mm, of which 1965 mm (93.66%) occur during June to September. Usually maximum monthly rainfall occurs in July. The average monthly rainfall in July is 709 mm. There is practically no rainfall from December to April.

2.3.1.3 Temperature

The mean of the highest air temperature recorded in Mumbai is 35° C in the months of March, April and May while the mean lowest is 16° C recorded in the month of January. Mean daily maximum and minimum temperatures are 31° C and 24° C respectively.

2.3.1.4 Visibility

At Bombay from November to March smog hangs over the land, obscuring everything in view. This happens only for short periods most often shortly after sunrise but also occasionally in the evenings. Visibility is generally good for most part of the year.

2.3.1.5 Relative Humidity

Mean yearly relative humidity at 0830 hours is 77% while the same at 1730 hours is 71%. The monthly average is lowest in February (62%) and highest in July to September (85%).

2.3.1.6 Cyclone

In general the west coast of India is less prone to cyclonic storms compared to the east coast. From the information reported by India Meteorological Department (IMD) a total of 1034 disturbances occurred in the Bay of Bengal during the period 1891 to 1970 of which 363 intensified to cyclonic storms, the rest being 'depressions'. On an average the number of cyclonic disturbances per year during this period was about 13. However, if the data is updated to 1990, the number of cyclonic events per annum works out to be 16, varying from a minimum of 8 to a maximum of 18. It is observed from the tracks of the cyclones in the Arabian Sea from 1877 to 1992 that only 10 storms endangering the Mumbai coast have occurred in the above said period i.e. at a frequency of once in 12 years.

2.3.2 Oceanography

2.3.2.1 Tides

The tides in the Mumbai region are of the semi-diurnal type i.e. characterised by occurrence of two High and two Low Waters every day. There is a marked inequality in the levels of the two low waters in a day. The various tide levels with respect to Chart Datum reported at Mumbai are shown below:

Highest High Water	:	*+5.39 m*
Mean High Water Springs (MHWS)	:	*+4.42 m*
Mean High Water Neap (MHWN)	:	*+3.30 m*
Mean Sea Level (MSL)	:	*+2.51 m*
Mean Low Water Neap (MLWN)	:	*+1.85 m*
Mean Low Water Springs (MLWS)	:	*+0.76 m*
Lowest Low Water	:	*- 0.44 m*

The distance from the Mumbai floating light to the Elephanta deep is 26 km, and it will take 1½ to 2 hours to navigate this distance. Probability curves for HHW and tide levels 1 and 2 hours before HHW indicate that virtually on all occasions the tide level will exceed + 2.7 m two hours before high water and + 3.0 m one hour before high water. Hence larger vessels taking advantage of this tide, should therefore, enter the channel between two and one hour before high water and berth within one hour after high water.

2.3.2.2 Currents

The currents in the Mumbai region in the near shore zone are tide induced with reversal at high and low waters. The currents in the creeks are also affected by the freshets which result in not only increasing the strength of the ebb current but also limiting the propagation of the tide upstream. The normal maximum currents inside the harbour are about 2 to 3 knots although 4 knots occur on ebb flow during the monsoons.

2.3.2.3 Waves

The significant waves entering the harbour are the long period swell waves generated by deep sea storms. These mainly arise just before and during the monsoon and their direction of approach is normally from South – West. Whatever the wave-front orientation outside the harbour, the waves running up the harbour tend to be refracted in to a constant pattern. Waves are also substantially attenuated by the time they reach the berthing facilities in the harbour.

As the Mumbai harbour is sheltered, no significant wave climate exists within the harbour area. The wave height reaches a maximum of 1.5 m under normal conditions with wave period ranging from 6 to 10 s.

The offshore and nearshore wave rose diagram is as shown in **Figure 2.4**.

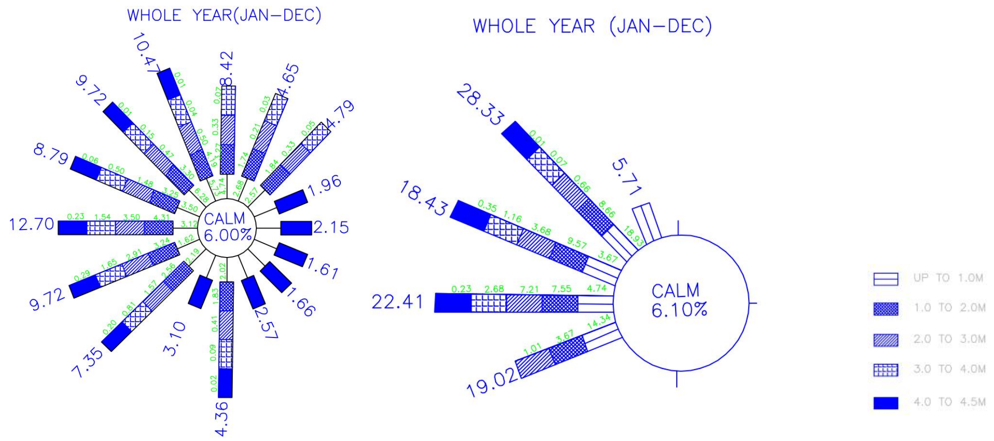


Figure 2.4 Offshore and Nearshore Waverose Diargram

2.3.3 Geology of the Area

The geological origin of rocks in the Mumbai region is that of the Deccan traps- a series of vast lava flows accompanied by volcanic eruptions at the close of Cretaceous period. Over the Deccan Plateau, the flow strata have remained nearly horizontal, but in the Mumbai area, they are inclined as much as 150 towards west. The type of rock is amygdaloidal basalt showing different grades of weathering from slightly to completely weathered.

This basalt layer is overlain by residual soil which in turn is overlain by marine clay. In general, the colour of marine clay is grey to dark black and its nature is soft to very soft. These are silty marine clays. At some places, these are mixed with fine to medium sized sand and gravels and at some places with gravels of weathered rock. The thickness of this layer is variable. The residual soil is the weathering product of underlying basalt. These are reddish brown in colour. These are hard to very hard in strength.

The Deccan trap basalt are of two types viz: amygdaloidal basalt and compact basalt. The difference between these two is that amygdaloidal basalt contains gas cavities whereas compact basalt does not. The basalt in the area of Pir Pau and Jawahar Dweep are of amygdaloidal type. These basalts are fine grained and show thin to thick bands of weathering. At some places, these rocks are highly jointed and show weathering and staining along these joints. Otherwise these are fresh and are strong to very strong in strength.

3.0 DETAILS OF EXISTING FACILITIES

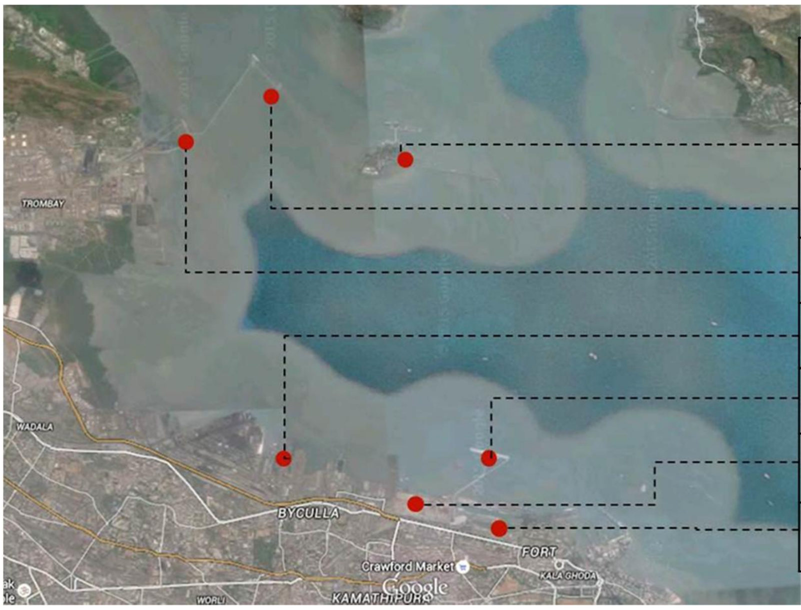
3.1 Mumbai Port

The port is geographically spread into different areas based on the type of cargo to be handled.

- Main Harbour in Colaba area – for handling dry bulk, breakbulk, general cargo, automobiles
- Jawahar Dweep (Butcher island) – for handling Crude and POL products
- Pir Pau – for handling chemicals

Mumbai port was handling coal at Haji Bunder and this has recently been discontinued due to environmental considerations. The Princess & Victoria Docks in the Main Harbour have been closed and filled up to create stackyard for containers.

The relative locations of port facilities are as shown in **Figure 3.1**.



Terminal
Jawahardweep
NPP & 2nd Chemical Berth
OPP
Haji Bunder
OCT
Princess & Victoria Docks
Indira Dock

Figure 3.1 MbPT Relative Locations of Existing Facilities

3.2 Port Navigational Channel

The main navigational Harbour Channel is, for the great part, a natural deep-water fairway and the channel has been deepened to 11 metres only close to facilities. With a mean high water neap tide of 3.3 metres, the channel is adequate to meet the requirement of most of the cargo vessels, passenger ships and tankers. With good lighting arrangements navigation is allowed at the port round the clock. This channel also acts as a common channel to Mumbai and JN port.

The Mumbai harbour channel is presently maintained at a depth of 10.7 m to 11 m CD. The total length of the dredged channels of Mumbai Port is about 30.4 km. A major part of the dredged channels (length 23.1 km) is the main harbour channel running between the Prong's Reef at the western end of the harbour and the oil berths at Jawahar Dweep. The entrance channel to the Indira Dock and Harbour wall berths take off from the main harbour channel at a distance of about 10km from the Prongs reef. There is a dredged channel about 2 km long which takes off from the northern end of Jawahar Dweep to the Pir Pau Oil terminal.

Figure 3.2 Navigational Channel to Mumbai Port

The details of approach to the various berthing facilities are given in **Table 3.1**.

Table 3.1 Approach to Various Berthing Facilities

Approach From Main Channel	Length (km)	Min Width (m)	Min Depth (m)
Pilot Station to Jawahar Dweep	7.0	325	13.5
Jawahar Dweep to Pir Pau	2.5	200	8.7
To Indira Dock	1.7	300	7.6

3.3 Berthing Facilities

The berthing facilities are in three groups: Main Harbour comprising Indira Dock berths and Ballard Pier berths handling dry bulk, general cargo, break bulk, cars etc.; Jawahar Dweep berths handling crude and POL products and Pir Pau berths handling chemicals. Their details are given hereunder.

3.3.1 Indira Dock

The Indira dock works on a lock-gate system with a lock length of 228.6 m and a width of 30.5 m, through which vessels can enter and leave the docks at any state of tide. There are 21 berths inside the basin and 5 berths along the harbour wall (**Table 3.2**). The design depth available inside dock and at outside berths is 8.8 m and 7.5 m, respectively. The depth of berths inside the basin can be further increased by 1.2 m by impounding water by electric pumps.

The layout of Indira Dock berths with back-up spaces and sheds is shown in **Figure 3.3** hereunder.

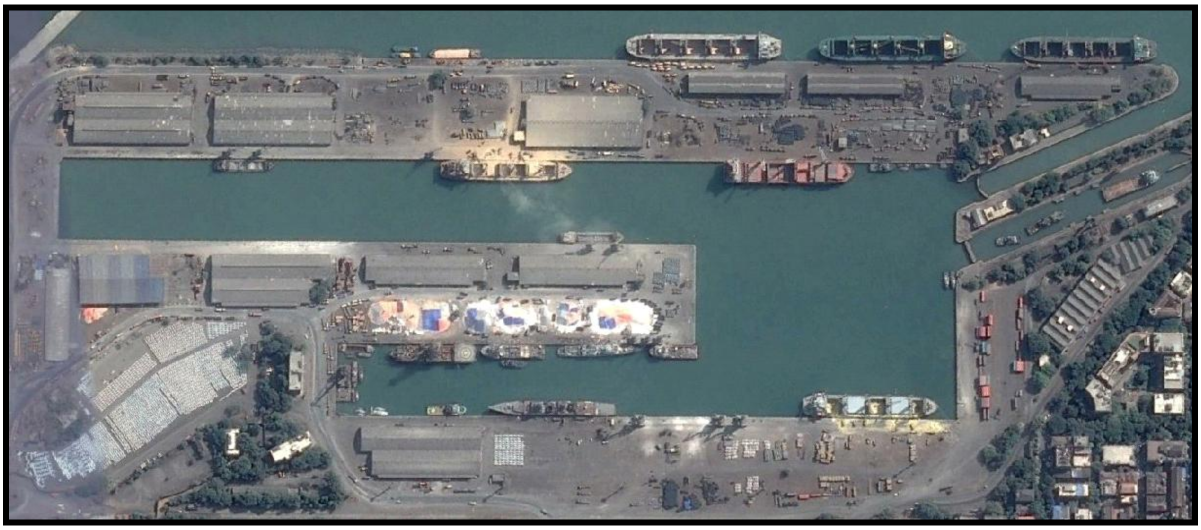


Figure 3.3 Layout of Berths in Indira Dock with Back up Space & Sheds

Figure 3.4 Numbering of Berths in Indira Dock

Table 3.2 Berth-wise Details at Indira Dock

Name of Berth	Width of Wharf (m)	Length of Wharf (m)	Designed Draft (m)	Berth Type
1 Indira Dock	13.72	180	8.84 to 9.14	Container
2 Indira Dock	13.99	158	8.84 to 9.14	Container
3 Indira Dock	13.84	158	8.84 to 9.14	Container
4 Indira Dock	13.84	158	8.84 to 9.14	Container
5 Indira Dock	13.82	158	8.84 to 9.14	Container
6 Indira Dock	13.84	158	8.84 to 9.14	Multi-purpose berth
7 Indira Dock	18.36	152	8.84 to 9.14	Multi-purpose berth
8 Indira Dock	18.36	152	8.84 to 9.14	Multi-purpose berth
9 Indira Dock	13.42	152	8.84 to 9.14	G.Cargo+Tanker
J/E Indira Dock	18.97	130	8.84 to 9.14	Heavy lifts
10 Indira Dock	18.29	152	8.84 to 9.14	Multi-purpose berth
11 Indira Dock	18.29	152	8.84 to 9.14	Multi-purpose berth
12 Indira Dock	13.72	152	8.84 to 9.14	Multi-purpose berth
12A Indira Dock	18.26	180	8.84 to 9.14	Multi-purpose berth
12B Indira Dock	18.26	180	8.84 to 9.14	Multi-purpose berth
13B Indira Dock	16.61	180	8.84 to 9.14	Multi-purpose berth
13A Indira Dock	16.61	180	8.84 to 9.14	Multi-purpose berth
13 Indira Dock	16.61	158	8.84 to 9.14	G. Cargo + Bulk cargoes
14 Indira Dock	20.29	158	8.84 to 9.14	G. Cargo + Bulk cargoes
15 Indira Dock	20.29	158	8.84 to 9.14	G. Cargo + Bulk cargoes
16 Indira Dock	16.30	158	8.84 to 9.14	Multi-purpose berth
17 Indira Dock	16.54	158	8.84 to 9.14	Multi-purpose berth
18 Indira Dock	9.22	183	7.5 CD	Multi-purpose berth
19 Indira Dock	27.13	168	7.5 CD	Multi-purpose berth
20 Indira Dock	18.26	168	7.5 CD	Multi-purpose berth
21 Indira Dock	18.26	168	7.5 CD	Multi-purpose berth
22/23 Indira Dock		431	6.1 to 6.4	

As can be seen from the figures, berths 1 to 17 are inside the dock basin and berths 18 to 23 are outside along the dock wall. Inside berths 6 to 9 are used for berthing port crafts and are not used for handling cargo. Berth no. 17 is also not operated since it is close to the lock gate.

The principal cargo handled are steel, sugar, yellow peas, fertilisers, project cargo, cars and containers. There are 12 sheds with a total area of 76,740 m^2. In addition there are 26 open plots with a total area of 56,939 m^2. There are three 16 T electric Wharf Cranes serving Berth 2, 3 and 4 of the dock. Apart from these there are eight 10 T cranes, which are used at various berths according to the requirements.

The port also uses six 14 T Mobile Harbour Cranes (MHC), one Tower crane of 20 T. Forklifts of capacity, 3 × 16 T, 20 × 3 T and 2 × 1 T are also owned by the port to aid to its handling capacity.

3.3.2 Ballard Pier Berths

There are two berths on the southward extension of Indira Dock named Ballard Pier. The Ballard Pier Extension (BPX) and the Ballard Pier Mole Station (BPS) are the two berths. The BPX has a modern passenger terminal building which houses check-in baggage facilities, a lounge, duty-free shop, curios and handicraft stalls, toilets etc.

Table 3.3 Berth-wise Details at Ballard Pier

Name of Berth	Width of Wharf (m)	Length of Wharf (m)	Designed Draft (m)	Berth Type
Ballard Pier Station	10.24	244	10 CD	Break-bulk berth
Ballard Pier Extension	22.38	244	9.5 CD	Passenger cum Cargo Berth

The layout of BPS & BPX berths with back-up space and Passenger Terminal is shown in **Figure 3.5**.

Figure 3.5 Layout of BPS & BPX Berths with Back up Space & Passenger Terminal

3.3.3 Jawahar Dweep Marine Oil Terminal

For handling Crude oil and Petroleum products, there are four jetties at Jawahar Dweep (Butcher Island). The layout of Jawahar Dweep with the four oil jetties are shown in **Figure 3.6** hereunder. While JD 1, JD 2 and JD 3 were commissioned first during 1950s, JD 4 was commissioned during 1980s. The first three jetties can handle panamax tankers and JD 4 can handle suez max tankers dead freighted to the permissible draft. The physical parameters of the berths are given in **Table 3.4**.

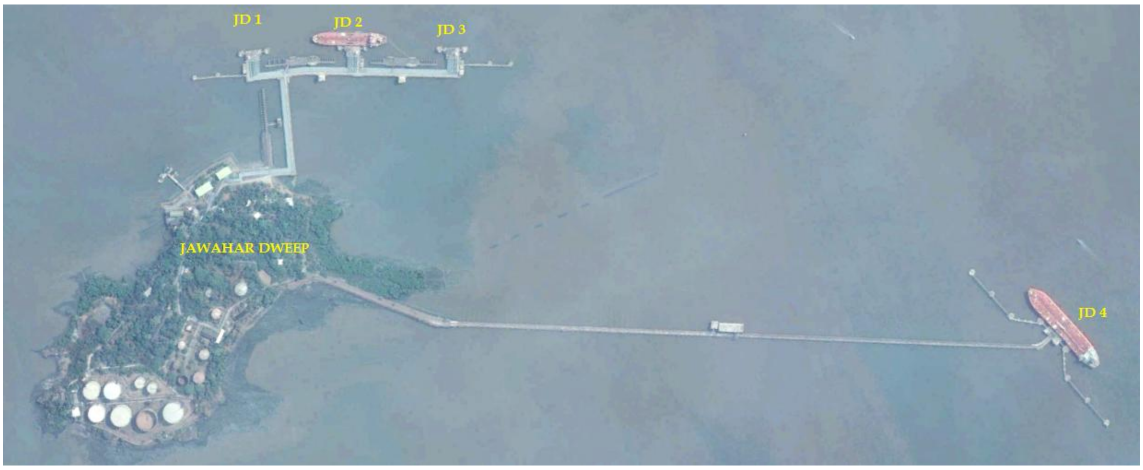


Figure 3.6 Marine Oil Terminal at Jawahar Dweep

Table 3.4 Jawahar Dwep Berths for Handling Crude Oil & POL products

Name of Berth	Length (m)	Designed Draft (m)
Jawahar Dweep -1	244	11.58
Jawahar Dweep -2	244	10.97
Jawahar Dweep -3	244	11.58
Jawahar Dweep -4	493	14.30

JD 1, JD 3 and JD 4 have 5 × 12" marine loading arms each while JD 2 has 3 × 12" marine loading arms. These jetties handle crude oil, white oil and black oil POL products. The berths at Jawahar Dweep are connected to the mainland by a set of submarine pipelines as detailed in the **Table 3.5** hereunder. These pipelines are, in turn, connected to the two oil refineries of BPCL and HPCL and also to the marketing terminal of IOC.

Table 3.5 Details of Submarine Pipelines at Jawahar Dweep

S. No.	Nomenclature	Product	Diameter (inches)
1.	C	Crude	42
3.	B1	Black oil	36
4.	W1	Naphtha	30
5.	W2	HSD	30
6.	W3	SKO	30
7.	FW	Fresh water	8

All the berths have been provided with firefighting facilities as per statutory requirement.

At Jawahar Dweep BPCL have 8 tanks for storing HSD/SKO/FO with a total capacity of 182,864 KL while Mumbai Port has 8 tanks for storing LDP/Naphtha/Ballast with a total capacity of 34,456 KL.

3.3.4 Pir Pau Chemical Terminal

All Chemicals and LPG are handled at the two berths at Pir pau. These are located at the northern extremity of the harbour's deep waters. While the old jetty is nearer to the shore, the new jetty, constructed during 1996, is located about 2 km offshore of the old one. The location of Pir Pau berths along with the tankage terminal onshore is shown in the **Figure 3.7** hereunder.

Figure 3.7 Chemical Terminal at Pir Pau

Table 3.6 Details of Pir Pau Jetties

Name of Berth	Length (m)	Designed Draft (m)
Pir Pau Jetty - old	174	7.5
Pir Pau Jetty - new	197	12.0

Both the jetties have 1 × 12"; 2 × 10"; 3 × 8" marine unloading arms and 11 pipelines as follows: 1 × 600 mm; 1 × 350 mm; 7 × 300 mm and 2 × 200 mm. Onshore, Aegis has 55 chemical tanks of total capacity 210,000 KL along with 2 spheres for LPG of total capacity 20,000 KL while Chemical Terminal Trombay Ltd. has 22 chemical tanks with a total capacity of 41,000 KL.

3.4 Ship Repair Facilities

Mumbai Port has two systems of repair facilities – slipways in Workshop area at Clerk Bunder adjoining Mazagon Docks and Hughes Dry Dock within Indira Dock. The relevant details are furnished hereunder.

3.4.1 Slipways at Clerk Bunder Workshop Area

There are 6 slipways at Clerk Buner Workshop area. These are used for repair of small port crafts, barges, small yachts and other smaller size vessels with less than 1.5 m draft. This location is adjacent to Mazagon Docks Ltd., India's largest naval shipyard. This location is open to the sea and is exposed to cyclones and subject to heavy siltation. The MbPT workshop has more than 200 skilled workforce who are involved in supporting ship repair to port crafts including hauling up and down the vessels on slipways and also working as crew in workshop flotilla. The location of the slipways is shown in the **Figure 3.8**.

Figure 3.8 Slipways at Clerk Bunder Workshop Area

The broad features and capacity of the slipways are presented in **Table 3.7**.

Table 3.7 Slipway Features and Capacity

Slipway No.	Length (m)	Beam (Transverse) (m)	Cradle Height from Ground (m)	Capacity as Weight of Craft that can be Hauled up	Gradient
1.	87.782	8.4	1.00	150 T	1 in 16
2.	96.012	8.4	1.00	150 T	1 in 14
3.	87.604	8.2	1.00	150 T	1 in 14
4.	87.604	8.4	1.00	150 T	1 in 14
5.	65.659	4.7	0.81	40 T	1 in 14
6.	43.891	4.9	0.83	40 T	1 in 10.5

3.4.2 Hughes Dry Dock (HDD) at Indira Dock

MbPT has a dry dock at Hughes Dock. The dimensions of this dry dock are presented in **Table 3.8**:

Table 3.8 Dry Dock Dimensions

Dock	Length (m)	Width (m)	Depth (m)
Hughes Dry Dock	304.8	30.08	9.75

The length can be divided into two compartments of variable length. Two caissons can be used but presently there is only one caisson. The maximum size of the vessel that can be dry docked is 190 m in length and 27 in width. Views the dry dock with vessels docked inside are presented in **Figure 3.9** to **Figure 3.12**.

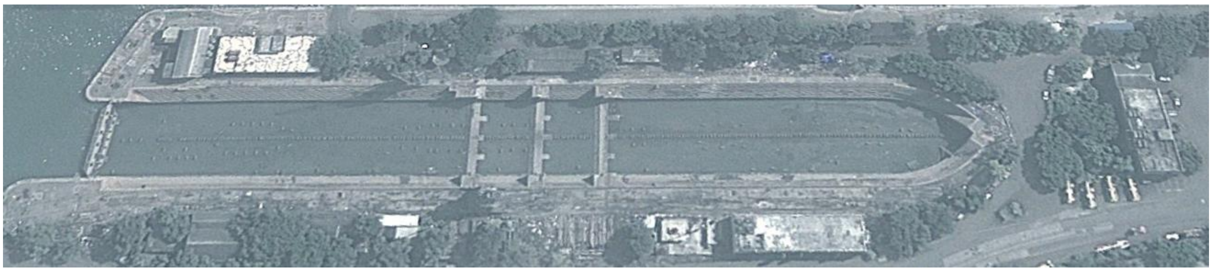


Figure 3.9 General View of Hughes Dry Dock

Figure 3.10 View of Dry Dock with Two Vessels Docked

Figure 3.11 View of Dry Dock with Three Vessels Docked

Figure 3.12 View of Dry Dock with Single Vessel Docked

Facilities available at the Dry Dock:

- There is one substation on each side of the Dry Dock with multiple power sockets along the length of the dock for using equipment and machinery and for giving power supply to the vessels dry docked. One motor generator frequency- converter for supply of power at 60 cycles, 380 volts is also fitted in the east substation. The substation caters to the utilities at the Dry Dock.
- There is one ELL crane of 20 T capacity on the west side and one ELL crane of 5 T capacity on the east side operable throughout the length of the Dry Dock. However, the 20 T crane can only be operated under a derated capacity of 10 T.
- There are 5 capstans each of 10 T capacity (2 no. at the entrance, 2 no. at mid dock and 1 no at the end) along with 4 no. intermediate capstans of 6 T capacity.
- For firefighting, there are two pumps of 170 m^3/hr capacity each with working pressure of 7 bar fitted in the HDD pumping station. The fire line with hydrants is provided all around the Dry Dock.
- One salt water pump of 170 m^3/hr capacity with working pressure of 7 bar fitted in the HDD pumping station. The fire line runs along the length of the west side of the Dry Dock.
- 3 nos. air compressors 850 CFM, auto working at 7 bars are fitted in Compressor House along with accessories and two air vessels of 10 m^3 capacity. The distribution line runs throughout the east length of the Dry Dock.
- 7 lighting masts of 20 m height to provide adequate lighting in the Dry Dock and its working are have been provided.
- Chipping & painting (moving) equipment include 4 no. water jet pumps for hull cleaning with fresh water; 4 no. grit blasting machine with two nozzles to clean area of 25 m^2/hr/nozzle; 6 no. spray painting machine; 8 no. scaffolding sets (quick assembly type) each set containing about 110 members; 1 no. of caisson and 13 no. of sluices with associated power packs.

As at present, the responsibility of the Port is only upto docking of the vessel in the Dry Dock. The vessel owners have to make their own arrangement of carrying out the required repairs. For this purpose, the Port issues licences from year to year to approved contractors/agents, granting them permission to undertake work in connection with the vessels in the Dry Dock and no other person will be allowed to undertake any such work unless holding the Port licence. The Contractors/agents desirous of obtaining the licence for carrying out works in the Dry Dock shall submit an application to the Chief Mechanical Engineer stating clearly the nature of work intended to be carried out in the Dry Dock, viz. either chipping and painting or ship repair work. In case of ship repair work they should further mention whether they want to carry out hull repairs or repairs to stern gear or both.

The Contractors/agents desiring to carryout chipping and painting work inside the Dry Docks shall be necessarily registered with the Mumbai Dock Labour Board and they must have facilities such as enough number of painting gears and other necessary tools for chipping, scrapping, etc. including tested ropes, slings and chains, pulley blocks necessary for various operations required in connection with chipping and painting work inside the Dry Dock. They shall be bound to employ foremen and tindalls of experience to supervise the work of chipping and painting and such foremen and tindalls shall be bound to take care to prevent accidents.

The Contractors/agents desiring to carry out repairs to hull, stern gear etc. shall have a workshop of their own, which shall be equipped at least with the following:

- Portable air compressor
- Portable diesel/transformer/rectifier/welding sets for either AC or DC arc welding along with necessary accessories
- Pneumatic caulking, drilling & riveting machines
- Lathes and power saws
- Grinding, boring, shaping and milling machines
- Pipe drilling machine
- Gas cutting equipment with necessary accessories

They should also have ready stock of materials for carrying out general repair works on vessels. They should also have all safety equipment required by their workmen to enable them to carry out work in an efficient and safe manner. The Contractors/agents should have a qualified Engineer in overall charge of the work, technically competent supervisors and adequate strength of skilled and unskilled workers for undertaking repairs on vessels.

3.5 Flotillas and Harbour Craft Facilities

For effective operations and management, the port has good fleet of flotillas, i.e., dredgers, hopper barges, dock tugs, harbour tugs, pilot and survey vessels. Six pilot launches and 9 other launches are also part of the port flotilla. Port also owns a survey vessel called ‘Sanshodhinee’, equipped with ‘State-of-the-Art’ navigation and survey equipment for carrying out hydrographic surveys in the harbour.

3.6 Port Railways

MbP is having its own rail network system from the Dock to Wadala the Central Railways Interchange point. The Railway runs about 10 km of straight route between Ballard Pier and Wadala and has an extensive network of track of about 100 km. It serves the Docks as well as the important installations and factories on the Port Trust Estates. It has its own fleet of 5 diesel locomotives. The Railway handled around 1.014 million tons of traffic during 2002-03. For handling ICD traffic, a full-fledged Rail Container Deport has been set up at Cotton Depot with facilities for reception, stacking etc. of containers. It can handle two trains of 45 wagons with double discharge facilities.

