BENCHMARKING AND TRANSFORMATION OF MAJOR PORTS IN INDIA

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Submitted

IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY

TO

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

DEHRADUN

May, 2018

UNDER GUIDANCE OF

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भारत के प्रमुख बंदरगाहों में बेंच मार्किंग तथा परिवर्तन

द्वारा

ए जनार्धना राव

डॉक्टरऑफ फिलॉसफी की डिग्री कीआवश्यकता कीआंशिक पूर्ति के लिए

(पेट्रोलियम और ऊर्जा शिक्षा विश्वविद्यालय)
May 2018

के मार्गदर्शन में

गाइड
डॉ टी बंगार राजू
प्रोफ़ेसर और प्रमुख
परिवहन प्रबंध विभाग
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ऊर्जा शिक्षा विश्वविद्यालय
देहरादून

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Acknowledgements

I would like to state that I worked upon this thesis solely based on my utmost fascination to the Port Sector and my inner urge to contribute substantially towards indelible progress of the Major Ports. This thesis has been kept on track and seen through to completion with the support and encouragement of numerous people including my family, well-wishers and various institutions. I would like to thank all those people who made this thesis possible. It is a pleasant task to express my thanks to all those who contributed in many ways to the success of this study and made it an unforgettable experience for me.

At this moment of accomplishment, first of all I pay special honor to my guide, Dr. T. Bangar Raju- HOD & Professor, Department of Transportation, UPES and Co-Guide Dr. Hiranmoy Roy – Associate Professor, Department of Economics & IB UPES. This work would not have been possible without their guidance, support and encouragement. Under their guidance I successfully overcame many difficulties and learned a lot. I am very much thankful to them for considering me as their Research Scholar.

I would like to express my sincere gratitude to University of Petroleum & Energy Studies (UPES) for allowing me to undertake this research. I am very grateful to Chancellor, UPES & Vice-Chancellor, UPES for the motivation that they have given during this journey of research.

My utmost respects go to Dr. L.R. Thapar for his constant support in shaping the research output. My sincere regards to the members of SoB-UPES for their constant assistance and help that they have extended to me.

My sincere thanks to the members of FRC, UPES for their constant and invaluable suggestions that have helped in enhancing the quality of this research work. My sincere thanks to the officials of Indian Ports Association (IPA), all Major Ports, Indian Ship Owners Association (INSA) and various stakeholders in the port sector for providing much required inputs and support that helped in carving this research work.

A special thanks to my family. Words cannot express how grateful I am to my family for continuously motivating and encouraging me to continue this journey.

I would also like to acknowledge the immense contribution of my friends who supported me in writing, and induced me to strive towards my goal. Last but not least, I would like to express appreciation to my beloved wife who was always in my support during the inevitable ups and downs of conducting my research, this helped me a lot to work for hours together tirelessly.

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

17-5-2018
A JANARDHANA RAO

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Thesis Completion Certificate

This is to certify that thesis on "Benchmarking and Transformation of Major Ports in India" by Mr. A. Janardhana Rao in partial completion of requirements for the award of the Degree of Doctor of Philosophy is an original work carried out by him under my supervision.

It is certified that the work has not been submitted anywhere else for the award of any diploma or degree of this or any other University.

13/5/18

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13/05/18

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EXECUTIVE SUMMARY

BENCHMARKING AND TRANSFORMATION OF MAJOR PORTS IN INDIA

Economic buoyancy coupled with progressive flow of foreign investments have fueled growth in Indian foreign trade during the last three decades. Easing of quantitative restrictions and tariff levels across product lines have resulted in growth of India's international business and trade. Consequently, both imports and exports have seen an upward trend resulting in a spurt in demand for shipping of cargo across many nations across the world. Recognising the need for existence of robust ports that act as key nodes in the supply chain cycle, government of India has allowed private participation including 100% FDI investments in port sector. Ports in India, due to strategic reasons, were under the control of both Federal and State governments in India. However, due to numerous reasons, performance standards of these ports stagnated at low over a period of time and they could not match-up to the growing needs of India's foreign trade. Taking into cognizance of the prevailing conditions at the publicly owned ports, government of India allowed private investments at major ports of India that are aimed to make them competitive vis-à-vis the private ports. Investments through PPP mode at various processes of these ports are aimed at improving their operational efficiency and result in financial gains.

It is interesting to note that ports in India have improved in their cargo handling capacities with private ports taking a lead over their public counterparts. There has been a significant growth in the cargo handled by these ports with major ports handling 64.83 MT during the year 2016-17 and with CAGR of over 4% from 2007 to 2017. The non-major ports handled 48.52 MT during the year 2016-17 with a CAGR of over 10% from 2007-17. In spite of these growth trends, Indian ports have to go a long way to match their performance standards at par with the counterparts of the world. Efficiency trends displayed by some the world ports are resultant of meticulously designed performance standards. Benchmarking standards has resulted in competitive spirit among the ports and helped them to enhance their performance and efficiency. Lack to such benchmarks have resulted in lopsided performance among the major ports. Performance declared by the major ports merely show the actuals which, often times, cannot be compared to any benchmarks due to numerous factors like infrastructure facilities at the ports, type of cargo handled, clientele, etc. Considering the existence of a vacuum in efficiency comparison mechanism, this research has framed its business problem.

> **Although privatization has resulted in efficiency improvements at Major Ports of India, lack to efficiency benchmarks are hampering the measurement of their absolute efficiency.**

As an attempt to probe the implications of theory and practice of benchmarking, a search of existing literature is made with key words including ‘performance’, ‘efficiency’, ‘benchmarking’, and ‘performance standards’. The search resulted in gathering of research papers covering various sectors, apart from ports, including aviation, agriculture, banking, airlines, power, automobiles, shipping etc. from across 200 research articles covering 27 journals of international repute. The literature is segregated into broad themes of ‘performance and efficiency – general’, ‘performance and efficiency – ports’, ‘benchmarking – general’, ‘benchmarking – ports’. A review of literature highlights the fact that benchmarking is attempted in numerous sectors and is slowly gathering momentum in port sector at some selected parts of the world. However, most of these studies relied on publicly available data and used both parametric and non-parametric tools for benchmarking. The studies have also proved that benchmarking has resulted in significant improvement in efficiencies of these ports. However, gaps gathered from the literature review prove need for more studies on benchmarking using newer techniques that allow usage of data that can be gathered from personal interactions and observations that are generally not in public domain. Literature on Indian ports reveal a greater need and scope for benchmarking studies that can comprehend and suggest in proposing of benchmarking standard**s** for sustainable efficiency improvements.

These gaps have helped in devising the following research problem, research questions, and research objectives:

Research Problem

> Numerous studies have measured efficiency of Indian major ports. However, these studies could not prescribe any effective and implementable standards for improvement in efficiency parameters. This warrants a comprehensive research to set performance benchmarks in comparison to the best-in-class ports and thereby explore measures for improvement of overall efficiency resulting in optimisation of capacity and financial gains.

Research Questions:

- How to benchmark various Key Productivity Parameters in port operation for Major Ports of India?
- How port efficiency can be improved using benchmarks?

Research Objectives:

- To determine & calculate benchmarks for Key Productivity Parameters in port operation for Major Ports of India;
- To explore the initiative required to improve efficiencies at major ports of India and transform them into best- in- class ports.

To answer the first research question of determining 'important KPIs' and 'calculate benchmark', major ports were clustered on the basis of cargo being handled following which a comparison of selected performance indicators on basis of literature review in relation to some of the best ports is done and finally a survey method is used to identify reliable and pragmatic benchmarking standards. For the second research question, 'efficiency improvements at major ports of India', deep 'Root Cause Analysis' carried through Fish-Bone diagram analysis, "5 Whys analysis" are captured in deep-dive analysis chapter that form basis for suggestion of measures to improve efficiency standards at these ports.

Overall, this research encompasses a unique exercise of exploring solutions after deep dive analysis into the real productivity issues in Major Ports by taking into consideration the aspirations of stakeholders and it is what distinguishes from other research studies. These solutions are vividly described under various heads like Technology upgrade, Process optimization, Pricing & incentive alignment and Value creation in the last chapter.

ABBREVIATIONS

AHP	-	Analytic Hierarchy Process
BOT	-	Built Operate Transfer
CE	-	Chief Engineer
Chen.	-	Chennai
CHPT	-	Chennai Port Trust
CME	-	Chief Mechanical Engineer
Coch	-	Cochin
COL/CMB	-	Colombo
CoPT	-	Cochin Port Trust
DBGT	-	Dakshin Bharat Gateway Termial
DMU	-	Decision Making Units
DPR	-	Detail Project Report
DPW	-	DP world
EDP	-	Early Departure Procedure
EIR	-	Equipment Interchange Receipt
ELC	-	Electric Level Luffing Crane
EOI	-	Expression of Interest
GTI	-	Gateway terminal
HDC	-	Haldia Dock Complex
JEB/JAB	-	Jebal Ali
KoPT	-	Kolkata Port Trust
KPL (Ennore)	-	Kamarajar Port Limited
KPT	-	Kandla Port Trust
KRI	-	Krishnapatnam
KTPD	-	Killo Tons Per Day
MbPT	-	Mumbai Port Trust
MgPT	-	Mormugao Port Trust
MMC	-	Mobile Harbor Crane
MMT	-	Million Metric Ton
MOHP	-	Mechanical Ore Handling Plant
MPSS	-	Most Productive Scale Size
MT	-	Metric Ton
MTPA	-	Metric Ton Per Annum
MUN	-	Mundra
NMPT	-	New Mangalore Port Trust
NWT	-	Non-working time
OCR	-	Optical Character Recognition
OCT	-	Outer Container Terminal
OPEX	-	Operating Expenditure
POL	-	Petroleum Oil Lubricants
PPT	-	Paradip Port Trust
PSA	-	Port of Singapore
QC	-	Quay Crane
QRS	-	Quick Release System
RFQ	-	Request for Qualification
RTGC	-	Rubber Tyred Gantry Crane

SAH	-	Salalah
SIN	-	Singapore
SPM	-	Single Point Mooring
SVRS	-	Special Volunteer Retirement Scheme
TAMP	-	Tariff Authority of Major Ports
TPH	-	Tons per Hour
TRT/TAT	-	Turnaround time
TT	-	Tractor Trailer
ULA	-	United Liner Agencies
VPT	-	Vishakhapatnam Port Trust
WT	-	Working time
YOK	-	Yokohama

CHAPTER I - INTRODUCTION

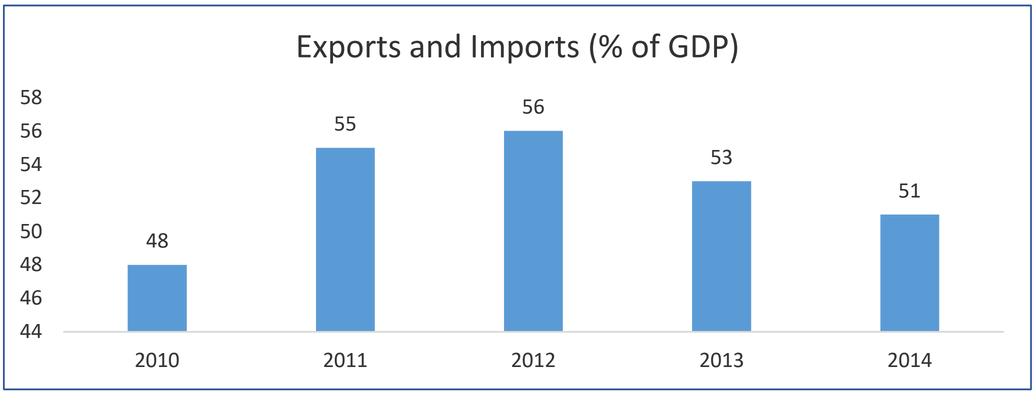
India, a major maritime nation, is bestowed with a vast coastline of 7517 Kms including the two island territories, dotted with 12 major ports and 176 non-major ports. Cargo Volumes handled in Indian Ports has seen a strong growth in the last decade. Traffic has grown by around 10% CAGR during this period. Volumes are expected to continue growing at this rate as India’s GDP growth rate accelerates back to 7-8% YoY basis.

The demand for coal, petroleum, container and other commodities can further accelerate if the plans for debottlenecking of logistic infrastructure are implemented in time, and the ‘Make in India’ push drives greater industrial production and foreign trade. Further, the Sagarmala initiative is expected to drive coastal movement of cargo to further increase the volumes handled at the Indian Ports.

1.1 Background

Ports play a vital role in the international trade of any country. In India, exports and imports account for almost 50% of the country’s GDP (Figure – 1.1). Maritime trade further contributes to a significant 90% of the total export-import trade value of the country (Figure – 1.2).

Figure 1.1 Indian Seaports and contribution to GDP through export-import trade



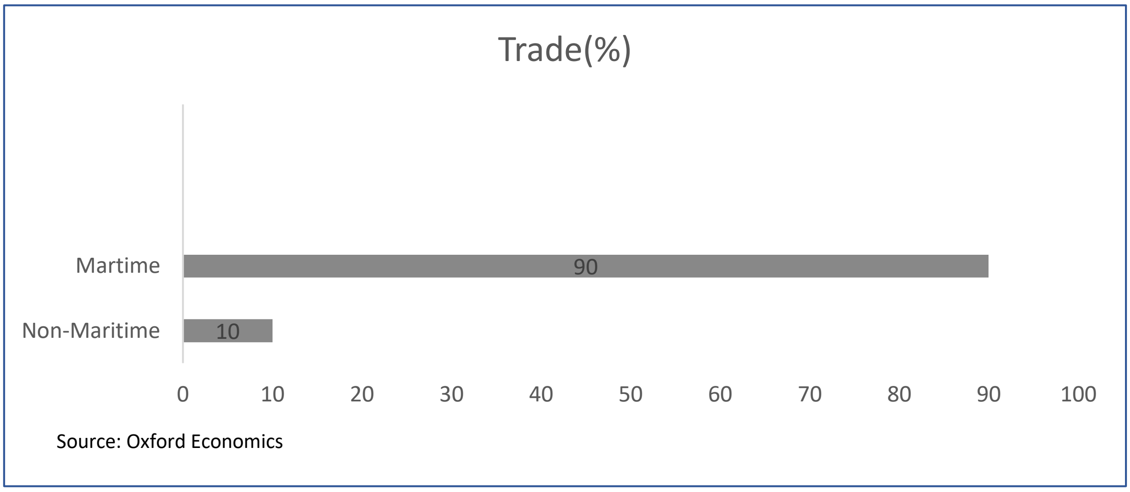


Figure 1.2 Contribution of Maritime trade to total export-import trade value in India

Source: Oxford Economics

1.2 Major Ports in India - An Overview:

Major ports form the backbone of India's port network accounting for 57% of overall port traffic. India has 12 major ports across the coastline of the country – Kandla, JNPT and Mumbai on the western coast; Kolkata and Paradip on the eastern coast; and Vizag, Chennai, New Mangalore, VOC, Ennore, Cochin and Mormugao on the southern coast of India. These ports handled approximately 556 million tonnes (MMT) of cargo in the year 2013-14. The following figure depicts location-wise distribution of major ports in the country.

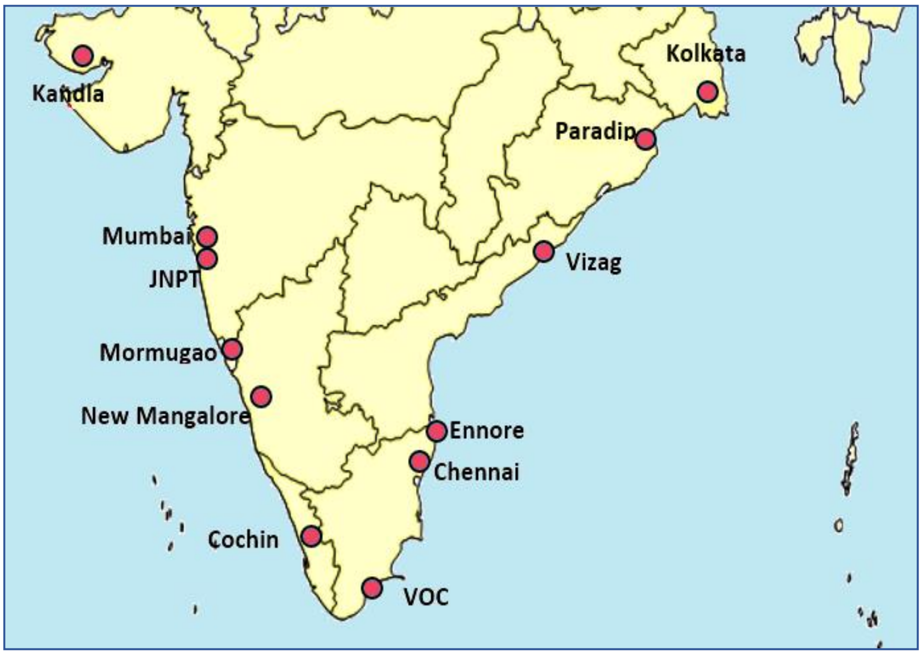


Figure. 1.3 The location and traffic of all major ports in the country.

Total traffic handled by major ports during the current year 2014-15 is around 582 Million Metric Ton (MMT).

Table below gives total traffic handled by the major ports of India during 2016-17

Table 1. 1 Traffic handled by the Major Ports during 2016-17

Port	Traffic (MMT)	Port	Traffic (MMT)
Kandla Port Trust	92	Kolkata Port Trust	46
Mumbai Port Trust	62	Paradip Port Trust	71
JNPT Port Trust	64	Vizag Port Trust	58
Mormugao Port Trust	15	Ennore Port Corporation	30
New Mangalore Port Trust	37	Chennai Port Trust	53
Cochin Port Trust	22	VOC Port Trust	32

Source: Major Ports of India: A profile 2016 – 17 by Indian Ports Association

Though the major ports of India contribute significantly to the national economy, they have been losing share to non-major ports in the recent years – traffic volumes at major ports decreased from 71% in 2006-07 to 57% in 2013-14.

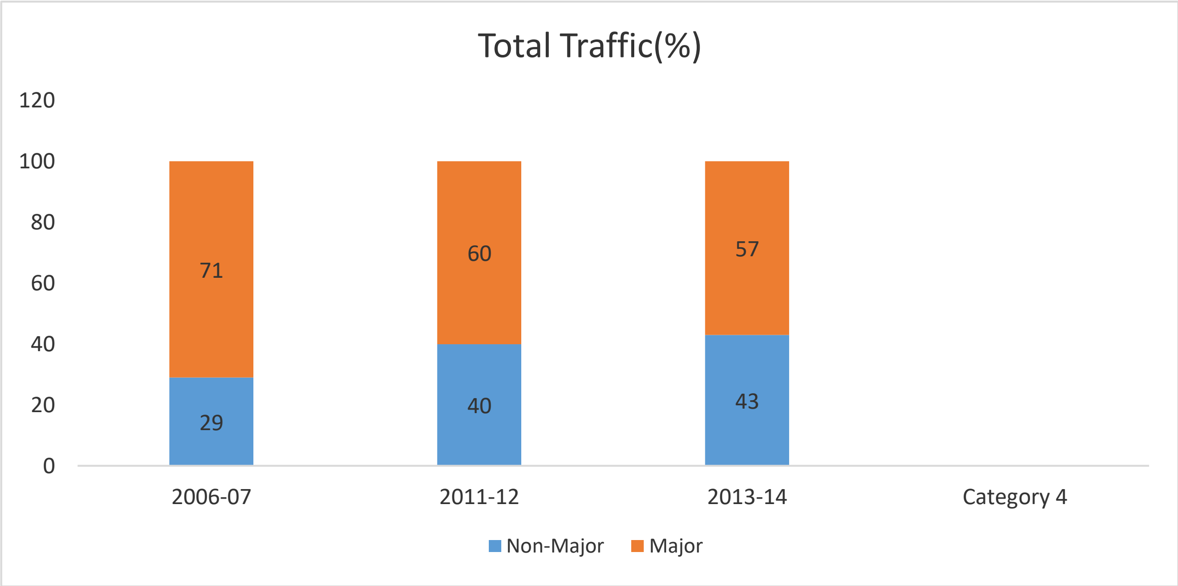


Figure 1.3 (b) Traffic handled by major and non-major ports of India

Source: Major Ports of India: A profile 2016 – 17 by Indian Ports Association

The 12 Major ports have faced key challenges in the last 8 years with a decline in profitability and market share. Operating profit margins have shrunk from 43% in 2008 to 28% in 2014 with a low of 23% in 2013. Although profitability has seen an uptick, other key challenges need to be addressed to sustain the growth in profitability.

1.3 Major ports losing share to non-major ports

Government policies to open-up port sector to private participation has seen a sharp rise in the number of private ports and has led to a shrinkage in the cargo volumes handled by major ports.