At Wadala, the port has developed marshalling yard where the port’s rail borne cargo is interchanged with Trunk railways. Central railways allow 3 movements of rakes at Wadala towards North for MbP’s freight trains during non-peak hours without affecting the city passenger traffic windows.

Thus, Central Railways locomotives run up to Wadala, the interchange point for MbPT’s locomotives. MbPT’s locomotives take over between Wadala and the MbP’s Docks.

At present, all rail borne traffic from MbPT undergo this change over due to the availability of Over Head Electric (OHE) system only up to Wadala and non-availability of OHE system between Wadala and port’s docks.

3.7 Internal Road Connectivity

Mumbai Port Trust owns and maintains about 63 km long Roads in MbPT Estate. The Main Roads are about 20 km in length and the secondary roads are about 43 km in length as shown in **Figure 3.13**.

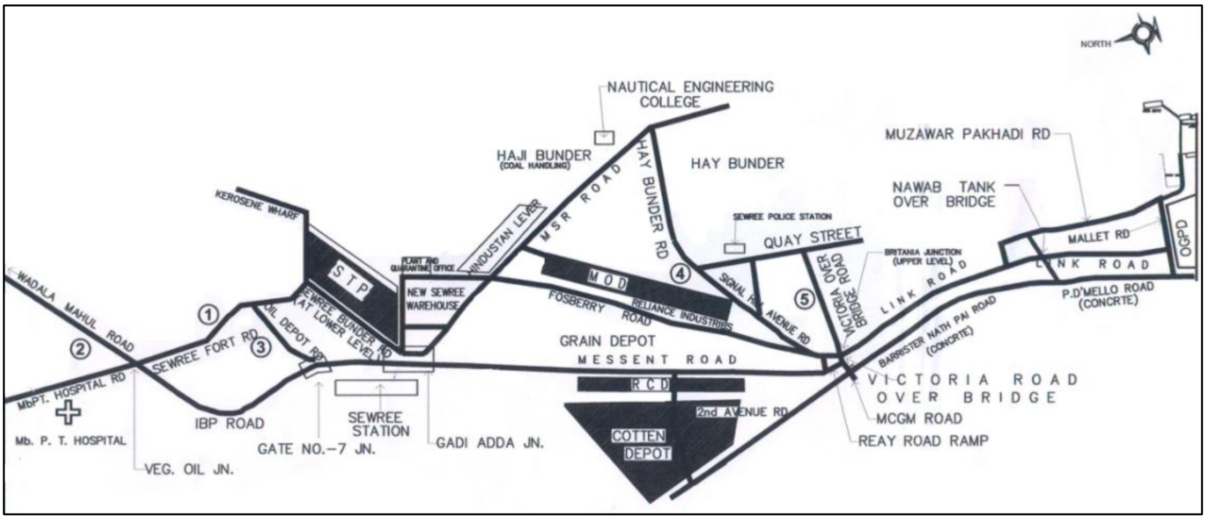


Figure 3.13 Internal Road Connectivity in Mumbai Port

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled at Mumbai Port during the past 5 years is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years

Commodity	FY 11	FY 12	FY 13	FY 14	FY 15
POL+ Crude + Product	33.23	33.31	34.79	35.98	36.29
Fertilizer	0.49	0.40	0.51	0.30	0.17
Coal	3.87	4.32	4.02	4.22	4.30
Others	16.34	17.60	17.89	18.23	20.0
Containers	0.65	0.55	0.83	0.45	0.54
Grand Total	**54.59**	**56.19**	**58.04**	**59.18**	**61.31**

The grand total of the traffic includes traffic handled at stream through lighterage/transhipment operations and also POL including crude & products moved through pipelines. The actual traffic handled at alongside berths will be about 50 to 55% only.

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to Mumbai Port is given in the **Appendix 1**. The key observations are as follows:

1. Only 55% cargo (≈34 MT) is handled by MbPT. The rest is directly managed by third parties
2. Due to draft and beam size limitations, Indira dock manages only 6 MTPA on 27 berths. Modern vessels have an average beam size of 32 meters, which the lock gate limits entry into the inside berths as it has beam size limitations of 27–28 meters. As a result, inside berths are underutilized and have low occupancy while the outside berths have extremely high occupancy.
3. Old infrastructure / lack of mechanization, difficult to sustain mechanization: The port's cranes are of extremely low capacity, which brings down productivity. Low capacity cranes also necessitate reliance on ship cranes as the berth infrastructure is so old that it cannot withstand modern equipment and heavy cranes, rendering mechanization difficult to sustain
4. Mumbai port has recently decided to discontinue coal handling at Haji Bunder (1.8 MT) because of significant pollution issues in the nearby areas.

5. Analysis has revealed that container handling at MbPT proves to be more costly for customers than JNPT. Multiple handling charges at MbPT limit the cost effective catchment area from MbPT to only around 8 km from the port. Further deep-dive and customer interviews have revealed several reasons why MbPT will not receive substantial container volumes in the future. With JNPT in its proximity, and given JNPT's scale, it is unlikely that MbPT will be able to compete with JNPT for container volumes
6. Despite a minor dip last year, steel volumes at MbPT have picked up. The total volume of steel handled last year was around 4.7MT, which was at a CAGR of 13% over the last three years given the immense signs of growth in the manufacturing and construction sectors, these volumes are only expected to grow in the near future. Current steel productivity can be increased by installing multipurpose gantry cranes on the berth. Currently, steel cargo at the berth is being handled by ship cranes that limit berth productivity owing to their design and limited capacity. BPS already has sufficient load bearing capacity strength to handle a 35.5 MT crane, and also has the rail track to support a rail mounted crane. The only capital expenditure required is in terms of purchasing and installation of the crane. MbPT can evaluate the opportunity of handling steel using a multipurpose crane at BPS on a PPP mode
7. The Offshore Container Terminal berth is built to have two berths in phase 1. The OCT was planned to handle container volumes, however, after careful evaluation of the prospects for OCT, not much container traffic can be expected at the terminal. Therefore, MbPT should consider handling alternate commodities at OCT.
8. Vehicle volume at Mumbai port has increased by 80% over the last 3 years due to a significant increase in exports. 83% of the vehicles exported are from Maharashtra belt, which currently are operating as captive customers. 17% of the remaining export is from Haryana (Maruti Suzuki), which is largely because of the vessel sharing agreements that the company has with other OEMs.
9. Evacuation through busy Mumbai: Since the port is located in the southern-most part of Mumbai, evacuation through road leads to cargo going through the busy Mumbai city traffic, which makes evacuation very slow and inefficient.

4.3 Performance of the Berths

AECOM has carried out a detailed analysis of the performance of the berths during 2014 -15 and the results are furnished in the tables hereunder. This analysis looks into the port operations in three groups: POL and Chemical traffic, general cargo traffic and Steel products traffic.

4.3.1 Performance in Handling of Liquid Products

POL traffic is being handled at Jawahar Dweep Berths and Chemical traffic is being handled at the Pir Pau berths. The performance of these berths has been discussed below:

Table 4.2 Peformance of Jawahar Dweep Pol Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Maximum	Minimum	Average
1.	JD 4	64.09%	Crude - Imports	1,25,49,704	148	Ship size	1,65,209	1,59,539	1,33,039
						Parcel size	1,00,827	26,230	84,795
			Crude - Exports	4,00,570	7	Ship size	1,56,516	73,580	97,219
						Parcel size	87,850	50,143	57,224
				1,29,50,274	**155**				
2.	JD 3	57.76%	Crude - Imports	1,77,389	5	Ship size	73,655	73,580	73,620
						Parcel size	49,788	26,404	35,478
			Crude - Exports	12,03,928	24	Ship size	93,322	73,531	77,931
						Parcel size	51,334	45,286	50,164
			POL - Imports	4,45,805	24	Ship size	76,586	29,990	47,012
						Parcel size	43,732	3,831	18,575
			POL - Exports	10,72,214	39	Ship size	75,570	28,610	46,439
						Parcel size	40,027	6,000	27,493
				28,99,336	**92**				
3.	JD 2	40.54%	POL - Imports	4,23,628	25	Ship size	47,999	28,610	41,818
						Parcel size	36,033	323	16,945
			POL - Exports	6,89,143	32	Ship size	50,605	28,810	44,038
						Parcel size	35,703	5,252	21,536
				11,12,771	**57**				
4.	JD 1	59.91%	Crude - Imports	4,27,586	14	Ship size	93,322	73,580	76,438
						Parcel size	50,099	25,358	30,549
			Crude - Exports	21,24,345	46	Ship size	93,322	73,531	77,446
						Parcel size	51,712	4,992	46,181
			POL - Imports	4,02,349	21	Ship size	39,979	8,968	19,158
						Parcel size	21,337	3,900	14,273
			POL - Exports	11,02,834	38	Ship size	93,322	28,610	46,439
						Parcel size	46,742	3,588	29,022
				40,57,114	**119**				

Table 4.3 Peformance of Pirpau Chemical Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Maximum	Minimum	Average
1.	NPP	80.91%	Chemicals	16,74,017	277	Ship size	47,076	7,088	20,617
						Parcel size	32,121	480	6,057
			POL	74,000	11	Ship size			
						Parcel size			
				17,48,017	**288**				
2.	OPP	40.38%	Chemicals	3,34,686	77	Ship size	35,208	10,000	15,131
						Parcel size	12,076	514	4,406
			POL	1,18,086	24	Ship size			
						Parcel size			
				4,52,772	**101**				

Observations:

- *POL berths at Jawahar Dweep*: It can be seen that the berths have reasonable occupancy level. The capacity of the berths varies with the average parcel size. While JD 4 handled almost 13 million tonnes, JD 1 could handle only about 3 million tonnes, primarily because of the average parcel size.
- *Chemical berths at Pir Pau*: The new chemical berth handled about 1.8 million tonnes with a high 85% occupancy level. This is once again related to the average parcel size which is only about 6,000 tonnes.

4.3.2 Performance in General Cargo Handling

The general cargo is handled at the Main harbour which includes Indira Dock inside berths, Indira Dock outside berths and Ballard Pier berths BPX and BPS.

Indira Dock inside berths: There are 16 cargo handling berths. Because of the limitation on the size and draft of the vessels that could be handled inside added with the lack of shore based equipment, the performance of these berths are far below par. All the berths, together, have handled about 1.53 million tonnes during 2014-15. Out of which 0.56 million tonnes are steel products.

Indira Dock outside berths: There are 4 cargo handling berths. These berths also lacked shore based equipment to handle cargo. However, during 2014-15, these four berths handled cargo volumes totalling 1.64 million tonnes more than the inside berths. Out of this 1.14 million tonnes are steel products.

Ballard Pier berths: There are 2 berths and these also do not have handling equipment on shore. During 2014-15, both these berths handled total traffic of over 3 million tonnes, almost as much as all the Indira Dock berths, out of which 2.45 million tonnes are steel products.

Table 4.4 Peformance of Main Harbour Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Max.	Min.	Avg.
1.	Indira Dock inside berths (1 to 16)	35.76%	Steel - Imports	3,98,737	62	Ship size	31,755	4,545	17,256
						Parcel size	20,270	352	4,691
			Steel - Exports	1,61,295	30				
			Others - Imports	6,40,329	124				
			Others - Exports	3,31,133	39				
				15,31,494	**255**				
2.	Indira Dock outside berths (18 to 21)	57.6%	Steel - Imports	8,81,105	47	Ship size	63,618	22,130	47,123
						Parcel size	51,018	1,401	18,747
			Steel - Exports	3,04,944	21	Ship size	61,114	34,167	54,872
						Parcel size	26,432	595	14,521
			Others - Imports	3,34,405	54				
			Others - Exports	1,17,096	57				
				16,37,550	**179**				
3.	Ballard Pier berth BPS	~100%	Steel - Imports	10,11,327	49	Ship size	63,123	17,224	44,543
						Parcel size	39,128	773	20,639
			Steel - Exports	49,533	5				
			Others - Imports	2,05,726	23				
			Others - Exports	5,346	6				
				12,71,932	**83**				
4.	Ballard Pier berth BPX	84.91%	Steel - Imports	13,87,488	51	Ship size	72,871	28,418	53,339
						Parcel size	39,792	3,927	27,206
			Steel - Exports	6,159	2				
			Cars - Imports	15,582	5				
			Cars - Exports	1,76,255	58				
			Others - Imports	1,91,372	51				
			Others - Exports	78,664	32				
				18,55,520	**199**				

4.3.3 Performance in Handling of Steel Products

It can be observed that out of over 6 million tonnes of cargo handled in the Main Harbour berths almost 70% is steel products. In view of the significant traffic in steel products, the performance of these berths in this aspect is specifically examined in the following paras.

Table 4.5 Peformance with Reference to Handling of Steel Products During 2014 – 15

Berth No.	No of Ships	Import	Export	Total Cargo	Average Parcel Size	Working Time at Berth in Days	Productivity in TPD
ID 1	1	2,078	-	2,078	2,078	0.71	2934
ID 2	9	33,950	50,595	84,545	9,394	33.54	2521
ID 3	6	32,847	16,393	49,240	8,207	19.13	2575
ID 4	5	22,770	15,383	38,153	7,631	15.71	2429
ID 5	1	-	6,239	6,239	6,239	4.96	1258
ID 12	7	28,200	1,270	29,470	4,210	11.29	2610
ID 12A	13	79,062	19,271	98,333	7,564	34.17	2878
ID 12B	7	47,162	10,997	58,159	8,308	22.63	2571
ID 13	8	31,728	17,258	48,986	6,123	24.25	2020
ID 13A	2	6,039	3,567	9,606	4,803	4.58	2096
ID 13B	3	5,176	4,543	9,719	3,240	4.08	2380
ID 14	3	24,409	-	24,409	8,136	3.83	6368
ID 15	13	50,293	4,531	54,824	4,217	23.63	2321
ID 16	7	35,013	11,248	46,261	6,609	11.79	3923
TOTAL 1	**85**	**3,98,727**	**1,61,295**	**5,60,022**	**6,588**	**214**	**2777**
ID 18	31	5,14,171	1,24,439	6,38,610	20,600	83.42	7656
ID 19	25	2,66,039	68,327	3,34,366	13,375	52.79	6334
ID 21	10	1,00,895	1,12,178	2,13,073	21,307	30.25	7044
TOTAL 2	**66**	8,81,105	3,04,944	**11,86,049**	**17,970**	166	**7011**
BPS	53	10,11,327	49,533	10,60,860	20,016	127.42	8326
BPX	51	13,87,488	6,159	13,93,647	27,326	170.00	8198
TOTAL 3	**104**	23,98,815	55,692	**24,54,507**	**23,601**	297	**8262**
	255	**36,78,647**	**5,21,931**	**42,00,578**	**16,473**	**678**	**6194**

It could be seen from the above table that the productivity of the inner berths of Indira Dock is the lowest. This is mainly because of the limitation in the size of vessels to be handled there. Without going into the intricate components of productivity, it could be seen that, prima facie, the ship and parcel sizes influence it. With the ship and parcel sizes increasing at the outer berths as well as the Ballard Pier berths, the productivity also increases.

4.4 Enhancing Performance in Handling of Steel & Other Cargo

As indicated earlier that steel products constitute a major share in the total dry bulk and general cargo handled at the Main Harbour. There is a good potential for this traffic to increase in future also. Hence it is suggested that handling of all the steel products be shifted to the new offshore container terminal.

This was planned as an exclusive container terminal to handle about 1.24 MTEU in the first phase. However, contrary to expectations, the container traffic at Mumbai port hovers between 40,000 to 50,000 TEU only per annum. Though the two berths have been completed with proper approaches, no container handling equipment has been installed either at the berth or at the stackyard. In view of this the Port has already permitted the licensee to handle automobile exports through a mutually agreed special revenue share.

Under such circumstances, this suggestion is made to shift handling of steel products to these berths. To start with each berth can be equipped with one 100 T Harbour Mobile Crane. This supplemented by ship's gear can provide a productivity of about 12,000 TPD. With allowable berth occupancy of 65%, each berth will be able to handle about 2.7 MTPA. Both the berths will be able to handle the present traffic and also the future growth up to 30%. When the traffic grows beyond this limit, another crane can be supplemented to increase the berth capacity.

This arrangement will have the following advantages to the customers, viz.

- Bigger ship with larger parcels could be handled
- Ships could be turned around faster than at present
- With two exclusive berths with higher capacity, pre-berthing detention will be manageable

The port has already taken up the OCT project for rebidding, it is expected that the new player will compete with MbPT for cargo including steel.

With the steel products shifted to OCT, the other berths will be available to handle the other cargo. All the six berths – BPX, BPS, ID 18, 1D 19, and ID 20 & ID 21 - can handle the other cargo, whose traffic at the present is less than 3 MTPA. It may be necessary to equip berths BPX and BPS with quay based cranes to increase the productivity. Thus, in long term there may not be need for utilising the Indira Dock inner harbour berths with their inherent deficiencies. Such a move will be welcome by the trade as they stand to gain.

5.0 DETAILS OF ONGOING DEVELOPMENTS

In order to meet the growing traffic demands, Mumbai Port Trust has taken slew of developmental projects which are in various stages of implementation. The expansion projects which are developed and are currently ongoing as well as those that are planned are discussed in this section.

5.1 Development of Offshore Container Terminal

MbPT awarded the license to develop an offshore container terminal to Indira Container Terminal (ICT) Pvt. Ltd. through a global tendering process on DBFOT basis for a period of 30 years. ICT Pvt Ltd. is a special purpose vehicle promoted by Gammon India Ltd. & Gammon Infrastructure Projects Ltd., collectively called the Gammon Group and Dragados SPL, Spain. The license was awarded during December 2007.

The project involved construction of two offshore container berths for a total length of 700 m capable of handling 6000 TEU container vessels about 1 km away from the junction of Victoria Dock and Indira Dock; filling up of Princess and Victoria Docks and with the surrounding areas to get a stackyard space of 35 hectares; create a railway container depot with 3 sidings and equipped with rail mounted gantry cranes; equip the berth with quay side gantry cranes; provide requisite RTGs and other container handling equipment at the yard; provide all the other infrastructure and service facilities associated with a full-fledged container terminal.

Owing to the delay in Licensee achieving the financial closure and the delay in finalising the EPC contract, the actual construction work could start only during early 2011. By the later part of 2014 the berths with approaches were completed as also filling up of Princess and Victoria Docks. As of now, the berths have been constructed as shown in the **Figure 5.1**.

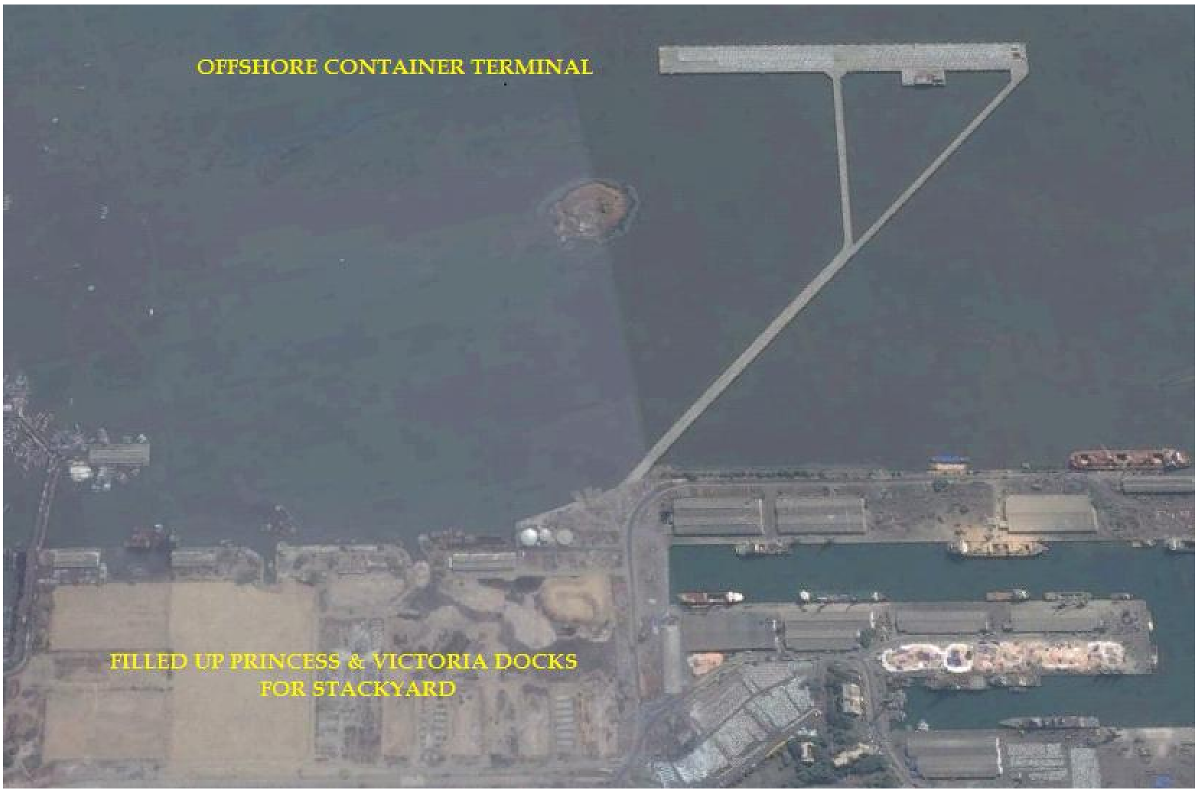


Figure 5.1 Offshore Container Terminal as at Present

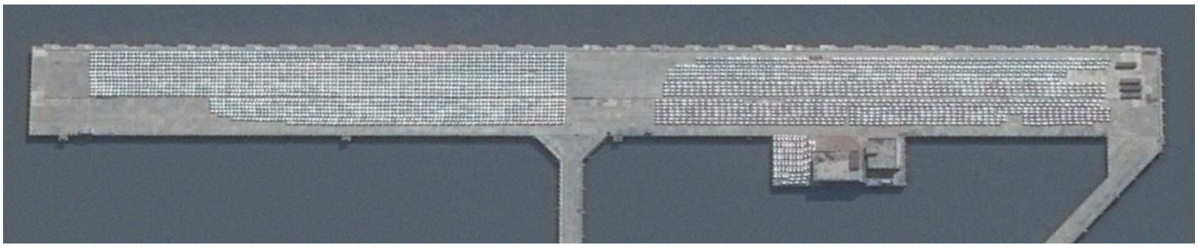


Figure 5.2 Car Units Waiting for Export at Offshore Container Terminal

5.2 Development of 2nd Chemical Jetty at Pir Pau

Currently the chemicals and LPG are handled at Old Pir Pau (OPP) jetty and at New Pir Pau (NPP) jetty. The old jetty has limited capacity. With the increase in the throughput, NPP has been consistently operating at high berth occupancy of over 85%. Hence MbPT felt the requirement of 2nd Chemical jetty and initiated action for its construction. This jetty has been completed and the capital dredging work is substantially completed. Non-hazardous cargo vessels are being handled since June, 2015. The berth would handle liquid Chemicals/Specialised grades of POL product.

The proposed berth is located 650 m away from the first chemicals berth in the same alignment on south of first chemical berth. The sea bed beyond the first chemical berth (present depth 6.5 to 7.5 m below low water) is dredged to -9m CD and maintained at -8.7m CD. This will permit fully laden vessels up to 35,000 DWT (or partially loaded 47,000 DWT size) to sail through and navigate at high tide to the second chemical berth. The area in front of the berth will be dredged to a depth of -15.0 m CD.

The overall length of the berth is 260 m between outer mooring dolphins. The berth comprises a double decked service platform of size 35 m × 15 m; two berthing dolphins each of 14m × 14 m; four mooring dolphins each of 10 m × 19 m and one multi-stories control room of size 10 m × 15 m. The overall width of the approach trestle is 11.5 m.

The second chemical berth has marine unloading arms for handling cargo. The existing fourteen pipelines in addition to two service lines are being extended up to second chemical berth from the first chemical berth with the provision for two service pipelines (fresh water and firefighting) on the new pipeline. The firefighting system at the first jetty is being upgraded by providing an additional pump and two water pipelines – 450 mm & 300 mm to meet the OISD guidelines and this will serve as a common facility for the both the jetties.

The location and layout of the 2nd chemical jetty is shown in the **Figure 5.3**.

Figure 5.3 Location and Layout of 2nd Chemical Jetty

5.3 Additional Crude Oil Jetty at Jawahar Dweep JD 5

Presently, the jetty JD 4 at Jawahar Dweep, which was commissioned in 1984 capable of accommodating tankers up to 125,000 T displacement, handles the crude oil imports of the two refineries at Mumbai. Now MbPT has initiated action for the construction of an additional jetty JD 5 to supplement JD 4. This move is initiated consequent to the following developments:

- Due to recent leakage of crude oil pipelines and deteriorated approach trestle structure from the island to JD 4, it is felt that it could not be repaired for further use. Hence a new approach trestle is required.
- During an interaction with the two oil companies having their refinery at Mumbai viz. BPCL & HPCL during December 2014, they desired that with their proposed expansion proposals it would be preferable to have a jetty which will be able to handle fully loaded suez max tankers and partially loaded VLCCs to avail the freight advantage.

- During this meeting the requirement of additional crude oil pipeline from the island to Pir Pau was also discussed. The existing 42” crude submarine pipeline is presently used by BPCL/HPCL for transfer to crude oil to Pir Pau. However, Oil companies required a separate submarine pipeline for each company. Accordingly MbPT is proposing to use the existing 36” ONGC pipeline abandoned in 2010. This pipeline shall be tested and upgraded during the construction of J5.

The location and other details of the proposed JD 5 are presented in the **Figure 5.4**.

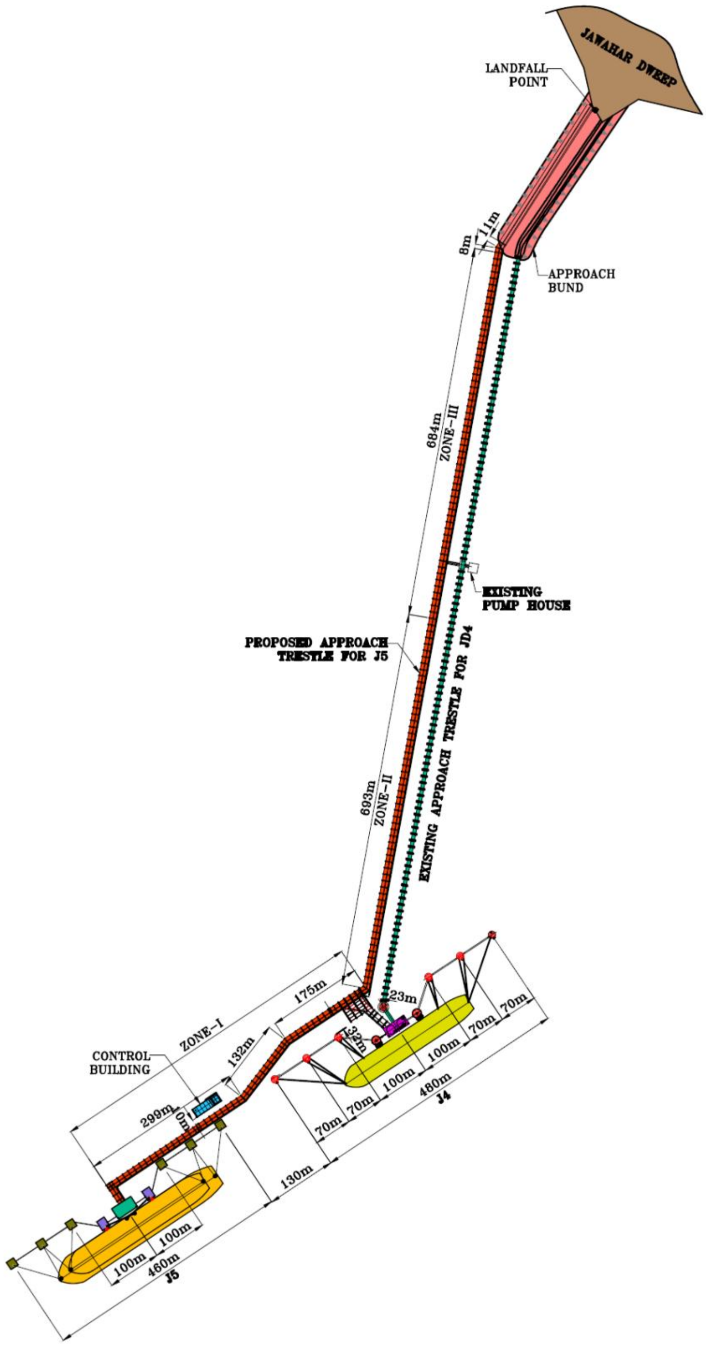


Figure 5.4 Location and New Approach Trestle to JD 5 & JD 4

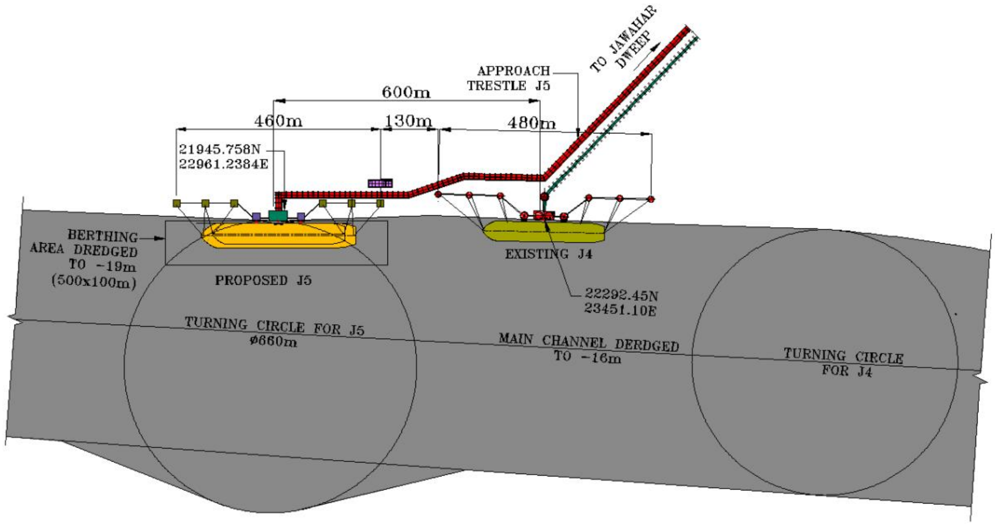


Figure 5.5 Relative Locations of JD 4 & JD 5

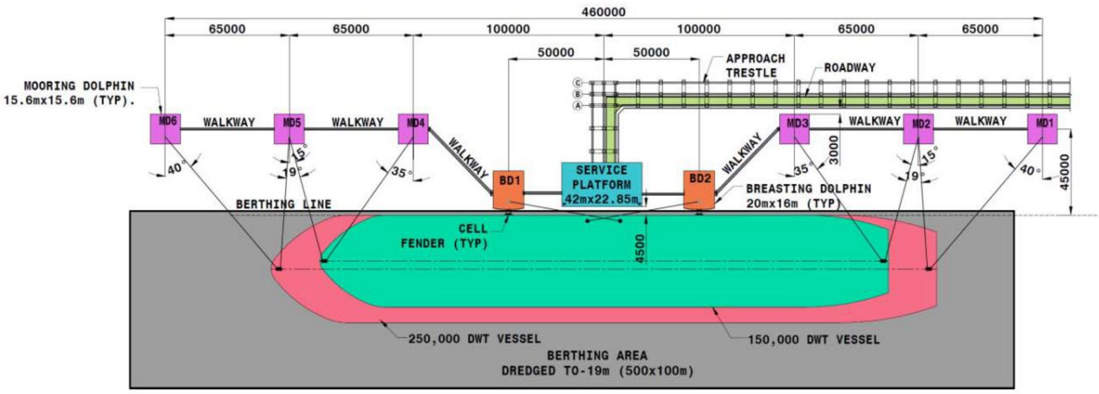


Figure 5.6 Layout Details of JD 5

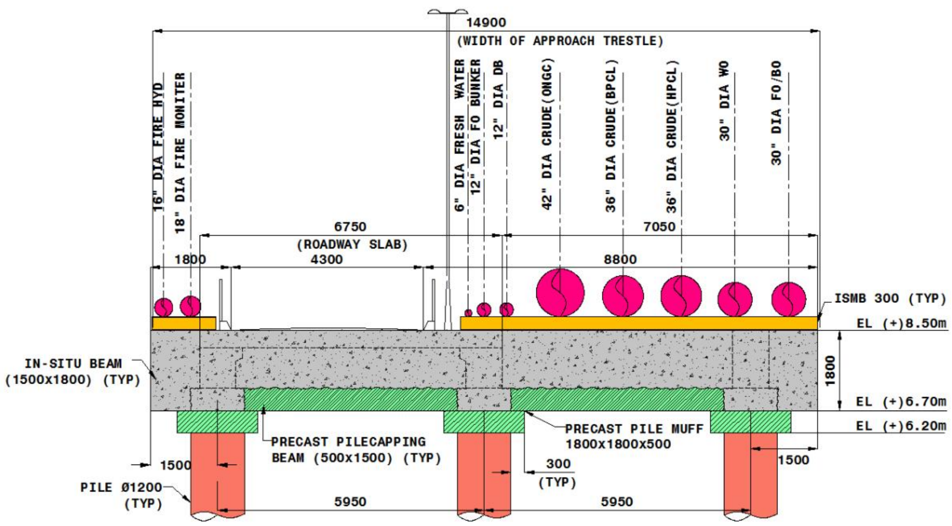


Figure 5.7 Cross Section of New Appoach Trestle

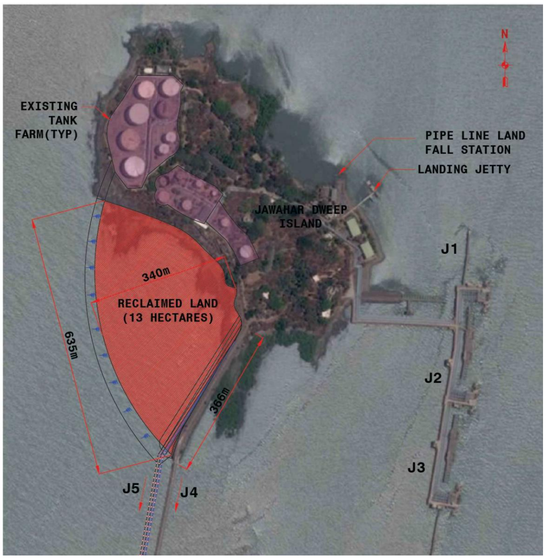


Figure 5.8 Location of Land to be Reclaimed for Tank Farm

5.4 Setting up of a Bunkering Terminal at Jawahar Dweep

Mumbai port proposes to set up a bunker terminal to supply fuel to ships calling at the port. On an average about 4,000 vessels enter Mumbai Port every year. Currently bunkering is done at the port through barges. But the intake of bunker fuel is limited because of the higher cost as compared to Singapore. Hence, traditionally India has never been an attractive place for establishing a bunkering terminal. However, with the recent reductions in excise and customs duties on fuel, MbPT felt that they can try establishing a proper bunkering terminal. Based on a DPR prepared by a consultant the port has initiated action in this regard.

BPCL and HPCL have their own refineries at Trombay which produce bunker fuel. These two intend to aggressively market the same in and around Mumbai Port and increase sales volumes through competitive pricing. Hence it was decided that MbPT join hands with them and develop a Bunkering Terminal at Jawahar Dweep. Accordingly MbPT issued Letter of Intent to BPCL and HPCL during June 2015 and later signed a formal Memorandum of Understanding with them during December 2015. The objective of this MOU is to provide a financial, legal, authoritative and functional framework for development and operation of a Bunkering Terminal at Jawahar Dweep by MbPT, BPCL and HPCL.

Based on this MOU, MbPT will dedicate JD 2, which has consistently been having relatively lesser occupancy than the other three jetties, for this bunkering terminal. This jetty will be modified to accommodate barges also. The structural modifications to JD 2 will be carried out by MbPT at an estimated cost of about INR 11.40 crores and this cost will be borne equally by BPCL and HPCL. While BPCL is having its own tanks and pumps at Jawahar Dweep for bunkering, HPCL will take over the existing 6 tanks of MbPT including the land at Jawahar Dweep and refurbish these tanks and pumps for their use for bunkering. These barge bunkering facilities are expected to be commissioned within 2 years of signing of the MOU.

The capacity of this Bunkering Terminal is expected to be 2.0 MTPA. However, to start with, both BPCL and HPCL will guarantee to the port a minimum traffic of 0.25 MTPA each totalling 0.50 MTPA.

5.5 Setting up of a Floating Storage & Regasification Unit (FSRU)

In order to meet the growing demand of natural gas in the markets along the western coast of India, MbPT has decided to pursue the opportunity of setting up a Floating Storage and Regasification Unit (FSRU) in Mumbai harbour area. It is envisaged that the project will be implemented on a Public-Private Partnership (PPP) mode. In this connection MbPT has already got a feasibility report prepared.

The project will come up on the Karanja spoil ground near Uran, about 50 km from Mumbai. The plan is to connect the terminal to the national pipeline grid so that the natural gas can be transported further across the country to places of need.

The FSRU will be stationed alongside an offshore jetty with a twin berthing facility. It will be connected to the landfall point by a 5 km long submarine pipeline. The mother vessel will be berthed on the other berthing face and LNG transferred to the FSRU through marine unloading arms. The size of the FSRU will be 170,000 m^3 and this terminal is planned to handle 5 MTPA.

The location map is shown in **Figure 5.9** and the FSRU terminal is shown in **Figure 5.10**.

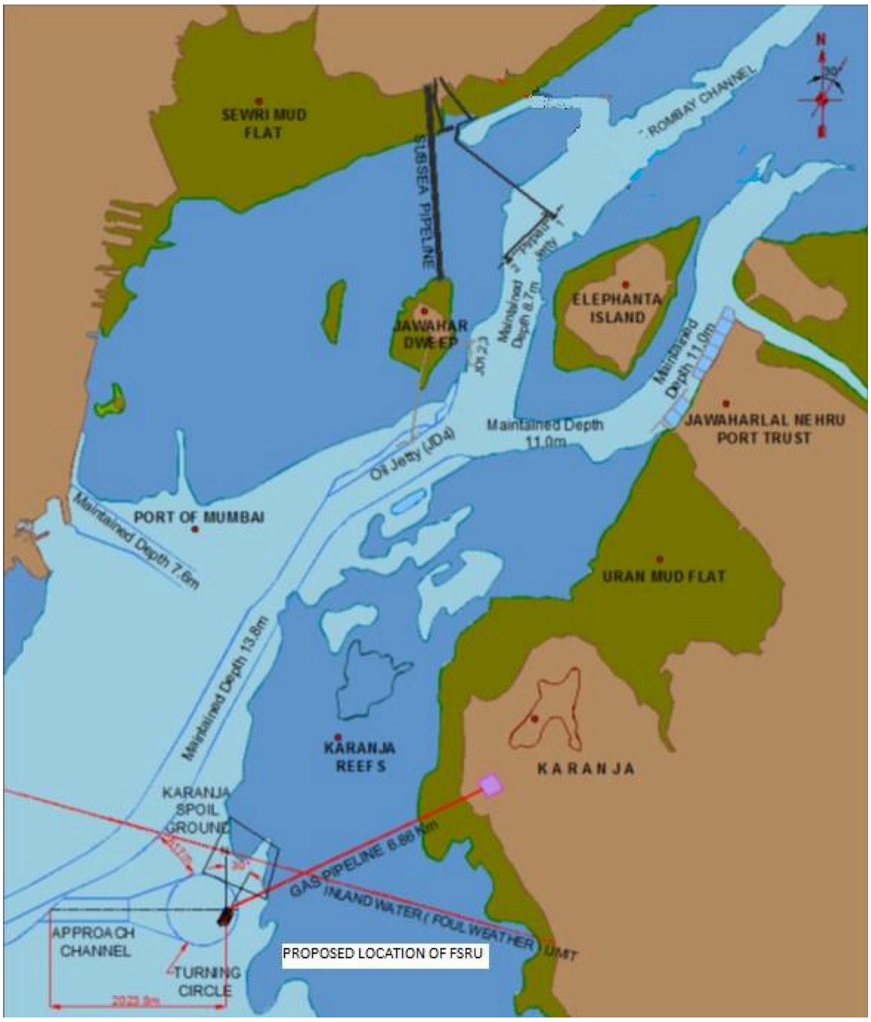


Figure 5.9 Location of FSRU Terminal

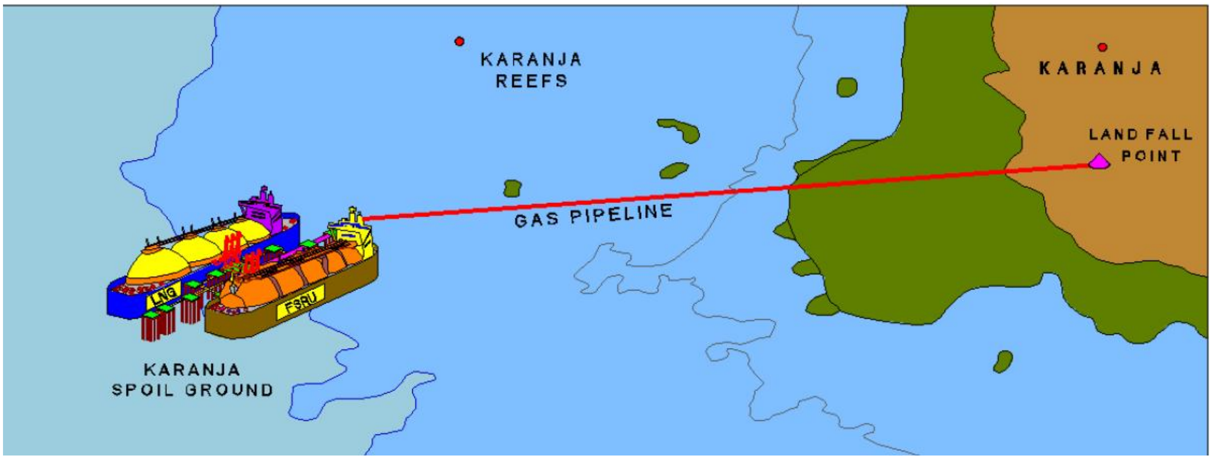


Figure 5.10 FSRU Terminal with Submarine Pipeline to Landfall Point

5.6 Wadala Kurla Dedicated Freight Rail Link

A dedicated freight line has been proposed between Wadala-Kurla (4.41 km) to decongest the Harbour Line. The third line that is being built between Kurla and Wadala stations will ferry freight and cargo trains that right now criss-cross suburban trains leading to their detention. At Kurla, an elevated corridor will carry this goods line over the two lines, completely segregating them and further take them on the fifth and sixth lines. The 4.41 km new Kurla-Wadala line would be linked to the 1,483 km national dedicated freight corridor of the western region.

This project comprise of laying a dedicated freight line of 4.41 km length from Raoli Junction Wadala to Kurla to establish a direct link between MbPT rail network and 5th and 6th lines being laid between Kurla to Kalyan by central railway to facilitate smoother evacuation.

The estimated project cost of this project is INR 176 cr. which is being implemented by Central Railways. MbPT has already entered into MOU with central railways as well as MMRDA for project implementation.

6.0 TRAFFIC PROJECTIONS

6.1 Projections Based on OD Study at National Level

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Mumbai up to 2035 has be derived as presented in this section. This section covers the traffic projections for the port of Mumbai.

In terms of volumes, Mumbai is the 4th largest major port in the country handling more than 60 MTPA of cargo. Mumbai is situated strategically located in one of the busiest industrial hinterlands of the country and is additionally well connected to serve the North and Western hinterlands of the country like Rajasthan, Delhi-NCR, Punjab and Haryana.

Currently the port handles 61.7 MTPA of cargo out of which POL is the largest component. Other key commodities include Thermal Coal (imports), construction intensive commodities like Steel and Cement and Iron ore.

6.2 Major Commodities and their Projections

6.2.1 Thermal Coal

The port imported ~7.4 MTPA of thermal coal in 2014-15. Out of the 7.4 MTPA, ~2 MTPA was for the 140 MW capacity Trombay plant, ~2.3 MTPA was at Haji Bunder and ~3 MTPA was at Dharamtar. A recent decision by the port to not handle any coal that enters city limits, the handling of coal at Haji Bunder has been stopped. Also the Tata power plant cannot expand beyond the current capacity due to paucity of land. Due to these reasons, it is envisaged that the volume of coal handled at the port might remain constant or even go down in the worst case in the future.

Consequently in 2020, the total coal traffic is expected to be around 5.2 MTPA, 4.6 MTPA of which would be thermal coal and ~0.6 MTPA would be coking coal. This 4.6 MTPA would constitute 3 MTPA of thermal coal for Tata power plant in Trombay and remaining would be handled at Dharamtar for small coal traders. The traffic is expected to remain the same in 2025 as well. In 2035, the total coal traffic is expected to be around 6 MTPA out of which 5 MTPA would be thermal coal and 1 MTPA would be coking coal.

6.2.2 Steel

In 2014-15, the port handled 4.1 MTPA of steel in imports for the steel multiplier industries present in the Mumbai hinterland and exports of roughly 0.6 MTPA of steel from the JSW Dolvi plant. Going into the future, the volumes of steel handled at the port is expected to grow with the steel multiplier relative to the GDP.

The overall volume of steel handled at the port is expected to grow to 7-8 MTPA by 2025 and 13-15 MTPA by 2035. This traffic would primarily be led by the huge steel demand coming from the hinterlands of Mumbai region led by automobile growth, industrial growth and increased construction activity.

6.2.3 Cement

The real estate hub of Mumbai's demand is catered to by the port. The total cement at the port is 1.3 MTPA – most of which is handled at the railway yard currently. This is expected to change moving forward with traffic from railways becoming negligible. This traffic would be replaced by 1.0 MTPA of coastally shipped cement from surplus areas like Gujarat. Going into the future the volumes are expected to grow to 1.25 MTPA by 2025 and 2.0 MTPA by 2035.

6.2.4 POL

The port imported 25.7 MTPA of crude, large part of which is used for two refineries in Mumbai - BPCL and HPCL Mumbai. The HPCL refinery is expected to increase its capacity by 3 MTPA by 2025 and hence the volume of crude handled the port is expected to go up by similar quantum. It should be noted that some of this crude from Bombay High oilfields is not actually handled at the port but just passes through the pipelines. Beyond 2025, the Mumbai port could also feed some of the crude requirement of a Greenfield refinery expected to come up in Maharashtra. For the traffic projections, it has been assumed that less than 10% of this new refinery's capacity will be served by the Mumbai port. It has to be noted that this is contingent to increase in crude production capacity at Bombay High by 5 MTPA.

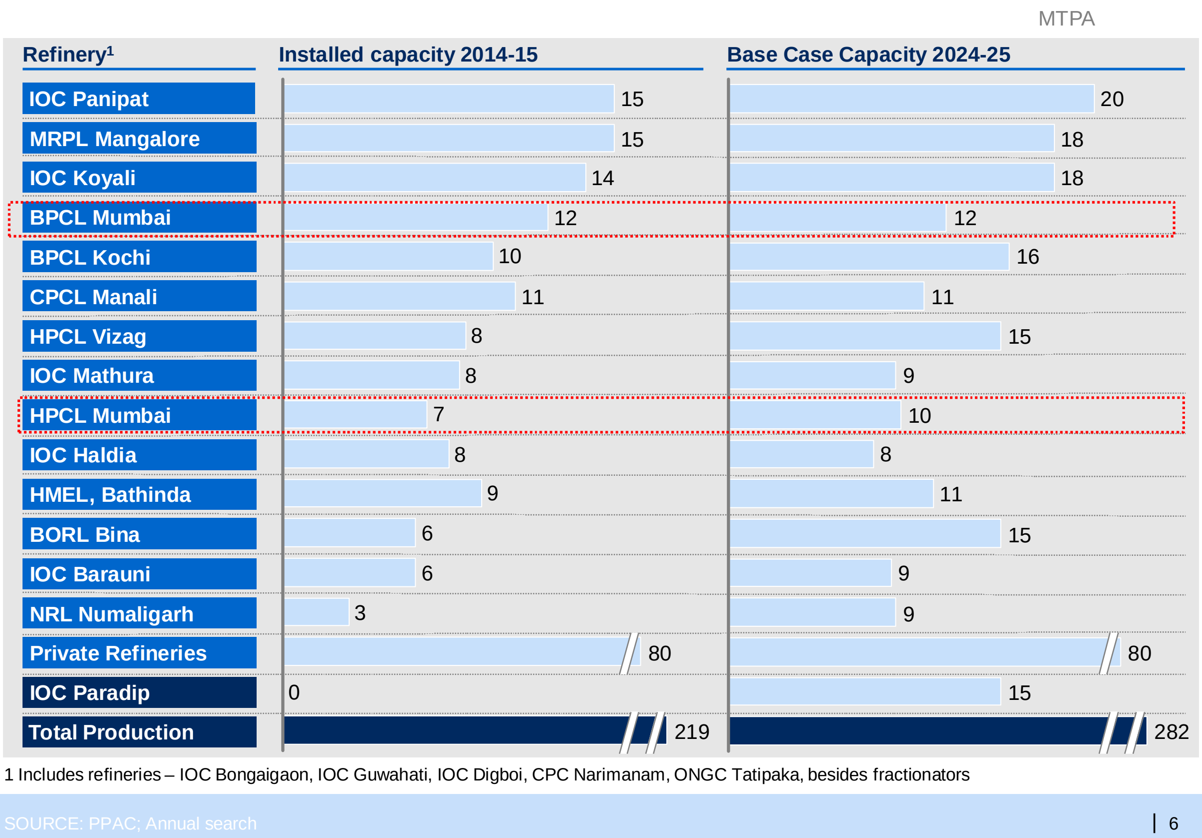
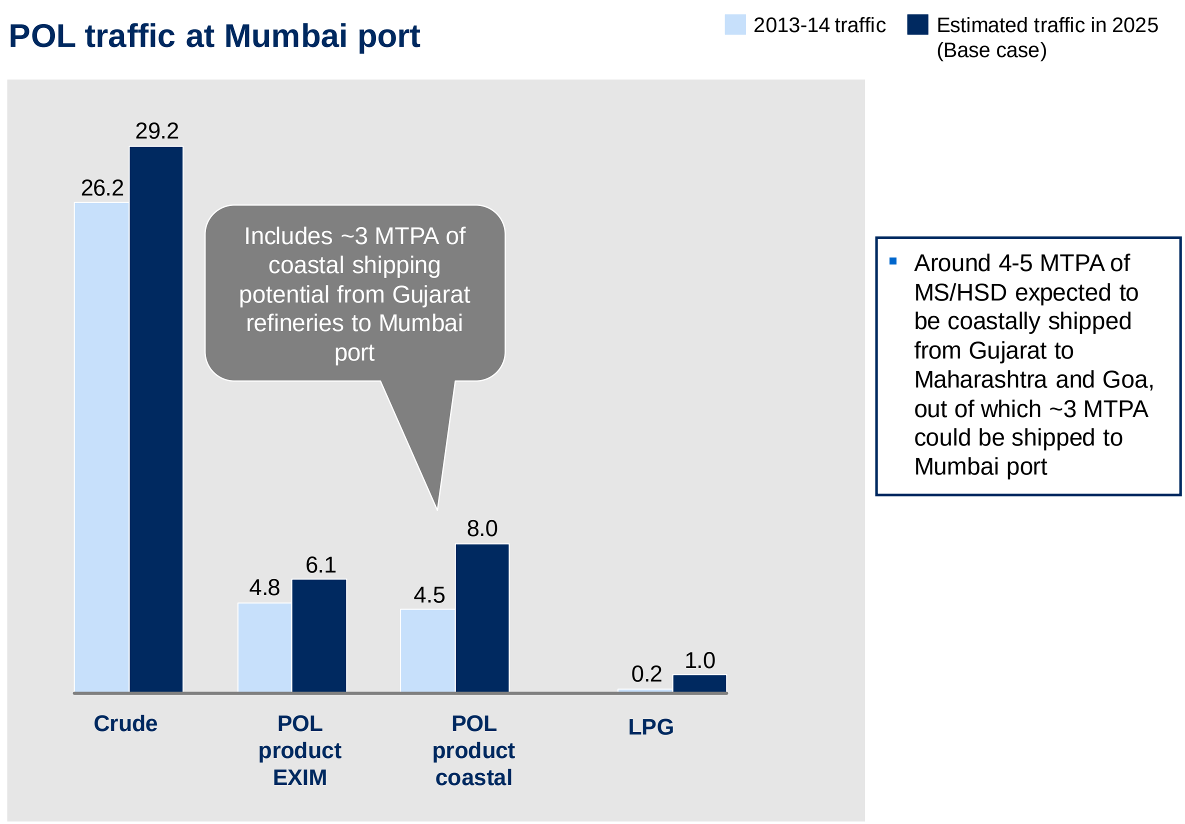


Figure 6.1 Refineries served by Mumbai Port

The port also handled traffic of ~10.6 MTPA of POL product due to EXIM and coastal movement of POL products. This traffic is expected to go up in the next 10 years as the regional demand of product is met by the excess product produced by refineries in Gujarat. Due to limited expansionary plans of refineries in Mumbai, the region currently served by these refineries is expected to face a deficit of ~5 MTPA in next 10 years. Some part of this deficit could be met by imports at Mormugao port and ports in Southern Gujarat as they will be closer. But a bulk of the traffic would continue to be at Mumbai port as the major demand centres in Maharashtra lie close to the port. By 2025, it is expected that ~ 3MTPA of product could be coastally shipped to Mumbai port from refineries in Gujarat to cater to the growing demands of the clusters around the Mumbai metropolitan region. In addition, there would be some organic growth of LPG. LPG imports in 2013-14 were ~0.2 MTPA which increased to 0.5 MTPA this year and are expected to increase to 1 MTPA by 2025. Besides LPG, traffic of POL product (both coastal and imported) would grow organically with incremental traffic of ~2MTPA by 2025.

The split of the current POL traffic and the projected volumes in 2025 are as shown in **Figure 6.2**.



SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

Figure 6.2 POL Traffic at Mumbai Port

The overall traffic of POL (Crude and product) at the port is expected to reach ~39 MTPA by 2020, 44-50 MTPA by 2025 and 53-61 MTPA by 2035 owing to the refinery expansion, coastal shipping of product and greenfield refinery coming in the region.

6.2.5 Iron Ore

The port caters to the demand of Iron ore for the JSW Dolvi plant which imported 5.2 MTPA in 2014-15. This traffic is handled at the midstream and as JSW is expected to import this iron ore at its own port, the import of iron ore are expected to go down in the future to ~1-2 MTPA.

6.2.6 Automobiles

Mumbai port serves as a port for exporting automobiles manufactured in the Pune cluster. The port handled around ~1.3 lakh vehicles in 2014-15. Most of these exports were from manufacturing plants of Volkswagen (Chakan), Tata Motors (Pune), Ashok Leyland (Bhandara), Mahindra and Mahindra (Chakan, Kandivali, Nashik) and General Motors (Pune). Mumbai plant is closest to these manufacturing plants and hence logistic cost to export from these plants via Mumbai port is the lowest.

SIAM is targeting ~10 million units of exports by 2025 from India. Out of these 10 million units, 2 - 2.5 million units are expected to be passenger vehicles and 0.3-0.5 million units will be commercial vehicles. Based on the growth over last few years, it seems difficult that India would be able to meet these export targets in 2025. Hence, it has been assumed that the country will meet these targets in the optimistic case in 2025 and base case in 2035.

Using the targets set by SIAM and available data on growth plans of the manufacturing plants in the vicinity of Mumbai port, Mumbai port can expect traffic of 2.4 lakh units in 2020, 2.9 lakh units in 2025 and 3.9 lakh units in 2035 in the base case. Out of the 2.4 lakh units in 2020, passenger cars could be around 1.7 lakhs and remaining would be commercial vehicles. Similarly in 2025, 2.2 lakh vehicles would be passenger cars and 0.7 would be commercial vehicles. In 2035, out of the total vehicular traffic of 3.9 lakh units, passenger vehicles would be ~2.7 lakh and 1.2 would be commercial vehicles. It is to be noted that most of this export traffic is contingent on expansionary plans of Volkswagen plant in Chakan. They have announced planned expansion to 2 lakh units per annum from their current capacity of 1.3 lakh.

It is also worth pointing out that the above analysis doesn’t take into account exports of two and three wheelers manufactured in the hinterland region. Bajaj has manufacturing plants in Aurangabad and Chakan where they manufacture both two and three wheelers. Similarly, Piaggio vehicles have a plant in Baramati where they manufacture two wheelers. But as these vehicles are largely moved as part of containerised cargo, JNPT is their preferred port. Hence they have not been considered as part of the analysis.

6.2.7 Others Cargo

Commodities included under others cargo are rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo. Some of this traffic is handled midstream as well. While total ‘others’ cargo handled at Mumbai port is 4.1 MTPA, around 1.5 MTPA was handled midstream. Going forward in 2025, total others cargo handled actually at the port would be 4.4 MTPA and 2.2 MTPA would be handled midstream.

The overall commodity wise projections for the port are shown in **Table 6.1**.

Table 6.1 Overall Commodity Wise Projctions

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Total)

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	36.3	39.3	44.2	49.5	53.1	61.5	Coastal shipping of ~3 MTPA from Gujarat
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	Doesn't include coastal shipping potential
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.08	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[1]	3.8	4.6	6.2	6.5	10.2	11.6	1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**61.7**	**62.7**	**71.0**	**79.3**	**94.7**	**110.3**	

1. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

A part of the above mentioned traffic projections include cargo that is not actually handled at Mumbai port (ONGC Bombay High Crude to refineries and JNP, POL product at OPL Wadala). The amount of cargo actually handled at the port is shown in **Table 6.2**. It should be noted that the cargo handled midstream at Mumbai port (Iron ore, some part of Coal and other commodities) is included in this.

Table 6.2 Mumbai Port Traffic Projections

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Handled[1])

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo							
POL	23.8	27.3	32.2	37.5	41.1	49.5	
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	▪ As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	▪ 2014-15 cement is handled at the railway yard
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.08	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[2]	3.8	4.6	6.2	6.5	10.2	11.6	▪ 1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**49.3**	**50.7**	**59.1**	**67.3**	**82.7**	**98.3**	

1. Includes midstream cargo but excludes ONGC BH Crude to refineries , ONGC BH Crude to JNP, OPL Wadala
2. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

Out of the above traffic, traffic handled midstream is around 4.2 MTPA in 2020, 4.7 MTPA in 2025 and 7 MTPA in 2035. This would include some part of coal traffic, all of iron ore traffic and most of other commodities cargo.

6.3 Coastal Shipping Potential

Mumbai is strategically positioned to serve the large demand hinterland of Mumbai and the adjoining areas through coastal shipping, Steel and fertilizers can be major commodities to Mumbai in case coastal shipping revolution takes place in the country (**Figure 6.3**).