The loss of share by major ports is attributed to three key areas:

- Low productivity levels and higher turn round time
- Congestion issues in road evacuation
- Insufficient draft to handle large vessels

1.4 Higher Turn round time in major ports of India

Average turn round time of vessels at major ports of India are much higher in comparison to International benchmarks for Container vessels and Dry bulk vessels, as can be seen from the Figure 1.4 (a)

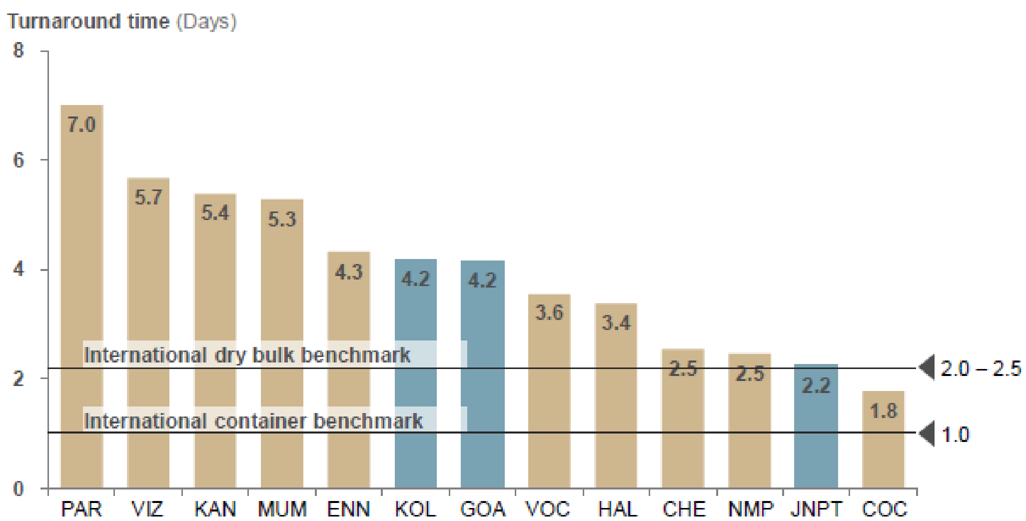
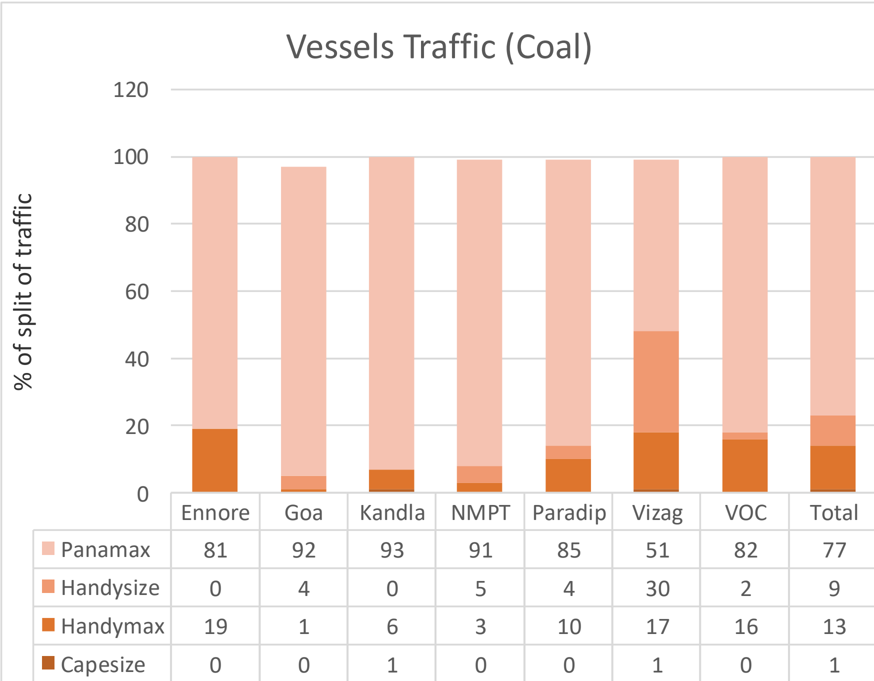


Figure 1.4 (a) Turnaround time status at major ports of India.
Source: National Perspective Plan, Sagarmala, Ministry of Shipping, 2015.

1.5 Size of Coal vessels visiting major ports of India

Panamax vessels are most frequent at major ports of India for Coal traffic. Cape size vessels to achieve economy of scale are rare as can be seen from the Figure – 1.4(b). Average parcel size ranged between 40546 tonnes to 66844 for Panamax vessels against 110666 tonnes registered in one Indian Major Port. This is primarily due to availability of lesser draft at Indian ports.



	Ennore	Goa	Kandla	NMPT	Paradip	Vizag	VOC	Total
Panamax	81	92	93	91	85	51	82	77
Handysize	0	4	0	5	4	30	2	9
Handymax	19	1	6	3	10	17	16	13
Capesize	0	0	1	0	0	1	0	1

Figure 1.4 (b) Vessels Traffic (Coal), FY 2015

Source: Indian Port Association

1.6 Logistics share in Indian GDP

India spends 12-15% of GDP on logistics costs as compared to 9-12% for other BRIC nations, and just 7-8% for developed countries. A 0.5% decrease in logistics cost, relative to GDP, leads to a 2% increase in trade and a 40% increase in exports, as can be seen from the Figure 1.5 (a)

Therefore, it is important that high logistics costs be curbed both directly through improving port cost efficiency, and indirectly through port operational efficiency, Charges related to vessels, stevedoring and storage have a direct impact on costs, on the other hand vessel turn-around time (TAT), long dwell time, and high rake and truck turn-around time increase inventory costs and freight burden, which have an indirect impact on overall logistics costs. Likely impacts of high logistic costs of seaports are shown in the Table 1.4

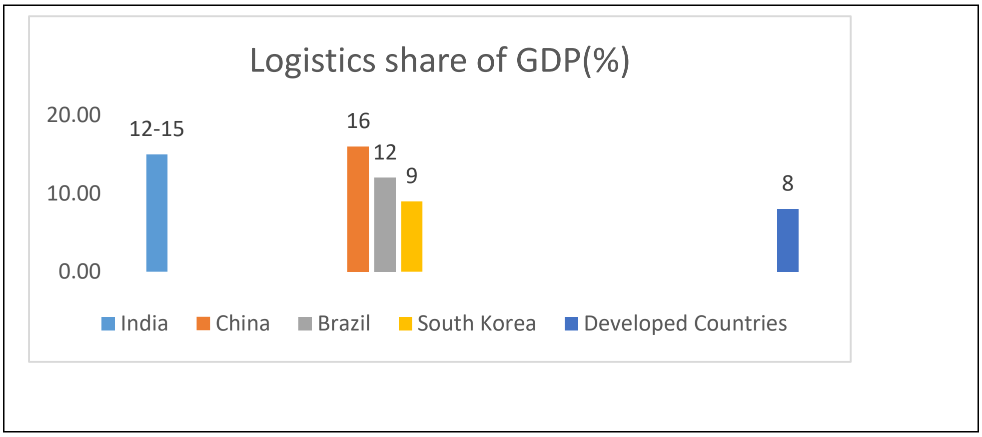


Figure 1.5 (a): Comparison of logistics share to GDP.
Source: India Transport Report 2014

Table 1.4 Impact of high logistic costs of seaports

Direct Impact through Port's charges		Indirect Impact of operations on costs
Vessel related charges		High TAT increases overall shipping costs
Stevedoring Charges		Congested yards & long dwell cargo dwell time increases inventory costs
Storage charges		High rake & truck TAT at ports increases freight burden
Improve port cost efficiency	⟷	**Improve port operational efficiency**
Source: India Transport Report 2014		

1.7 Capacity augmentation

According to the 12th Five-Year Plan of the Planning Commission, Government of India, the port sector to receive significant investments to enhance capacity, and to reach a capacity of 3,200 MMT by 2020, which is four times the capacity handled in 2013-14. (Figure 1.6(a) and 1.6 (b)). However, there is a need to ensure capital efficiency by also maximizing utilization of existing infrastructure.

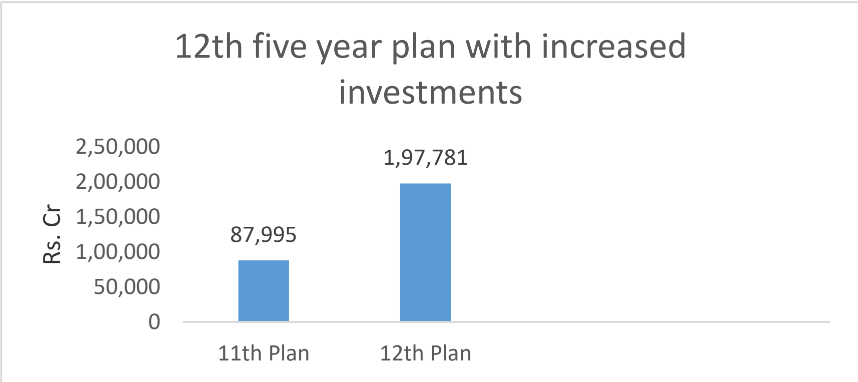
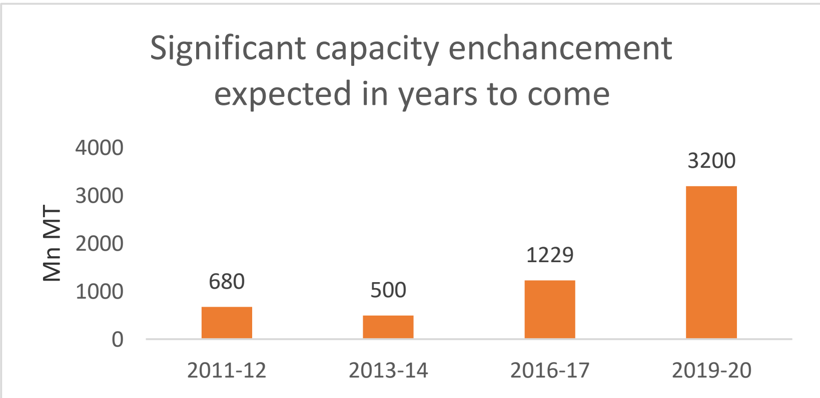


Figure 1.6 (a): Expected Investments in Ports Sector in the years to come.
Source: Planning Commission, Maritime Agenda 2020



1.6 (b): Expected capacity enhancements in years to come.

Source: Planning Commission, Maritime Agenda 2020

Therefore, it is critical to achieve greater productivity and efficiencies to unlock capacity, and ensure that we do not undermine our competitiveness and slow down economic growth. Process delays and operational bottlenecks are the key reasons behind under-utilization of capacity. Focused efforts are required to streamline these operations and strengthen processes along the entire value chain.

1.8 Quantitative Benchmarking

1.8.1 Benchmarking Theory:

Formal definition of benchmarking used by Rank Xerox, 2013 ‘Continuous systematic process of evaluating companies recognised as industry leaders, to determine business and work processes that represent best practices and establish rational performance goals.’ In operational terms it is frequency condensed to ‘the search for industry best practices that lead to superior performance.’ ‘Best Practices’ refer to the methods used in work processes that best meet customer requirements. Benchmarking is not ‘what we want to achieve’ but ‘how they are to be achieved’.

Types and ways of Benchmarking Theory:

1. Types of Benchmarking – Product and Process
2. Ways of process benchmarking/How benchmarking is done?

a. Benchmarking Internal Operations – to find the best-performing unit within your own company;

b. Benchmark vis-à-vis competitor;

c. Best-in-class – Comparing your performance vis-à-vis the best in industry;

d. Strategic benchmarking – integrates strategic competitive analysis with best-in-class benchmarking.

1.8.2 Techniques of Benchmarking/Classification:

i. Analytical Hierarchy Process (AHP) – (Saaty 1980; Partovi, 1994; Ragavan & Punniyamoorthy, 2003; Punniyamoorthy & Murali, 2008.
ii. Data Envelopment Analysis (DEA) – (Banker et al, 1984, Wober, 2002)
iii. Principal Component Analysis (PCA) – De, 2001; Buyukzkan & Marie
iv. Confirmatory Factor Analysis (CFA) – Buyukozkan & Marie, 1998
v. Stochastic Frontier Analysis (SFA) approach - (Walters, 1963; Braeutigam, 1999)
vi. Partial Productivity Measures (PPM) approach - (Saari, 2006)
vii. Discriminant Analysis- (Itoh, Matsuoka and Okada 2005)
viii. Cluster Analysis - (Fengrong et al. 2014)

In view of various techniques of benchmarking with different sets of assumptions and limitations studied in literature review, it is proposed to use the ‘best in class’ method using ‘Root Cause Analysis’ technique.

In this phase, it is proposed to collect data for 12 major ports as well as relevant private Indian ports and international ports to benchmark performance on all three key dimensions of

1) Financial,
2) Operational, and
3) Organizational capability

In each of these benchmarking focus areas/ dimensions, a set of targeted and specific metrics was used for comparing performance. These metrics have been shortlisted since they provide the most specific and insightful understanding of the relative performance of the ports. The KPIs shortlisted under following heads are:

1. Demand and utilization
2. Marine services
3. Productivity
4. Equipment
5. Yard and gate productivity
6. Labor
7. Profile/cost metrics

In case of any specific situation /context for a port, other relevant metrics added as required for building an in-depth and specific understanding of the port's performance.

1.8.3 Selection of benchmark ports and data normalization

The major ports have been clustered based on cargo categories (mechanized dry bulk, conventional dry bulk, containers, and break bulk) for the purpose of benchmarking, relevant and comparable private Indian Ports and international ports were selected to ensure that these benchmark ports are comparable on the following parameters:

- Size of port
- Number of berths
- Type of commodity

- Degree of automation

During the benchmarking phase, it was proposed to conduct a ‘customer survey’. The survey to be a combination of online and face-to-face discussions with key port stakeholders. The objective of this survey was to provide an external perspective on stakeholders’ views of the port, rank KPIs determined by literature review and highlight the key concerns and issues being faced by them in conducting operations at the port.

List of some of the stakeholders surveyed:

- Container liners and bulk ship owners/operators
- Terminal operators
- Cargo handling /stevedore agents
- Railways
- Logistics and transport providers
- Exporters/importers (end-customer)

As an outcome from the benchmarking phase, a list of priority focus areas was identified for each of the 12 major ports across financial, operational and organizational metrics.

1.9 Business Problem:

Although privatisation has resulted in efficiency improvements at Major Ports of India, lack to efficiency benchmarks are hampering the measurement of their absolute efficiency.

Ports, handle 80% of world trade by volume and over 70% by value. In 2000, 5.88 billion tons was moved through World's ports. In India also, Ports play a vital role in the overall economic development of the country. About 90% by volume and 70% by value of the country's international trade is carried on through maritime transport. Hence, the significance of Ports in the overall economy of the country needs no emphasise. Having recognized the immense importance of the role of Ports, Indian Ports are still languishing at Turn Round time of 2.25 days and Average Pre-Berthing Detention at 6.94 Hrs on Port Account. Ideally, there should not be any pre-berthing detention (Zero Pre-berthing detention) and also Overall Turnaround time should not exceed 1 day in any case. Ship-standing cost is in the level of US$ 9,000 per day (Approximately 6, 12,000 Rs. Per day). If Vessels stay longer for various reasons, Trade and the Nation lose economically. Similarly, Vessel related charges are reportedly high in Indian ports and consequently entails high transactional cost. It is required to study and do in-depth research to quantify the loss and measures to mitigate/minimise the loss.

1.10 Motivation for Study:

Efficiency and productivity at ports across the world has been an area of interest for researchers and policy makers from times immemorial. Numerous studies in the western and eastern world have proved positive relationship between port performance and development of an economy. Setting standards for performance of ports, actually, help in enhancing of performance of ports and numerous initiatives in this direction are already at implementation stage among countries competing for a niche maritime sector. In the Indian context, significant number of researchers have attempted to measure efficiency and productivity in hindsight. However, considering, the buoyant aspirations of Government of India, existence of performance benchmarks in the port sector can alone help in enhance absolute efficiency levels at the Major Ports of India. The current research, therefore, is an attempt to set and achieve performance benchmarks for the Major Ports of India.

CHAPTER II- LITERATURE REVIEW

With intent to conduct literature survey of the research works done hitherto, a theme based approach is used to search various sources. Apart from research works, numerous manuscripts, newspaper articles, industry reports, and orders are reviewed. Following table shows details of the same:

Table 2.1: List of Journals & Database explored for Literature Review

Key Words Used	**Journals Explored**	**Databases**
1. Benchmarking 2. Maritime sector 3. Performance measurement 4. Port Performance 5. Port Evaluation 6. Port Efficiency 7. Port Productivity 8. Pre-Berthing Detentions 9. Transactional Costs 10. Port Sector Reforms 11. Indian Ports 12. Port Privatization	1. Transport Research 2. Maritime Policy & Management 3. International Journal on Production Management 4. Transport Reviews 5. Transportation Planning and Technology 6. Applied Economics 7. International Journal of Logistics Research and Applications 8. Transport Policy 9. Transportation Research–A to E 10. Journal of Economics & Business 11. Journal of Maritime Research 12. World Development 13. Maritime Policy 14. UNCTAD Reports 15. World Bank Reports 16. Reports of Ministry of Shipping 17. Reports of Indian Port Association	Scopus Taylor & Francis Elsevier Google-scholar Palgrave

Literature collected from the above sources is thematically collated as:

Table 2.2 Thematic segregation of Literature Review Data

1. Performance and Efficiency a. In General, b. In Port Sector	2. Benchmarking a. In General b. In Port Sector
3. Pre Berthing Detention	4. Transactional Cost

Table 2.3 Author-wise Literature Review					
Author(s)	**Year**	**Context**	**Variables**	**Conclusions**	**Gaps**
M.R.Ghasemi Joshua Ignatius Sebastian Lozano Ali Emrouznejad	2015	A fuzzy expected value approach under generalized data envelopment Analysis	CO2 equivalent, quantity of energy, gross electricity, average annual emissions, substituted fuel	The results of validation and model comparisons showed that the proposed model is able to handle asymmetric fuzzy numbers, discriminate efficient DMUs ~~better~~ and avoid infeasibility problems when combined with the super-efficiency method.	Fuzzy expected GDEA model requires solving only one linear programming problem, which would generate results for fuzzy expected CCR, fuzzy expected BCC, and fuzzy expected FDH models in a unified way
Jacek Strojny	2015	Implementation of the AHP and benchmarking in Strategic Analysis of Polish Regions	GUS data (National statistical data)	Application of AHP method allows customizing the analysis to the information needs, arising from the management of the territorial unit.	Necessary to find a compromise between Theoretical assumptions and Practical measurement capability.
Subhadip Sarkar	2015	Assessment of performance using MPSS based DEA	Productivity, schools	The proposed method offers ranking to the DMU based on their performance index. Although, it does not	Deficits are found high in case of schools like B-E in both outputs. Selection of right variables is an issue.

				have any resemblance with the ranking found in case of CCR DEA or from their super-efficiencies, but, it clearly supports the claim of these two models that the schools E and F are very close to be referred as efficient performers.	
Reetesh Sharma Mark Thomas	2015	Cathay & Southwest: flying the flag of good practice in airline mergers	Southwest airlines, cathay pacific airlines	The success of M&As results from giving importance to both the business model and human factors, as the latter ultimately impacts the customers' loyalty and perception of the brand.	Business performance is influenced by external factors which are beyond firm's control and thus, not considered for analysis.
Navarro-Chavez & Zamora-Torres	2014	Allocative and economic efficiency of 32 container ports across the world for year 2012.	Fixed Assets, Operating Expenses, Number of terminals, Container Yard Area, Throughput (TEUs)	Results on efficiency realize the need to advance strategies for reduced costs and a better mix of inputs.	

Mustafa Jahangoshai Rezaee	2014	Using Shapley value in multi-objective data envelopment analysis: Power plants evaluation with multiple frontiers	Generation capacity (MW) Planned outage count to total properly operated hours (%)	In the proposed MODEA model, each function is a category of inputs and outputs. Each category produces a frontier and DMUs must compete in multiple frontiers to reach higher efficiency than others.	Despite other multi-objective problems, the existing methods and procedures for obtaining Pareto solutions cannot be useful. This approach is based only on Shapley value.
Enzo Barberio Mariano Vinicius Amorim Sobreiro Daisy Aparecida do Nascimento Rebelatto	2014	Human development and data envelopment analysis : A structured literature review	Cultivation costs, intermediate consumption materials, total expenses	The data envelopment analysis can be an excellent tool to help in the measurement and analysis of issues related to human development, and through it indexes with lower arbitrary weights can be composed, in addition to evaluating the efficiency in generating quality of life from wealth or economic, social and environmental resources.	The economic and environmental dimensions have an important role in the analysis of quality of life, which proves that all these concepts still need a more precise definition.

Rajasekar et. al.	2014	Measured operational efficiency of Major Ports of India 1993-2011,	No. of Berths, Length/No. of Docks, Total Staff, , Throughput (TEU), Throughput (Tons)	Proved that size does not determine port efficiency. Suggested need for long-term plans and modernisation of facilities to maintain efficiency.	Selected only few of the major ports
Kazim Baris Atici Victor V. Podinovski	2014	Using data envelopment analysis for the assessment of technical efficiency of units with different specializations : An application to agriculture	Cultivation costs, intermediate consumption; materials, total expenses	This paper proposed a way to overcome the above problem based on the incorporation of production trade-offs between different outputs in DEA models.	Computations show that the use of conventional VRS and CRS models in our application results in poor efficiency discrimination due to a large number of outputs in each regional sample.
Adel Hatami-Marbini Mohsen Rostamy-Malkhalifeh Per J. Agrell Madjid Tavana Fatemeh Mohammadi	2014	Extended symmetric and asymmetric weight assignment methods in data envelopment analysis	A panel of district heating plants in Denmark 2000–2001 around 286 plants for with two inputs and four outputs.	One of the most enticing, yet frustrating, features of non-parametric frontier analysis with DEA is the endogenous dual weight determination. The absence of the requirement to impose an a priori functional form turns DEA into a	Complete flexibility to assign dual weights may also lead to results that are nothing but mathematical abstractions, failing to detect best system practice among outliers and mavericks with little or no predictive value.

				powerful, informative and cautious performance assessment method.	
Min Yang Yong Jun Li Liang Liang	2014	A generalized equilibrium efficient frontier data envelopment analysis approach for evaluating DMUs with fixed-sum outputs	Performance of each nation.	The proposed approach improves EEFDEA approach (Yangetal.,2014) and FSODEA approach. 1- the equilibrium efficient frontier can be achieved in only one step instead of many steps in prior study. 2- the constraint in EEFDEA and FSODEA that the sign of ad-justments of fixed-sum outputs of a DMU must be identical is relaxed in GEEFDEA approach. 3-the order of evaluation which can affect the results in EEFDEA is not necessary in the proposed GEEFDEA approach.	The current approach is applied to evaluating performance of each participating country in the 2012 London Olympic Games.