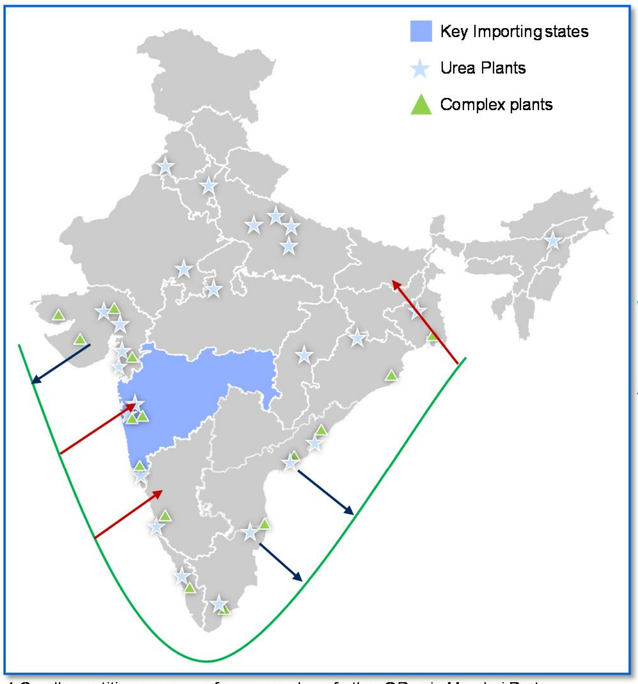
- **Steel:** ~2 MTPA of steel can be coastally shipped to Mumbai port primarily from Odisha and Jharkhand. Small quantities can come from West Bengal and Andhra Pradesh.

Figure 6.3 Coastal Shipping Potential- Steel

- **Fertilizers:** ~2 MTPA of fertilizers can be coastally shipped to Mumbai port primarily from Andhra Pradesh and Gujarat (**Figure 6.4**).

COASTAL SHIPPING FERTILISERS

~2 MTPA fertilizer can be shipped to Mumbai Port by 2025; AP and Gujarat will be the key source states



Key ODs with coastal shipping potential to Mumbai Port

Route[1]	Volume, '000 TPA
Gujarat to Maharashtra	1,284
AP to Maharashtra	606

1 Small quantities can come from a number of other ODs via Mumbai Port

SOURCE: DGCIS data 2013-14

Figure 6.4 Coastal Shipping Potential- Fertilizer

The **Table 6.3** summarizes the potential of coastal movement for key commodities.

Table 6.3 Possible Opportunities Via Coastal Shipping

Mumbai Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.45	0.60	1.07
Steel (Unloading)	1.03	1.37	2.47
Cement (Loading)	-	-	-
Cement (Unloading)	-	-	-
Fertilizer (Loading)	0.28	0.34	0.50
Fertilizer (Unloading)	1.73	2.11	3.12
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	0.01	0.01	0.01

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small.

7.0 CAPACITY AUGMENTATION REQUIREMENTS AND PROPOSALS

7.1 Vision for the Port

Mumbai port being located within a busy commercial city is slowing moving towards handing of the cleaner cargo. The coal handling operations have already stopped and there is no growth likely for other dry bulk cargo being handled at the dock or berths.

Keeping in view the Mumbai being financial capital of India, one of the tourist destinations and also high net worth individuals residing there is a demand for development of facilities for leisure, tourism etc. for which suitable waterfront needs to be reserved.

Also there is a great demand for having repair facilities for these vessels and the Hughes dry dock in the current set up is not being able to meet this requirement.

The above aspects need to be kept in mind while suggesting the capacity augmentation proposals for the port.

7.2 Dry Docking Facilities

7.2.1 Performance of Hughes Dry Dock

To start with, the performance of the HDD during the past 5 years is presented in the **Table 7.1**.

Table 7.1 Peformance of Hughes Dry Docks Over the Past 5 Years

Year	Port Crafts		Others' Crafts		Total Crafts		Occupancy In Days
	No.	GRT	No.	GRT	No.	GRT	
2010 - 11	12	2,874	66	1,33,542	78	1,36,416	289
2011 - 12	1	32	66	1,69,488	67	1,69,520	322
2012 - 13	10	2,035	64	94,548	74	96,583	303
2013 - 14	7	1,458	55	67,048	62	68,506	302
2014 - 15	4	885	40	1,07,446	44	1,08,331	289

The organisations that have utilised the Dry Dock and the number of vessels dry docked by each are presented in the **Table 7.2**.

Table 7.2 Organisations Using Hughes Dry Dock

Organization	No. of Vessels Occupying Dry Dock						
	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-16 up to Nov 15	Average Stay per Vessel
Navy	0	2	0	4	5	0	14 to 20 days
Coast Guard	6	11	7	2	2	5	15 to 23 days
SCI	5	7	6	4	1	1	13 to 17 days
MDL	2	3	0	1	1	2	14 to 26 days
MbPT	4	1	10	8	5	3	5 to 17 days
Coastal (Indian Flag)	38	39	48	38	30	35	5 to 18 days
Foreign Flag	3	3	3	4	0	0	5 to 15 days
Total	**58**	**66**	**74**	**61**	**44**	**46**	

It could be seen that the dry dock has been occupied almost for the whole year which shows it popularity. It also shows that the majority of the vessels are coastal vessels, mainly vessels related to activities of offshore oil fields such as offshore supply vessels, Anchor handling tugs, material barges etc. It is also understood that with the closure of Mereweather dry dock, there is always a long waiting list of vessels requiring dry docking.

7.2.2 Limited Operations at Hughes Dry Dock

As already explained under section 3, the responsibility of the Port in dry dock activities is only upto docking the vessels. The actual repair or refurbishing work is done through licenced private contractors/agents arranged by the vessel owners themselves.

Presently HDD is being unproductively utilised. The reason being the matching onshore infrastructure i.e. workshops, equipment for the ship repair is not available at the dry dock. Further HDD requires investment on its upkeep and the regular maintenance. Most of the infrastructure with the dry dock is several decades old and have outlived their economic life. The material handling equipment including cranes are in bad state and working at far lower than their rated capacity. This has affected the productivity of dry dock substantially and increased costs for undertaking ship repair activity. This is discouraging ship-owners to use it for serious repairs rather it is being used to undertake minor repairs resulting in lesser revenue.

Since no workshop facilities are available for repair of merchant vessels at the port, the ship owners, hiring the dry dock, have to engage contractors to undertake the repair works. The engagement of the contractors and getting the works done are the responsibility of the ship owner and the port does not come into the picture. The mobilization and transportation of manpower, machines and raw materials to work site, causes avoidable delays. Further, as a mandatory requirement, for certain work such as chipping and painting, the ship owners have to hire Dock Labour Board workers. There workers have different work culture and their productivity is poor. Besides shiprepair activity is considered as secondary activity and as such receives a relatively lower priority from the Port.

Mumbai Port Trust is not keen to make any investments on the dry dock and revive its working condition. Ship repair using dry docks is not the core activity of Mumbai Port. It is understood from the port official in charge of dry docks that there is always a great demand for the dry docks. While the dry dock caters to 60 to 70 vessels in a year, there is always a queue of about 100 vessels.

Apart from development and operation of dry dock infrastructure, the port is also facing constrains of manpower required for operating drydock. It is understood that the port workers attending to the drydocks are old and by 2017, most of them will retire. This will leave a big manpower gap which the port will not be able to meet.

At this point of time, developing drydock infrastructure by Mumbai Port would require extensive investment on physical infrastructure and recruitment and training of manpower to operate dry dock. Since, dry docking is not the core business of the port and it contributes less than 5% of total revenue generated, it is commercially not attractive to make investment in upgrading infrastructure. In such circumstances, it would be commercially attractive to integrate the project with ship repair infrastructure and allow private parties to develop and operate it.

Developing a ship repair yard at Mumbai Port trust is a win-win situation for all stakeholders. Mumbai Port Trust generates additional source of revenue from ship repair activity in the form of fixed rentals and profit-sharing. Ship Repair Company finds a semi-developed industrial land for setting up ship repair yard. The shipping companies with ships deployed in Mumbai region and coast of India find the most suitable location and infrastructure for getting their ships repair. In the absence of repair infrastructure in Mumbai the companies had to spend large sums of money to relocate their vessels to international waters to get their ships repaired.

7.2.3 Market Potential at Mumbai Region for Ship Repair

In order to examine the prospects of developing ship repair infrastructure at the port, Mumbai Port has appointed a consultant to conduct a Feasibility Study and later prepare a Detailed Project Report for development of Dry Dock in Mumbai Port and advise the port on the technical and financial feasibility of the project. The consultants have already submitted the draft DPR which is under examination by the port.

According to them Mumbai is one of the prominent maritime centres of India with the largest offshore oil & gas field, a naval base, two major ports and five active non-major ports. In the present scenario of ship repair industry in India, it has been found that there is large demand-supply gap of infrastructure, especially in Mumbai. This has led to more than 200 ships permanently stationed in Mumbai and more than 5000 ships visiting the region for trading acticvity. A demand – supply assessment for high value vessels with less than 28 m beam shows the need for at least 4 repair berths in Mumbai Port. As against this, only one dry dock HDD is available. With the use of caisson at the centre, a second dock is created by which two ships could be accommodated at a time. Hence, developing a ship repair yard through private participation of an established ship repair company could provide a win-win situation to all stakeholders.

Due to its strategic location, custom-built infrastructure specially designed for ship repair activity and the availability of suitable support system, MbPT ship repair yard could be the most competitive yard for ships less than 100 m long on the west coast of India. A ship repair yard located closer to the region of deployment of vessels, generally wins contract compared to the ship repair yard located in far – off location. For the repair yard located in the vicinity, even though its cost of repair is high, the mobilisation, demobilisation costs and overhead costs are far more lower compared to a repair yard which is located at a far off location.

7.2.4 Dry Docking Facility

The first step should be to refurbish the existing HDD. Considering the present situation and the constraints of MbPT to make any investments, it is preferable to develop HDD separately as an independent unit by partnering with a private ship repair company. In addition to replacing the current cranes and other equipment, it is necessary to set up self-contained workshops to take care of all ship repair requirements.

To support each dry docking facility there is a requirement of at least one wet berth for afloat repairs. There will be many instances where the ships might only need afloat repairs. Therefore adequate number of wet berth needs to be provided to complement the dry docking facility. The inner berths 1, 2 and 3 could be allocated for this purpose along with the backup space of boundary as marked in red in **Figure 7.1**. The building currently being used for CISF could also be made part of the integrated dry docking facility for use as an office area and worker amenities.

HDD can be used to repair one large vessel (with LOA about 210 m long corresponds to beam limitation of 28 m at lock gate) or two small vessels (of LOA of about 120 m) simultaneously. With modernisation it c.an be used to handle significantly large number of vessels.

Considering that the major demand is for the repair of OSVs and other smaller vessels, any additional dry docking facility should be developed to cater to ships with size limited to about 120 m only. Such vessel will have docking draft in the range of 3.5 m to 4.0 m. This would rule out the options of providing slipways or marine lifts. There is not adequate space available to develop a Graving dock. Therefore the options for additional dry docking facility would be limited to either a floating dock or shiplift.

Providing shiplift would require creating significant fixed infrastructure in the form of dry berths, transfer bays, shiplift support structures at much higher cost as compared to floating dock. On the other hand floating dock could be brought to the site, even on hire basis, and demobilised in case of non-utilisation. Therefore floating dock is considered as a complementing facility for the HDD and could be taken up as a separate projects alongwith the HDD development. The proposed scheme is shown in **Figure 7.1**.

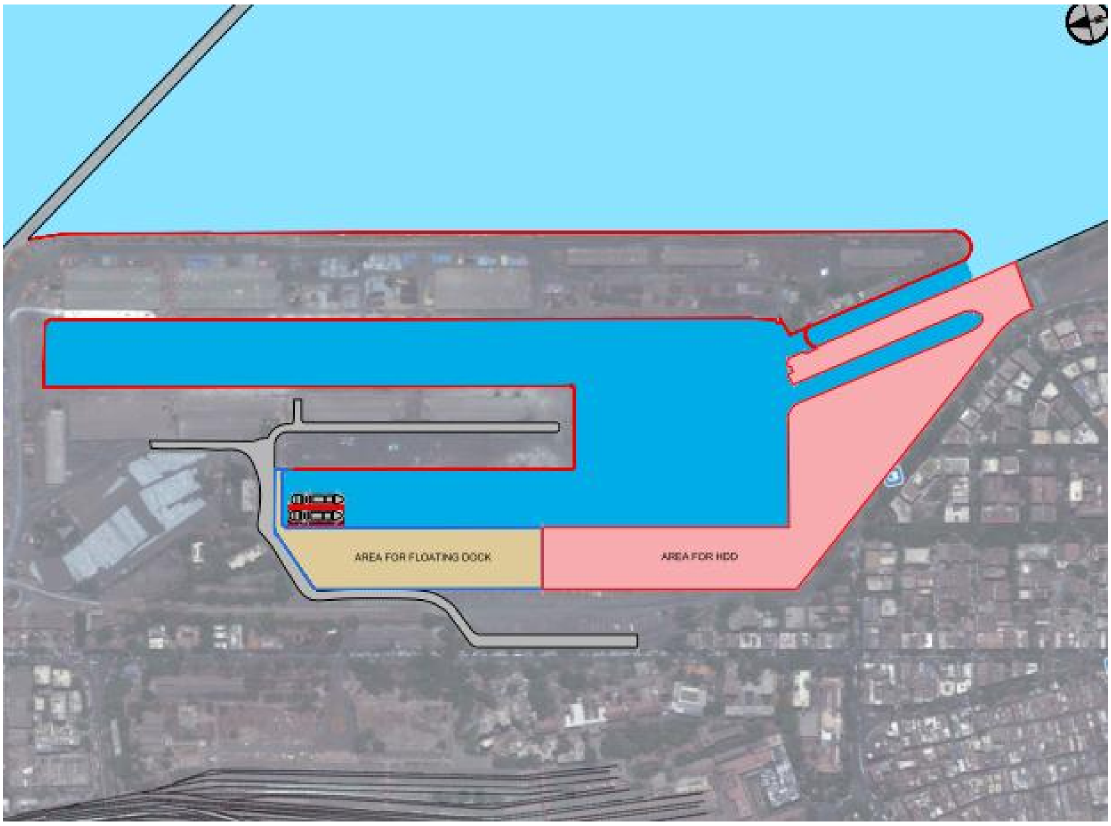


Figure 7.1 Proposed Plan for Creating Dry Docking Facilities at Indira Dock

7.3 Redevelopment of Indira Dock

The location, features, limitations and performance during 2014-15 have all been described in the earlier sections 3 and 4. However, the salient aspects are recaptured hereunder.

- Indira Dock (renamed Alexandra Dock) is more just over 100 years having being constructed during 1904-1914
- It works on a lock-gate system with a lock length of 228.6 m and a width of 30.5 m, through which vessels can enter and leave the docks at any state of tide.
- The normal ships are limited to 175.26 m LOA; 24.38 Beam and 8.84 m to 9.14 m draft while certain berths can handle ships up to 190.5 m LOA; 25.91m Beam and 9.14 m draft
- There are 21 berths out of which 16 are used for handling cargo.
- These berths do not have ship-shore transfer cranes and have to depend on the ships' own gear.
- Absence of shore cranes along with small size of ships, the productivity of these berths is very low.
- During 2014 -15, the 16 inside berths handled about 1.5 million tonnes of cargo through 255 ships whereas the 4 outside berths handled about 1.6 million tonnes through 179 ships. During the same period the two Ballard Pier berths BPX and BPS handled 3.1 million tonnes through 282 ships.
- Of the 1.5 MT handled during 2014-15, about 0.56 MT was steel products.
- The principal cargo handled are steel, sugar, yellow peas, fertilisers, project cargo, cars and containers.

7.3.1 Options for Redevelopment of Indira Dock

In view of the limitation of Indira dock to handle vessels with beam over 28 m, only less than half the vessels carrying breakbulk visit these berths which results in the low capacity utilisation. Many of the berths either remain unutilised or used for parking of the vessels under rough weather conditions.

Two options are considered for redevelopment of Indira Dock viz. complete closure of the dock including the berths and the dry dock, filling it up and using the reclaimed area for using the space for commercial purposes or partial closure of the dock keeping the dry dock open and operational. These two options are further discussed in detail in the following sub sections.

7.3.1.1 Option 1: Complete Closure of Indira Dock

In this option the entire dock basin including the dry dock will be filled up and area reclaimed. It is shown in the **Figure 7.2**.

Figure 7.2 Option 1 - Complete Clouser of Indira Dock

In this option, Indira Dock inner basin along with Hughes Dry Dock will be closed and filled up as shown in the **Figure 7.2**. The outer wall could be extended to accommodate one more berth. The water front and the backup area could be redeveloped with new sheds and shore based cranes for handling cargo. The available area could be used for hospitality industry, tourism activities and for accommodating important government offices.

However, the crucial impact of this option is the closure of the popular Hughes Dry Dock. Mumbai is a bee-hive of marine activities related to the offshore oil fields, Western Naval Command etc. and hence, there is always a heavy demand for ship repair facilities. The Port has already closed and filled up the Mereweather Dry Dock within Princess Dock. If Hughes Dry Dock is also closed, there will not be any facility for ship repair. The slipways in the workshop area can handle only very small crafts.

By letting out the space for purposes other than port related activities, the primary role of the port as a service unit gets defeated. In this context it has to be noted that the earlier Port's attempt to attract agencies for setting up Flotel and Floating Restaurants has not been successful with no or poor response. These units may appear incongruous in such a port environment and with the adjoining Western Naval Command.

7.3.1.2 Option 2: Complete Closure of Indira Dock

In this option the dock shall be closed partially, keeping the dry dock open and operational. This option is not preferred as it would not only take away the available berthing space but also devoid the small crafts using the dock during inclement weather conditions.

7.3.1.3 Recommended Option

It is proposed that the entire western arm be utilised for lay berths for the dry docking facilities and the berths on eastern side shall handle the cargo and other port usages such as storage of cargo etc. The proposed plan is shown in **Figure 7.1**.

7.4 Cruise Terminal

Mumbai port is already handling cruise vessel and currently these are being handled at BPX berth. However this berth being one of the deeper berths at the port is in great demand and vessels having higher draft are first lightened here and then proceed to India dock or to harbour wall berths. The adjacent berth BPS is also a deep water berth and being used for cargo handling. Handling passenger traffic and cargo at the same berth is not an ideal situation and detriment for development of a modern international class cruise terminal. Keeping in view of the location of BPS and BPX berths being close to the city, it is suggested that a long terms view be taken to develop these berths and the entire backup area for a cruise terminal and associated facilities.

7.5 Requirement for Capacity Augmentation for Cargo Handling

7.5.1 Oil Handling Facilities

7.5.1.1 Berths

As regards the liquid cargo, it is assessed that with the development of JD5, second chemical berth and the FSRU for LNG, there may not be any additional requirement for berths.

7.5.1.2 Storage Area

The storage tanks associated with berth JD5 are already being developed on the area to be reclaimed on the Jawahar Dweep. As could be seen from the traffic projections there is an opportunity to handle additional liquid cargo by way of coastal shipping. While there will be adequate capacity of berths, additional tankfarms would need to be developed. For this purpose suitable area as shown in **Figure 7.3**, towards the eastern side of Jawahar Dweep Island could be reclaimed.

Figure 7.3 Proposed Reclamation for Additional Storage Tanks

7.5.2 Requirements of Berths for Breakbulk, Containers and Cars

The assessment for the required berths for the key cargo like Breakbulk, containers and Cars has been made considering the profile of vessel visiting the port, parcel sizes, existing handling system and possible improvements etc. Accordingly, based on the projected traffic, the following requirement for berths has been assessed for break bulk, containers and cars (**Table 7.3**).

Table 7.3 Berth Requirement

S. No.	Commodity	Total Berths Needed		
		2020	2025	2035
1.	Break Bulk	3	4	8
2.	Iron and Steel	3	4	6
3.	Ro-Ro Cars and Containers	2	2	2
	Total Number of Berths	**8**	**10**	**16**

Though it may appear the number of berths available currently at Indira dock and outside are adequate for the projected traffic, the following factors need due consideration:

1. Indira dock has a limitation due to which vessels with beam over 28 m cannot enter. The maximum permissible draft is 8.8 to 9.1 m.
2. The harbour wall berths have a maximum permissible draft is 7.5 m.
3. BPS and BPX berths are deeper having draft of 10 m and 9.5 m respectively. As per the long term planning these berths shall be fully dedicated for cruise terminal.
4. OCT berths were required to be deepened for a depth of 15 m below CD but the dredging undertaken till date is upto 12 m below CD only due to presence of rock. As now siltation has taken place, the current water depths are about 11 to 11.5 m below CD.
5. It may also be noted that the OCT project stalled and discussions are ongoing to revive it by rebidding. The availability of OCT and its backup area would be dependent on conclusion of the ongoing negotiations.
6. The Western arm of Indira dock shall be used for providing the floating dry dock and lay berths and shall not be available for cargo handling.
7. It is observed that permissible draft of vessels is a constraint at port due to which vessels have to be lightened / top loaded at the anchorage or deeper berths. This results in higher handling costs. It is therefore required that additional berths having deeper draft are provided at the port to reduce the handling expenses.
8. Over 50% of the vessels carrying steel and over 35% of vessels carrying other break bulk are having beam over 28 m and therefore these cannot be handled at inner berths of Indira dock.

It is therefore assessed that total of 14 berths outside dock would be needed to cater to the traffic projected for master plan horizon for breakbulk, steel and containers. Against this only 3 berths are available at harbour walls and 2 or 3 available at OCT. With the increase in cruise ships over a period of time the availability of berth BPS and BPX for cargo handling operations will be very much limited.

The suggested plan for augmentation of berthing facilities is as below:

- Year 2020 - Existing berths would be adequate to cater to projected traffic. Cars, Containers and part of Steel shall be handled at OCT.
- Year 2025 - Provide additional berth of 300 m length and 35 m width along OCT for steel.
- Year 2030/35 - Provide additional berths (total 600 m length and 35 m width) with berthing line slightly west of the berthing line of OCT (to clear off the turning circle). This shall be preferably connected to the approach trestle of OCT, which is wide enough to support the proposed traffic.

In view of the limited traffic for containers, there may not be a need to deploy dedicated rail mounted container quay cranes and instead mobile harbour crane could suffice, which could be used for handling containers as well as steel products. The placement of mobile harbour crane would however need to be carefully planned such that their pads transfer the loads directly on the beams, which are spaced 7 m c/c along the berth length. Alternatively gantry type rail mounted harbour mobiles cranes could be deployed.

It is expected that the deck which has been designed for the UDL of 3 T/m^2 as well as IRC class 70R and class AA loads could support handling of steel coils which are anyway to be placed directly onto the trailers.

The proposed layout of the additional berthing facilities is attached as **Figure 7.4**.

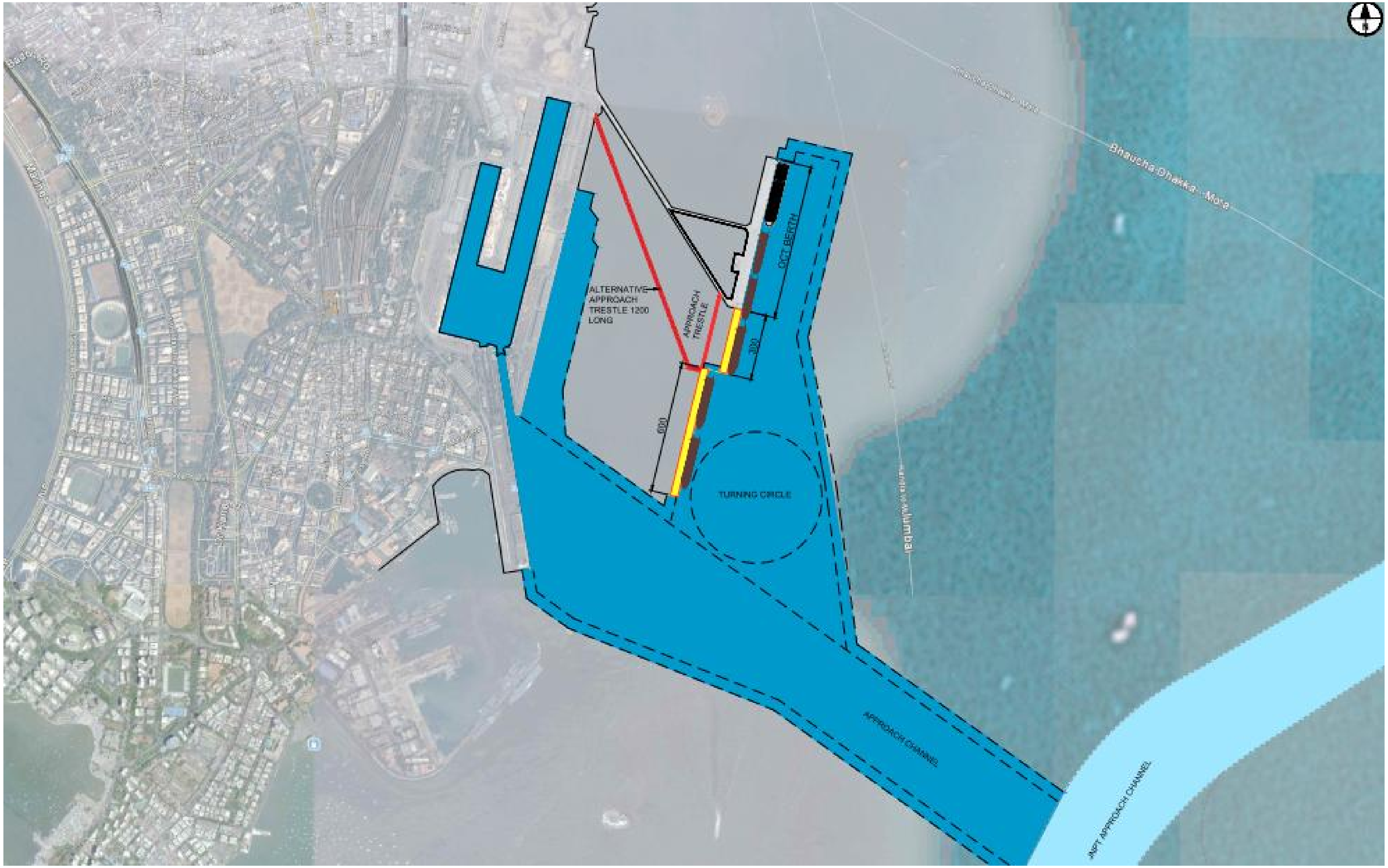


Figure 7.4 Proposed Layout of Additional Berthing Facility

7.5.3 Storage Space Requirement for Containers, Break Bulk and Steel

<u>7.5.3.1 Required Storage Area</u>

Currently, the storage area for the above cargo is located at Indira dock. For containers the yard is being built as part of OCT development.

The factors to be taken into account in determining the size of the storage areas are cargo throughput and dwell time, stacked densities, angle of repose, maximum and average stacking height, aisle space, peaking factor, etc. Out of these one of the key factors is the dwell time of cargo at the port. The following assumptions have been made with regards to the cargo dwell time:

1. Containers - 5 days
2. Steel - 16 days
3. Other Break bulk - 7 days

For cars it is assumed that a space to store maximum of 5600 cars is needed. Also based on the discussions with port personnel it is assumed that space for storage of about 80,000 T of pulses would be needed. Basis these assumptions, the storage area required for the breakbulk, steel and containers has been worked out as shown **Table 7.4**:

Table 7.4 Estimated Storage Space

S. No.	Commodity	Requirement of Storage Area (m^2)		
		2020	2025	2035
1.	Breakbulk	53,496	64,918	94,289
2.	Iron and Steel	46,027	51,945	100,603
3.	Ro-Ro Cars	100,800	100,800	100,800
4.	Containers	10,204	16,582	22,959
Total Storage Area Required (Ha)		**21**	**23**	**32**

<u>7.5.3.2 Area Currently Available for Storage</u>

Considering the proposals for allocating the back space for Hughes dock and proposal for locating the floating dock along the western arm, the actual area that would be available for cargo storage is given below:

1. Open Storage - 80,000 Sqm
2. Covered storage - 60,000 Sqm

The above does not take into consideration the storage area being developed as part of yard for OCT.

7.5.3.3 Recommendations

It could be seen from the above that the total storage space needed is higher than currently available around Indira dock. Therefore part of the cargo would need to be stored at the yard being developed for OCT.

It could be observed that significantly higher storage area is mainly on account of considering the time horizon of 2035. Before that the additional storage space would be needed on account of cars only (about 9.0 Ha). It is therefore suggested that part of the area at OCT yard (about 10 Ha) be kept reserved for future augmentation requirements. Initially this area could be developed at minimal expenditure for parking of cars. This would utilise the part of land area created by erstwhile Victoria dock.

In case it is observed that that is a need of additional area on account of increased traffic, multilevel car parking be planned to reduce the area requirement for cars. Similarly, additional storage areas be planned away from berths for the cargo that dwell longer at port.

Also as part of OCT yard development, there is a proposal to provide rail sidings and it is suggested that this area be also reserved as part of cargo handling activities and access corridor and utilised for faster evacuation of steel and containers.

7.6 Development of Marina

It is observed that even after reserving the storage area required for cargo projected to be handled by year 2035, there will still be sufficient space available at the backup yard developed for OCT. It is suggested that in this balance area the possibility of developing a Marina with associated facilities be explored. Only few issues as below would need to be addressed:

1. It would involve dredging part of the area reclaimed in the Princess dock.
2. The port is not a clean environment and yachtsmen do not like having their yachts covered in grime. However, a properly managed marina will have mechanisms in place to minimize this negative aspect.
3. Currently, this area is inside the port security zone. This situation is unacceptable for a marina which, by definition, implies leisure use and visits by family and friends. The obvious solution is to move the ISPS line such that the allocated area is no longer subject to this regime.
4. Boats would still have to pass through the port's ISPS waters when moving to and from the marina but this should not be a problem because it is a situation that occurs in hundreds of ports worldwide, and anyway such boats will be under visual and radar observation throughout by the port control tower.

To develop this into an international class marina and waterfront, the backup land on west side has to be suitably planned for:

- Modern yacht club
- Boating-related commercial retail premises (e.g. chandlers, sea school, boat sales, cafe).
- A boatyard for servicing the yachts.
- Hotels / Restaurants
- Adequate car parking in support of the foregoing
- Extensive landscaping so as to create a pleasant environment.

The conceptual layout is attached as **Figure 7.5**.

Figure 7.5 **Conceptual Layout of Victoria and Princess Dock Development**

7.7 Workshop Area

The workshop area is located at the Clarke Basin, as mentioned in para 3.4.1, has small slipways which are capable of repairing only small crafts. Due to the heavy siltation this facility is currently even not be effectively used for this purpose also. Upgradation of this area for repairing of the bigger ships will be very cost intensive and may not be financially viable. Approximately 4 ha including 0.9 ha of covered area is available and it is suggested that the port may find an alternative use for this land parcel which could be either leasing it out to MDL, who has facilities adjacent to it, or use it for the purpose of storage of cargo being handled at port.

8.0 SHELF OF NEW PROJECTS AND PHASING

As part of the Mumbai Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

8.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given in **Table 8.1**.

Table 8.1 Ongoing Projects

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (INR in Crores)	Mode of Implementation
1.	Offshore Container Terminal	7.7	600	Port's funds
2.	Additional Crude Oil Jetty at Jawahar Dweep, JD 5	20.0	811	Port's funds
3.	Bunkering Terminal at Jawahar Dweep	2.0	50	Port's funds
4.	Capital dredging of 5th Oil Berth	_	66	Port's funds

8.2 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given in **Table 8.2**.

Table 8.2 Projects to be Completed by Year 2020

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (INR in Crores)	Mode of Implementation
1.	Handling of Steel Cargo at OCT	4.0	100	Port's funds
2.	Development of Marina at Victoria and Princess Dock	–	200	PPP
3.	Setting up of a Floating Storage & Regasification Unit (FSRU)	5.0	2,740	PPP
4.	Upgradation of Cruise Terminal at BPX	–	54	Port's funds
5.	Dry Docking Facility at Indira Dock	–	50	PPP

8.3 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given in **Table 8.3**.

Table 8.3 Projects to be Completed by Year 2025

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (In Crores)	Mode of Implementation
1.	Extension of OCT berth by 300 m	4.5	150	PPP

8.4 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given in **Table 8.4.**

Table 8.4 Projects to be Completed by Year 2030

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (In Crores)	Mode of Implementation
1.	Extension of OCT berth by another 600 m	2.5	100	PPP

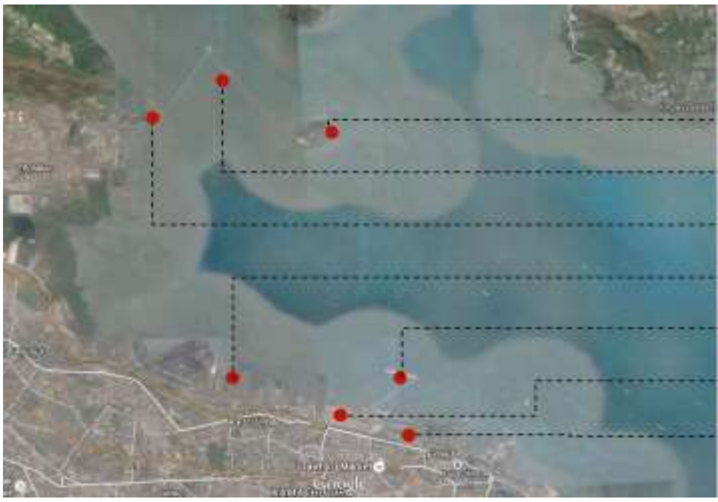
Appendix-1: BCG Benchmarking Study for Mumbai Port

7 Mumbai Port Deep-dive

1.1 Port overview

Mumbai port (MbPT) is located almost midway on the western coast of India. With some of its docks built in the 1870s, it is a legacy city port with old infrastructure that is in need of modernization and upgrades.

It has a dry cargo handling dock, Indira Dock; marine oil terminals for POL with four jetties at Jawahardweep; bunders and dry docks; and storage areas for uncleared and export cargo. Distribution of berths and the cargo mix across Mumbai under Mumbai port:



Terminal	Cargo	Volume
Jawahardweep	POL	24 MTPA
NPP & 2nd Chemical berth	Chemicals	2 MTPA
OPP	Chemicals	
Haji Bunder	Coal	1.8 MTPA
OCT	-	-
Princess & Victoria docks	-	-
Indira dock	Break & dry bulk	6 MTPA

Figure 203: Berths and cargo mix at MbPT

Only 55% cargo (34 MT) is handled by MbPT. The rest is directly managed by third parties.

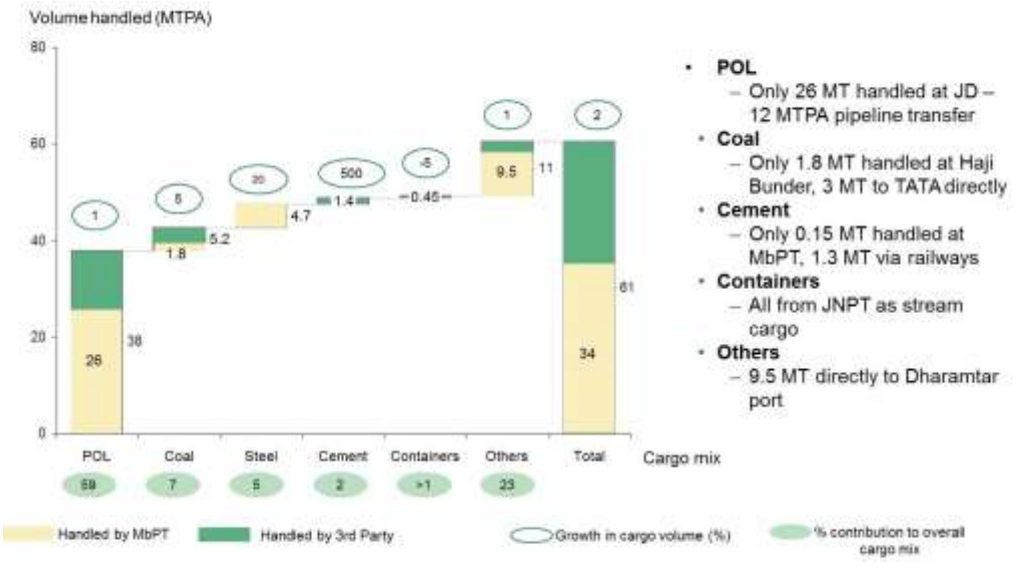


Figure 204: Cargo handling at MbPT

Due to draft and beam size limitations, Indira dock manages only 6MTPA on 27 berths. Modern vessels have an average beam size of 32 meters, which the lock gate's beam size limitation of 27–28 meters limits entry into the inside berths. As a result, inside berths are underutilized and have low occupancy while the outside berths have extremely high occupancy.

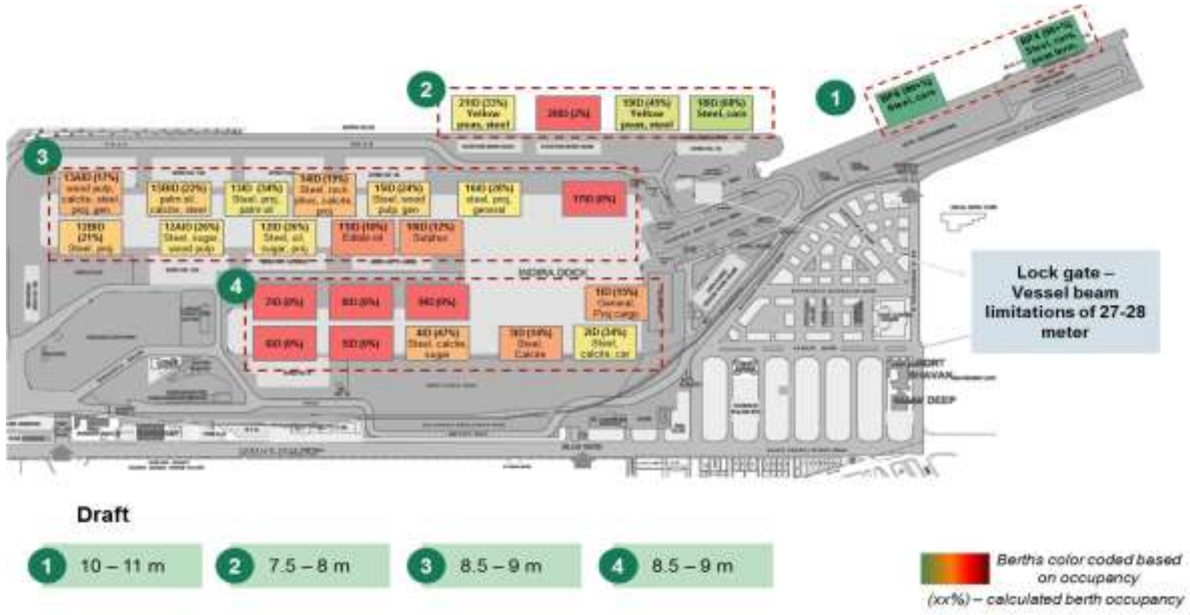


Figure 205: Low occupancy across Indira dock berths

MbPT has one of the highest numbers of employees among the major ports of India. As a consequence, despite positive operating margins, PAT is negative due to high contribution to pension and gratuity.

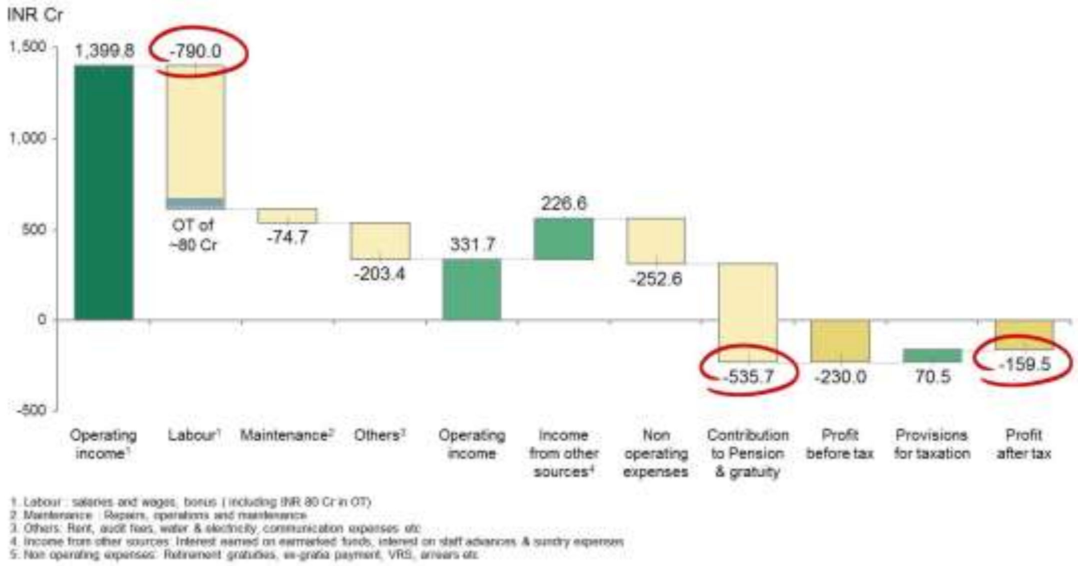


Figure 206: MbPT losses

Being a legacy city port, Mumbai port has four key challenges:

- Evacuation through busy Mumbai: Since the port is located in the southern-most part of Mumbai, evacuation through road leads to cargo going through the busy Mumbai city traffic, which makes evacuation very slow and inefficient.
- Old infrastructure / lack of mechanization, difficult to sustain mechanization: The port's cranes are of extremely low capacity, which brings down productivity. Low capacity cranes also necessitate reliance on ship cranes as the berth infrastructure is so old that it cannot withstand modern equipment and heavy cranes, rendering mechanization difficult to sustain.
- Surplus labor force: MbPT has one of the highest numbers of employees among the major ports, and has low manpower utilization. For example, they employ as many as 12–13 employees for every stevedore loading gang, which leads to a lot of inefficiencies.
- Difficult to attract large vessels due to low draft: Because of the old infrastructure with draft as low as 7 meters, modern ships with large vessels are unable to dock. In addition beam width restrictions further restrict docking of modern vessels.

1.2 Key findings and initiatives from deep-dive

1.2.1 POL: Productivity improvement

POL constitutes 60% of the total cargo volume at Mumbai port. POL volume is largely driven by captive refineries—BPCL, HPCL and ONGC production at Bombay High. With increase in the capacity of refineries and the projected increase in production at Bombay High, it is expected that POL volumes at MbPT will increase.

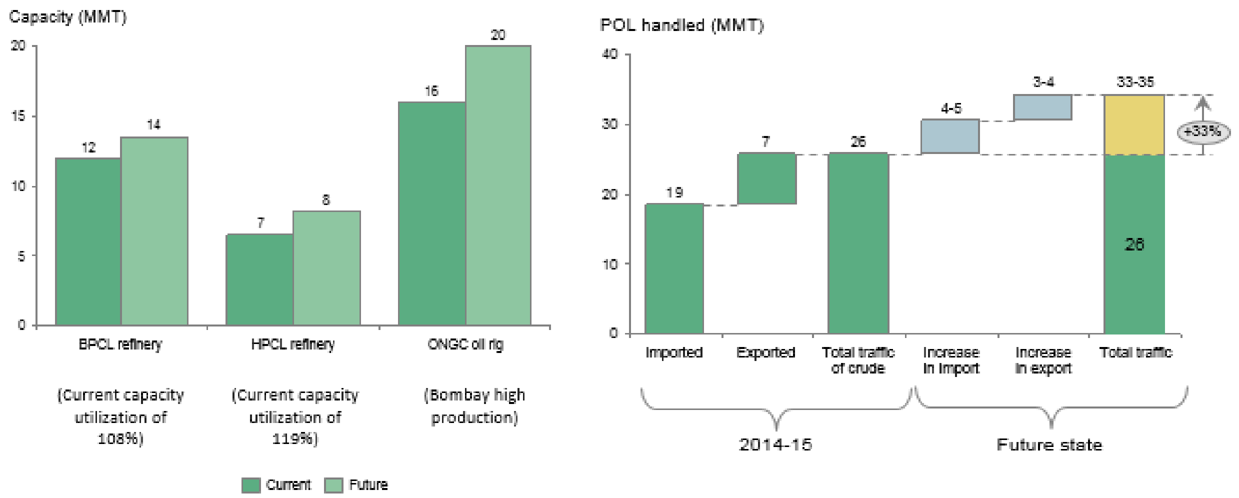


Figure 207: Increase in capacity of refineries and respective increase in POL handled at MbPT

Assumptions behind projected POL volume to be handled at MbPT:

a) Increase in refinery capacity based on reports by Ministry of petroleum
b) Bombay high's production will increase from the current 16 MMT to 20 MMT by 2020, as per an interview with a representative at ONGC (the data point was also validated based on secondary research)
c) Crude used by refineries will continue to be in the same ratio (Bombay high: gulf crude)
d) Capacity utilization of refineries same as 2014
e) Growth in transshipment is based on the CAGR of last 2-3 years

However, with current productivity levels, MbPT may not be able to comfortably manage volumes with the existing berths as berth occupancy would increase above 70%.

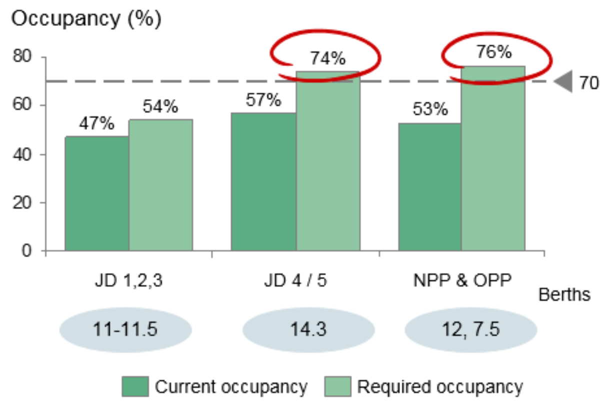


Figure 208: Occupancy required is way above standard norms of 60-65%

The average flow rate achieved is much lower in comparison to best the designed productivity and capacity installed. Installed flow rate for crude is around 6,000 T/hr, whereas for petroleum products it is around 2,000 T/hr.

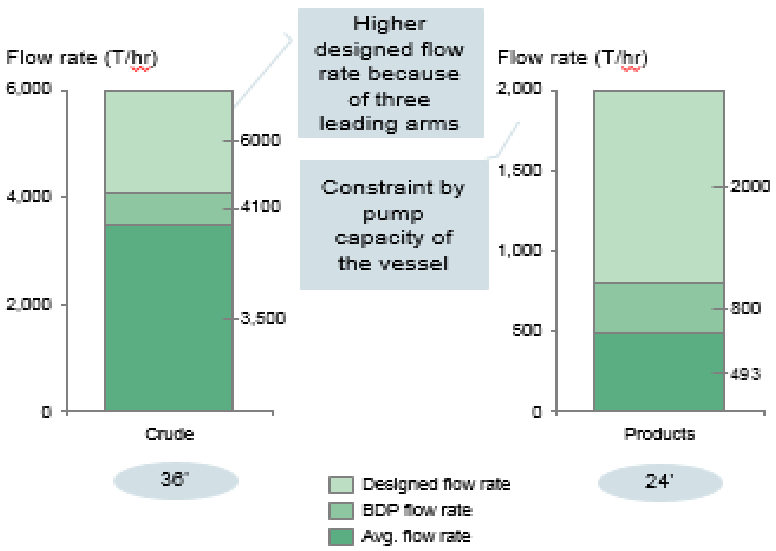


Figure 209: Low average flow rate achieved at Mumbai port

Additionally, the non-working time at Mumbai port is significantly higher in comparison to the 12 major ports in India.

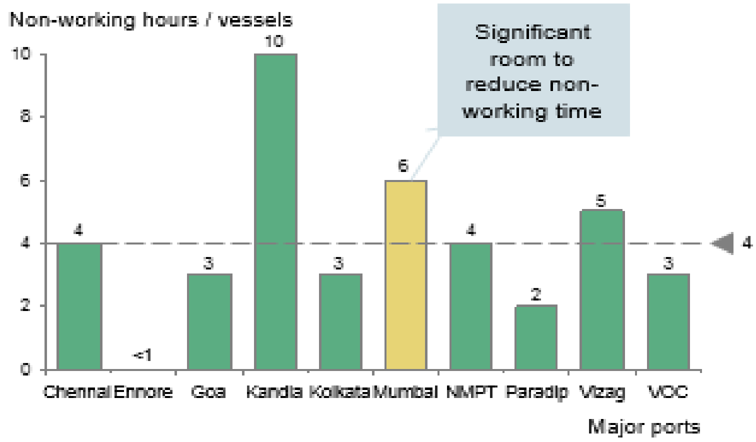


Figure 210: High non-working time at MbPT

In order to reduce the mooring time, installation of 'Quick Release System' can be a potential solution.

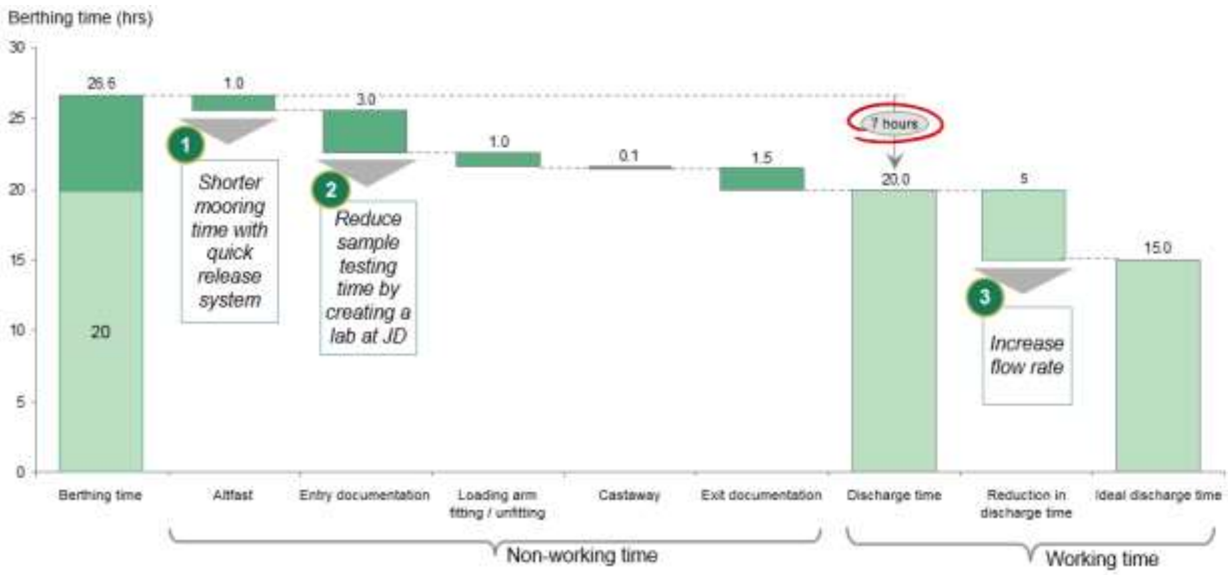


Figure 211: Results from on-berth observation of a liquid bulk ship at JD

Some of the observations for the delay in non-working and working time at Jawahardweep berths are as follows:

- High mooring time
- Transportation time involved in sending sample to testing laboratories for a few customers
- Low flow rate achieved

1.2.1.1 Initiative: MbPT 1.1 Install Quick Release Systems on berths

Initiative Overview

Reduce non-working time in way of reducing mooring time by implementing quick release system on all Jawahardweep berths.

Key Findings

High mooring time is due to the following issues:
- Slow tugs are used to moor the vessel – altfast and cast away
- Two/three tugs are used at a point of time to altfast
- During cast away, similar process is used
- In total, around 1 hour and 30 minutes is spent on altfast and cast away

Recommendations

In order to reduce the mooring time, installation of 'Quick Release System' can be a potential solution.

The process of quick release system is given below:

Figure 212: Process followed in Quick Release System

Expected Impact
Benefits of installing quick release system (QRS) are as follows:

- Reduction in mooring time by ~ 35% (by around 20 minutes)
- Reduction in overturning movement
- Reduction in mooring crew's exposure to risk
- Benefit for oil companies due to faster turnaround time for vessels
- Less labor and no tugs required in operations

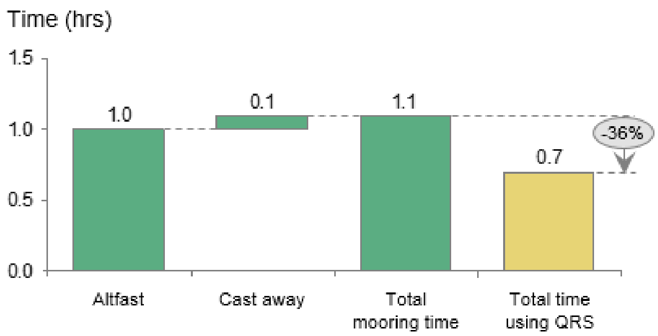


Figure 213: Reduction in mooring time (by around 20 minutes)

Quick release system will lead to a productivity increase of 2% because of the reduction in mooring time. Investment required for installing quick release system on Jawahardweep berths is as follows:

- Each berth will require an initial investment of Rs. 1–1.5 Cr
- Berth strengthening will be required to fix the capstone

1.2.1.2 Initiative: MbPT 1.2 Set up sample testing facilities at JD

Initiative Overview

Policy changes to ensure usage of common / HPCL's testing laboratory on Jawahardweep for all vessels.

Key findings

HPCL has a testing laboratory on Jawahardweep, however according to information provided by the port, BPCL, ONGC and IOCL sometimes use the testing facilities on Pir Pau for sample testing. If a common testing lab is set up at Jawahardweep, the time for taking samples to Pir Pau can be eliminated. This will ensure reduction of clearance time by at least 30-40 minutes, which is the time taken by the launches to take the sample.

Currently, one of the refineries (HPCL) have their testing lab at Jawahardweep, however, it is only used for captive consumption. MbPT should make policy changes to mandate all customers to use testing laboratory on Jawahardweep. MbPT should also facilitate the discussion among HPCL, BPCL and ONGC before making policy changes.

While one of the captive customers has confirmed that they use HPCL facility, policy implementation will ensure usage of testing facility by all vessels coming on the port.

Recommendations

Policy implementation to ensure usage of common testing facility at Jawahardweep.
Expected Impact

Implementing the policy of using testing facilities on JD for all the customers will lead to a productivity increase of 2-3%.

1.2.1.3 Initiative: MbPT 1.3 Improve flow rate by leasing tank farms at JD and implementing low performance penalties

Initiative overview

Average flow rate achieved at Jawahardweep is very low, in comparison to the installed capacity. While unloading is dependent on the pumping capacity of vessels, loading flow rate can be significantly improve. This will lead to a faster turn-around time on berths.

Key findings

Low flow rate achieved at MbPT due to the following:

- Mumbai port has no control over the flow rate achieved by refineries or vessels
- While the installed capacity is high, capacity utilization remains low
- There are a few old tank farms on JD

Currently, only 6 tank farms are operational. 4 of the tank farms are used by HPCL only as bunkers, whereas the other 2 are used for keeping furnace oil. In addition to this, the refineries have limited capacity to expand in Mumbai city, and are using low capacity tanks.

For crude, the installed capacity is around 6,000 T/hour through three loading arms, whereas for petroleum products, the installed capacity is around 2,000 T/hour through single loading arm. However, currently, on an average, the flow rate achieved for crude is around 3,500 T/hour, and for petroleum products is around 459 T/hour.

Flow rate depends upon the pumping capacity of ONGC/refineries in case of loading, whereas in case of unloading, it depends on the pumping capacity of the vessel. In most cases, the flow rate is finalized by refineries and vessels, and MbPT is informed of the flow rate.

For petroleum products, dedicated loading arms are allocated, depending upon the nature of the product.

By observing a vessel unloading petroleum products at MbPT, we found that the vessel was idle for at least 4 hours because of a changeover of storage tanks required at the refinery. This results in loss of productive time at the berth by vessels.

As part of proposed JD 5 plans, multiple tank farms are proposed, in Phase II of the implementation. Considering that the refineries are increasing capacity in the next 1-2 years, it is worth evaluating plans to bring forth the Phase II plan.

Recommendations

In order to increase productivity, MbPT can look at the following two measures:

1. **Implement low performance penalty on refineries/vessels**

   Penal wharfage charges of an additional 1%/hr on slow flow rate than standard norms (4,100 T/hr for crude and 950 T/hr for products).

2. **Bring forward the phase II plan of JD 5 to create tank farms on Jawahardweep**

   Tank farms eliminate issues of reduction in pressure while loading crude due to short distance discharge in comparison to existing discharge through 7.5KM pipeline.

   Investment required per tank is around Rs. 80-90 Cr with installed capacity of 0.12 MMT. MbPT should reach out to the refineries in order to partner for investment in tank farms, and should look at a joint capex investment model. In a discussion with refinery officials, the proposal for additional tank farms on JD was welcomed. This is also included as part of infrastructure development under JD 5 berth.
   MbPT should discuss these plans with refineries before finalizing and should look at co-investing along with refineries in creating the tank farms.

   Expected Impact

   Overall productivity improvement of around 25%.

   The penalty clause will ensure adherence to average flow rate by vessels as well as refineries.

   In addition to the increased flow rate, MbPT will also be able to earn revenue of Rs. 26 Cr annually from rental income based on current rental structure.

   In short term, the projected target for flow rate can be looked at around 800 T/Hr for products and 4,100 T/hr for crude. Projected average target flow rate is equal to the 90% percentile flow rate achieved by vessels last year.

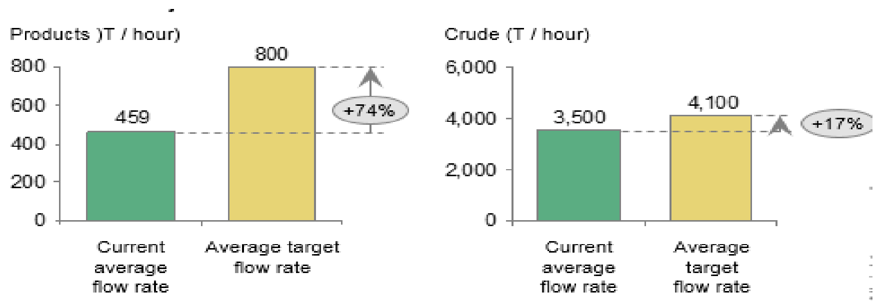


Figure 214: Increase in flow rate of Products by ~75% and crude by ~ 15% (blended 25% productivity increase)

Coal: Cargo shift to Dharamtar

1.2.1.4 Initiative: MbPT 2.1 Shift coal to Dharamtar

Initiative Overview

Mumbai port has recently decided to discontinue coal handling at Haji Bunder (1.8 MMT) because of significant pollution issues in the nearby areas.