				4-it remains to maintain all advantages of EEFDEA approach such as common platform evaluation and full rank orders.	
Ole B. Olesen Niels Christian Petersen	2014	Stochastic Data Envelopment Analysis — A review	Manager talent, inefficiency-environment	The outcome of an efficiency analysis based upon DEA is for these reasons easy to communicate to decision makers. Equally important, the outcome extends beyond the estimation of measures of inefficiency.	The outcome of an efficiency analysis based on disaggregate data are more easily understood by the involved decision makers, but the discriminating power of the corresponding confidence intervals is weak in the well known scenario with a limited number of observations in a multidimensional input output space.
Mahdi Mahdiloo Reza Farzipoor Saen Ki-Hoon Lee	2014	Technical, environmental and eco-efficiency measurement for supplier selection: An extension and application of data envelopment analysis	the factors incorporated into the models are separated as inputs and outputs	This paper proposed a new way of modeling undesirable outputs in DEA and applied it to technical, environmental and eco-efficiency measurement of suppliers of the Hyundai Steel Company in South Korea. This study shows	The unavailability of the upstream suppliers' data is a limitation of our study. The MOLP model enables the identification of a DMU as being eco-inefficient if the DMU is either technically or environmentally inefficient.

				that the existing DEA models for this purpose are computationally intensive, since for a data set with n DMUs, running3_n models and linear programming is required	
Dilek Demirbas Helen Flint David Bennett	2014	Supply chain interfaces between a port utilizing organisation and port operator	Port, performance, throughput, operations	This study explored the role of ports within supply chains and examined the interfaces between an organisation that utilizes a port and a port authority/operator, through a case study of a UK port and steelworks.	It may still miss important factors in the interfaces between an organisation that utilizes a port and a port authority or operator, as well the data used were only from one country.
Port regulator of SA	2014-15	Benchmarking South African Ports: container and automotive terminals	Throughput	South African terminal performance looked at through the lens of productivity measures registers variable results against the global sample as determined	
Gunter Festel &	2014	Benchmarking of		The developed	

Martin Würmseher		industrial park infrastructures in Germany		benchmark methodology using the correction factors made a discussion based on comparable and comprehensible figures possible. It is well suited to evaluate best practice in the field of industrial park infrastructures.	
Avinash Panwar; Bimal Nepal; Rakesh Jain Om; & Prakash Yadav	2013	Implementation of benchmarking concepts in Indian automobile industry – an empirical study		It was observed that large auto companies possessing many plants prefer to carry out internal benchmarking through transfer of best practices from one unit to another	Lack of standards at industry level makes assessment a challenge.
Javier Morales Sarriera Tomas Serebrisky Gonzalo Araya Cecilia Briceno-Garmendia Jordan Schwartz	2013	Technical efficiency analysis of container ports in Latin America and the Caribbean.	Total area, Berth length, Number of cranes in container ports.	Gains in productivity from the use of ship-to-shore gantry cranes and berth length are the largest among the inputs considered.	Analysis of port efficiency, such as dwell times and crane productivity.

Andreia Zanella Ana S Camanho Teresa G Dias	2013	Undesirable outputs and weighting schemes in composite indicators based on data envelopment analysis	All variables were specified as outputs and an identical input level	Two alternative approaches that can be used for the construction of CI in this context: an indirect approach, based on a traditional DEA model, including a transformation in the measurement scale of undesirable outputs; and a direct approach, based on a directional distance function model, that allows for dealing with the undesirable outputs in their original measurement scale	Directional CI model has weaknesses related to the possibility of obtaining negative marginal rates of substitution between desirable and undesirable outputs for DMUs located on downward-sloping segments of the frontier
Mahmood Mehdiloozad S. Morteza Mirdehghan Biresh K. Sahoo Israfil Roshdi	2013	On the identification of the global reference set in data envelopment analysis	Upper bounded variables	With the help of the introduced notions, it was demonstrated that the convex hull of the GRS is equal to the minimum face, from which it was immediately concluded that the minimum face is a polytope. Three	The current study is mainly concerned with the identification of all the possible reference units of an evaluated inefficient DMU.

				types of multipleness may occur in any non-radial DEA model: multiple URSs (TypeI), multiple projections (TypeII), and multiple supporting hyperplanes (TypeIII).	
Ali Mohammadi Shahin Rafiee Ali Jafri Tommy Dalgaard Marrie Trydeman Thu Lan T. Nguyen Robert Borek John E. Hermansen	2013	Joint Life Cycle Assessment and Data Envelopment Analysis for the benchmarking of environmental impacts in rice paddy production	Rice paddy fields Water supply Water Consumption	The LCA results implied that the spring rice paddy has a lower environmental impact, with regard to global warming, acidification, eutrophication, non-renewable energy demand and water depletion per kg produced compared to the summer rice paddy.	More attempts are required to develop further uses of the LCA þ DEA methodology in this field.
Amy L. Fraher	2013	Airline downsizing and its impact on team performance	US Airlines, Pilots	Commercial pilots working in downsized airlines reported increased mistakes, distraction, and stress resulting in a decrease	Although this study included pilots from most major US air carriers, a significant proportion of study volunteers (87 percent) were employed by a single carrier. The

				in trust, morale, and organizational commitment, with a corresponding increase in suspicion and selfishness.	sample is not large enough to make statistically significant generalizations to the entire US commercial airline pilot population
Tony Diggle	2013	Water: how collective intelligence initiatives can address this challenge	Agriculture, water resources, climate change, policy, finance, governance.	There are major issues over water to do with lack of access, poor health and sanitation, infant mortality and shortages for agriculture to name just a few.	The major decisions are taken by policy makers and governments outside the industry, thus insiders work is not shown independent that of outsiders.
Maik Huettinger	2013	What determines the business activities in the airline industry? A theoretical framework	Airlines, privatization, labour, finance	A model has been developed to enable researchers and managers to further systematically analyze the determinants which actually form and influence the development of the airline business.	The research should consider additional aspects: as the focus of this work is put on the strategic/environmental aspects (as a dependent dimension), the influence of other distinguishing parameters (such as occupational culture and national cultures), therefore, have to be minimized.
Shahriar	2013	Financing company	Stock, finance,	There were several	Leonardo

Khaksari Stefan Platikanov		growth at MRV Engenharia e Participacoes SA	inflation,	conflicting goals among which Leonardo Correˆ a's needed to strike the right balance. He was expecting the company to grow steadily in the next several years and wanted to preserve as much as possible financial flexibility and borrowing capacity for the future.	Correˆ a's needed to decide on the features that would make investors interested in the securities.
Luliya Teeratansirikool, Sununta Siengthai; Yuosre Badir & Chotchai Charoenngam	2013	Competitive strategies and firm performance: the mediating role of performance measurement	Cost leadership, financial measures, firm performance, non-financial performance, differentiation	Results fully support the importance of using both financial and non-financial performance measures for firms pursuing a cost leadership strategy and a differentiation strategy, consistent with the conventional theories	There may be variables omitted from the model in this study that may also moderate, or mediate, the relationship between different performance measures and firm performance, not all organizations experience improved performance through the development of performance measures.
Mengying Feng John Mangan Chandra Lalwani	2012	Comparative investigation of port performance between Western Europe and	Speed of handling, Proximity, Safety, Logistics services,	The Humber port authorities are proposed to diversify port ownership to reduce	Research areas to broader and more randomized samples of more ports in both the regions.

		Eastern Asia and develop a strategy to improve their port performance.	Shipping services, Risks.	cost and improve infrastructure, encourage diversified investment for infrastructure improvement; Xiamen needs to improve its custom services, enhance govt. support, and expand hinterland by improving infrastructure, increase logistic demand.	
Rajasekar & Deo	2012	Linkage between size and efficiency at Indian major ports 1993 – 2011.	Labour, Port Location, Length of Berth/Quay, No. of Quay Cranes, Number of Yard Cranes, No. of Straddle Carriers, No. of Prime Mover Tractors/Forklifts, No. of Trailers/Vehicles/ Trucks, Number of Lifters/Stackers, Throughput	Found little influence of size on efficiency. Suggested containerisation and long-term planning for productivity.	

			(TEU), Traffic Handled		
Mengying Feng John Mangan Chandra Lalwani	2012	Comparing port performance: Western European versus Eastern Asian ports	Port service provider, port regulations, port transport	The findings from this research assist port managers and policymakers to examine local port performance and develop their operations strategy to improve port performance accordingly.	More focus is done on Chinese ports rather than all Asian ports.
Vanumamalai Kannan S.K. Bose N.G. Kannan	2012	Improving the service quality of ocean container carriers: an Indian case study	Container carriers, services, Indian market	This study attempted to find out the list of criteria that decide the service quality of ocean container carriers in the Indian market and then attempted to measure the service quality of the select container carriers.	Though it has identified the areas of strengths and weaknesses of container carriers, it has not attempted to suggest what these container carriers should do to improve weak areas
Milla Laisi Olli-Pekka Hilmola Hilmola Mikko Sutela	2012	North European companies' relation with Russia and China: future outlook on transport flows	Economy, trade	Even if the state of the world was totally different during year 2006 and 2009 our three surveys completed during the	

				years indicated that transportation flows are not that greatly affected between North European companies and Eurasian economies.	
Ole Jørgen Anfindse Grunde Løvoll Thomas Mestl	2012	Benchmarking of marine bunker fuel suppliers: the good, the bad, the ugly	Marine bunker fuels, quantity	From a user perspective the main strengths of the presented benchmark are: institutive and easy to understand, applicable for few or even singleton samples; and able to pinpoint different density reporting schemes.	
John Williams Cheryl Brown Anita Springer	2012	Overcoming benchmarking reluctance: a literature review		This study of peer-reviewed literature dated 2005-2010 found research on the topic of benchmarking reluctance to be limited.	
Vanumamalai Kannan S.K. Bose N.G. Kannan	2012	Improving the service quality of ocean container carriers: an Indian case study	Container carriers	It has first attempted to find out the list of criteria that decide the service quality of ocean	There were gaps in all shipping lines operating in india except hanjin and hapag,

				container carriers in the Indian market and then attempted to measure the service quality of the select container carriers.	
Antero Putkiranta	2012	Benchmarking: a longitudinal study		Between 1993 and 2004 the use of benchmarking grew appreciably and changed from internal use to competitive benchmarking.	Why benchmarking changed over time is not clear.
Pjevcevic, Radonjic, Colic	2012	Serbian River Port efficiency measurement using DEA	Throughput, Berth Length, No. of cranes, Warehouse Area	Assessed inefficiency sources and formulated proposals for improving services.	Data insufficiency and limited timeframe.
Nwanosike, Tipi, Smith	2012	Reforms and efficiency improvements at 6 Nigerian ports 2004 – 2010 using DEA	Throughput, Ship Rate, Berth Length, No. of cranes, No. straddle carriers, no. of prime movers, no. of trailers/vehicles/trucks, no. of water ways, total staff	Cargo throughput and traffic improved significantly with concessionaire agreements.	Mismatch between number of ports and number of variables considered.
Lu & Wang	2012	Measurement of	Throughput, berth	Probed reason for	

		operating efficiency of 31 east-Asian major container terminals using DEA	length, port draft, no. of cranes, port area	inefficiency, potential areas of improvement at inefficient terminals by using returns to scale approach to assess returns to scale.	
Gi-Tae Yeo Michael Roe John Dinwoodie	2011	Measuring the competitiveness of container ports.		A well-managed logistics function can enhance the marketing function and thereby corporate productivity, and effective channel management relies on the choice of an efficient container port in an efficient logistics chain.	
Bhatt & Gaur	2011	Impact of containerisation on port efficiency at JNPT and Mundra Ports.	Crane hours, No. of Trailers/Vehicles/ Trucks, Average cycle of Internal Transport, Truck Turnaround time, Slot density, Yard utilisation rate, Effective working rate	Improved berth operational efficiency at container terminals with privatisation.	Only two ports compared
Gi-Tae Yeo	2011	Measuring the	ship owners,	This method	Continuous updating of research

Michael Roe John Dinwoodie		competitiveness of container ports: logisticians' perspectives	shipping company executives, shippers, logistics related companies, and freight forwarders	successfully overcomes difficulties encountered in quantitative analysis in this field, namely in identifying apposite factors for measuring port competitiveness, making estimates from inaccurate data, and quantifying inputs from qualitative data.	using these approaches is likely to be required to regularly re-evaluate port competitiveness in this vital, dynamic and unpredictable region. Additional surveys will also be required in other regions to undertake comparative studies and analyses of the competitiveness of the ports in them and thereby their potential to offer alternative distribution channels.
Rama K. Jayanti S.V. Jayanti	2011	Effects of airline bankruptcies: an event study	Market share, Share price, Companies	Show that bankruptcies do influence the market value and share of rival firms and this effect is especially pronounced for bankruptcies of major firms compared to minor firms.	This would need keeping a watchful eye on industry specific events for predicting Bankrupting of company.
A.S. Gbadegesin F.B. Olorunfemi	2011	Sustainable technological policy options for rural water supply management in selected rural areas of Oyo State, Nigeria	Water supply, water consumption, water storage	The existing policy to supply water through boreholes especially in situations where there is no regular electricity supply to power the	Solution to changing political policies is not addressed.

				machines, as currently obtained in the rural areas studied, is counter productive.	
Olli-Pekka Hilmola	2011	Benchmarking efficiency of public passenger transport in larger cities	Bus companies, rail operators, private vehicles	Problem with economic growth is that larger amounts of people will get an opportunity to use private car transportation – in larger scale need to modify our transportation systems in a manner that travel need is fulfilled by the most environmentally friendly means.	This research work has pointed only some frontier cities, there does not exist any support that these sorts of systems could favour nor support the objectives of year 2020 or 2030 in terms of transportation sustainability.
Lucio Cappelli Roberta Guglielmetti Giovanni Mattia Roberto Merli Maria Francesca Renzi	2011	Peer evaluation to develop benchmarking in the public sector	Motor training institutes, training courses	the training content necessary: first, to place “peers” in a position to be able to autonomously and fully carry out their evaluation work on the basis of the CAF model; and second, to render the evaluation activities systematically comparable among the	

				various administrations.	
Robert de Souza Albert Wee Kwan Tan Hafidzaturrafeah Othman Miti Garg	2011	A proposed framework for managing service parts in automotive and aerospace industries		Most significant thing to take note of the proposed framework is to quantify the customer service level for different customer segments, and provide the necessary processes, enablers and supply chain network to meet each service level.	
Wanke, Barbastefano, Hijjar	2011	Efficiency determinants at 25 Port terminals in Brazil using DEA.	No. of loaded shipments, throughput (in tons), no. of berths, terminal area, parking lot for trucks, rail-road connectivity	Efficiency indicators grouped basing inputs and outputs for production function analysis. Found private terminals to be more efficient.	The study is not on panel data.
Bergantino & Musso	2011	Studied various influencing factors on port efficiency using a multi-step approach.	Throughput (tons), container lot size, port location, port accessibility, terminal area, container yard size, customer satisfaction,	Checked external and internal factors influencing efficiency. Found environmental factors like economic condition, port accessibility, and employment level to	

			education level of employees, GDP of the nation.	influence efficiency.	
Ifeoluwa Ajelabi Yinshang Tang	2010	Principle Project Management Performance Improvement.		Benchmarking an outward looking evaluation tool, compares the performance of project management activities.	
Susila munisamy Gurcharan Singh	2010	Efficiency of Asian container ports	Berth length Terminal area Quayside cranes Total yard shipment	Inefficiency in Asian container ports is due to pure technical inefficiencies rather than scale inefficiencies.	Port managers must improve their management practices to favor efficient ways and to meet customer requirements.
Dotun Adebanjo Ahmed Abbas Robin Mann	2010	Investigation of the adoption and implementation of benchmarking.		Awareness and effectiveness of benchmarking compares quite well with a range of other management techniques.	
Ahmed Salem Al-Eraqi Adli Mustafa Ahamad Tajudin Khader	2010	Evaluation of the efficiency of cargo ports situated in the regions of East Africa and Middle East	Ship calls, throughput, berth length, terminal area and equipment handling.	Small seaports are efficient while big seaports are inefficient. The throughput of seaports in this region is not stable, due to the instability in the region.	The determination of the estimated efficient seaports in the region will be better evaluated by selecting the important seaports of the region in terms of the number of equipment, storage

					capacity and berth length.
Maria Bjorklund	2010	Development of benchmark tool that can be applied to improve corporate social responsibility.		The development of a tool/framework that offer guidance regarding which potentials that is most meaningful to implement in order to improve the performance. It is of large importance to identify practices that improve performance in order to help companies not to be engaged in superfluous activities that can serve only as "green washing."	
Breno Nunes David Bennett	2010	Green operations initiatives in the automotive industry: An environmental reports analysis and benchmarking study	Environment, society, economy	The main initiatives undertaken by the three automotive companies rather than making a comparison between them.	
Adrien Presley Laura Meade	2010	Benchmarking for sustainability: an application to the		It provide a contribution to the literature by seeking to develop a	

		sustainable construction industry		framework that is generic enough for a green build to benchmark the indicators they particularly want to focus on.	
Vanumamalai Kannan	2010	Benchmarking the service quality of ocean container carriers using AHP	Shipping lines, services	Paper identified and clustering of various attributes that decide the service quality of container carriers in the Indian environment. After clustering of attributes under seven criteria, four decision choices were hypothesized and then the AHP hierarchy was structured.	
Liu	2010	Efficiency determinants at 25 Port terminals in Brazil using DEA	Throughput (tons), service standards, time spent on operations, average idle time, energy consumed, container lot size,	Efficiency indicators grouped basing inputs and outputs for production function analysis. Found private terminals to be more efficient.	Too many variables considering the number of DMUs.

			no. of tugs, income, personnel expenses, accounts receivable turnover, depreciation, direct & indirect labour, no. of berths, terminal area, no. of quay cranes, no. of buildings, no. of warehouses, no. of waterways, customer satisfaction, average age of workforce		
Simoes, Marques	2010	Performance of 41 European ports in 2005 using DEA	Throughput (TEU), throughput (tons), no. of passengers, Operating expenses, capital employed.	Found inefficiency by reducing noise, presence of outliners and 'curse of dimensionality'.	Only one year data considered
Wu, Goh	2010	Port operations efficiency in emerging markets using DEA	Throughput, berth length, terminal area, no. of quay cranes, no. yard cranes, no. of	Regardless of input-output volumes, planning facilities based on actual cargo demand achieves efficiency.	Study on container terminals suggests for further studies covering non-tangible factors that influence terminal efficiency.

			straddle carriers, no. of prime movers/forklifts, no. of trailers/vehicles/trucks, no. of lifters/stakers	Ports of emerging economies lack heavy equipment but are operationally competitive than advanced ports.	
M.B.M de Koster B.M. Balk W.T.I van Nus	2009	Using DEA for benchmarking container terminals.	Quay gantry cranes, total quay length, terminal area.	DEA is commonly used to benchmark container terminals by using public data. The method requires no prior information on the data and is a powerful tool to relate multiple inputs to multiple outputs.	
Hokey Min Seong-Jong Joo	2009	Assessing the comparative strengths and weaknesses of leading third-party logistics providers in the USA.	Current assets, fixed assets and other assets such as intangible assets.	The proposed BCC version of DEA model mitigates the impact of economies of scale on the 3PL's financial efficiency and thus helps to identify the true sources of inefficiencies.	To develop innovative ways to analyze and interpret secondary data sources available from both private and public (e.g. government) sectors.
Jiang, Li	2009	Performance Measurement of	Throughput, berth length, no. of	Propose technical efficiency parameters,	

		Seaports in Northeast Asia	quay cranes, no. yard cranes, US imports, US exports, GDP	proved availability of substantial efficiency improvement opportunities & heterogeneity.	
Panayides, Maxoulis, Wang, & Ng	2009	Review & critical analysis of DEA as technique measuring port efficiency.	Review Paper	Suggested for use of greater number of input-output variables with adequate sample size.	Only cross-sectional data used. Time series data would give better results.
Barros &Mangi	2008	Efficiency drivers at 39 Japanese Seaports, 2003-2005 using DEA	Throughput (tons), throughput (TEUs), no. of vessels handled, no. of quay cranes, no. yard cranes, workforce	Technical efficiency scores of unique assets exhibit differentiated levels. Hub port strategy improved efficiency. Ports with similar asset configurations pursued same strategies & similar performances & differentiated strategies result different efficiencies.	
Park, Ro-Kyung	2008	Verified 24 Korean container ports Efficiency for 3 years using DEA	Throughput (TEUs), time spent on operations, direct & indirect labour, length of quay, container yard area, no. of container cranes.	To understand efficiency and for future planning, results of both techniques used are required.	
Mohd Daud	2008	Perceived resistance,	Age,	It is hoped that the	Examination of comprehensive

Norzaidi Soiong Choy Chong Mohamed Intan Salwani		user resistance and managers' performance in the Malaysian port industry	Education, Department, Gender, Position, Task technology fit, User resistance, Manager's performance.	above suggestions will provide some insight to organization's contemplating technological usage on what should be done in order to overcome resistance and encourage voluntary usage.	dimension of perceived resistance, user resistance, and intranet usage.
Yen-Chun Jim Wu Chia-Wen Lin	2008	International comparison of logistics/port operations with a main focus on India.	Total tons throughput, level service, use's satisfaction, ship calls, total cargo moved through docks, ship working rate, number of containers, number of ships, total containers handled, Revenue obtained from port activities.		Internal port operations, Efficient customs clearance operations.
Photis M.	2008	Integration of seaport	Container	Traditional methods and	Identification of

Panayides Dong-Wook Song		container terminals in supply chains	Terminals.	measures for measuring port performance can be significantly enhanced by incorporating supply chain variables.	factors that may lead to integration and empirical investigation of whether and to what extent those factors are actually predictors of container TESCI.
Violeta Roso	2008	Factors influencing implementation of a dry port.	TEU's Handled at ports, TEU's on rail.	That transport issues might be closely related to psychological and behavioral issues and if actors involved are not well-informed on the matter problems might arise.	
Wai Peng Wong Kaun Yew Wong	2008	A review on benchmarking of supply chain performance measures.		Benchmarking is an essential cornerstone for companies to remain at the forefront of excellence in a level playing field market. A clear understanding of their inherent features will help to provide a more optimal approach to benchmarking in supply chain.	
Cherie Blanchard	2008	Adding value to		It is important for	

Clare L. Comm Dennis F.X. Mathaisel		service providers helping them to learn Wal-Mart's best practices in SCM.		every company to examine its industry and its own business strategy in order to determine if a SCM technique will support its goals. If service providers can learn from Wal-Mart how to achieve these benchmarks then they can become more competitive and add more value for their clients.	
Sandra Moffett Karen Anderson-Gillespie Rodney McAdam	2008	Exploration of theoretical understanding and practical application lead benchmarking and performance measurement as a way to achieve organisational change.	Beyond Internal and External Performance Measures Lead and lag performance measures, Upstream performance dimension, Lead Benchmarking Indicators	Use of benchmarking there is an indication that across all organisation sizes more focus is placed on operational issues than strategic issues. The location of lead benchmarking and performance measurement was clearly identified as	

				being upstream in the organisation.	
Anatoliy G. Goncharuk	2008	Performance benchmarking in gas distribution industry.	Material cost, Amortization, Employees, Accounts payable, Operating revenues.	Using both domestic and international performance benchmarking gives the important information for company management about capability of improving of the efficiency. The analysis has revealed weak influence of the factor of regional location on efficiency of the companies.	
Jeanette Raymond	2008	Technique of benchmarking to improve the quality of the public procurement process.		Major reforms and benchmarks are needed for effective implementation of government procurement policies. Benchmarks are also necessary so that politicians and	

				government officials will perform tasks to generate benefits for the country rather than for themselves.	
Yen-Chun Jim Wu Chia-Wen Lin	2008	National port competitiveness: implications for India	Land, Equipment, Labor Input, Tug boats, Cargo, Actual Throughput, Service Level output.	This study found that the ports of Shanghai in China and Chittagong in Bangladesh had efficiency levels between 2000 and 2005 that even surpassed those found in advanced countries. Although our findings suggest that India's efficiency score is unsatisfactory, with the country ranking 6th among ports using the CCR model and 10th using the BCC model, India showed considerable improvement during the 2003-2005 period	RCA indicators are only able to examine past and present industry conditions based on export results, and do not provide a detailed explanation of the reasons for changes in levels of competitiveness.
Chudasama,	2008	Measured efficiency	No. of Berths, No.	Performances have been	

Pandya		of Indian Ports in competitive environment 2002-2006.	of Quay/Container Cranes, No. of Yard Cranes, No. of Straddle Carriers No. of Prime Mover Tractors/Forklifts, No. of Trailers/Vehicles/ Trucks, No. of Lifters/Stackers, Throughput (Tons), Number of Vessels Handled/Total Traffic	diverse with some ports registering better technical efficiency and some on scale of operations.	
Pranav J. Deshpande Ali Yalcin Jose Zayas-Castro Luis E. Herrera	2007	Discrete simulation approach to benchmarking performance measures of terminal operations of less-than-truckload (LTL) freight carriers.	Truck arrival rate, outbound freight volume, Inbound freight volume.	Simulation models can be used at the highest level of detail to interact with and evaluate the policy recommendations of more aggregate optimization-based models.	
Mark Jaques Barry Povey	2007	Assessing the changing role, attitudes and knowledge of UK	Business units, Industry sector.	Although BL has been restructured towards start-ups and small businesses the	Need to use sophisticated benchmarking tools such as Product 10 (BPD) on these companies.

		business advisors to the benefits of benchmarking and benchmarking tools.		benchmarking tools available to the advisor have not changed to reflect this, and therefore cannot be used by the majority of the advisors clients.	
Glenn R. Luecke Ying Li Martin Cuma	2007	Use of nodes in cluster efficiency by studying the NAS parallel Benchmarks (NASPB) on Intel Xeon and AMD Opteron dual CPU Linux clusters.		The performance results from running the NASPB show that better performance can sometimes be achieved using 1 ppn. The performance results in this paper also show that the Opteron/Myrinet cluster is able to achieve significantly better utilization of the second processor than the Xeon/Myrinet cluster.	
Okke Braadbaart	2007	Collaborative benchmarking, transparency and performance: Evidence from The Netherlands water	Customer per km mains, total water sales, water sales per connection, water source	Benchmarking enhanced transparency. Benchmarking did not affect utility performance until benchmarking results	The test results presented here do not offer support for the managed competition proposition that yardstick regulation is necessary for benchmarking to make an impact on economic performance.

		supply industry		entered the public domain.	
Cheon	2007	Impact of institutional reforms on efficiency from 1991 to 2004.	Throughput (TEUs), Frequency of ship visits, terminal area	World ports improved due to reforms that resulted in decentralised management, technological progress, & scale adjustments. However, the study also found that overdependence on technologies has its own limitations.	
Cheryl Henderson-Smart Tracey Winning Tania Gerzina, Shalinie King and Sarah Hyde	2006	Benchmarking teaching and learning in response to an institutional need to validate a new program in Dentistry at the University of Sydney, Australia.	Students, staff, resources.	The main purpose of benchmarking is self-regulation and quality improvement in teaching and learning.	
Yean Pin Lee Suhaiza Zailani Keng Lin Soh	2006	Understanding factors for benchmarking adoption in Malaysia.	Top management commitment, Internal Assessment, Employee Participation, Benchmarking	The employee participation, top management commitment and the role of quality department are the three discriminating factors	There is a relationship between industry and benchmarking adoption. Therefore, it is recommended to extend the framework to a more distinguished industry such as service, construction and public

			limitations, quality department, customer orientation and benchmarking adoption.	for benchmarking adoption, regardless of the customer orientation of the company and benchmarking limitation	sectors.
Cullinane, Wang	2006	Efficiency of 69 container terminals with over 10,000 TEUs throughput across 24 European countries during 2002.	Throughput (TEUs), terminal area, container yard area, no. of quay cranes, no. of yard cranes, no. of straddle carriers, no. of prime movers, no. of tractors/forklifts, no. of trailers/vessels/trucks, no. of lifters/stakers	With large data, found low efficiency. Found linkage between cargo volumes and performance.	
Chen Lin	2005	Service quality and prospects for benchmarking of Peruvian water sector	1) Wage 2) Price of Capital 3) Water billed 4) Number of customers 5) Positive rate	The dimension of performance is especially important for the water and sewerage industry in developing countries.	Efficiency change, frontier change, quality change

			of chlorine tests 6) Continuity of service		
Karen Anderson Rodney McAdam	2005	An empirical analysis of lead benchmarking and performance measurement.	Public sector manufacturing industries.	Across all size sectors, there is more of focus on operational issues than that of strategic issues. Larger organizations were more likely to strategically implement and make effective use of lead benchmarking.	More in-depth explanation of the reasons why the approaches and attitudes to lead benchmarking and performance measurement are taken in organizations.
Anne Graham	2005	Current attitudes and practical experience of airport benchmarking.	Economic performances, Operational performances, Environmental performances.	Considerable developments within the area of airport benchmarking in recent years and the sector no longer lags so much behind other industries, including airlines, in the knowledge and practical use of performance indicators.	Further study covering higher number of operations needed.
Jackie Fry Ian Humpherys	2005	Use of best practice benchmarking in civil	Regions, Passengers	The high uptake of benchmarking is	

Graham Francis		aviation.	handled.	probably due, in part, to the turbulent nature of civil aviation.	
Lloyd M. Austin	2005	To describe and analyse the adoption of economic value added income as a benchmark.	Price, Net profit after tax, Capital.	The adoption of EVA as a method of benchmarking performance and controlling monopoly earnings has been a successful strategy for ACNZ.	
Hsiu-Li Chen	2005	A competence-based strategic management model factoring in key success factors and benchmarking.	Airports, Number of passengers, Air cargo.	The study of strategic management is one of the most important issues in all business areas, since every decision made by an organization's managers has strategic implications, and people at every organizational level have a role to play in developing, implementing and changing the organization's	Focus on different organisations in different industries and undertake comparative analysis across these organizations.

				strategies.	
K.L.H. Wynn-Williams	2005	Performance assessment and benchmarking in public sector.		A public sector organisation that needs to balance financial management with services for the public good must be clear in the manner that potential conflicts are managed; it is here that the greatest need is seen for stated and agreed process benchmarks.	
Vinh Van Thai Devinder Grewal	2005	An analysis of the efficiency and competitiveness of Vietnamese port system	Volume of cargo handled, TEU's handled, Ports of Vietnam,	This study has revealed some basic problems as far as efficiency and competitiveness are concerned. In order to achieve comparative advantage in the international market, the port system of Vietnam should note these issues and works out strategies to improve.	Methods of capital rising and finance related issues are not discussed in this paper.
Lee, Chou, Kuo	2005	Port Efficiency at 16 Container Terminals	Throughput (TEUs), average	Ranked selected container ports in Asia	

		in Asia Pacific Region using Recursive DEA	idle time, vessel working rate, no. of tugs, direct & indirect labour, no. of berths, terminal area, no. of quay cranes, no. of yard cranes.	Pacific region considering operational efficiency.	
Clyde Kenneth Walter Richard F. Poist	2004	North American inland port development: international vs. domestic-only shippers.	Company size, operations, Size of operations in central lowa, Respondent information.	The target market for a North American inland port is primarily international shippers, not domestic-only shippers. The most-desirable features of a North American inland port appear to be both information and facilities-based.	Research on Inland ports and their development.
Chinonye Ugboma Innocent C. Ogwude	2004	Determinants of service quality and determines the quality of service offered by two ports in Nigeria.	Port Harcourt, Lagos	The port industry received strong ratings on the “responsiveness” and “tangibles” dimensions of service quality and lower ratings on the empathy dimension.	Identification of service quality in ports.
J. Bauer	2004	Performance		Benchmarking is	

S.J. Tanner A. Neely		measurement audit template can be used as a basis to examine and improve performance measurement in organizations.		recognized by successful organizations as a practical and proven tool to accelerate improvement by learning from other outstanding organizations.	
Mahmoud M. Yasin Marwan Wafa Michael H.Small	2004	An analysis of JIT implementations in the manufacturing services and public sectors.	Procedures and oriented modifications, operations oriented modifications, human related problems, Supplier related problems.	The extent of modification efforts undertaken in preparation for JIT and potential problems encountered during the JIT implementation process are significantly correlated.	Operational, Strategic and organizational facets and effective JIT practices.
Syed Omar Sharifuddin bin Syed-Ikhsan Fytton Rowland	2004	The availability of a knowledge management strategy in a public organisation in Malaysia.		Most of employees agreed that the Ministry could gain a lot of benefits from managing knowledge. In addition to improving work quality, having up-to-date information and improving decision	

				making, it was believed that by managing knowledge the Ministry would be able to respond to customer needs.	
Manuel Cuadrado Marta Frasquet Amparo Cervera	2004	Benchmarking techniques to the sphere of ports.		Transport intermodality has stimulated the increase in sea traffic and has favoured the development of ports as logistics platforms. The services can be analysed in relation to the following dimensions: time, safety and cost by establishing concrete indicators to measure and evaluate each of these dimensions.	
Manuel Cuadrado Marta Frasquet Amparo Cervera	2004	Benchmarking the port services: a customer oriented proposal	Cost, safety, time	These services can be analysed in relation to the following dimensions: time, safety and cost by establishing concrete indicators to measure and evaluate	This proposal is based on a client oriented approach and it considers that the processes that should be analysed are those implicit in the motives for choosing one port over another.

				each of these dimensions. Detailed analysis of these indicators will decide which of the services should be improved to increase the level of competitiveness.	
Ana Cristina Paixao Peter Bernard Marlow	2003	Fourth generation ports and a methodology for implementing the concept of agile ports.		Uncertainty is certainly the one that is causing the most concern within the port industry, obliging ports to become more competitive. Agility is one such strategy that will help ports to adjust to the new economy.	
R. Dattakumar R. Jagadeesh	2003	A review of literature on benchmarking.		A scrutiny of the publications shows that several aspects of benchmarking along with many interesting and diversified applications, have been covered in sufficient detail.	Need further exploration on the topic, to make it more useful.

Paula Kyro	2003	Revising the concept and classification for both theoretical and practical purposes of benchmarking.	Performances, Technology, Process, Competence and strategy.	Benchmarking requires some conceptual rethinking. It was argued that the need for re-conceptualizing is due both to the appearance of three new forms of benchmarking, and new fields of benchmarking.	
Hesham Magd Adrienne Curry	2003	In order for benchmarking to be successful in public sector organisations, it is important to have a full commitment to continuous improvement.		It is vital for public-sector organisations to develop a desire to change processes as well as outputs and an organisational willingness to search for ideas outside the organisation in order to achieve successful benchmarking.	
Louise boulter	2003	Legal issues in Benchmarking.		The practice of benchmarking creates a new area of interest for the law. Organisations conducting benchmarking studies	

				should consider taking responsibility for raising the awareness of employees conducting benchmarking practices on the law.	
Ana Cristina Paixão Peter Bernard Marlow	2003	Fourth generation ports – a question of agility?	Transport modes, cargo	Uncertainty is certainly the one that is causing the most concern within the port industry, obliging ports to become more competitive. To become proactive rather than reactive, port operators must adopt new management strategies like agility.	Other aspects are not defined like land utilization and expansion.
Gordon Rankine	2003	Benchmarking container terminal performance	Terminals, productivity,	With increasing pressure on costs and efficiency of land utilisation benchmarking is a particularly useful tool for any container terminal.	
Mahmoud M.	2002	Benchmarking		The applied art of	

Yasin		practices and theory reviewed from 1986 to 2000.		benchmarking has become broader in nature to include strategies and systems.	
Per V. Freytag & Svend Holensen.	2001	The process of benchmarking, benchlearning and benchaction.		Benchmarking, benchlearning and benchaction is not a one-time project. It is a continuous improvement strategy and a change management process. Benchmarking is a part of the TQM system, and it relates well to other TQM initiatives.	
Norman Jackson	2001	Benchmarking in UK higher education.		The challenge for higher education will be to develop benchmarking in a way that will help people learn about and improve their own practice while improving the overall capacity of the system to develop, improve and regulate itself.	

Woon Kin Chung	2001	Benchmarking Singapore's high TQM maturity organisations.		Organisations can be expected to be at different TQM maturity levels at any point in time because of the influence of several factors, and that benchmarking provides useful findings to advance any TQM programme.	Inter-temporal study of the productivity leaders; Inter-country studies could be done as the TQM framework; testing of various TQM constructs and their contributions to the organisation's performance.
Carol Boyd	2001	HRM in the airline industry: strategies and outcomes	Airlines, Quality, Cost Minimization,	A number of cost minimization strategies have been identified that may erode health and safety standards in the industry. The survey findings strongly suggest that airlines' cost minimization and productivity maximization strategies have a degenerative effect on health and safety standards.	Solution to the apparent failure of airlines to practice what they preach in policy statements communicates a disheartening message about the actual position of health and safety in management agendas is missing.
Seung-Kuk Paik Prabir K. Bagchi	2000	Process reengineering in port operations.		Process reengineering is often regarded as one of	

				the surest ways to make fundamental improvement in operations. IT can be used as a powerful enabler and thus opens up new possibility for better performance.	
M. Kia E. Shayan F. Ghotb	2000	Importance of IT in port terminal operations.		The advancement of information technology provides a wide range of options for the container terminal operator to automate its information system. The use of computer simulation has become a standard approach for evaluating design of complex cargo handling facilities.	
Matthew Hinton Graham Francis Jacky Holloway	2000	Best practice benchmarking in UK-based organizations.		A great deal of benchmarking activity can be described as “results" benchmarking as opposed to “process" benchmarking.	

Davis Longbottom	2000	Investigating the status of benchmarking within UK.		Benchmarking methods will need to penetrate much further into the Marketing domain than appears to be evident at the present time.	
Kin Chung Woon	2000	Assessment of TQM implementation: Benchmarking Singapore's productivity leaders	Validity, quality	The organisations were found to have a medium level of TQM implementation. The TQM constructs in these organisations were also found to be highly interrelated.	The organisations were found to have a medium level of TQM implementation.
Alexander Kouzmin Elke Loffler and Helmut Klages Nada Korac-Kakabadse	1999	Benchmarking and performance measurement in public sectors.		Public sector organizations are becoming not only users, but providers and exporters of global information and associated services in an increasingly globalized market.	
Ingrid Lobo Mohamed Zairi	1999	Competitive benchmarking in the air cargo industry: Part II	Airlines,	The analsysis from the survey undertaken and the outcomes covered in this	

				paper have been useful in measuring the differences between the various organisations scrutinised and supporting the differences in scores by specifically highlighting the practices reported.	
Gregory M. Magnan, Stanley E. Fawcett, Laura M. Birou	1999	Benchmarking manufacturing practice using the product life cycle		The findings highlight many manufacturing practices that represent largely untapped opportunities.	
Bjørn Andersen & Rune M. Moen	1999	Integrating benchmarking and poor quality cost measurement for assisting the quality management work		The benchmarking model benefits from the structured activity analysis and the overall cost and performance picture visualized through the loss function.	
Khurrum S. & Bhutta Faizul Huq	1999	Benchmarking – best practices: an integrated approach		Senseless mistakes are avoided by setting goals and following the rules to achieve them. Companies that	

				benchmark identify specific areas of weakness, and find solutions to turn them into strengths.	
Jeffrey J. Dorsch Moahmoud M. Yasin	1998	Extent of Utilization of benchmarking in public ports.		Systematic sharing of benchmarking knowledge between the business community and the academic community is mutually beneficial.	
Sik Wah Fong Eddie W.L. Cheng Danny C.K. Ho	1998	Introduction of benchmarking to management practitioners.		It helps in identifying the sources of best practices as a result of assisting in promoting management perspectives.	
Raul Compes Lopez Nigle Poole	1998	Quality assurance in the maritime port logistics chain: the case of Valencia, Spain.		The efficient functioning of the international logistics supply chain requires the provision of high quality port services so that processes whereby goods are transported by	

				sea meet the expectations of the final consumers in respect of punctuality, quality, reliability and price.	
R. Love H.S. Bunney M. Smith B.G. Dale	1998	Benchmarking in water supply services: the lessons learnt	Water sales, sales of water, cost	A benchmarking project is likely to generate other additional benchmarking projects within the process studied or with interfacing processes.	In order for a benchmarking project to be a success there are certain difficulties and pitfalls which must be avoided like *Lack of a contingency plan, Failure to update the plan, Failure to communicate the plan and others whose solution is not given*
R. Love H.S. Bunney M. Smith B.G. Dale	1998	Benchmarking in water supply services: the lessons learnt		It became clear as the study progressed that while lots of organisations and people use the benchmarking jargon, much of the discussion relates to competitive analysis of product and equipment and not the benchmarking of processes.	
Ross L. Chapman	1997	Strategic quality	Shareholders,	The labour productivity	There are also anomalies

Peter Charles Murray Robert Mellor		management and financial performance indicators	Labour productivity.	ratio appears to be considerably more sensitive to QSA/TQM initiatives than either return on assets (ROA or ROTA as used here) or earnings on shareholder's funds (EOS, or EOSF as used here). Values for both ROA and EOS type ratios are susceptible to variable financial decision making.	regarding stated importance/ performance and measured performance in terms of labour productivity ratios (LPR) over "all" companies, especially in the significant indicator of deployment/ involvement. In addition, current research activities are targeting a small number of companies in the sample for a longitudinal study
Alan Stainer	1997	Logistics - a productivity and performance perspective	Labour, materials, transport, productivity	Logistics management must maintain and improve cost advantages reflected in total productivity, as well as customer service performance in order to remain healthy.	Many departments are left untouched like continual productivity and integrated performance excellence, to ensure that there are efficacious monitoring and communication systems in place and more.
Brian S. Codling	1997	Dynamics of best practice - a multidimensional perspective	System efficiency, culture	The considerations discussed in this paper give an explanation as to why many companies are surprised, both	

				positively and negatively, by the results that they have obtained in benchmarking. They also develop a rationale that "best practice" for a system is unique to a company	
Prabir K. Bagchi	1996	Role of benchmarking as a competitive strategy.		In an increasingly competitive marketplace, companies are searching for ways to achieve breakthrough improvements across the organization Benchmarking, involves critical self-evaluation – exposing one's weaknesses to the world.	Need to establish a link between the resources needed to manage a benchmarking study and the resultant benefits.
Jose L. Tongzon	1995	Systematizing international benchmarking for ports.	Total throughput, number of commercial vessel visits, vessel size and cargo exchange, number	Efficiency of a port must be compared with other ports of similar characteristics so that the assessment can be justified. Further overall	

			of container berths, number of gantry cranes.	performance can be compared on the basis of estimated principal component.	
Mohamed Zairi Mohamed Youssef	1995	A review of key publications on benchmarking part I		The authors conclude by noting that benchmarking is a process of raising awareness within an organization and developing a culture that is willing to learn.	

2.1 Major inferences derived from literature review:

1. Numerous studies exist on performance measurement at selected organisations in various sectors and are based on limited data (but not on comprehensive data across the industry).
2. Efficiency measurement at port sector is dominated with studies measuring relative efficiency using various techniques including Data Envelopment Analysis (DEA) in hindsight but do not propose any measures to improve efficiency.
3. Benchmarking studies in ports taken up at a few countries have contributed in efficiency gains at those ports/terminals.
4. In Indian context, numerous studies exist on port performance but there exists no study on setting benchmarks for performance improvement. This has led to an ambiguity of benchmarking performance standards.
5. Establishment of benchmarks in port sector would help in monitoring and thus enhancing the service quality levels at the major ports of India where by reducing pre berthing detention time, and faster turnaround time of vessels and reduction in the total transactional cost.