In order to retain part of the revenues, MbPT should move aggressively to partner with nearby ports—Dharamtar/PNP or TATA Power to shift coal handling. Additional capacity exists at both Dharamtar/PNP and TATA power to manage 1.8–2 MMT annually. In case of Dharamtar/PNP, MbPT will stand to earn lighterage charges, whereas at TATA power, MbPT will continue to earn part of wharfage charges.

Key Findings

Coal constitutes 4% of the total cargo handled at Mumbai port, increasing by 5% over the last year. While the total coal handled at MbPT is around 8.7 MMT, only 1.8 MMT is handled directly at Haji Bunder. MbPT earns nearly Rs. 14 Cr annually from coal handling at Haji Bunder.

Rest of the coal is managed by TATA power and JSW directly at their respective berths, and MbPT only gets wharfage from the respective companies.

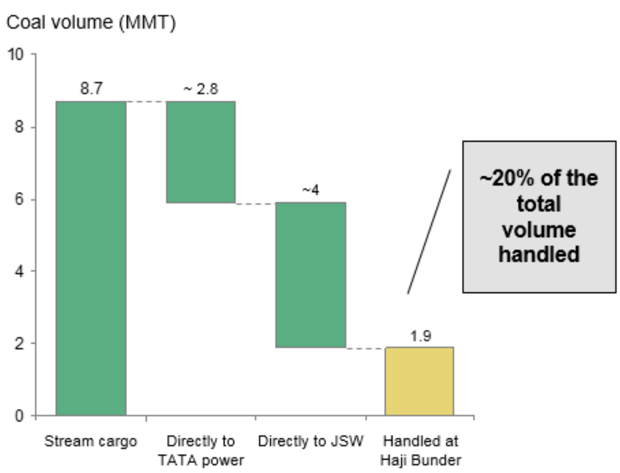


Figure 215: Coal volume handled at Mumbai Port

90% of the coal handled at Haji Bunder goes out to various parts of Maharashtra as given below:

- MahaGenco Nassik and MSPGC Bhusawal = 1.2 MMT
- Captive consumption of players such as Uttam Galva, Tarapore, JSW units = 0.4-0.5 MMT
- Traders = 0.2-0.3 MMT

Out of the total coal consumption, only traders are using coal for Mumbai city consumption. Mumbai port contemplated on managing coal in a pollution free manner, however, the investment required for implementing the initiative is around Rs. 350 Cr.

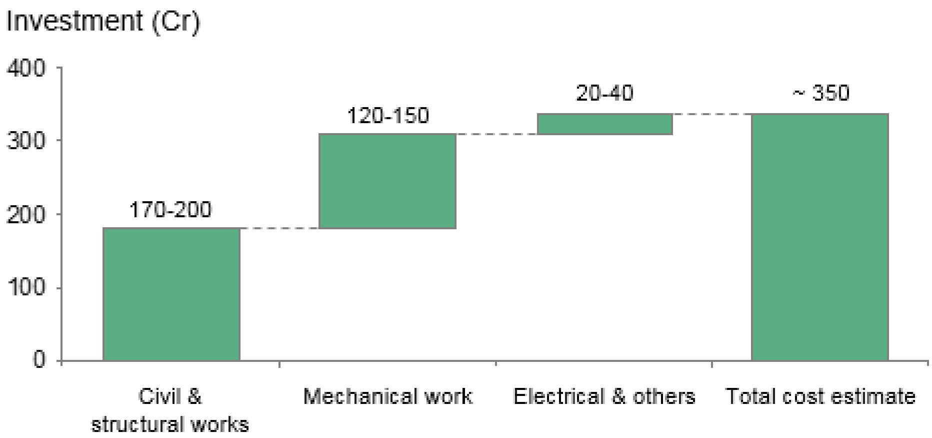


Figure 216: Investment required for pollution free handling

However, the IRR for the investment is around -6%. Alternatively, Mumbai port can look at increasing the cargo handling rates.

Option 1: To generate no returns on the project

- IRR almost 0%
- Increase the handling charges by **107%**
- Maha Genco to pay ~Rs. 24 Cr/MMT

Option 2: To generate healthy returns on the project

- IRR around 10%
- Increase the handling charges by **270%**
- Maha Genco to pay ~Rs. 43 Cr/MMT coal handled

Therefore, Mumbai port decided recently that it wants to discontinue handling coal at Haji Bunder.

Recommendations

Mumbai port has two strategic options to consider:

1. **Shifting coal to nearby ports in order to retain some part of revenue—Dharamtar/PNP port in the short-term**

Considering that MbPT has taken the decision to discontinue coal handling at Haji bunder, in order to retain part of the revenue, it is critical for MbPT to partner with Dharamtar/PNP port, and have a discussion with the port along with MSPGCs to finalize the coal shifting.

MbPT would also need to be competitive in terms of literage charges in comparison to other ports such as Hazira and Adani, so that it can continue to earn from the coal sourced for MahaGenco Nassik and Bhusawal.

90% of the coal handled at Haji Bunder is procured for consumption outside Mumbai. For MSPGC Nassik and Bhusawal, Dharamtar/PNP ports are almost equidistant vis-à-vis Mumbai port. Distance of Mumbai port from MSPGC Nassik is around 210 KM, whereas the same from Dharamtar/PNP is around 225 KM. While there will be a minor increment in logistics cost, it will be offset by delays in evacuation from Mumbai port.

It is also beneficial for Dharamtar/PNP port to manage this additional coal volume because of the following:

- Dharamtar handling ~ 4MMT of coal; working on low capacity utilization with 2 MMT free capacity
- May look at earning from existing capacity in the short-term

MbPT will continue to earn ~ Rs. 1.5 Cr annually by shifting coal to Dharamtar/PNP ports.

Figure 217: Distance from Dharamtar port

2. Explore options with TATA power to shift coal to their jetty in medium term

For ensuring revenue income in the medium-term, MbPT would need to partner with TATA Power to manage the additional 1.8 MMT coal. It is critical to engage with TATA Power to test feasibility and generate options that can benefit both the stakeholders.

TATA Power is already managing almost 3 MMT coal at their jetty. The capacity at the jetty is sufficient to manage additional 2 MMT. However, after discussion with TATA Power, the company has expressed its lack of interest in taking up the additional cargo. Even if MbPT shares half/full of the current revenue, it would not be significant enough to tempt TATA Power to take up the additional cargo.

However, TATA Power is facing some issues with their current operations. TATA Power spends around Rs. 40 Cr annually in dredging. In addition to this, TATA Power is involved in non-core activities such as barge operations, maintenance and unloading of coal from barges on conveyer belt.

MbPT may engage in discussion with TATA Power to explore options of shifting coal to TATA power jetty.

Expected Impact

Shifting coal to Dharamtar / PNP or TATA power will benefit MbPT as it will still be able to retain 50% of the total wharfage.

1.2.2 Containers

Container volumes have been on a decline at MbPT. Where the volumes had once been around 5 lakh TEU in 1995, they have now dwindled and reduced to ~50K TEUs, and have hovered around this figure for the past many years.

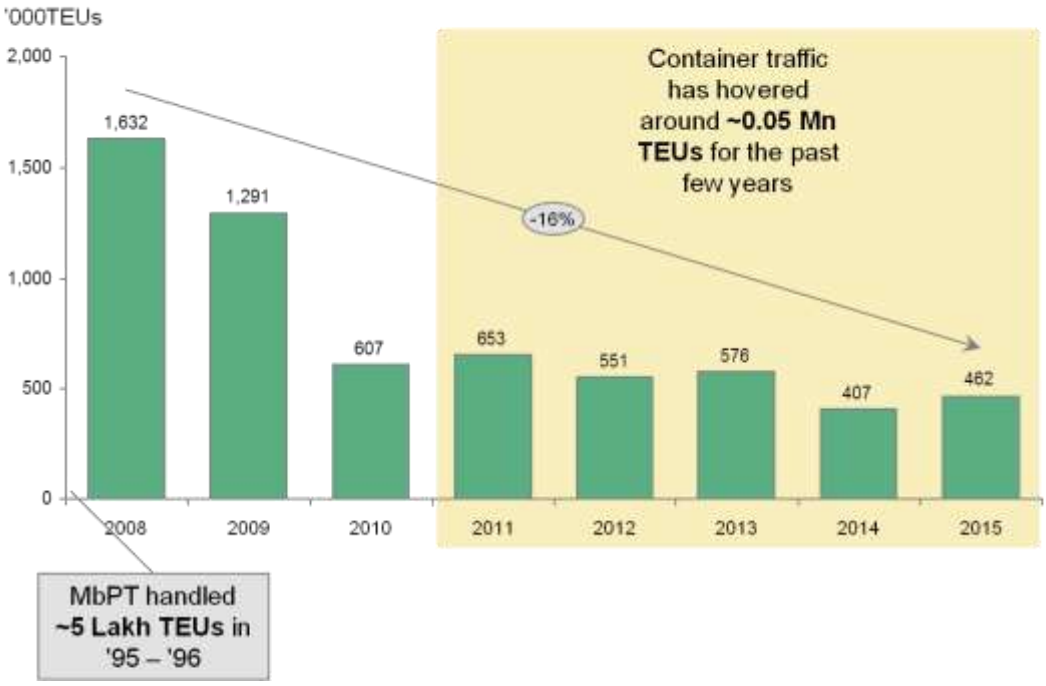


Figure 218: Container volumes at MbPT

Currently, almost 80% of the container volumes are from JNPT. The direct calls form a very small portion of the total volume. Even the ones that are direct are not calls from mother vessels but from aggregator vessels.

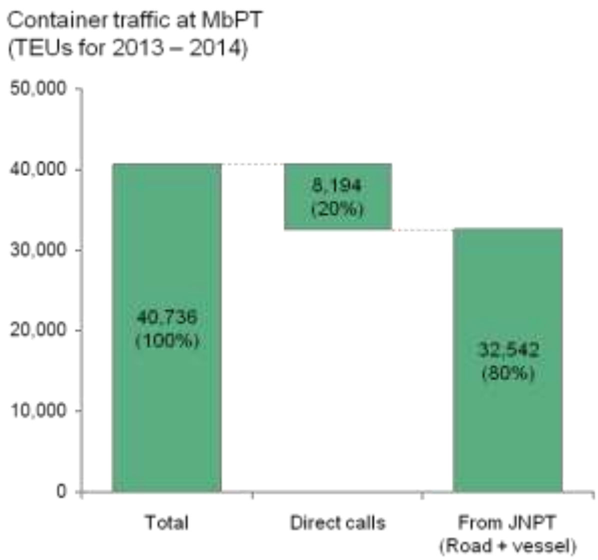


Figure 220: Split of container traffic at MbPT

Presently, the few containers that come to the port are handled at multiple berths. There is no dedicated berth for handling containers. The Offshore Container Terminal (OCT) was built for dedicated container handling but has not been operated for containers yet.

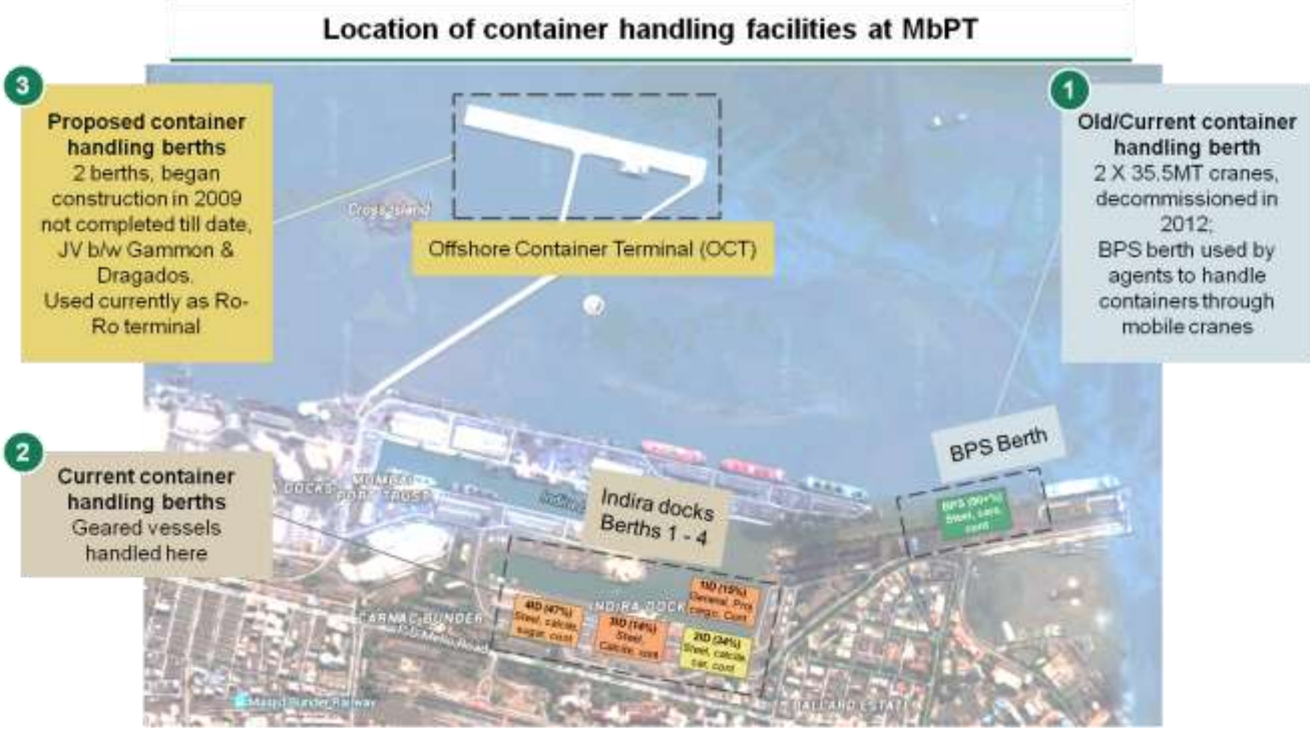


Figure 221: Current container handling facilities at MbPT

Our analysis has revealed that container handling at MbPT proves to be more costly for customers than JNPT. Multiple handling charges at MbPT limit the cost effective catchment area from MbPT to only around 8kms from the port.

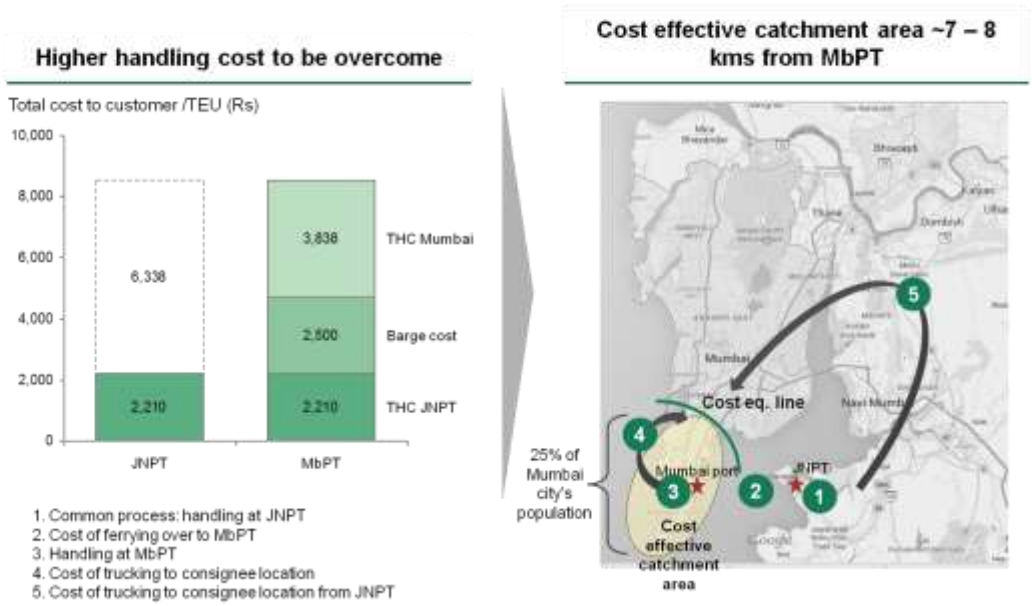


Figure 222: Multiple charges limit the cost effective catchment area from Mumbai port

Further deep-dive and customer interviews have revealed several reasons why MbPT will not receive substantial container volumes in the future. With JNPT in its proximity, and given JNPT's scale, it is unlikely that MbPT will be able to compete with JNPT for container volumes. Some of the reasons being:

- Scale of operations
- Customer willingness
- Evacuation challenges
- Cargo profile at MbPT

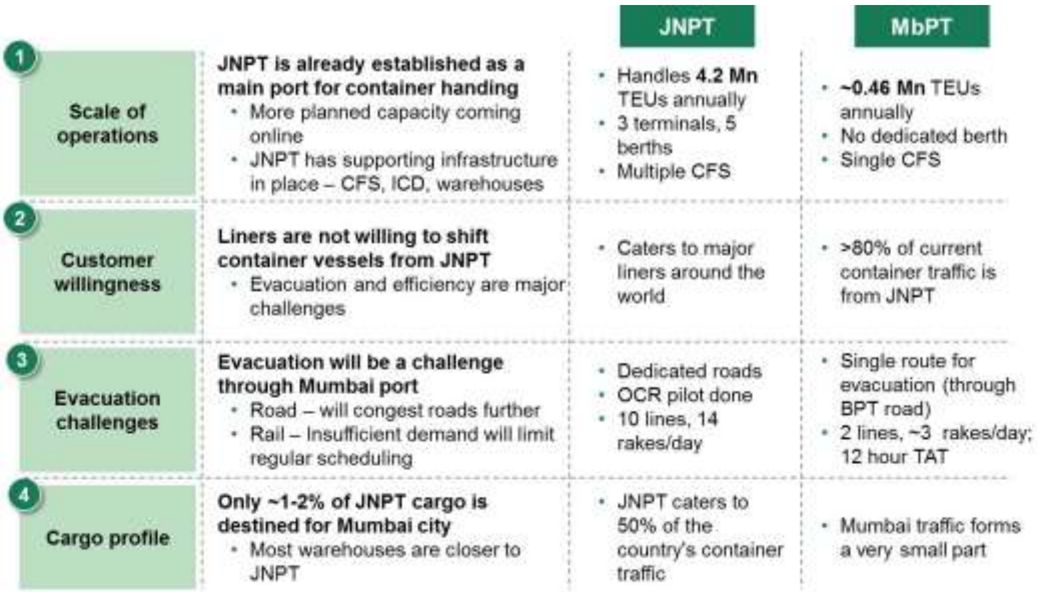


Figure 223: Container handling comparison between JNPT and MbPT

1. JNPT operates at a much higher scale for containers than MbPT: JNPT has more infrastructure to support easier container handling for customers. Ever since JNPT came online, MbPT has lost its container traffic to JNPT. Moreover, JNPT has also planned more capacity to come online in the next few years, which will make it even more challenging for MbPT to break into new customers for container traffic.

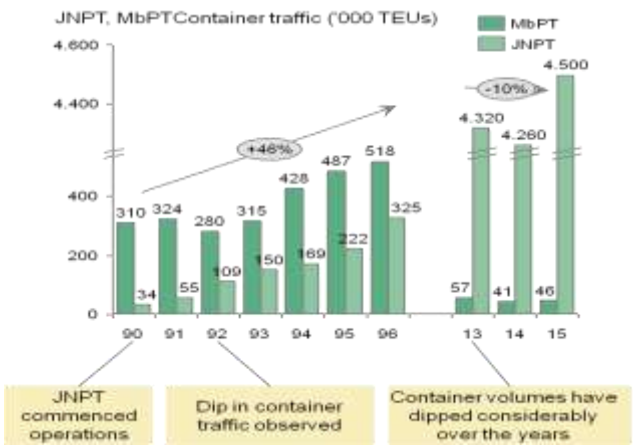


Figure 224: Container volumes at JNPT have outgrown MbPT traffic

JNPT handles close to 5Mn TEUs annually and plans to take its capacity to ~11 Mn TEUs by 2023, thereby emerging as the port of preference for container cargo. It provides dedicated capacity and facilities specifically for containers, making customers stickier and more averse to switch to a new port.

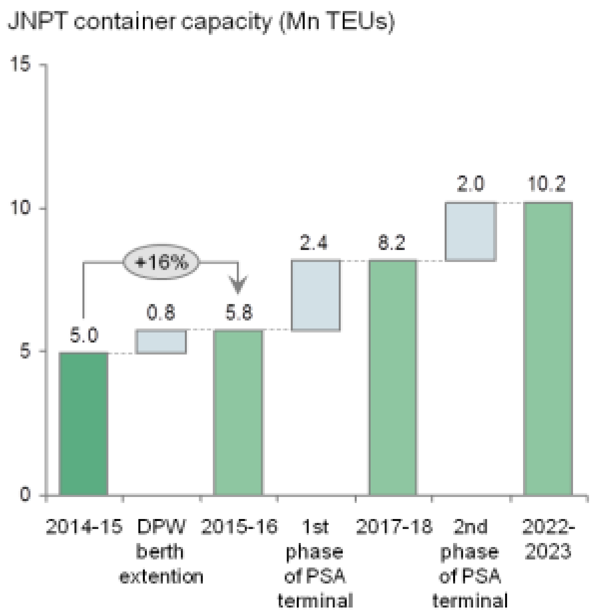


Figure 225: Additional capacity coming online at JNPT

2. Customer willingness: During the deep-dive interviews, leading liners and vessel agents cited JNPT as their preferred port, and indicated that they foresee many issues with container handling at MbPT. Hence, they are unwilling to shift completely to Mumbai for containers.

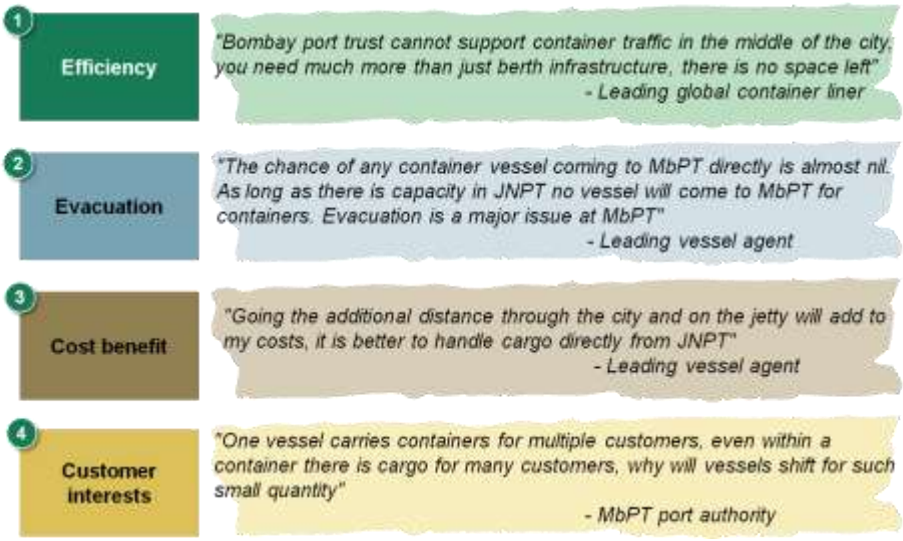


Figure 226: Liners and agents are unwilling to shift entire container vessels to MbPT for four major reasons

3. Evacuation challenges at Mumbai port: Mumbai port is situated in the southern-most part of the city, making evacuation to the rest of the city quite challenging. The main road used for evacuation, which is the BPT road, is already running at full capacity. The road is currently used to evacuate **9.7 MMT** of landed cargo, making it congested enough. The main gate used for evacuation—orange gate—has limited space outside and it will be a challenge to accommodate more traffic to evacuate containers. Most of the road outside the port gates is taken up by pillars supporting the freeway, and also houses dense population on either side of the road.

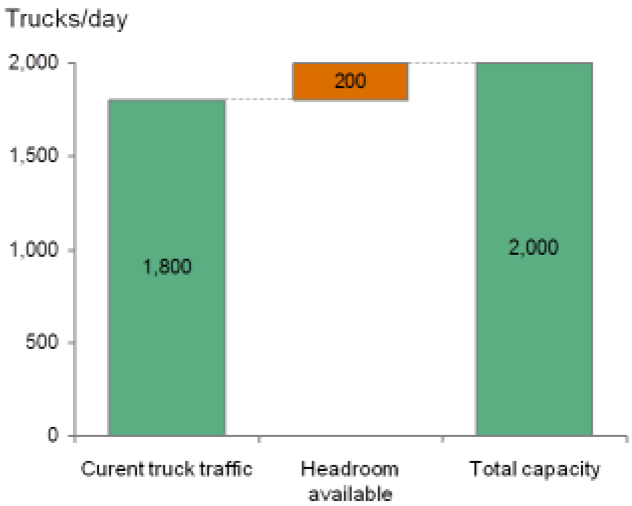


Figure 227: BPT road already running at capacity

Access to the freeway will also not add more capacity. The two-lane design of the freeway will make it difficult to accommodate city traffic with container cargo. Any event of a truck breaking down on the freeway will cause the entire way to be blocked further, adding to the city's traffic woes. Even if port traffic is allowed through the freeway, operational hours will be limited, which will lead to even longer queues outside the port gates.

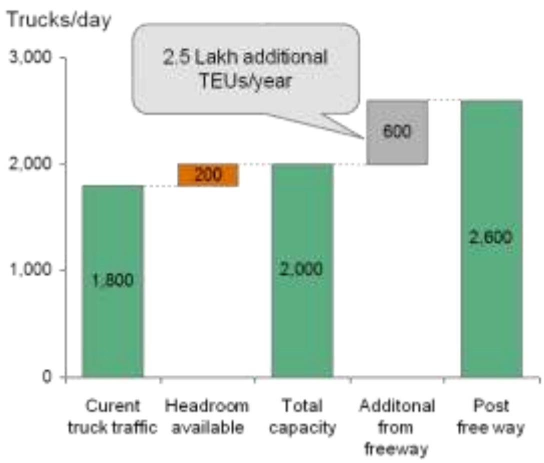


Figure 228: Not much capacity addition even after freeway access

Evacuation through rail: MbPT plans to add more rail lines for cargo evacuation. 3 more lines are planned with a dedicated goods line between Wadala and Kurla. However, since most of the cargo is evacuated through roads, agglomeration of cargo will still be an issue.

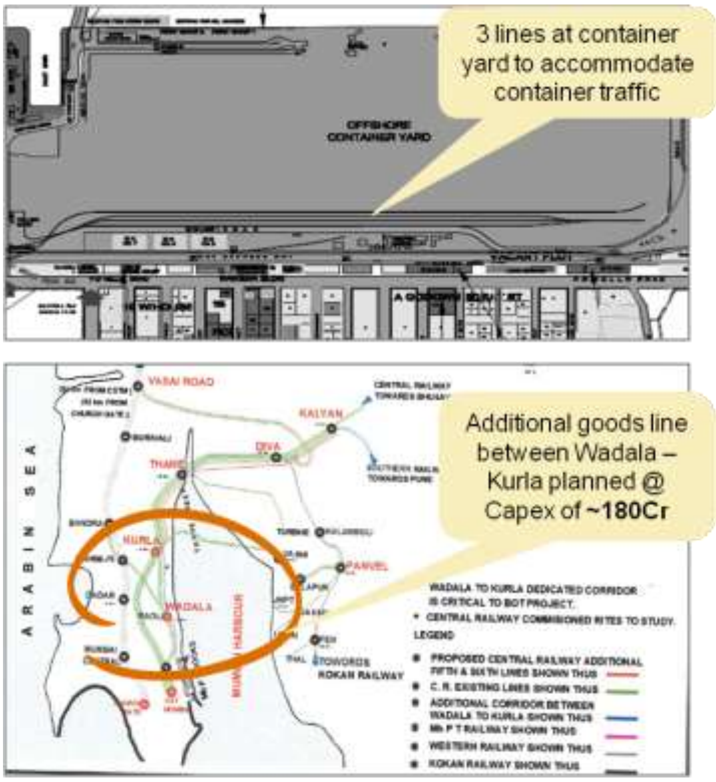


Figure 229: Additional rail lines planned at MbPT

The three additional lines will provide capacity for **5 rakes per day**, which translates to **1.5 lakh TEUs per year**. Given the current modal split and the low volumes expected for containers, agglomerating sufficient cargo to enable regular scheduling will be a challenge. There will not be enough demand to ensure regular rake scheduling and timely container evacuation.

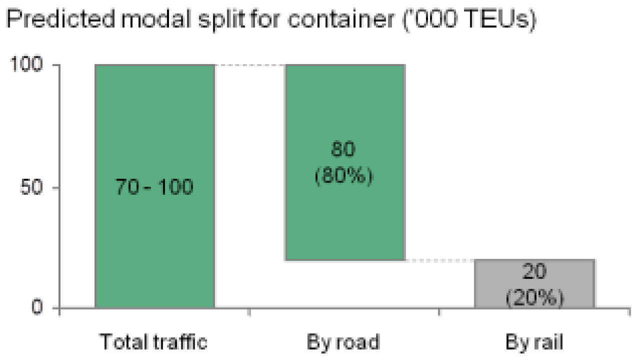


Figure 230: Current modal split at MbPT

4. Cargo profile: Most warehouses within the Mumbai area are located closer to JNPT. More warehouses are shifting out of the city to newer, less dense areas. Even at JNPT, only **1-2%** container cargo is destined for Mumbai city. This means that with the current customer profile and shifting locations, it will be difficult to serve customers from MbPT. This will render MbPT less competitive than JNPT for container cargo.