2.2 Major Gaps derived from Literature Review:

From the literature review, the following gaps were evident

a) Research papers on Indian ports hitherto focused on relative efficiency but not absolute efficiency. This results in lack of scope for efficiency improvements.
b) No attempts were made to set benchmarks covering holistic efficiency of ports in India such as Overall Port/Terminal Efficiency, Berth Efficiency, Yard Throughput, and Evacuation Efficiency

2.3 Theme Based Inferences and Gaps:

Literature reviewed in the above table is segregated into themes and shown in this table below:

Table 2.4 Theme analysis of Literature Review

Theme	Authors	Inferences	Gaps
Performance and Efficiency – In General	Ghasmi et. al. (2015); Sarkar (2015); Rezaee (2014); Barberio et. al. (2014); Atici & Podinovski (2014); Hatami-Marbini et. al. (2014); Yang et. al. (2014);	a. Numerous studies covering sectors such as manufacturing, services, human resources aspects, etc. have been assessed and is evolving. b. Numerous statistical, mathematical, psychometric & behavioral approaches were employed to measure performance.	i. Studies traced deviations between standards and actuals, but failed to suggest corrective actions to enhance overall performance
Performance and Efficiency – In Port Sector	Rajasekar et. al. (2014); Marales et. al. (2013); Rajasekar & Deo (2012); Lu & Wang (2012); Nwanosike (2012);	a. Studies measured comparative performance of ports across the world b. Studies depended on parametric and non-parametric models to	i. Studies concentrated on relative grading of ports ii. Few studies at some in China and selected European countries attempted to benchmark port

	Pjevcevic (2012); Nwanosike, Tipi, Smith (2012); Lu & Wang (2012), Pjevcevic et. al. (2012); Nwansoike (2012); Wanke, Barbastefano, Hijjar (2011); Bhatt & Gaur (2011); Bergantino & Musso (2011); Simoes & Marques (2010); Wu & Goh (2010); Jiang & Li (2009); Panayides (2009); Liu (2010); Muniswamy (2010); Al-Eraqi (2010); Chun et. al. (2008); Chudasama & Pandya (2008); Barros & Mangi (2008); Park & Ro-Kyung (2008); Cheon (2007); Cullinane & Wang (2006);	measure efficiency c. Studies are mostly based on performance indicators proposed by UNCTAD and World Bank agencies	performance. But no such attempt is made in Indian context where standards for various terminals are set and actuals are compared. iii. Further studies in Indian context, till date, have not attempted to trace reasons for efficiency/inefficiency. No study proposed measures for enhancing absolute efficiency at Indian ports. iv. In Indian context, studies concentrated on operational efficiency alone and ignored financial aspects.

	Lee et. al. (2005); Thai & Grewal (2005); Rankine (2003); Tongzon (1995);		
Benchmarking – In General	Jacek Strojny (2015); Festal & Wurmseher (2014); Panwar et. al. (2013); Mohammadi et. al. (2013); Williams et. al. (2012); Putkiranta (2012); Hilmola (2011); Cappelli et. al. (2011); Ajelabi & Tang (2010); Adebajo et. al. (2010); Bjorklund (2010); Nunes & Bennett (2010); Presley & Meade (2010); Peng et. al. (2008); Blanchard et. al. (2008); Moffett et. al. (2008); Goncharuk (2008); Raymond (2008); Deshpande (2007); Jaques & Povey (2007); Luecke et. al. (2007); Braadbaat (2007); Hannderson-Smart et. al. (2006); Lee et. al. (2006); Anderson &	a. Benchmarking is a process of setting standards and helps in enhancing overall performance of business entities b. Process of benchmarking is complex and is depended on type of processes and output.	a. Benchmarking is a tedious exercise where micro level assessments are required. b. At the same time it has to be reviewed periodically.

	McAdam (2005); Graham (2005); Fry et. al. (2005); Austin (2005); Chen (2005); Wynn-Williams (2005); Bauer et. al (2004); Dattakumar & Jagadeesh (2003); Kyro (2003); Magd & Curry (2003); Boulter (2003); Yasin (2002); Freytag & Holensen (2001); Jackson (2001); Chung (2001); Hinton et. al. (2000);		
Benchmarking – In Port Sector	Report of Port Regulator of SA (2014); Jorgen et. al. (2012); Kannan (2010); Koster et. al. (2009); Lin (2005); Cuadrado (2004); Rankine (2003); Dorsch & Yasin (1998); Tongzon (1995)	a. Benchmarking at a few of the world ports has enhanced their overall performance b. It helped in detecting areas of improvement and helped in control mechanism	a. Benchmarking, as a process, is not attempted at Indian port sector. This has resulted in inability to control both financial and operational opportunity losses.

From the theme based segregation of literature review, the following research problem is derived.

2.4 Benchmarking Studies:

From the literature reviewed, it can be observed that numerous studies covering a wide variety of sectors are available that have attempted to set benchmarks. Researchers proposed benchmarks in industries such as automobile, airports, manufacturing, etc. to enhance workforce performance. However, number of studies on ports sector are limited and generally focused on operations of container terminals alone. Koster et. al.(2009) used Data Envelopment Analysis (DEA) to set benchmarks at selected container terminals across the world. The authors suggested DEA as a better tool for benchmarking only if accurate and minute data variables, often times not in public domain are available.

Deshpande et. al. 2009 attempted performance benchmarking of terminal operators of less than truck-load freight carriers. They used discrete simulation approach for benchmarking and found the tool to be effective, especially, in live work environment.

Cuadrad & Cervera, 2004 proposed time, safety and cost as important dimensions for benchmarking of selected container ports. They argued that these indicators can help in identification of services for improvement in efficiency of ports. Tongzon, 1995 used Principal Component Analysis to benchmark homogeneous ports and suggested measures for efficiency measurement among them.

While the above studies have attempted to benchmark ports/terminals, their access is limited to publicly available data. However, to derive reliable benchmark standards, a study considering the real time data pertaining to various activities at ports (including navigation side, berth side & yard side operations) is required. The current study aims to set benchmarks at various terminals at the major ports of India with the help of narrowed down real-time data. The results of this thesis would benefit all the major ports to look to these benchmark standards and compare their performance. The study would also help them to derive policies to improve their efficiencies and strive to achieve these standards.

Chapter III - Research Methodology

3.1 Research Problem

Numerous studies have measured efficiency of Indian major ports. However, these studies could not prescribe any standards for improvement in efficiency parameters. This warrants a comprehensive research to set performance benchmarks in comparison to the best-in-class ports and thereby explore measures for improvement of overall efficiency resulting in optimisation of capacity and financial gains.

3.2 Research Questions:

- How to benchmark various Key Productivity Parameters in port operation for Major Ports of India?
- How port efficiency can be improved using benchmarks?

3.2 Research Objectives:

- To determine & calculate benchmarks for Key Productivity Parameters in port operation for Major Ports of India;
- To explore the initiative required to improve efficiencies at major ports of India and transform them into best- in- class ports.

3.3 Research Design

In pursuance of the first objective, of determining ‘important KPIs’ and ‘calculate benchmark’, major ports were clustered on the basis of cargo being handled. KPIs was determined through literature review and raked them by survey through Liker Scale analysis, the operational and financial data for each of the 12 major Indian ports was collected for benchmarking against relevant private Indian Private Ports as well as a group of relevant International ports. The benchmarking exercise was done for all important aspects of port operations, i.e, marine operations, berth operations, yard management, storage and evacuation in terms of Key Performance Indicators by normalization of data by taking the parameters: viz., Size of Port, Number of Berths, Type of commodity and Degree of Automation. For the second research objective, 'efficiency improvements at major ports of India', deep 'Root Cause Analysis' carried through Fish-Bone diagram analysis, "5 Whys analysis" are captured in deep-dive analysis chapter that form basis for suggestion of measures to improve efficiency standards at these ports.

3.4 Process details

Benchmarking Process, normalization, nature of data and metric used for benchmarking process are shown in Table 3. 5.1, 3.5.2, 3.5.3 and 3.5.4 respectively.

Table 3.5.1 Benchmarking Process

Benchmark KPIs	**Data Collection**	**Normalisation of data**	
KPIs were identified across parameters • Literature Review • find relative importance of KPIs and Rank them	**Specific data requests shared with the ports** • Standard format shared with all ports • Follow-ups and data gathered	**Collation of data in varying formats** • Integration of data points in similar formats • Data sanitation and normalization	

Table 3.5.2 Data normalization was undertaken for accurate benchmarking

Data clean up, re-analysis and normalization done to ensure 'like to like' benchmarking **Illustrations**			
Metrics used for benchmarking	**Metric standardised and redefined**	**Data analysis / consistency check**	**Normalization basis**
Capacity utilization	**Definition 1:** Actual throughput delivered / max throughout possible with 100% occupancy at best demonstrated productivity (%)	Best demonstrated performance calculated at each berth to calculate the max possible capacity	**Commodity:** Only berths with majority Coal traffic (> 60%) considered

	Definition 2: Actual throughput delivered / maximum possible output with 100% occupancy at benchmark productivity (%)		
Berth occupancy	**Original definition:** No. of days when berth was occupied by a vessel **Revised definition:** No. of hours when berth was occupied by a vessel	Calculation built up using all entries in vessel logs	**Mechanical and Conventional** berths benchmarked separately **Commodity:** Only berths with majority Coal traffic (> 60%) considered
Berth productivity	**Definition:** Metric tonnes of coal handled berth hour (working + idle time)	Only coal entries taken in case multi purpose berths	**Vessel:** Panamax, capesize vessels calculated separately Adjusted for share of coal traffic handled

Table 3.5.3 Data Collection

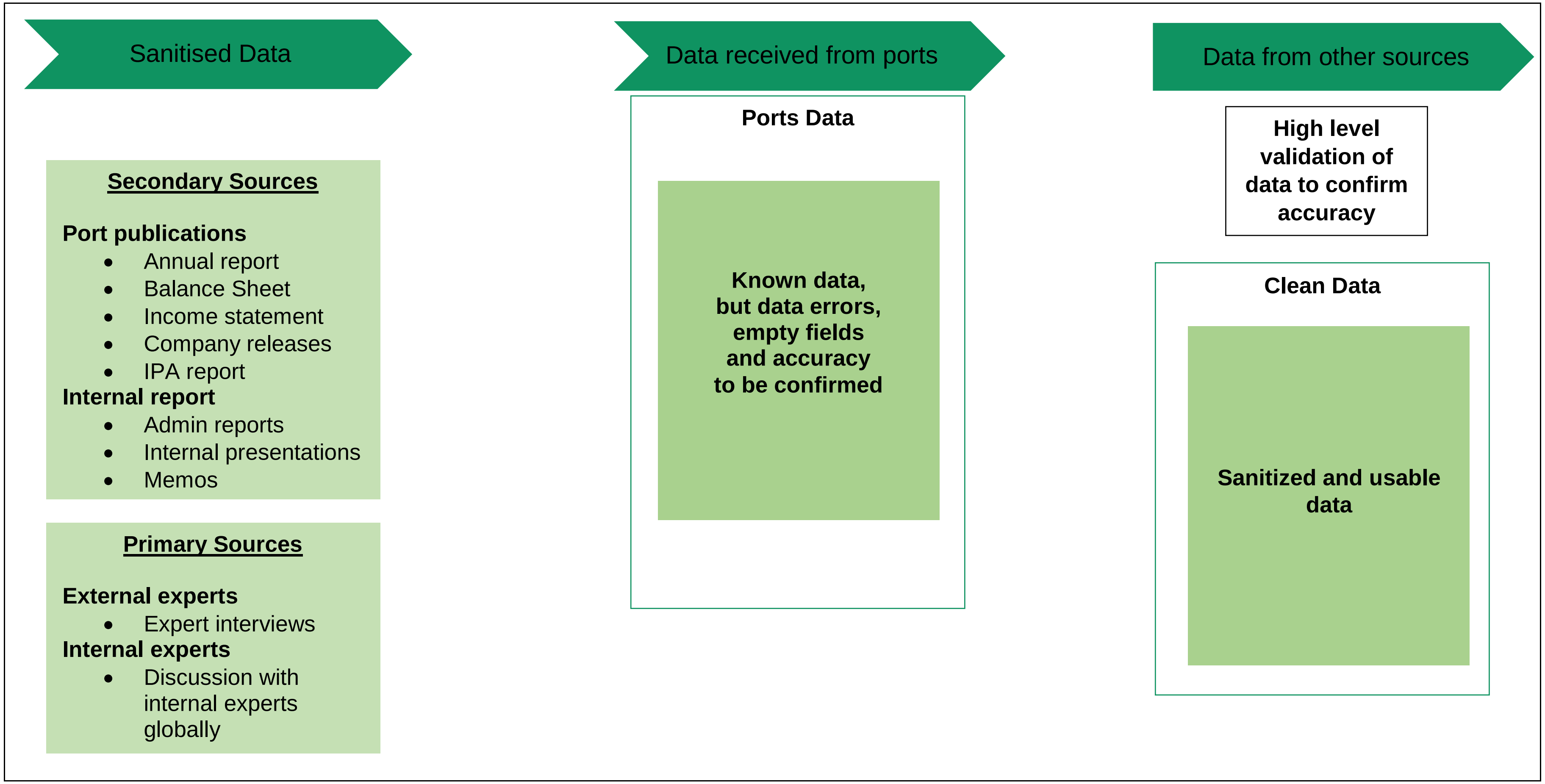


Table 3.5.4 Metric used for benchmarking process

Key utilization/demand metrics		**Key productivity metrics**		**Key cost metrics**
• Berth utilization (%) • Waiting time outside port (days) • Equipment utilization (%)		• Vessel turnaround time (days) • Non-working time at berth (days) • Berth output (MT per day) • Quay crane/gang output (MT per shift • Containers: RTG moves per hour • Containers: QC:RTG:Truck ratios • Containers: Truck turnaround times • Cargo dwell times		• Employees / MT handled • Gang size per shift • Fuel/energy cost per MT handled • Equipment maintenance cost per MT handled • Maintenance dredging cost per m3 excavated (if possible)

3.5 Research Methodology for Research Objective 1:

For the purpose of Benchmarking, the following steps are taken:

1. The Major Ports were clustered based on cargo categories (mechanised dry bulk, conventional dry bulk, containers and break bulk)

2. Important aspects of port operations were identified through Literature review viz., marine operations, berth operations, yard management, storage and evacuation. A set of targeted and specific metrics were used for comparing performance, they are:

- Berth output
- Vessel turnaround time
- Quay crane/gang output
- Containers: RTG moves/hr
- Containers: QC:RTG Truck Ratio
- Container: Truck turnaround times
- Cargo dwell times
- Waiting time outside port
- Berth utilization
- Equipment utilization
- Non-working time at berth
- Employees/MT handled
- Fuel/energy cost per MT handled
- Gang size per shift
- Equipment maintenance cost per MT handled
- Maintenance dredging cost per m3 excavated

3. To assess degree of importance of the identified KPIs, a survey was undertaken. A Likert type questionnaire (at Appendix- Survey Questionnaire) was administered among 200 key port stakeholders to get an external perspective.

[About Likert scale: It is a measuring tool or scale used to measure attitudes, beliefs, opinions behaviors and perceptions of individuals or consumers. It is a set question (called items) where each item has a fixed number of response categories used to know the agreements of respondents on variety of items, products and services]

The stakeholders were drawn from Senior Port Officers and experts, Customs Department, CHAs, ICDs, Freight Forwarders, Container Shipping Lines, CFSs, Ship-owners, Importers, Exporters, Railways.

The respondents were requested to indicate their perceptions about degree of importance to each of the 16 identified KPI (arranged in random fashion) in a five-point scale where *5* denotes maximum importance and 1 denotes minimum importance of a KPI. However, complete responses covering all the KPIs were obtained only from 185 respondents. Analysis of data was carried out with the responses completed on all respects from these 185 respondents. Distribution of scores for each KPI was found to be positively skewed with large variance. This is primarily due to the fact that the stakeholders more or less perceived each KPI as important. However, variance of each KPI was high, indicating non-uniform perspectives of the respondents. Highest mean was 4.00 and the lowest mean was 3.065. Descriptive statistics of the KPIs are depicted below. Cronbach alpha for the questionnaire was found to be 0.692387 implying moderately high reliability of the questionnaire.

[About Cronbach's alpha: Reliability of Likert scale are usually found using Cronbach's alpha which is a measure of internal consistency of the scale or questionnaire and is a function of the number of items in a test, item variances and the variance of the total score. Alpha is defined as:

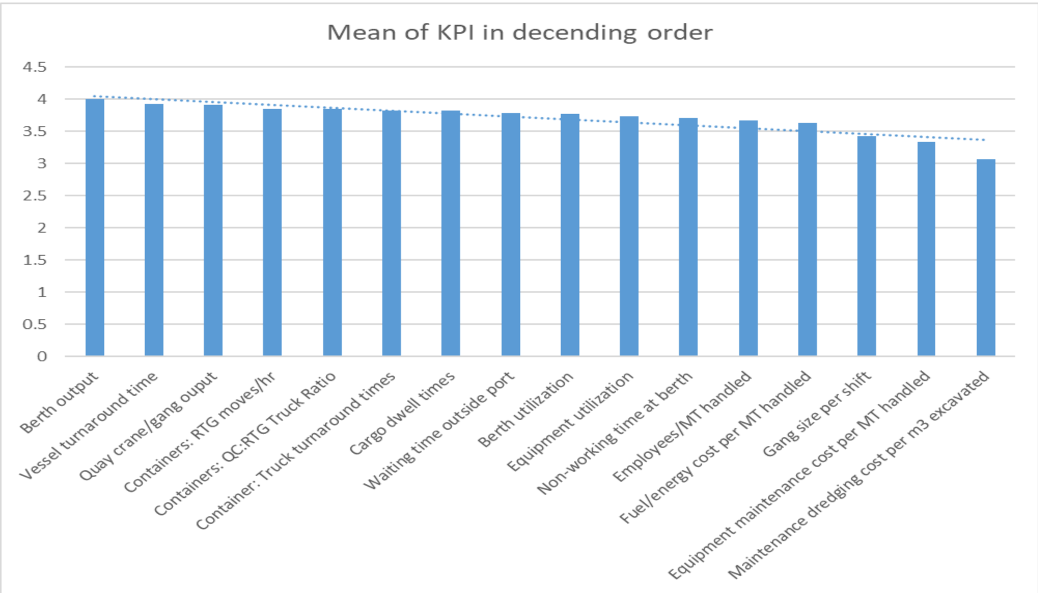
$$\alpha = \left(\frac{n}{n-1}\right)\left(1 - \frac{Sum\ of\ item\ variances}{Test\ variance}\right)$$

where n denotes the number of items. Cronbach's alpha increases as the intercorrelations among the items increase. Thus, it is known as an internal consistency estimate of reliability of test scores. It works well if the test is uni-dimensional]

Mean, variance and ranks of KPIs

KPIs	Mean	**Variance**	**Rank of KPIs**
Berth output	4	1277.373	1
Vessel turnaround time	3.924324	1228.827	2
Quay crane/gang ouput	3.913514	1071.787	3
Containers: RTG moves/hr	3.848649	1030.334	4
Containers: QC:RTG Truck Ratio	3.848649	929.5663	5
Container: Truck turnaround times	3.827027	1015.711	6
Cargo dwell times	3.821622	961.7466	7
Waiting time outside port	3.783784	923.6181	8
Berth utilization	3.778378	873.9455	9
Equipment utilization	3.735135	825.6434	10
Non-working time at berth	3.708108	899.3851	11
Employees/MT handled	3.664865	823.5958	12
Fuel/energy cost per MT handled	3.632432	761.7135	13
Gang size per shift	3.427027	628.5906	14
Equipment maintenance cost per MT handled	3.335135	552.4066	15
Maintenance dredging cost per m3 excavated	3.064865	522.1796	16
Questionnaire	3.707095	14533.45	

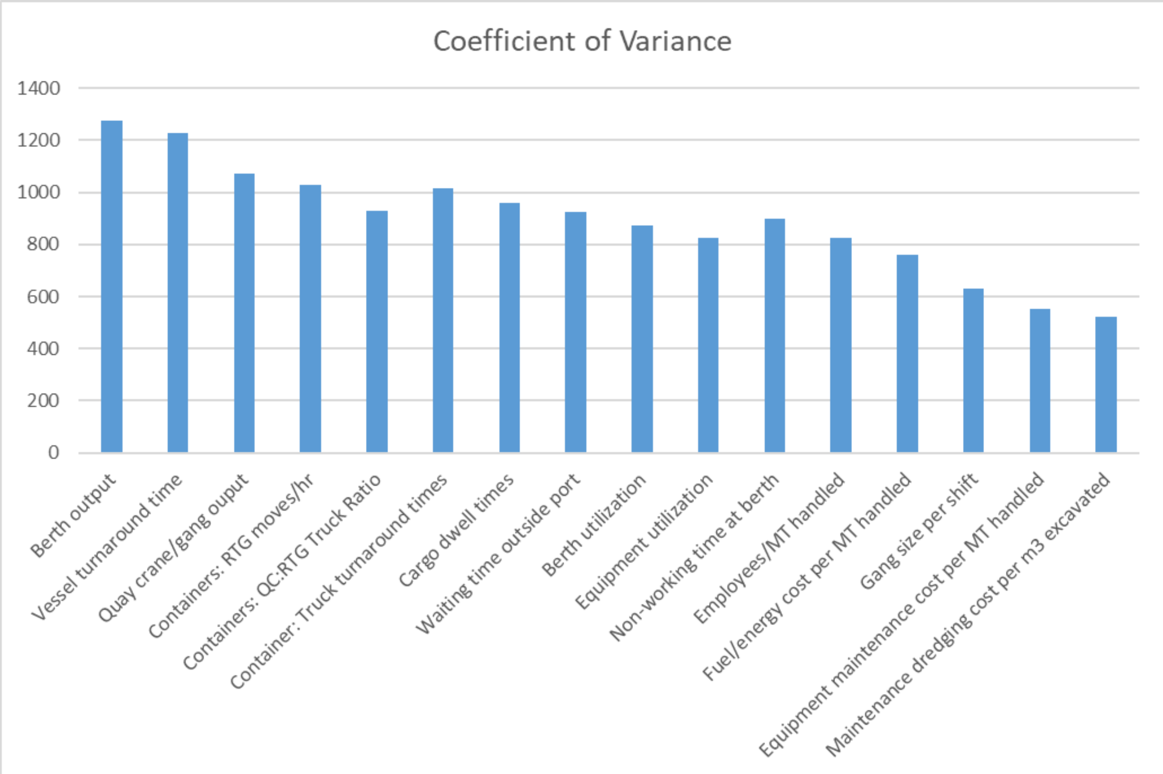
Relative importance of the KPIs was found to be directly proportional to the corresponding ranks in terms of mean score. Top three KPIs were Average Berth output, Average turnaround time and Quay crane/gang output. Graph showing mean score of the KPIs is shown below:



High value of variance of a KPI necessitated needs to see consistency of scores.

Consistence was reflected by Co-efficient of variation (CV) defined as $CV = \frac{SD}{Mean} X100$.

Graph showing KPI-wise CV is given below:



4.Relevant and comparable International Ports and private Indian Ports were selected by taking the following parameters:

* Size of the Port
* Number of berths
* Type of commodity
* Degree of mechanisation and automation

5. Operational and financial data for each of the 12 Indian major ports were collected for benchmarking against relevant international ports and private Indian ports

6. Normalization of the metrics was done by calculating the benchmarks by taking into account the extent of mechanisation, type of equipment, their capacity, process time,

pilotage time. It is a mathematical calculation based on actual data collected from the benchmark ports. These calculations were shown for each of the metrics and for each of the port in Chapter V.

3.6 Research Methodology for Objective 2

This exercise involves deep dive, having identified broad causes by 'Root Cause Analysis' (RCA) technique carried through Fish-Bone (Ishikawa) diagram, also called, Cause–and–Effect Diagram. Thus, Primary data were collected from a set of stakeholders such as Exporters, Importers, C&F Agents, Steamer Agents, etc.

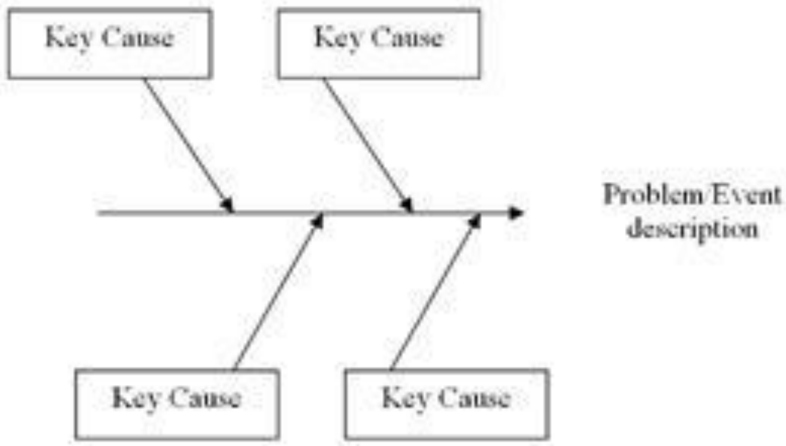
Purpose of Root Cause Analysis (RCA) is to get to the bottom of a cause for the gap between the benchmark and baseline, decide the corrective actions and develop plan that sustain the corrections. It uses DMAIC (define, measure, analyze, improve, control) approach to problem solving.

Fish-Bone(Ishikawa) diagram, also called, Cause–and–Effect Diagram:

The cause and effect diagram is also known as the fishbone diagram (as the key causes look like the bones of a fish when displayed visually, hence the name) and the Ishikawa diagram (named after Kaoru Ishikawa, who first proposed the tool). Constructing a Cause and Effect Diagram Step-by-Step:

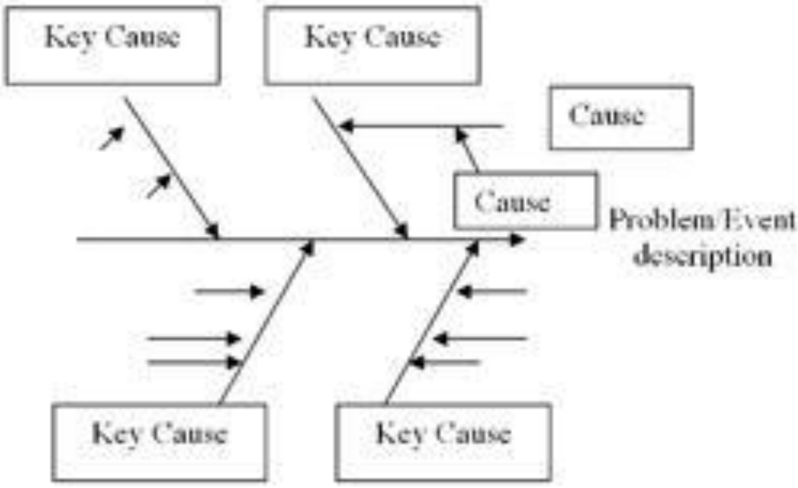
1. Define the problem (effect) to be solved-This first step is probably one of the most important tasks in building a cause and effect diagram. While defining your problem or event, your problem statement may also contain information about the location and time of the event. On the cause and effect diagram the problem is visually represented by drawing a horizontal line with a box enclosing the description of the problem on the tip of the arrow.

2. Identify the key causes of the problem or event-In this step, the primary causes of the problem are drilled down by using brainstorming techniques. Often these causes are categorized under people, equipment, materials, external factors, etc. Some of the commonly used primary causes (but not limited to) include the 4 M's of manufacturing (machine, method, material and manpower); the 4 S's of the service sector (surroundings, suppliers, systems, and skills); the 5 M's (measurement, maintenance, money, management, and Mother Nature); and the 8 P's (product, price, place, promotion, people, process, physical environment, and productivity). Other appropriate primary causes include service, quality, technology, consumables, work processes, environment, service level, etc. The image below shows how to visually depict these key causes on the cause and effect diagram.



3. Identify the reasons behind the key causes -The goal in this step is to brainstorm as many causes for each of the key causes. Tools such as the 5 Whys (the subject of a future column) can help you to drill down to these sub-causes. Provide one reason behind a key cause. These suggestions should be written down and connected to their appropriate key

cause arrow (see the image below). Remember that these reasons are free- flowing, form logical patterns, and are inter-connected to a key cause.



4. Identify the most likely causes- At the end of step three, we will have a good overview of the possible causes for the problem or event; if there are areas in the chart where possible causes are few, see if we can dig deeper to find more potential causes. We should focus more specifically on the potential cause(s) that have a high probability of taking place. It is not unusual for us to use techniques such as multi-voting to shortlist the areas that will have lasting impact on solving the problem at hand. In certain instances, we might collect additional data to better understand and quantify the potential causes. Simple hypothesis testing — such as asking "Where?", "When?", and "How?" — lead to a better understanding of the relationship between the potential cause and the problem tasked to solve.

5.Having identified the most probable causes, the relevant alternative solutions to bridge the gap between the benchmark and baseline are explored and solutions are provided with likely impact.

3.7 Theoretical Underpinning:

This research is the first of its kind in Benchmarking theory whereby the combination of normalization along with Best-in-class benchmarking and Root Cause Analysis was used for solutioning exercise, this will perhaps add a new dimension in the benchmarking exercise in port industry. This research contributes to the theory/literature of benchmarking, especially, in the context of Indian ports whereby the future researchers can get the benefit of standards for comparing operational performance of various ports in India.

3.8 Benchmarking Theory:

Formal definition of benchmarking used by Rank Xerox 'Continuous systematic process of evaluating companies recognised as industry leaders, to determine business and work processes that represent best practices and establish rational performance goals.' In operational terms it is frequency condensed to 'the search for industry best practices that lead to superior performance.' 'Best Practices' refer to – methods used in work processes that best meet customer requirements. Benchmarking is not 'what we want to achieve' but 'how they are to be achieved'.

Types and ways of Benchmarking Theory:

- Types of Benchmarking – Product and Process
- Ways of process benchmarking/How benchmarking is done?

a. Benchmarking Internal Operations – to find the best-performing unit within your own company;

b. Benchmark vis-à-vis competitor;

c. Best-in-class – Comparing your performance vis-à-vis the best in industry;

d. Strategic benchmarking – integrates strategic competitive analysis with best-in-class benchmarking.

What we propose to use the 'best in class' method using deep 'Root Cause Analysis' technique. It was proposed to collect data for 12 major ports as well as relevant private Indian ports and international ports to benchmark performance on all three key dimensions of

1) Financial,
2) Operational, and
3) Organizational capability

In each of these benchmarking focus areas, a set of targeted and specific metrics were used for comparing performance. These metrics have been shortlisted through Literature review and ranked using 5-point Likert Scale Analysis via Survey since they provided the most specific and insightful understanding of the relative performance of the ports. The KPIs shortlisted for benchmarking

- Berth output
- Vessel turnaround time
- Quay crane/gang ouput
- Containers: RTG moves/hr
- Containers: QC:RTG Truck Ratio
- Container: Truck turnaround times
- Cargo dwell times

- Waiting time outside port
- Berth utilization
- Equipment utilization
- Non-working time at berth
- Employees/MT handled
- Fuel/energy cost per MT handled
- Gang size per shift
- Equipment maintenance cost per MT handled
- Maintenance dredging cost per m3 excavated

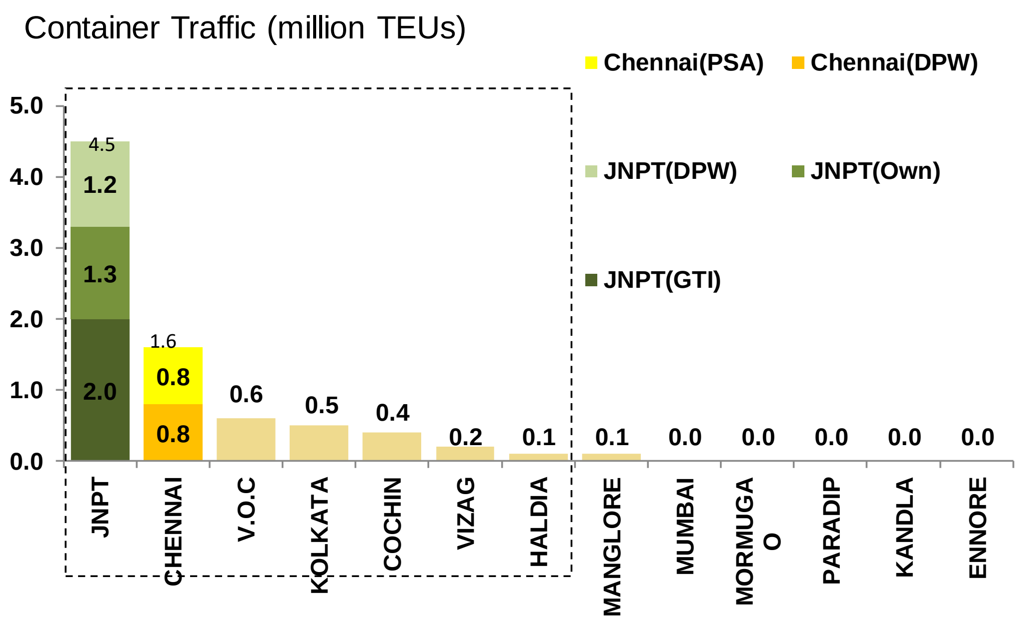
In case of any specific situation /context for a port, other relevant metrics were added as required for building an in-depth and specific understanding of the port's performance.

CHAPTER IV- ANALYSIS (OBJECTIVE 1)

(Normalization of Data and Comparing with best in class ports)

4.1 Container terminals

Seven ports with ten dedicated containers handling facilities handle 98% of container traffic in Major ports.



Dedicated facility	✓	✓	✓	✓	✓	✓	✓
Operator	**JNPT APMT DPW**	**PSA DPW**	**PSA**	**PSA**	**DPW**	**DPW**	**ULA**

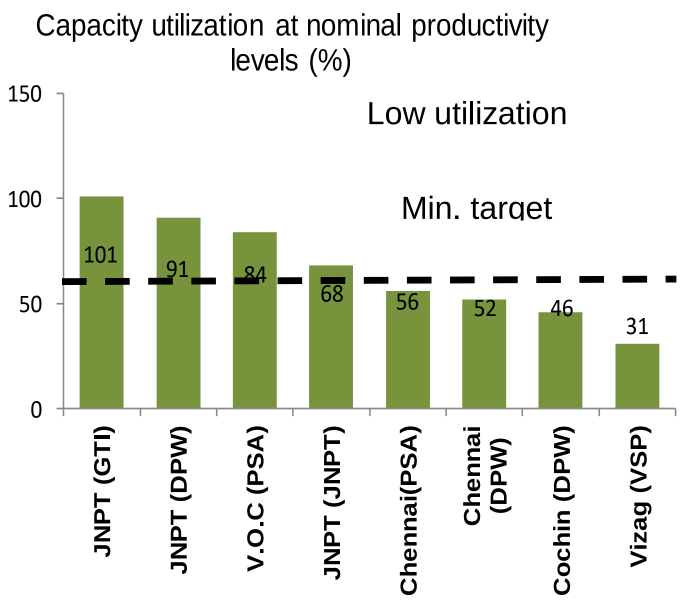
Figure 4.1: Container Traffic, 2014-15

Source: Indian Port Association Report

Observation:

- JNPT alone has handled over 50% of total container traffic of all Major ports of India followed by Chennai.
- Within JNPT, the operator JNPT handled 2 million TEUs which is more than the total traffic at Chennai (two operators) and is equal to sum of total traffic at VOC, Kolkata, Cochin, Vizag and Haldia taken together.
- DP world handled 2.6 million TEUs in four ports viz. JNPT, Chennai, Cochin and Vizag and got 1st rank in terms of operator-wise traffic, followed by JNPT at 2 million TEUs. PSA operating at Chennai, VOC and Kolkata handled 1.9 million TEUs and stood at 3rd rank. APMT handled 1.3 million TEUs at JNPT.

4.1.1 Underutilization of Container Capacity FY 2014-15



Stated Capacity (million TEU)	**1.8**	**1.2**	**0.5**	**1.3**	**1.3**	**1.5**	**1.0**	**0.7**
Nominal capacity (million TEU)	2.0	1.3	0.6	1.8	**1.4**	1.6	0.8	0.8

Figure 4.1.1: Capacity utilization at nominal productivity

Nominal capacity = # cranes x crane productivity x occupancy x TEU/move x 24 x 365		
TAMP norms for BOT operators QC (w twin-lift) = 25 moves/hr Qc (w/o twin-lift) = 20 moves/hr Mobile harbor crane = 20 moves/hr	TAMP norms for BOT operators Berth occupancy = 70%	**40' to 20' Ratio** 1.3

Capacity Utilization at nominal productivity level exceeded the target for each of the three terminals of JNPT namely GTI, DPW and PSA. The same for the fourth terminal at JNPT was close to the target.

For the other terminal at other ports (PSA at Chennai, DPW at Chennai and Cochin and VSP at Vizag) capacity utilization was less than the target.

4.1.2 Berth occupancy FY 2014-15

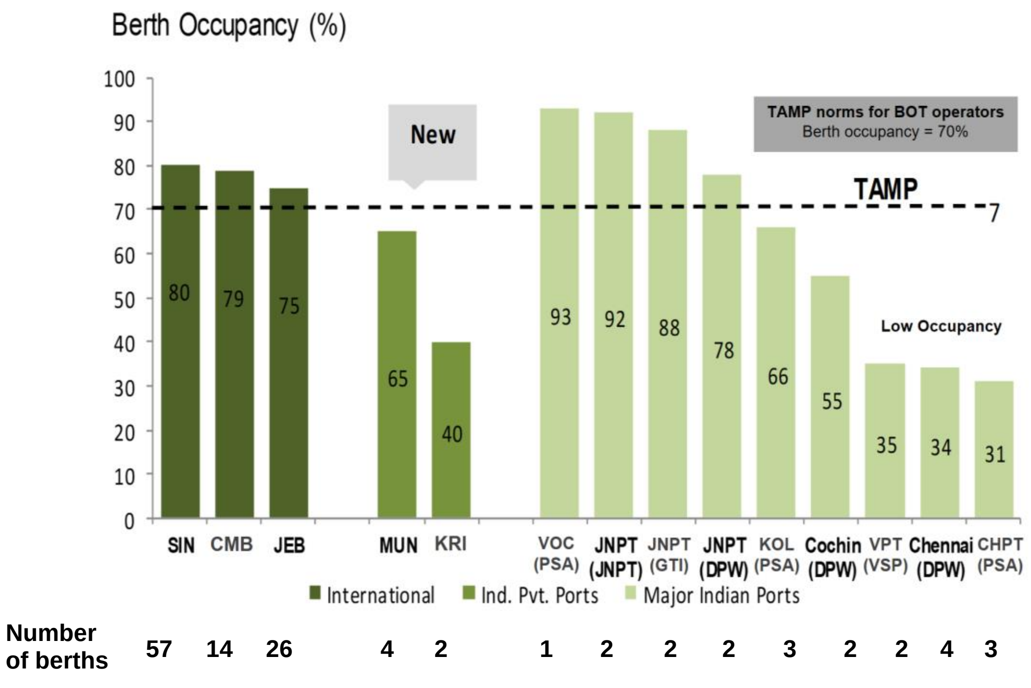


Figure 4.1.2: Berth Occupancy

Observations:

- JNPT recorded highest berth occupancy among the Indian Ports.
- High berth occupancy at the terminals of JNPT at the level of around 90% exceeded the same for international ports like SIN, JEB, etc. and also exceeded the TAMP norm.
- Such high berth occupancy tends to indicate risk of deteriorating physical performance in near future and immediate need to augment the capacity at JNPT.
- At Cochin and Chennai, berth occupancy at lower levels (much below the norm) tends to indicate need of effective business development plan to increase traffic resulting in better utilization of capacity so as to take maximum benefits of investment already made.

4.1.3 Berth productivity FY 2014-15

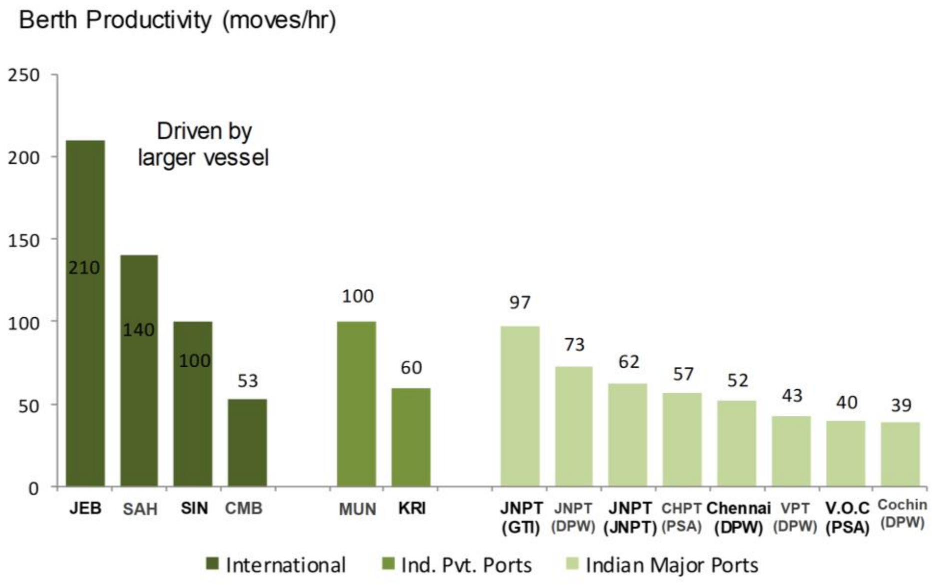


Figure 4.1.3: Berth productivity

Observations:

- Berth productivity in terms of number of TEUs moved per hour at Indian ports is much less in comparison to international ports like JEB, SIN, etc.
- Highest berth productivity among Indian Ports was recorded at GTI terminal of JNPT.
- Low berth productivity in Indian ports (other than JNPT) tends to indicate higher dowelling time of containers and container vessels at those ports. To make the ports attractive, such ports need to upgrade significantly berth productivity.