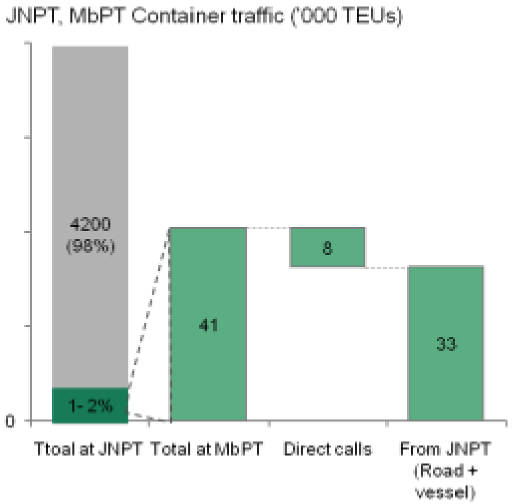


Figure 219: Only ~1-2% of JNPT cargo is destined for Mumbai city

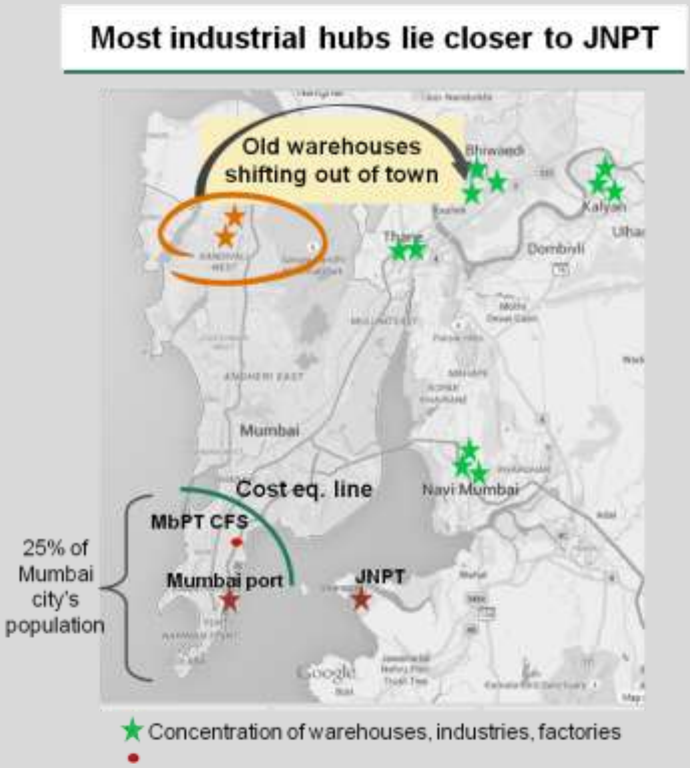


Figure 231: Proximity of industrial hubs to JNPT

Given these factors, the maximum estimated container volume that MbPT will be able to attract is about **0.07–0.10 Mn TEUs.** OCT is designed to have a combined capacity of **1.2 Mn TEU annually.** At this rate, the terminal will remain highly underutilized at about **7–8 % only.**

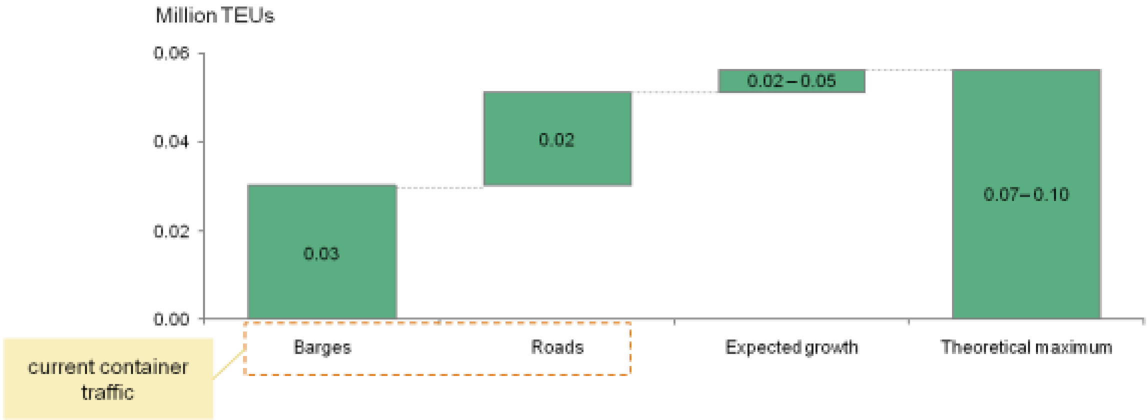


Figure 232: Estimated container volumes at MbPT

MbPT has planned further investment on the OCT as per the contract with Gammon, however, at the estimated container volumes, it will be difficult to recover the investment even in the next five years. Traffic of at least **0.5–06 Mn TEUs** per annum will be required to make up for these investments, which seem highly unlikely at the moment. Therefore, MbPT should consider alternative use for the terminal. With a little investment, it will be possible to use OCT to handle other commodities as well.

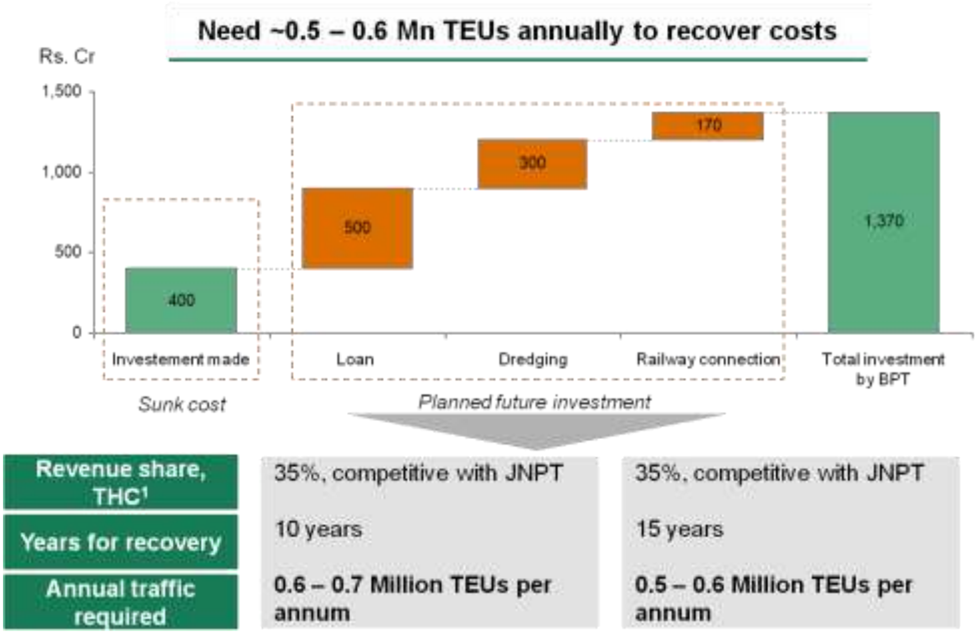


Figure 233: Further investment will be difficult to recover in the next five years even if OCT is operational at its theoretical maximum

1.2.3 Automotive: Retaining cargo

1.2.3.1 Initiative: MbPT 3.1 & 3.2 Provide better customer service to OEMs and reduce vehicle damage

Initiative Overview

Vehicle volume at Mumbai port has increased by 80% over the last 3 years due to a significant increase in exports. 83% of the vehicles exported are from the Maharashtra belt, which currently are operating as captive customers. 17% of the remaining export is from Haryana (Maruti Suzuki), which is largely because of the vessel sharing agreements that the company has with other OEMs.

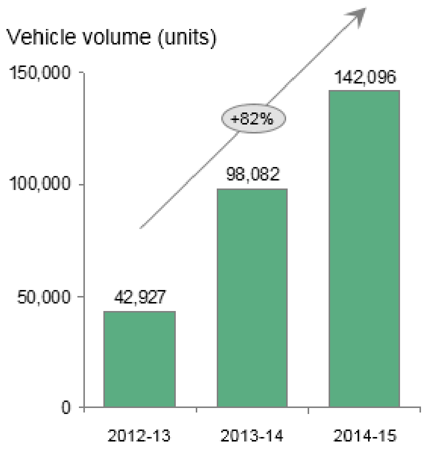


Figure 220: Increase in vehicle cargo at MbPT

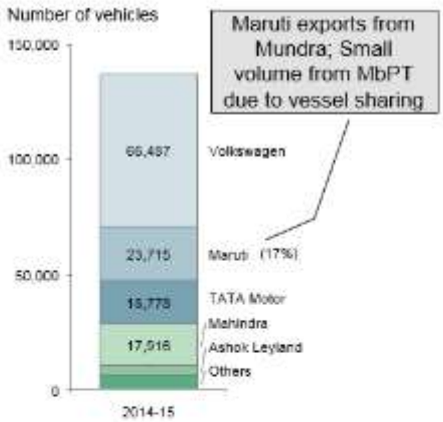


Figure 235221: Distribution of vehicle cargo

Currently, around 1,50,000 vehicles are handled at MbPT, out of which 99% are exported to different countries. The projected volume from Mumbai is expected to increase to 225,000–250,000 in the next 4-5 years.

Key Findings

Mumbai port faces significant competition from nearby ports, Dighi and Dahanu, in the future because of the following reasons:

	1 Land logistics & access to port	2 Storage at Port	3 Cargo loading on vessel
Dighi / Dahanu's advantage over MbPT	✓	✗	✓
Reason	**Cheaper & faster for OEMs to take cargo to competing ports**	**Dighi / Dahanu would need to recover yard investments**	**High cargo damage rate and limitations on large vessels**
Details	**OEMs face congestion to approach MbPT port** • No congestion issues at competing ports **Competing ports equidistant to industrial belts** • Dighi – Pune • Dahanu – Aurangabad • Mundra – Haryana	**Mumbai has allocated 37,000 sq m, has additional space to accommodate additional volume** **Dighi / Dahanu have no infrastructure currently** • In order to recover investment, ports would need to charge higher from OEMs	**High damage rate at MbpT** • ~3% damage to cargo vs ~1% at Mundra **Limitations on large vessels** • MbPT (11m), Dighi (12.5m), Dahanu (20m) and Mundra (18m)

Figure 236222: Reasons why MbPT faces competition

1. Automotive industrial belts have equal distance from competing ports:

   - The distance of Aurangabad industrial belt from Mumbai port (356 KM) is similar to the distance from Dahanu port (365 KM)
   - The distance between Pune auto belt from Mumbai port (165 KM) is similar to the distance from Dighi port (166 KM)

   While the logistic costs may not differ that much, Dighi and Dahanu ports have no congestion issues, unlike Mumbai port, which acts as a natural advantage over MbPT.

2. Storage at Mumbai port is currently a major area of concern for most of the OEMs. The yard area is not allocated specifically to OEMs, which increases the turnaround time of trailers.

•

3. An area of concern for Mumbai port is the significant percentage of vehicle damage. On an average, the vehicle damage (cargo damage) at other RO-RO ports is around 1%, which stands at 3% at Mumbai port.

   Some of the customers were dissatisfied with the level of service provided at Mumbai port:

   - *"Almost 3% of the vehicles get damaged at MbPT whereas at Mundra, the same is just 1%" – Maruti Suzuki*
   - *"There is 2.6% damage to vehicles, mostly dent, bumper damage, etc. We spent close to Rs. 20 L last year in repairs" – Volkswagen*
   - *"Proper maintenance of cars, covered and dedicated area can really help in reducing damage to the vehicles"– Volkswagen*

   90% of the damage pertains to denting, bumper breakage and underbody damages.

   In addition to the vehicle damage, Dighi and Dahanu have higher draft of 12.5 m and 20 m respectively, which makes it economical for vessel operators to manage cargo. Draft at Mumbai port is around 9 m, if OCT is not utilized.

Mumbai port recently opened OCT for RO-RO operations, which offers a higher draft of 12-14 m, however, because of the proposed increase in cargo handling charges by 30%, most of the customers have decided not to avail the facilities.

Recommendations

<u>Provide dedicated yard space to OEMs</u>

Option 1: Create a multi-layer vehicle parking for vehicle storage

Creation of a multi-layer vehicle parking would require an investment of Rs. 60-70 Cr. Mumbai port discussed the possibility of partnering with OEMs for joint investment in infrastructure, however, OEMs haven't shown any interest in the proposal.

Considering that there is no certainty of vehicle volume at Mumbai port due to competing ports, Mumbai port may not look at investing money in infrastructure creation.

Option 2: Create dedicated space for OEMs

An analysis of the space available at the port highlights additional land area that can be allocated for vehicle storage.

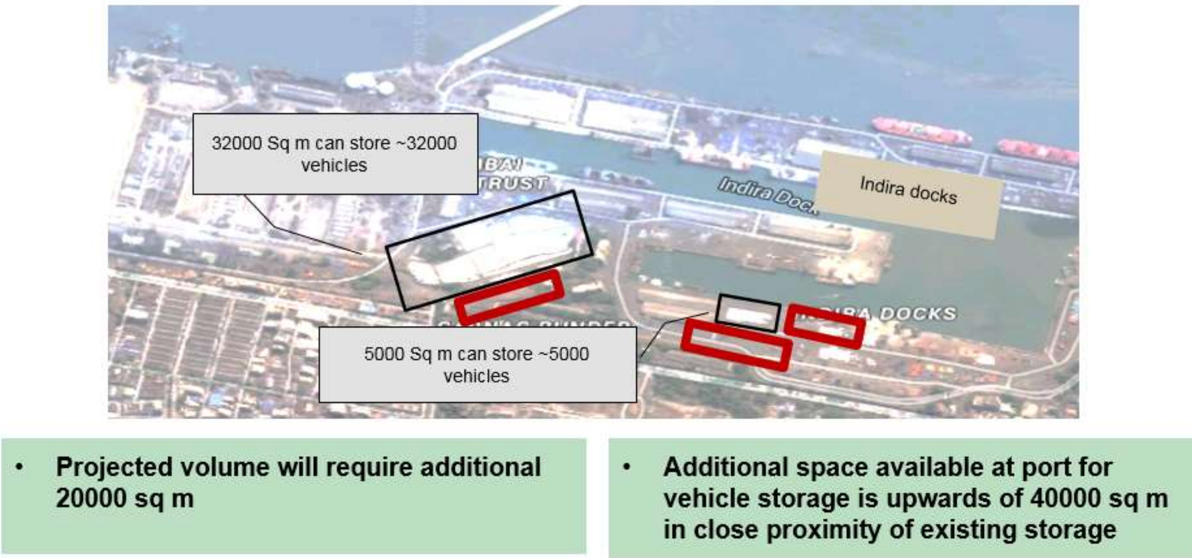


Figure 223: Additional space for vehicle storage (highlighted in red color)

Impact: Availability of additional vehicle storage space will eliminate the need for multi-layer vehicle parking. This would ensure capex avoidance of Rs. 60-70 Cr.

<u>Provide better customer service</u>

There are multiple levers that Mumbai port can look at to offer better customer service to OEMs:

1. Allocate dedicated team for cargo handling in storage area:
    - Create a core team of employees
    - Provide training in efficient car handling
    - Conduct periodic checks on vehicle handling

•

2. Clear pathway of stones/gravel
    - In 30% cases, the damage is to the underbody due to gravel/stones in the pathway to cargo loading
    - Conduct periodic cleaning of pathway for reduction in vehicle damage
    -
3. Focus on reducing the vehicle damage to below 1% overall

<u>Offer competitive pricing</u>

Considering that the port will face significant competition from other ports in Maharashtra—Dighi and Dahanu in the future—it is critical for Mumbai Port to be competitive in pricing. Going forward, Mumbai port should look at pegging cargo handling rates equal to or lower than Dighi and Dahanu.

Since Dighi and Dahanu would be creating infrastructure for vehicle storage, the ports would need to recover their investments. Mumbai port can be aggressive in pricing since no additional investment will be made.

Expected Impact

MbPT will earn Rs. 60–65 Cr based on projected cargo volumes.

1.2.4 Steel

Despite a minor dip last year, steel volumes at MbPT have picked up. The total volume of steel handled last year was around **4.7MMT**, which was at a **CAGR** of **13%** over the last three years. Steel volumes at MbPT are mostly made by imports.

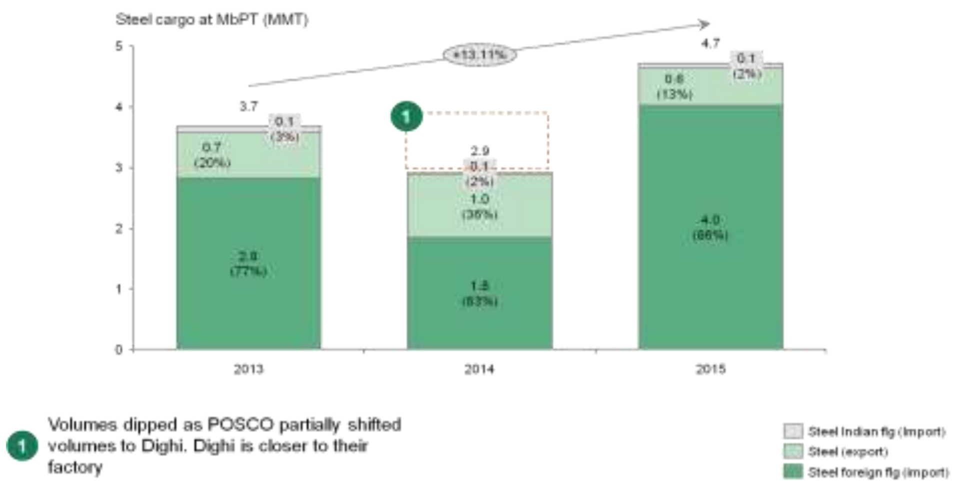


Figure 238: Steel Volumes at MbPT

Given the immense signs of growth in the manufacturing and construction sectors, these volumes are only expected to grow in the near future. BCG's proprietary demand and consumption estimation model suggests that construction and manufacturing sectors will remain the two major consumers of steel. Given the upcoming demand and the sectoral GDP growth coefficients for the state, Maharashtra's steel consumption in the construction and manufacturing sector alone is likely to reach **24.4 MMT**.

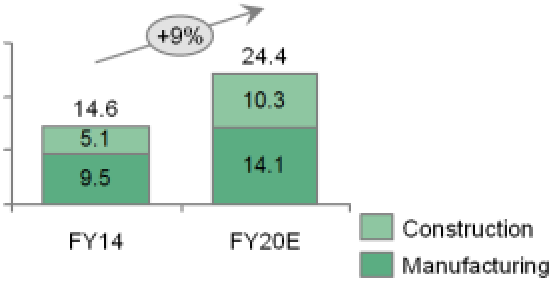


Figure 239: Maharashtra's estimated steel consumption by 2020

MbPT, therefore, will only continue to serve as a major port for handling imported steel cargo. Most volumes will be imported to cater to the state's demand. This will include both international import and inward movement through coastal movement. Using the BCG demand estimation model, which combines state demand and commodity correlation equations, the steel volumes at MbPT are expected to reach **~8 MMT** by the year 2020, **~80%** of which will still be made by imported volumes.

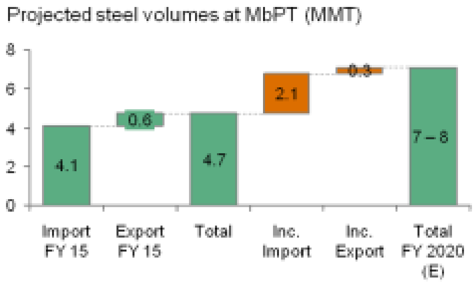


Figure 240: Predicted Steel Volumes at MbPT

Currently, steel at MbPT is handled at outer berths with most of the cargo being handled at BPS and BPX berths (**~70%** of the total volume). There is limited steel handling at the outer Indira docks mainly due to low draught, and outdated and low capacity cranes. As a result, BPS and BPX are highly congested. The outer berths are operating at high levels of occupancy; the port will need additional capacity to decongest current berths. Given the expected additional steel volumes, the port needs to add additional, or release existing, capacity to continue handling steel cargo.

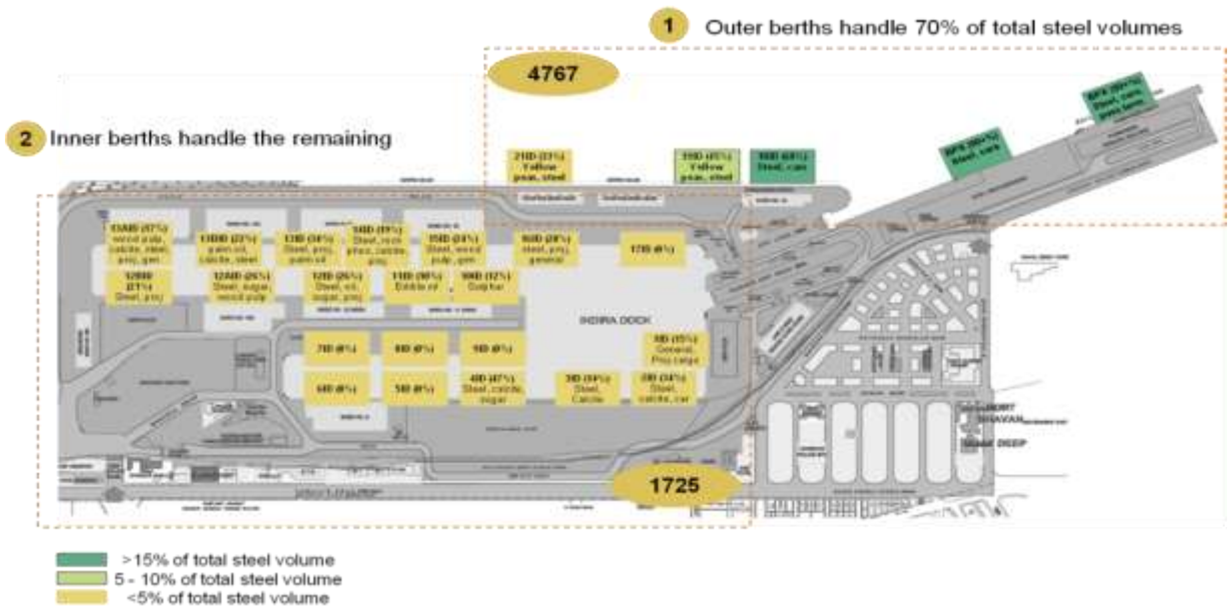


Figure 241: Steel handling distribution at MbPT

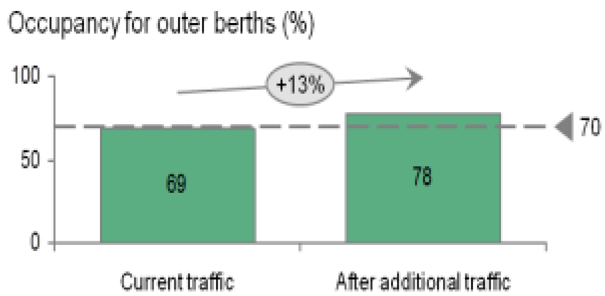


Figure 22442: Current occupancy for outer berths

Due to lower capacity shore cranes, the port mostly depends on ship cranes for unloading steel cargo. Outdated and underutilized equipment also limit MbPT's productivity for steel. Most of the cranes present at the port have been decommissioned and the ones that are present are of extremely low capacity (10 and 16 MT) when the steel coils themselves weigh anywhere between 15–30 MT.

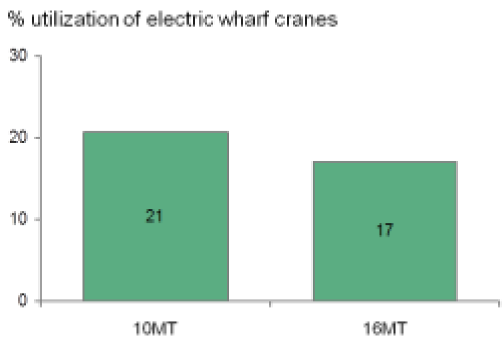


Figure 22543: Equipment utilization of wharf cranes

1.2.4.1 Initiative: MbPT 4.1 Installation of higher capacity shore crane will help increase productivity by ~20%

Initiative Overview

Current steel productivity can be increased by installing multipurpose gantry cranes on the berth. Currently, steel cargo at the berth is being handled by ship cranes that limit berth productivity owing to their design and limited capacity. Usage of berth cranes will instantly increase productivity by at least **20%**.

Figure 226: Increase in productivity for steel cargo by use of berth

Key Findings

BPS already has sufficient load bearing capacity strength to handle a 35.5 MT crane, and also has the rail track to support a rail mounted crane. The only capital expenditure required is in terms of purchasing and installation of the crane. MbPT can evaluate the opportunity of handling steel using a multipurpose crane at BPS on a PPP mode. The port can fix a revenue share to be charged from the private operator for operations through this mode. The details about the exact terms of the arrangement can be worked out on further deep diving into the proposed investments. There also exists a potential to increase berth hire charges for the use of new cranes. Additional charges can be over and above the existing berth hire charges for a quicker discharge.

Additional capacity of **~0.4 MMT** (~10% increase) can be released at BPS without building additional capacity. Even with the current steel cargo handling charges, additional revenue of **Rs. 4Cr** can be earned annually. Considering the upfront investment required to purchase a crane to be around 15 – 20 Cr and its annual maintenance expense to be around 1.5 – 2 Cr, and an increased berth hire charge, the payback period of the new higher capacity cranes would be between 5 – 6 years. Post which the crane would have paid for itself and the port and the PPP player can start making money on it.

Recommendation

BCG recommends adding crane to BPS due to ~30% higher productivity and quicker implementation. However the decision should be contingent on the port master plan expansion of OCT and if BPS continues to operated upto ~FY21 then this has sufficient payback to warrant the intermediate solution

However if this interrupts with port master plan to convert Indira dock into a marina/expansion of OCT within payback period, final decision can lie with Mumbai Port Trust.

Berth No	Productivity	Remarks
BPS - Indira Dock	●	Berth and required crane capacity known, thus crane can be added in ~6 months.
OCT	◐	Berth and crane capacity unknown, thus adding crane can take ~1-2 years

Figure 245: Berth for handling steel cargo

1.2.4.2 Initiative: MbPT 4.2 Use of second OCT berth for steel handling

Initiative Overview

The Offshore Container Terminal (OCT) berth is built to have two berths in phase 1. The OCT was planned to handle container volumes, however, after careful evaluation of the prospects for OCT, not much container traffic can be expected at the terminal. Therefore, MbPT should consider handling alternate commodities at OCT. One of these berths can be used to handle additional steel cargo. However, since the terminal was originally built to handle containers, it is only designed to handle spread load. It may not be possible to handle steel coils, which are commodities with point load on the berth.

With minor changes on the berth and steel handling, it is still possible to use OCT as a steel berth.

1. **Use of ship/wharf crane to load steel directly on to the trailer**

The spread of the trailer will help convert the coil's point load to spread load right from the time the coil is unloaded. There will be no requirement to unload the coils on to the berth. However, this method may not yield highest levels of productivity as more time will be required per coil for alignment and placement on the trailer using the crane.

Figure 22746: Loading steel coils directly on to a trailer

2. **Use of steel plates fixed on berths to serve as coil "pads"**

Another way of safely handling steel coils on a berth designed for spread load is the use of "steel plates" or "steel pads". The use of these plates distributes coil load evenly on to the berth. Productivity also remains unaffected. With the use of cranes of sufficient capacity, even twin lifting is possible. However, technical feasibility analysis will have to identify and clearly specify the maximum number of coils that can be safely placed on the berth without compromising safety norms.

Figure 228: Use of steel plates/pads to unload steel coils at berths

This will unlock an additional capacity of close to **2 MMT** for steel alone at MbPT, which at the current cargo handling rates translates to direct revenue of **Rs. 16 Cr** annually for the port. Though BPS would still be the preferred berth for steel handling as steel handling at OCT would be at much lower productivity, this would directly mean additional revenue for the port and an optimal use of the OCT berth.

1.2.5 Consolidation plan for MbPT

Going forward, Mumbai port may consider creating a consolidation plan for the port. Occupancy levels at Indira docks are fairly low, and most of the berths are under-utilized.

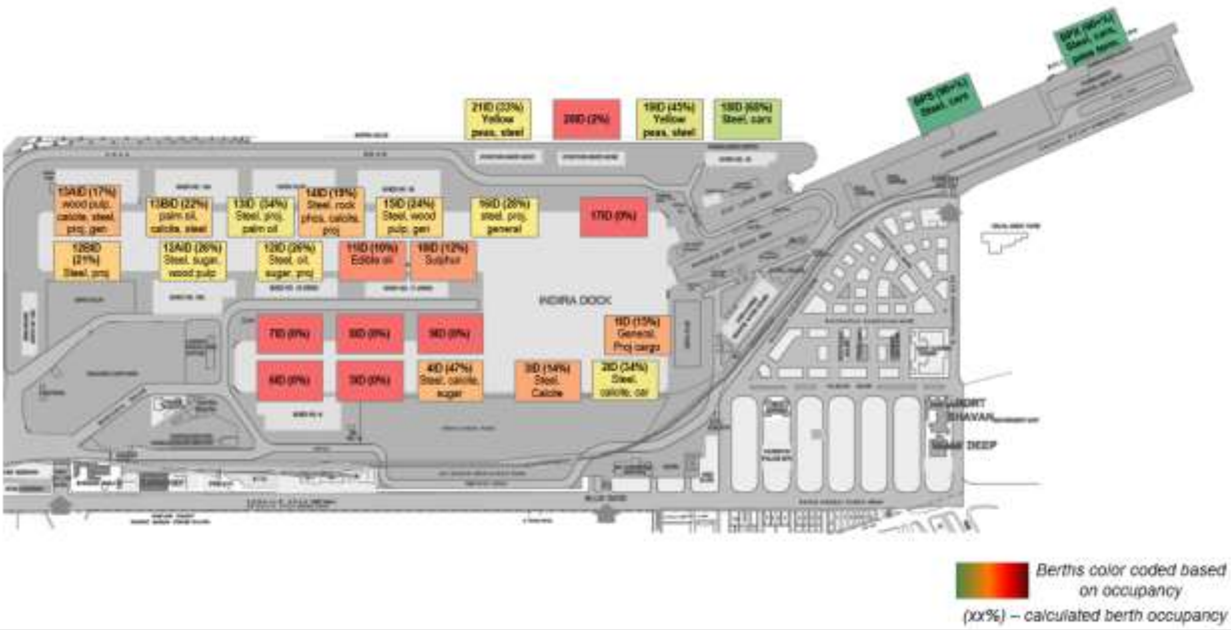


Figure 229: Occupancy levels across berths at Indira dock

Inside the Indira dock, occupancy of a few berths inside the Indira dock is zero: 5ID, 6ID, 7ID, 8ID, 9ID, 17ID and 20ID. In addition to this, the natural draft inside Indira dock is as low as 5-6 m, however due to lock gate, the draft can be increased to 7-8 m.

Projected volume of cargo at Mumbai port can vary depending upon the increased volume of steel, cement, containers and other cargo.

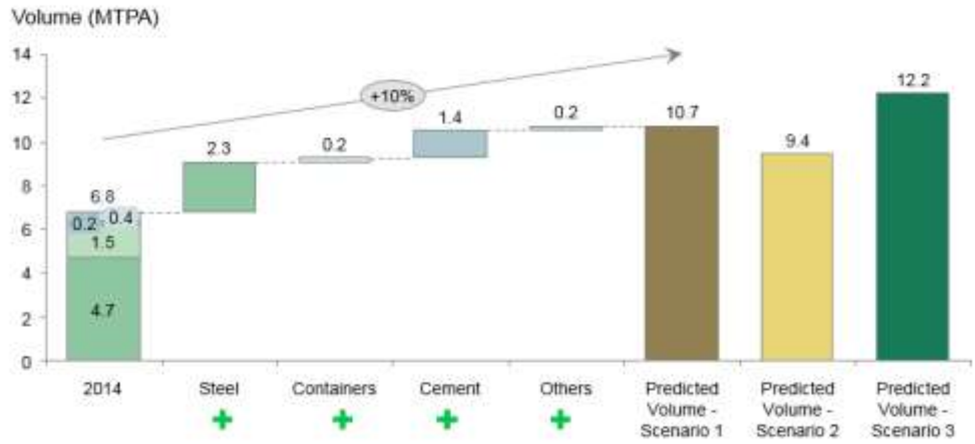


Figure 230: Multiple scenarios projecting cargo volumes on Mumbai port

Significant increase in projected cargo is not expected at Mumbai port because of the following reasons

- Evacuation challenges
- Limited draft
- Limited berth strength, leading to challenges in berth mechanization

Considering this, Mumbai port should look at utilizing OCT berths for usage of other cargo such as steel, RORO etc.

MbPT should take up berth utilization and consolidation plan as part of port master planning under Sagarmala.

1.2.6 Road evacuation

Most landed cargo is still being evacuated by roads at Mumbai port. Most of the cargo evacuated through road is break bulk and bulk cargo.

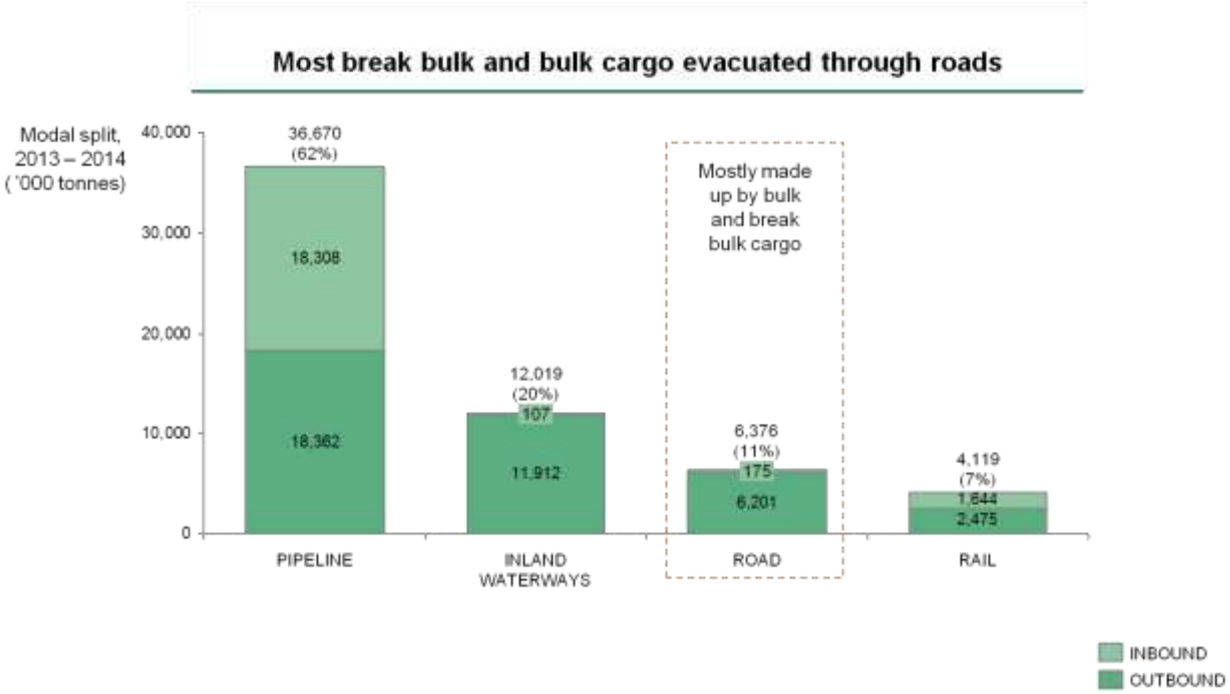


Figure 23150: 6 MMT of cargo being evacuated through roads

At the gates there are four operational lanes across three gates.

1. NOGPD – New Orange Gate Princess Dock (A)

- New orange gate princess dock
- **Lane 1** for exit
- **Lane 2**
  - Entry till 11 AM
  - Exit post 11 AM

2. OGPD – Orange Gate princess dock (B)

- Orange gate princess dock
- **Lane 3** for entry
- **Lane 4** not operational due to construction of railway line

3. YGPD – Yellow gate Princess dock (C)

- Yellow gate princess dock
- **Lane 5** for entry

Figure 251: Operational lanes at gates of Mumbai port

The evacuation operations were analyzed in two parts: **inside** and **outside port:**

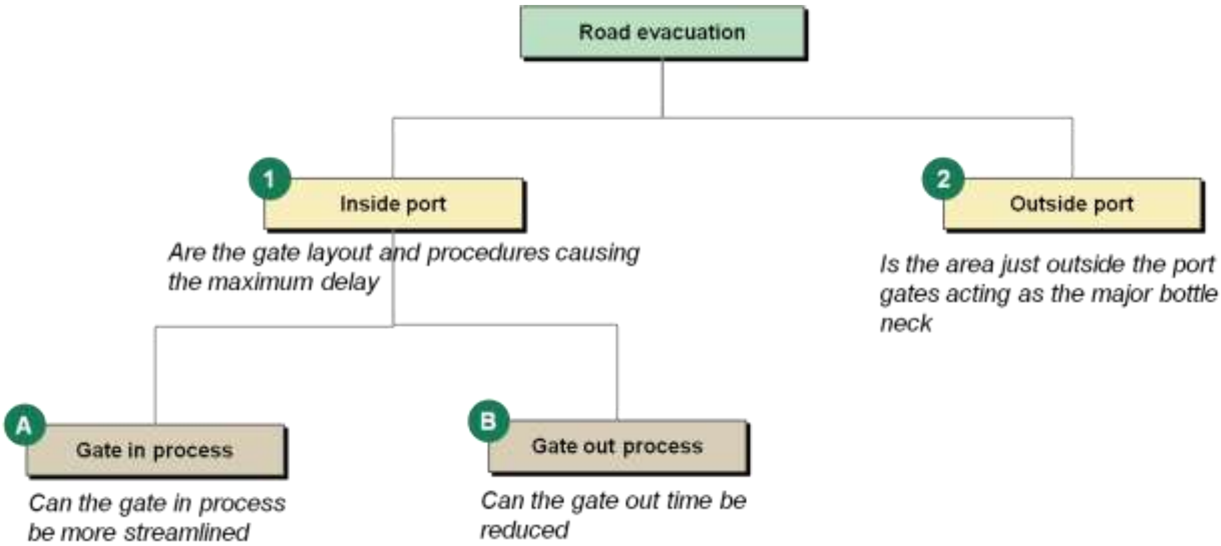


Figure 252: Evaluation buckets for analysis

1A. Gate in operations: Most data during the gate in operations is captured manually. There is also a lot of duplication of data entry during the same process. The MbPT and CISf authorities capture similar information at different steps making the entire process cumbersome and longer.

A VDS (vehicle duty slip) is issued before the vehicle enters the port premises. On entry both MbPT and CISF authorities check for the VDS and the validity of the DEP (dock entry permit). The CISF guards also make a manual data entry at their end. However, the information that is captured in this data entry has already been captured as in the VDS data fields. While issuing the VDS , MbPT also makes and entry in to a locally maintained database which is accessible later on at the fine payment counter. Therefore there exists a possibility to eliminate this extra step and cut down on a few minutes per truck by ensuring single data entry. Also if CISF and MbPT have clearly defined and mutually exclusive role mandates it would eliminate duplication of work.

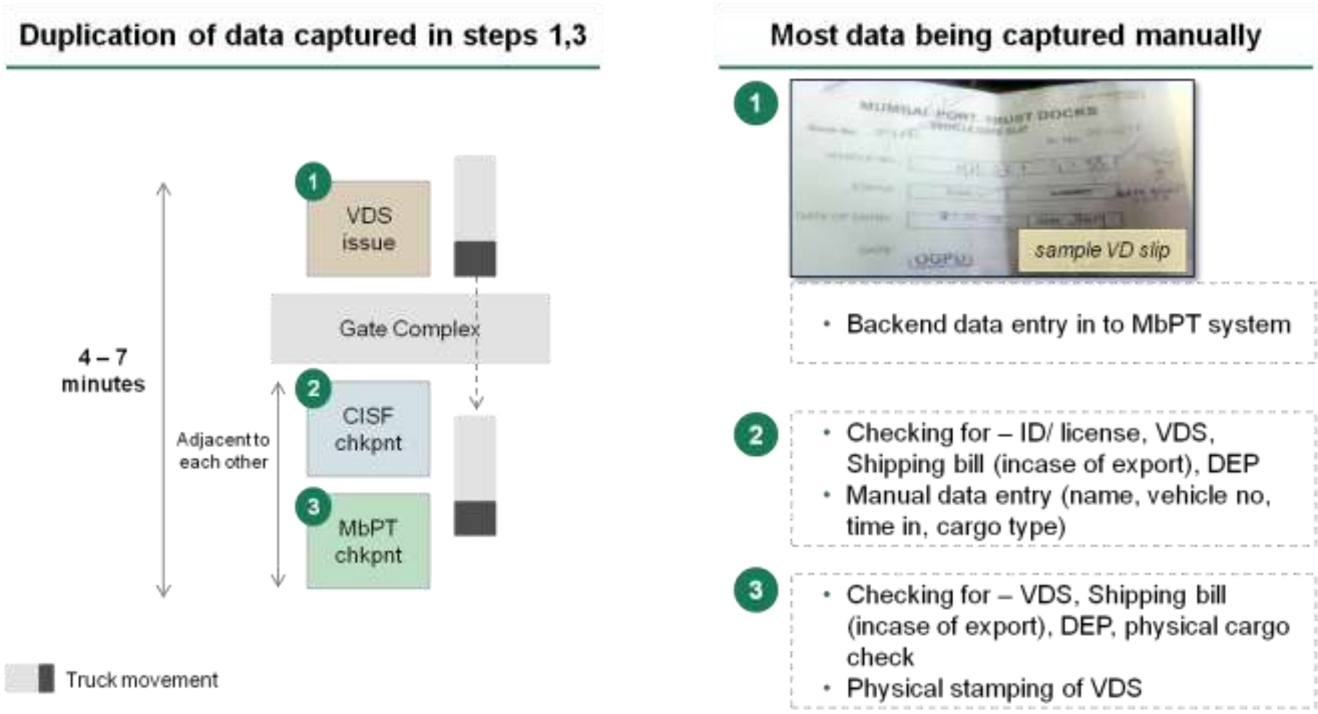


Figure 253: Gate in operations at MbPT

1A. Gate out operations: Trucks which have stayed at the port for >24hours need to pay a fine. For this they go to a fine payment counter which is situated ahead of the CISF and MbPT counters. The trucks usually park their vehicles and then proceed for the gate out formalities. The parking of vehicles along the road also causes long queues at the out gate. During this process the CISF also make a data entry into a locally maintained database. The trucks lose significant amount of time throughout this process. Here again, most data that is checked by both authorities is usually the same, a common system and alignment on role mandate will eliminate duplication and will save a few minutes per truck.

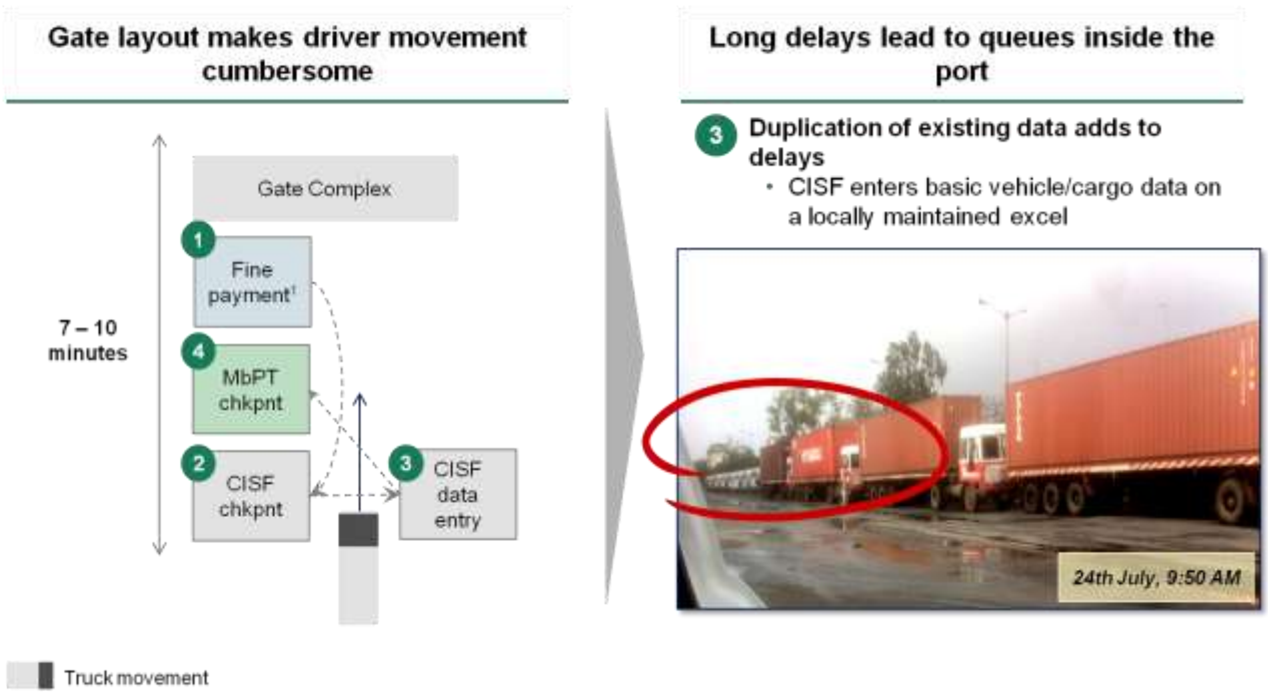


Figure 254: Gate out operations at MbPT

1. Initiatives to ease out gate evacuation

Four levers have been identified to improve gate performance:

1. Role mandate: Create role mandates – Clear role definition for CISF and MbPT to avoid duplication of work by having mutually exclusive roles.

2. Physical layout revamp: Some of the counters need to realigned or repositioned to ease out port congestion.

- **Gate in** – Push MbPT checkpoint further inside the port premise to allow parallel processing of >1 trucks at a time
- **Gate out** – Move the fine payment counter inside to lie first in sequence for trucks
- **Gate out** – move the MbPT counter inside to allow space for parallel processing
- **Gate alignment** – widen and realign YGPD to allow convenient maneuvering of trailers within the port

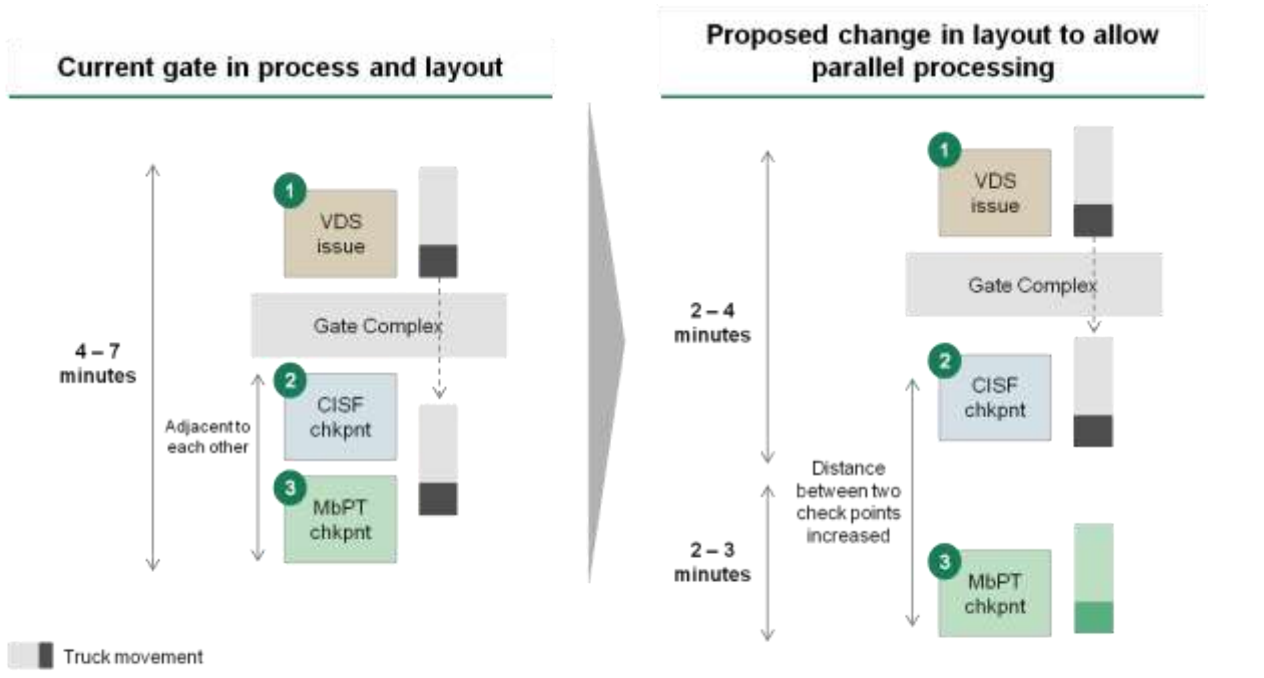


Figure 255: Moving MbPT checkpoint further inside the port premise will save up to 2 minutes per truck

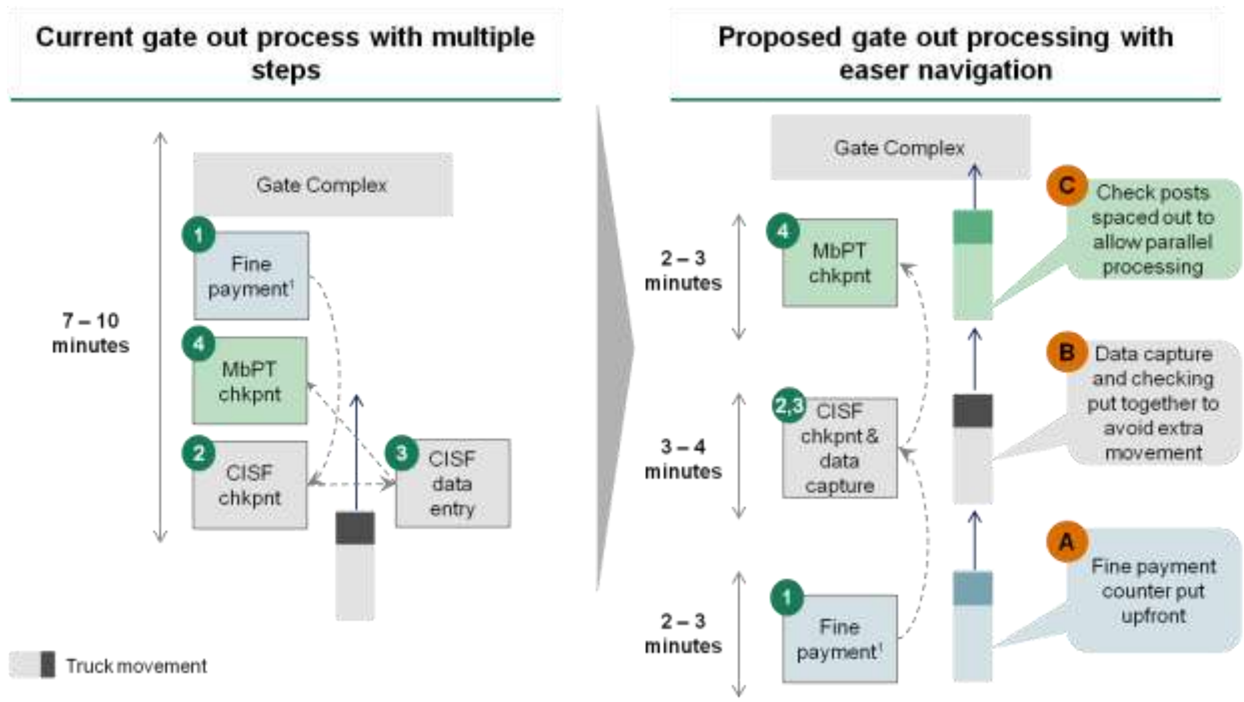


Figure 256: Realignment of check out counters to potentially save 3 – 4 minutes per truck

3. IT solutions: The port will need to invest in building IT capabilities to speed up data entry procedures.

- Install common database accessible by both CISF and MbPT

- Design database to allow data entry only once during entry, additional information to be added by users who access

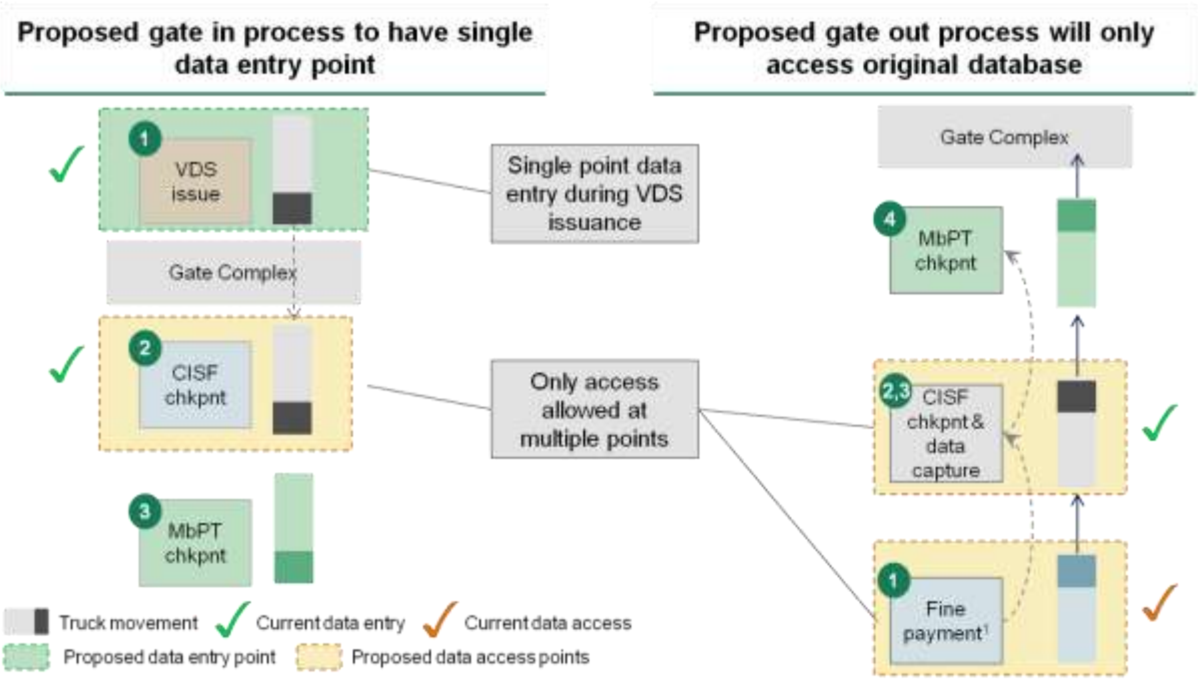


Figure 257: Common IT system will reduce delays caused at each data entry point

4. Appointment system: The port bound traffic could be split between the orange and the yellow gates. For this a check post needs to be built at the Y junction which splits traffic between the two gates and appoints routes to trucks.

- Split port bound cargo between BPT road and Mujahir pakadi road
  - TTs will reach in OGPD and YGPD in equal numbers
  - Equal splitting will ease out the traffic outside port and decongest operations
- YGPD reconstruction
  - YGPD should be realigned and widened
  - To provide sufficient turning radius for longer trailers

Figure 258: Potential to decongest by splitting traffic between OGPD and YGPD

Outside port: On ground observations show that the road just outside the port remains blocked even at non peak hours due to the freeway exit ramp right outside the port gates. Because of which the Port bound traffic is stopped every 3 – 5 minutes to allow public vehicle movement. A solution for this would be to

Block freeway exit for vehicles

- Public to use the next exit which is ~ 200 mts ahead
- This will free up gate area for free cargo movement

Figure 259: Blocking freeway exit outside port will clear out area outside port gates

Implementation of this solution will require liasoning with the Mumbai traffic department. The ramp outside port gates was initially meant for port traffic only however now the city traffic is allowed there. In order to allow city traffic, port bound traffic is made to stop every3 – 5 minutes which adds to the traffic woes outside the port gates.

Initiative summary

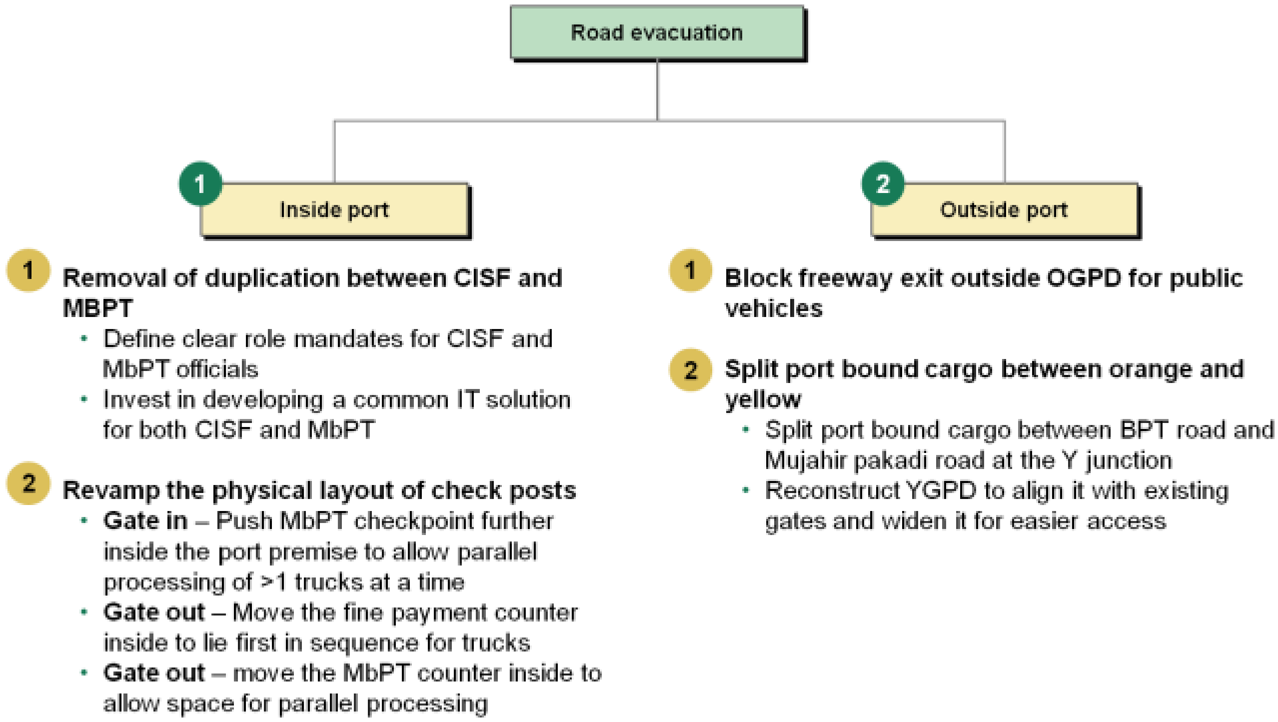


Figure 260: Summary for overall initiatives to ease out road evacuation from MbPT

Successful implementation of some of these initiatives will require working with external stakeholders like the CISF and the Mumbai traffic department. With complete buy in from all parties involved can the implementation be carried out.