4.1.4 JNPT own terminal and V.O.C lagging behind peers in quay crane productivity lowering their effective capacity

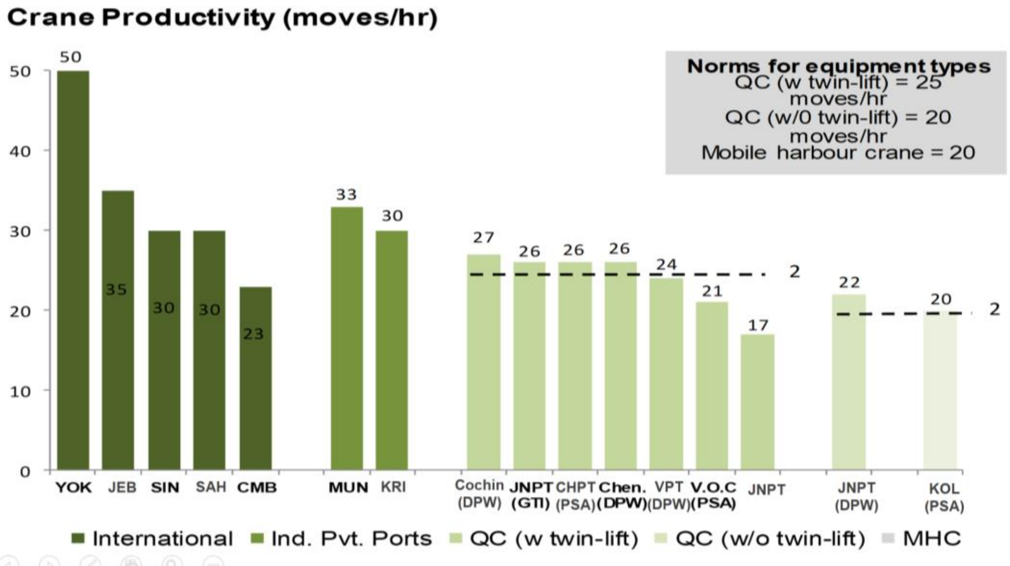
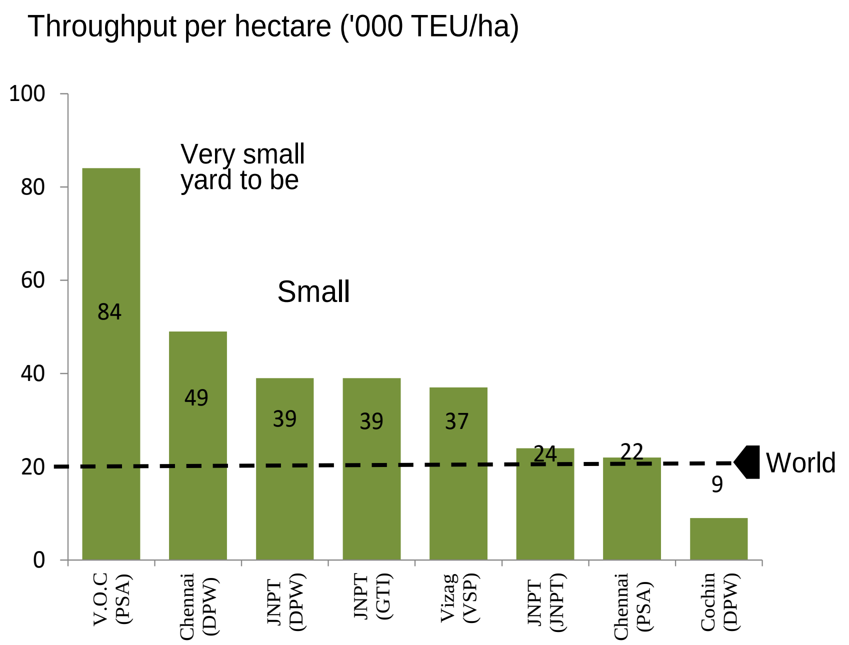


Figure 4.1.4: Crane Productivity

Observations:

- Crane productivity in terms of number of containers move per hour at Indian ports was much less than the same for international ports like YOK, SI, MUN, etc.
- Crane productivity at terminals of JNPT and Chennai just exceeded the norm for QC (w twin-lift). However, the same was much below the norm for PSA terminal at V.O.C.
- For QC (w/o twin-lift), crane productivity achieved the norm for MHC.

4.1.5 Yard throughput levels



Berth cap. utilization (%)	84	52	91	101	31	68	56	46
Stacked area (ha)	**6**	**17**	**29.5**	**52**	**7**	**35**	**35**	**40**
Paved area (ha)						**18**		

Figure 4.1.5: Throughput per hectare

Observations:

- Yard throughput level in terms of thousand TEUs per hectare exceeded the World average for PSA terminal at V.O.C., DPW at Chennai and JNPT, GTI terminal at JNPT and VSP terminal at Vishakhapatnam.

- For JNPT (own) terminal, Yard throughput was equal to the World average. However, the same were below the World average for PSA terminal at Chennai port and DPW terminal at Cochin port.

- Yard throughput level was found to have maximum correlation with Berth capacity utilization.

4.1.6 Ground slot density FY 2014-15

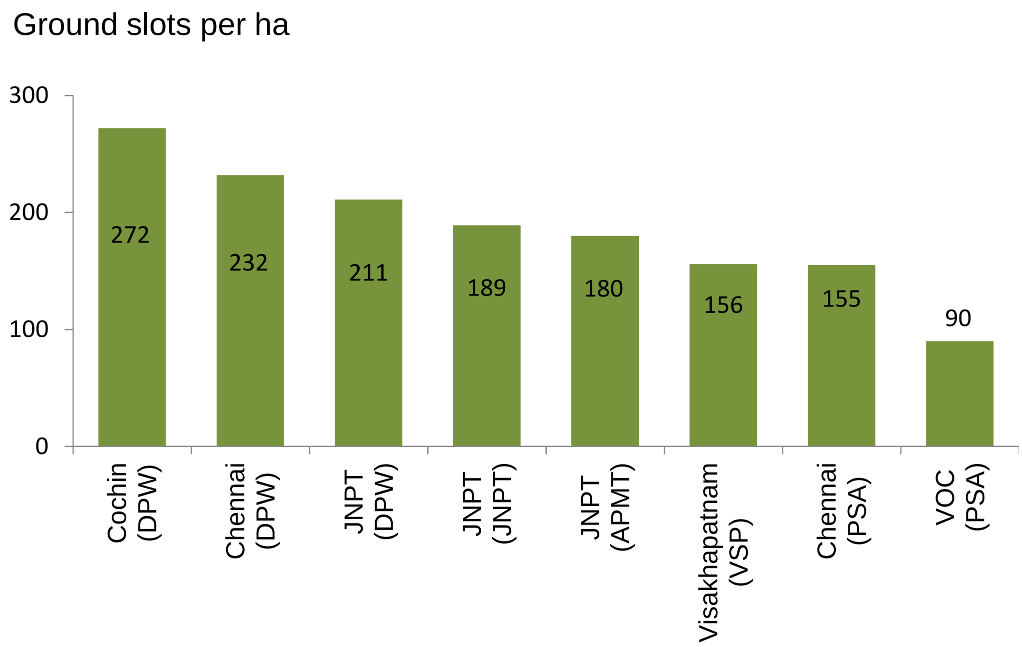


Figure 4.1.6: Ground slots per ha

Observations:

- Ground slot density in terms of ground slots per hectare was highest for DPW terminal at Cochin (272) followed by DPW terminal at Chennai (232).
- Despite having high container throughput, ground slot density at terminals of JNPT ranged between 180 to 211.
- Ground slot density appears to be negatively correlated with Yard throughput.

4.1.7 Yard space utilization FY 2014-15

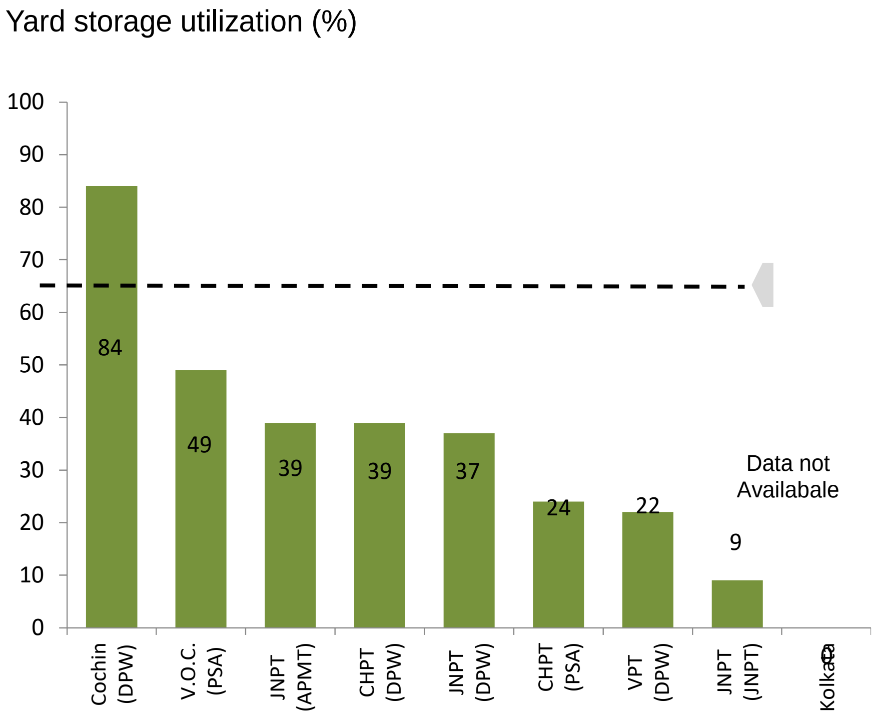


Figure 4.1.7: Yard Storage Utilization

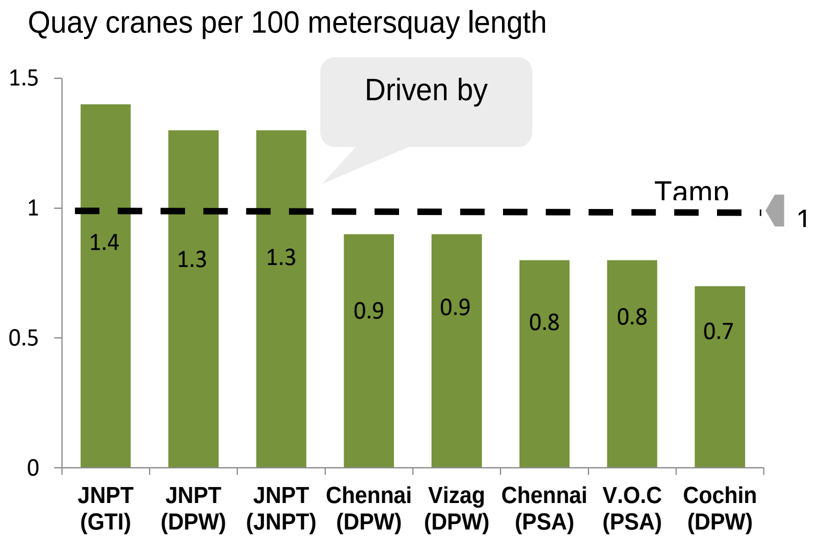
Act. Dwell Time (days)	7.5	2	3.4	2.6	2.4	3.5	3	3.3
Nominal Capacity = Ground slots x Operational stack height x 365 / Dwell time								
Ground slots / Stack height /Dwell time								

Observations:

- DPW terminal at Cochin port had highest Yard storage utilization (over 80%) followed by PSA terminal at V.O.C.

- High value of Yard storage utilization may tend to increase dwelling time of containers in ports. Thus, DPW terminals at Cochin port recorded highest dwelling time of 7.5 days. However, such negative relationship cannot be proved for PSA terminal at V.O.C. which recorded minimum dwelling time of 2 days despite having 49% of Yard storage utilization. Other factors like berth productivity, frequency of arrivals of container vessels, etc. may contribute to dwelling time of containers.

4.1.8 Number of cranes per meter quay FY 2014-15



No. of cranes	10	8	9	8	4	7	3	4

Figure 4.1.8: Quay cranes per 100 meters quay length

Observations:

- Number of Quay cranes per 100 meters of quay length contributes to terminal productivity in combination with other factors.
- Against TAMP norm of one Quay crane per 100 meters of quay length, GTI, DPW and JNPT (own) terminals at JNPT had an average 1.3 to 1.4 cranes per 100 meters of quay length, primarily to cater to high demand emerging from high arrival rate of container vessels.
- Each other terminal at Indian ports, other than JNPT could not achieve the TAMP norm.

4.1.9 Number of RTGCs in line with benchmarks except for own terminal at JNPT

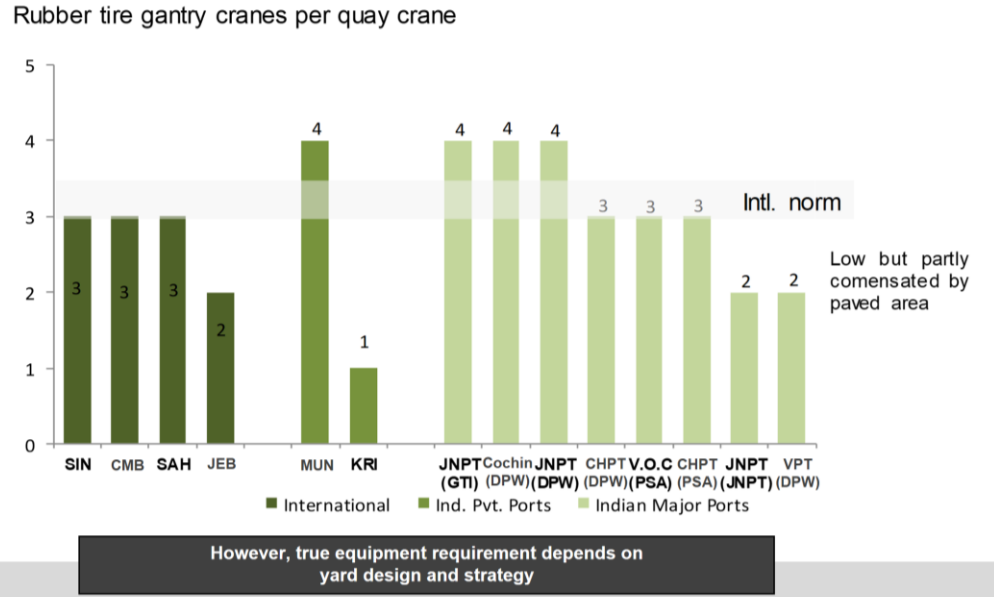


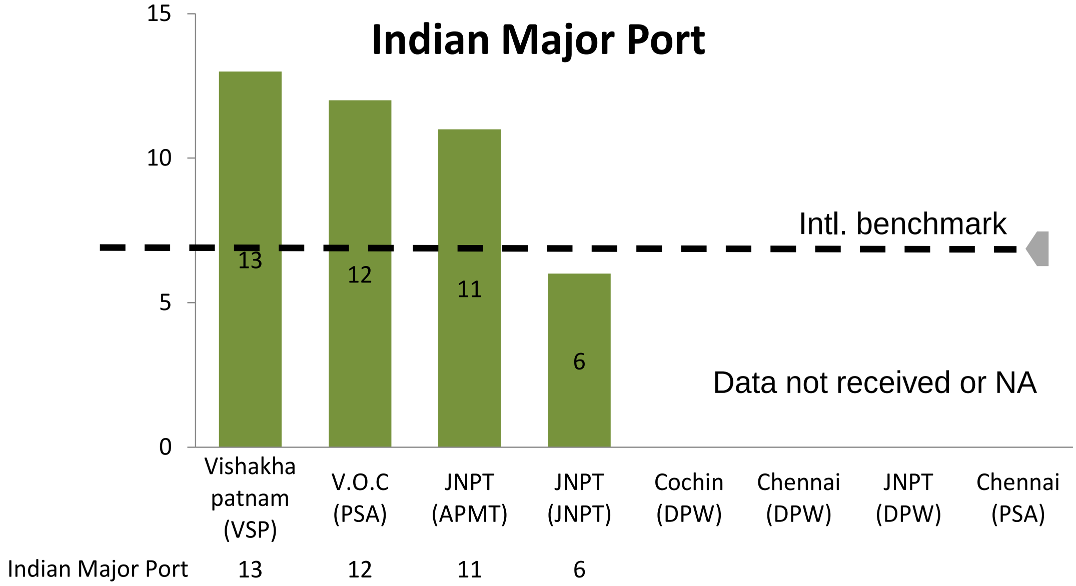
Figure 4.1.9: Rubber tire gantry crane per quay crane

Observations:

- Number of Rubber tire gantry cranes (RTGs) per quay crane (QC) is an important factor of terminal productivity.

- International ports like SIN, SAH, etc deploy on an average 3 RTGs per QC, which can be taken as International norm. Against this backdrop, private terminals at JNPT deploy 4 RTGs. Similar figure for PSA at V.O.C. is 3. JNPT (own) terminal with paved areas usually deploys 2 RTGs per QC

4.1.10 RTGC productivity above international benchmark levels for most terminals except JNPT own terminal



Number of RTGCs	12	8	40	18	15	22	29	18

Figure 4.1.10: RTGC Productivity

Observations:

- Each port or terminal wants to have adequate number of RTGCs and also to have higher productivity of RTGCs. Considering International benchmark of RTGC productivity at the level of 10 moves per hour, the diagram revels that Vishakhapatnam, APMT terminal at JNPT achieved higher productivity (11 to 13 moves per hour).

- However, productivity at other terminals of Indian ports was much less than the international norm.

4.1.11 Number of terminal tractors FY 2014-15

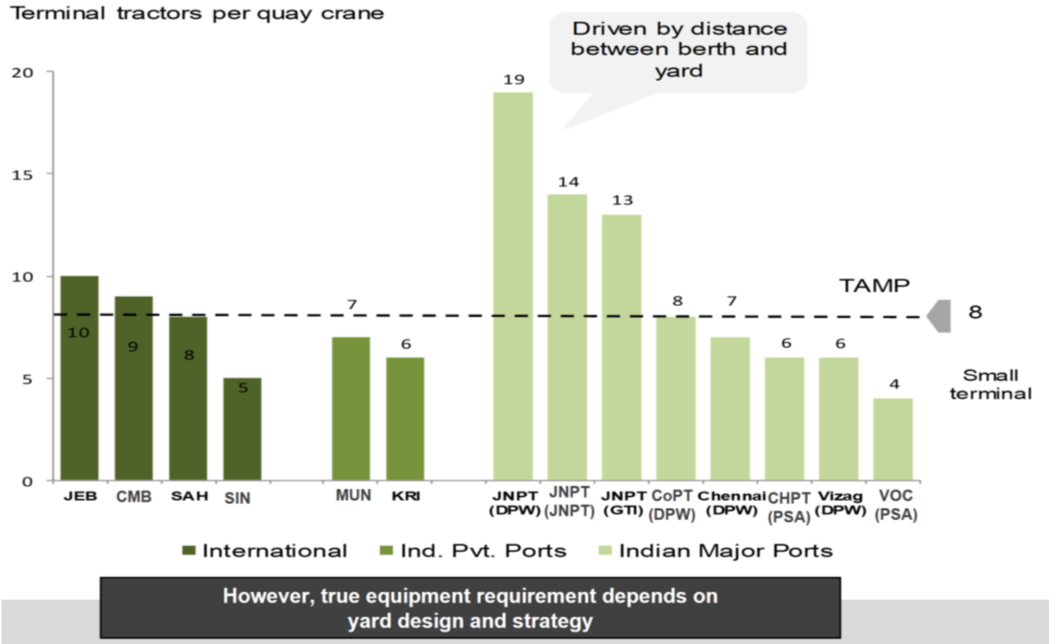
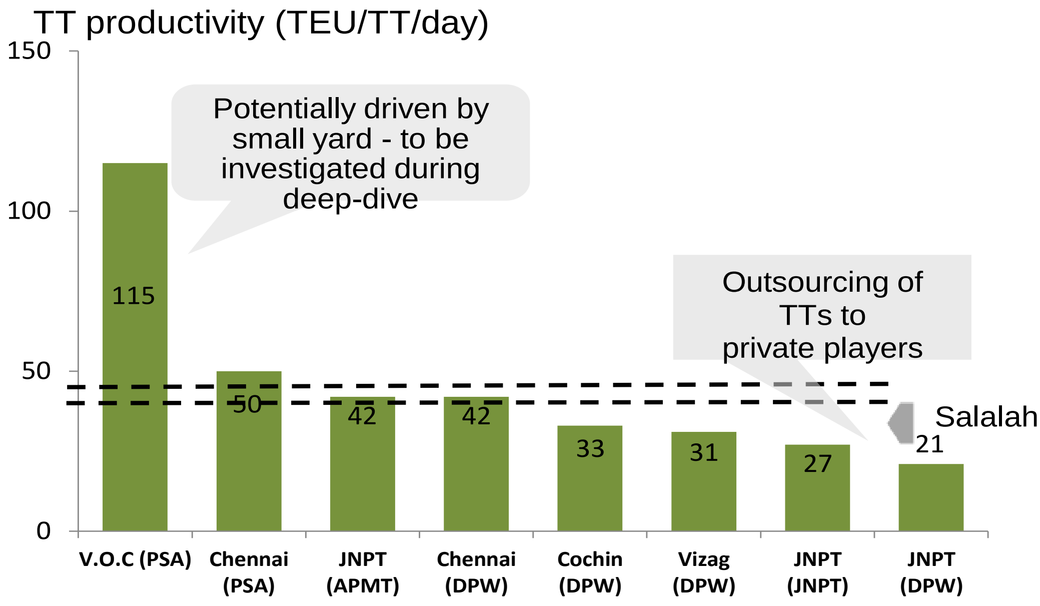


Figure 4.1.11: Terminal Factor per quay crane

Observations:

- To achieve higher value of crane productivity, adequate numbers of tractors are required to be assigned with a quay crane. Requirement of number of tractors may further increase if distance between berth and yard is more.
- Against TAMP norm of 8 tractors per QC, International ports like JEB, SAH deploy 8 to 10 tractors.
- Terminals at JNPT did well in this context by deploying 13 and above numbers of tractors per QC. DPW terminal at JNPT usually deploy 19 tractors because of higher distance between the berths and yard.
- Terminals at Vizag, Chennai and other small terminals failed to achieve the TAMP norm which appears to be on lower side.

4.1.12 TT productivity FY 2014-15



Number of TTs	12	43	130	54	30	22	130	150

Figure 4.1.12: TT Productivity

Observations:

- TT productivity is another factor contributing to productivity at berth / terminal. In comparison to international ports, most of the Indian ports had lower TT productivity in terms of number of TEUs per TT per day.
- However, by outsourcing of TTs to private players, PSA terminal at V.O.C. port achieved TT productivity as high as 115 TEUs per TT per day.
- TT productivity ranged between 42 to 50 for terminals like DPW, Chennai; APMT, JNPT; PSA, Chennai.
- High number of TTs in the fleet may not increase TT productivity. For example, DPW at JNPT recorded TT productivity of 21 only despite having 150 TTs in the fleet. Similar picture emerged for the JNPT (own) terminal.

4.1.13 Evacuation of containers FY 2014-15

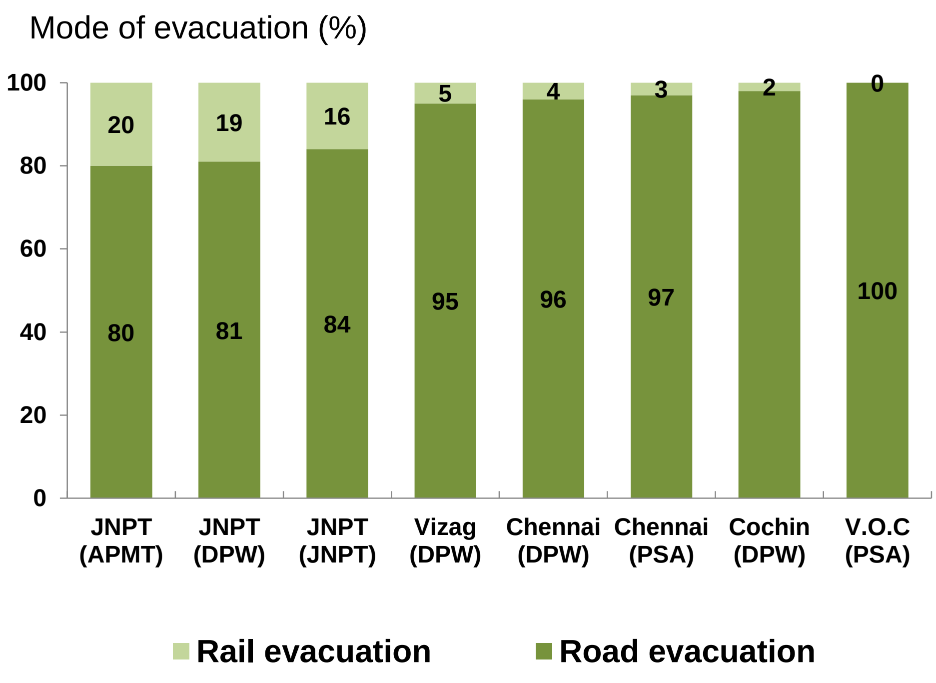


Figure 4.1.13: Mode of Evacuation

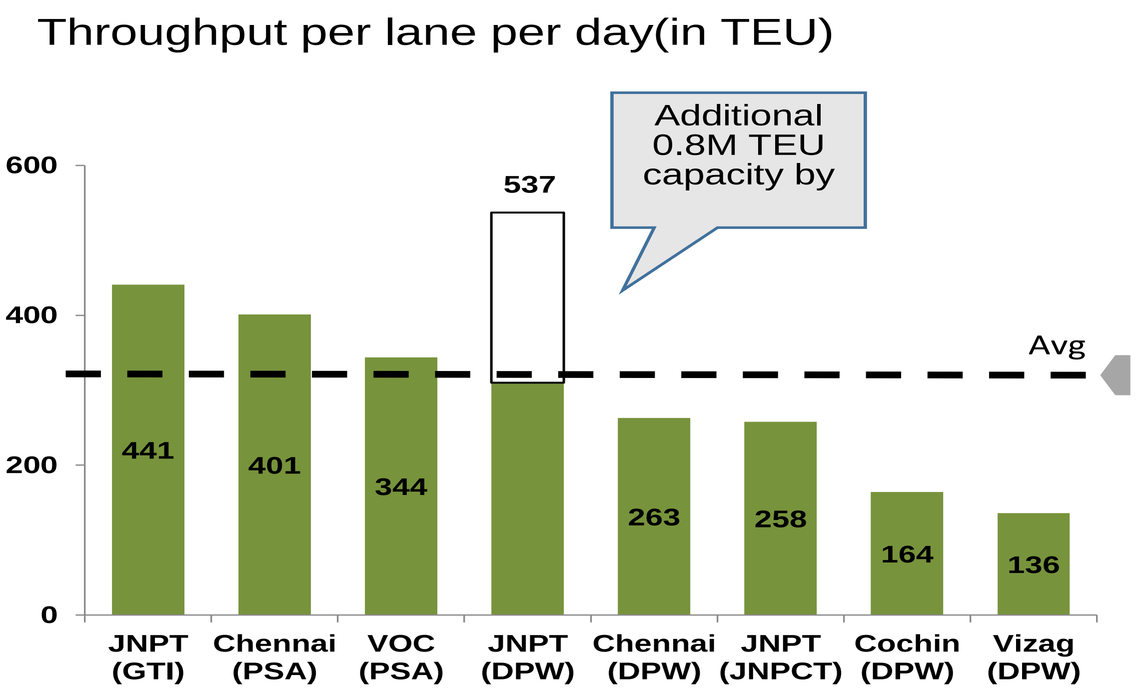
Observations:

- Evacuation of containers by road is a major feature at Indian ports. 80% and above containers are moved by road for various terminals.

- For APMT terminal, 20% of containers moved by rail, which is the maximum figure among the terminals in India.

- For faster, cheaper and environment friendly evacuation of containers, railway mode may be encouraged and railway connectivity to Dry ports may be explored.

4.1.14 Gate lane productivity FY 2014-15



Total Traffic (mn)TEU	1.6	0.7	0.5	0.9	0.7	1	0.4	0.2
Total Lanes	10	5	4	8	8	11	6	4

Figure 4.1.14 Throughput per Lane per Day

Observations:

- It is generally believed that more lanes are required for higher volume of traffic passing through gate. However, the same is not found to be true for JNPT (own); DPW, Cochin; DPW, Vizag.

- Average throughput per lane per day was highest for GTI terminal at JNPT and lowest at DPW terminal at Vizag.

- Average throughput per lane per day at the level of 340 TEUs was exceeded at GTI terminal at JNPT and PSA terminal at Chennai.

4.1.15 Truck turnaround time FY 2014-15

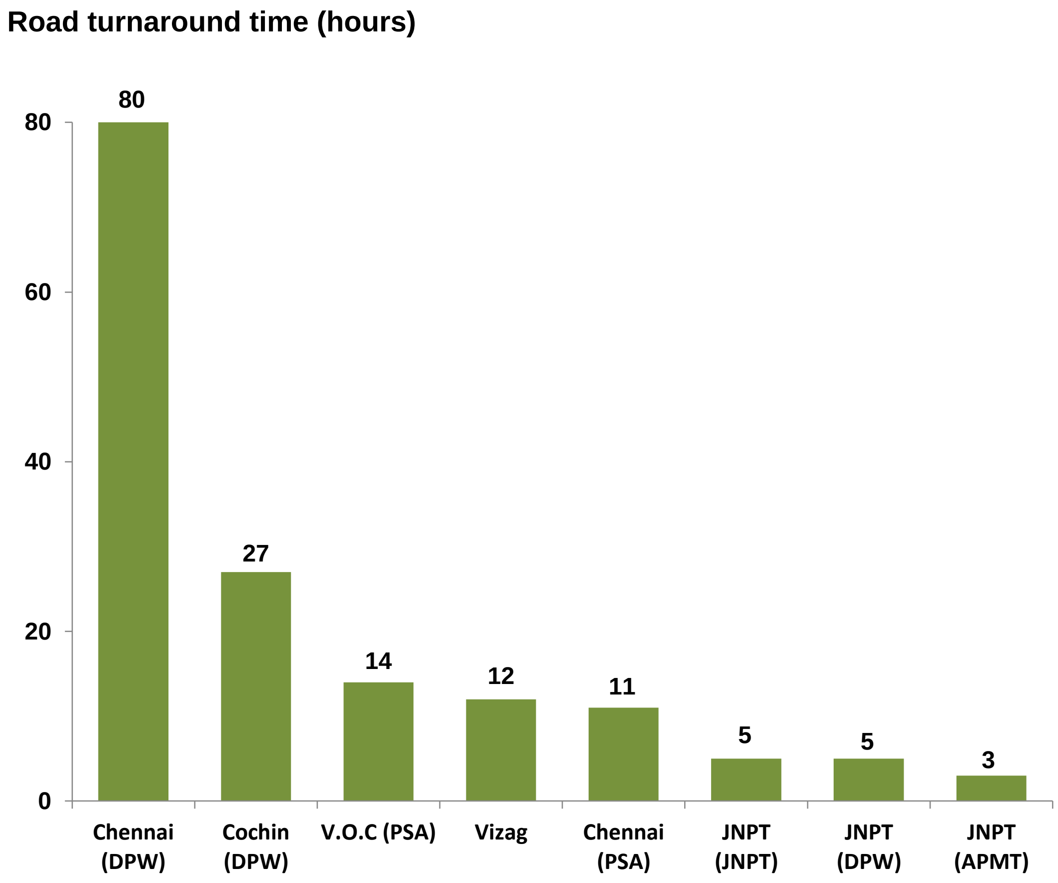
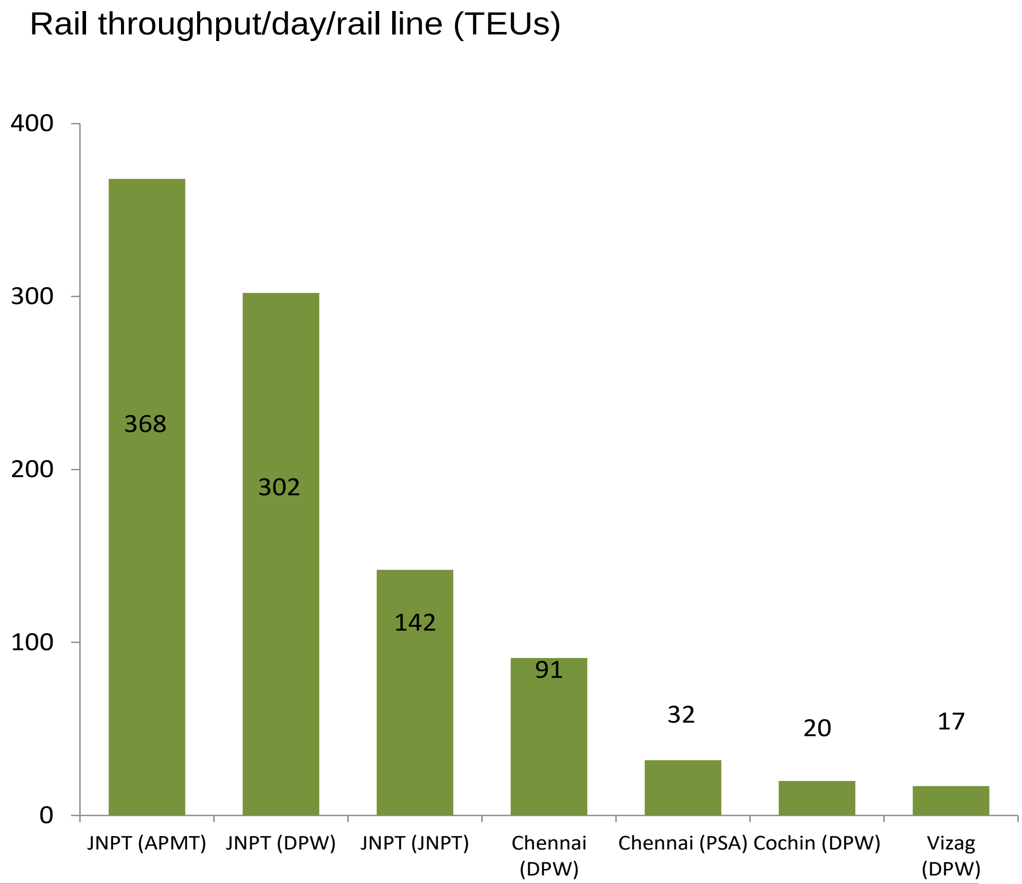


Figure 4.1.15: Road Turnaround Time

Observations:

- Road turnaround time at Indian ports was low (less than or equal to 5 hours) for three terminals. For other terminals, road turnaround time was on higher side (11 to 14 hours). However, road turnaround time was as high as 80 hours at DPW, Chennai followed by 27 hours at cochin.

4.1.16 Variation in rail line productivity between JNPT terminals FY 2014-15



Total Traffic (mn)TEU	**0.4**	**0.22**	**0.2**	**0.03**	**0.02**	**0.007**	**0.012**
Total Lines	**3**	**2**	**4**	**1**	**2**	**1**	**2**

Figure 4.1.16: Rail throughput/day/rail line (TEUs)

Observations:

- Rail line productivity in terms of number of TEUs moved through rail per day per line was greater than 300 TEUs for DPW, JNPT and APMT, JNPT. These are the two terminals where evacuation by railway mode was 19% to 20% of total container traffic.

- Rail line productivity was on lower side for other terminals like DPW, Vizag recording only 17 TEUs moved through rail per day per line followed by DPW at Cochin port.

- The productivity is likely to increase with increase in percentage of evacuation through rail and associated modernization of railway infrastructure.

4.1.17 Rail turnaround time for container terminals in India

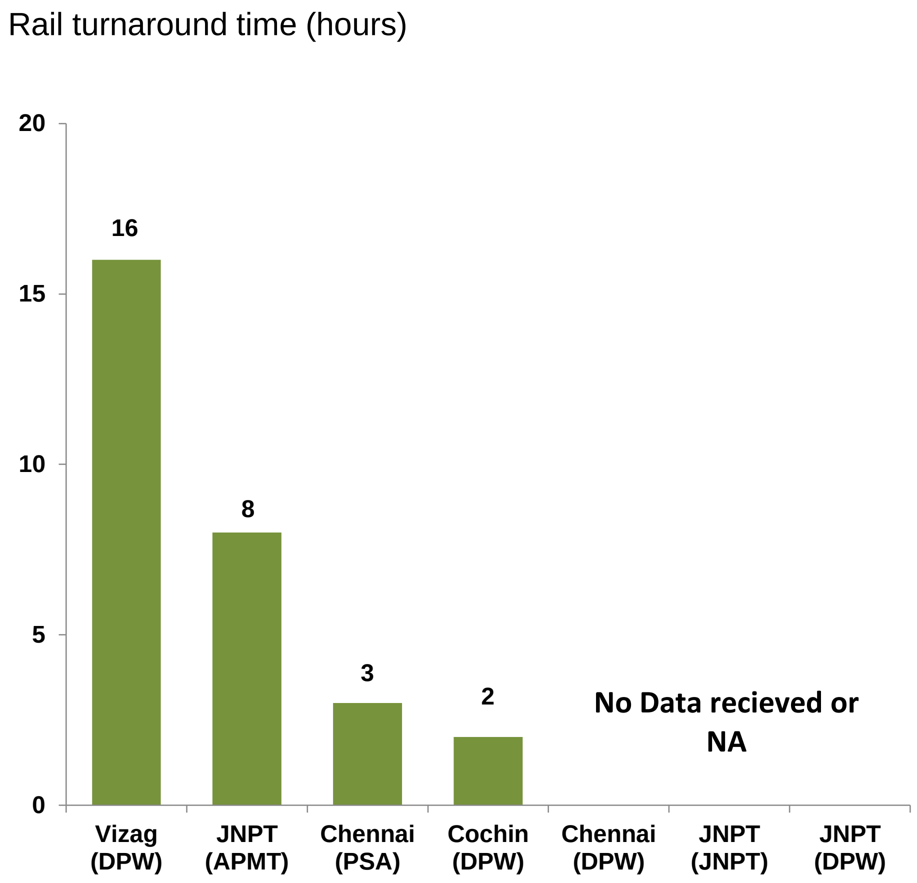


Figure 4.1.17: Rail Turnaround Time

Observations:

- Rail turnaround time at terminals depends on various factors like area of railway yard, density of wagons, etc.
- Rail turnaround time at terminals of Indian ports ranged between 2 hours (at DPW, Cochin) to 16 hours (at DPW, Vishakhapatnam).
- APMT terminal at JNPT with 20% share of evacuation through registered rail turnaround time at the level of 8 hours only.

4.2 Dry Bulk Terminals

For comparing Dry bulk fertilizer cargo those ports were bulk fertilizer traffic constituted 3% or more of overall bulk fertilizer traffic across 12 major ports

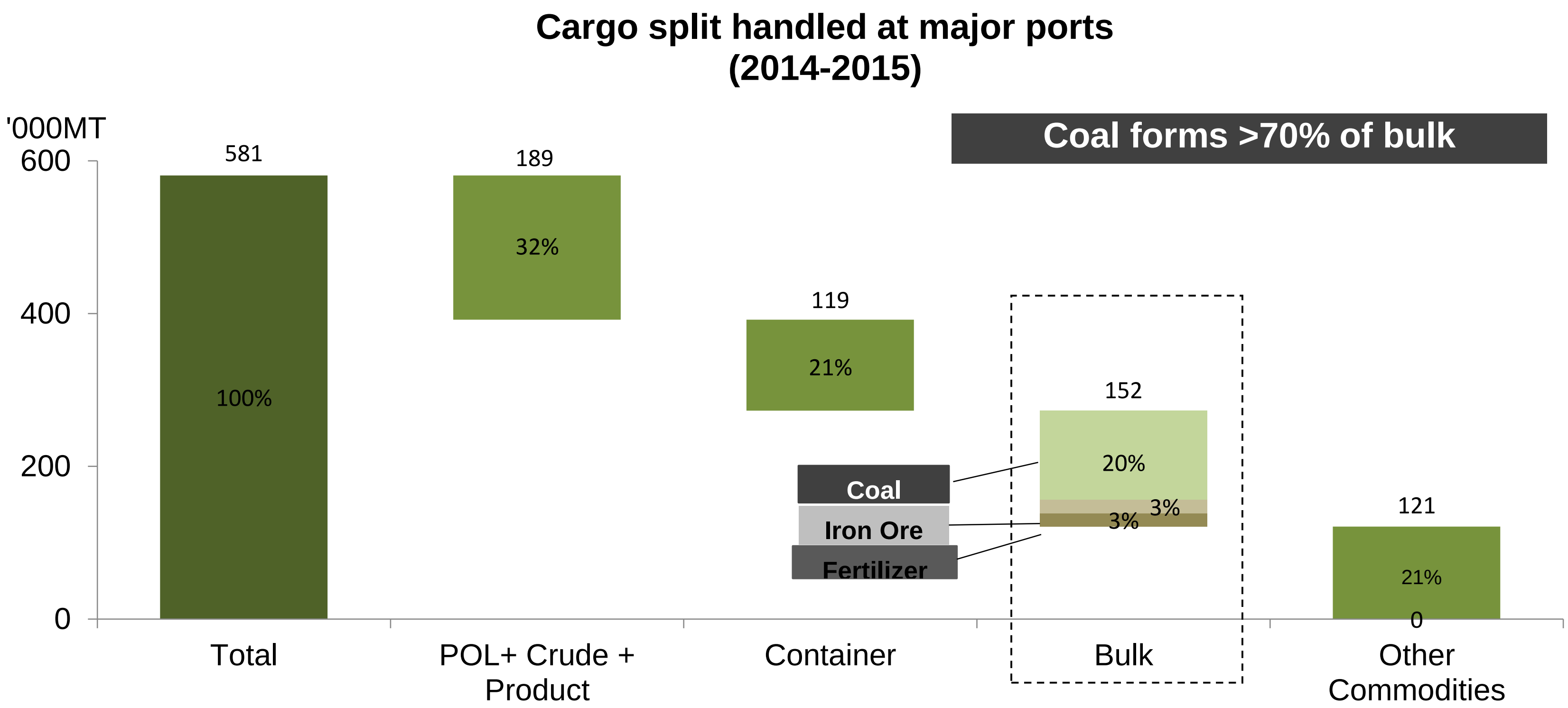


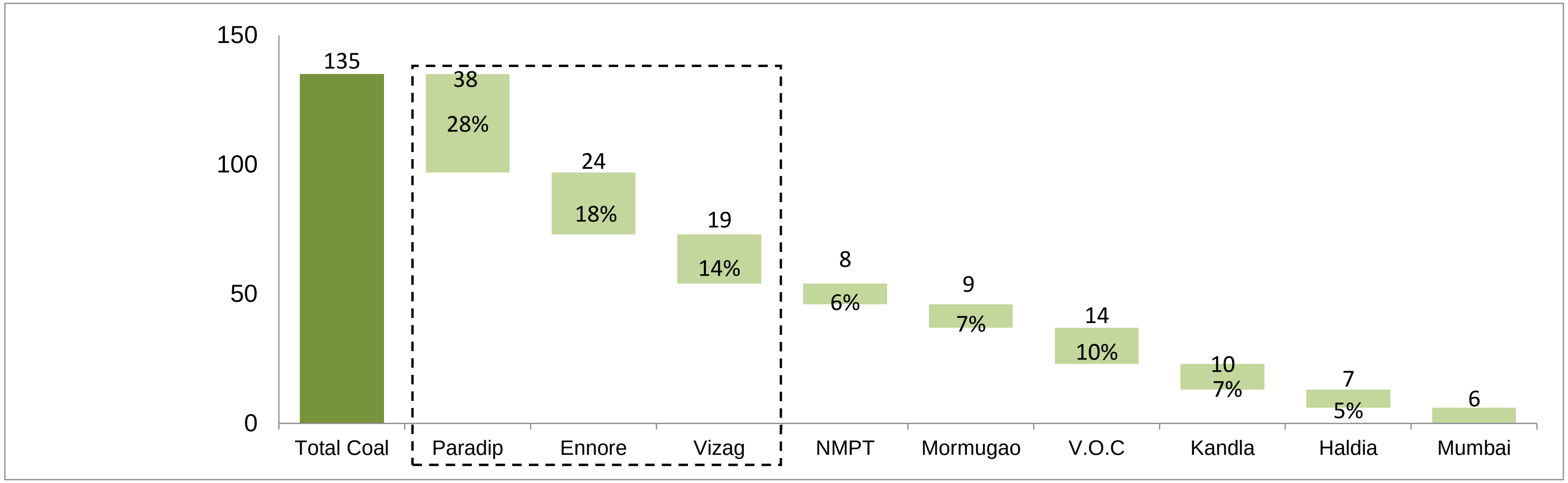
Figure 4.2: Cargo Split Handled at Major Ports

Observations:

1. Distribution of traffic at major ports of India:
   - Liquid Bulk Cargo - 32% ; Container - 21%
   - Break Bulk - 21% ; Dry Bulk Cargo - 26%

2. Paradip, Ennore and Vizag together handled 81 million tonnes of coal which constitute 60% of total coal traffic

4.2.1 Distribution of coal traffic handled by the major ports FY 2014-15



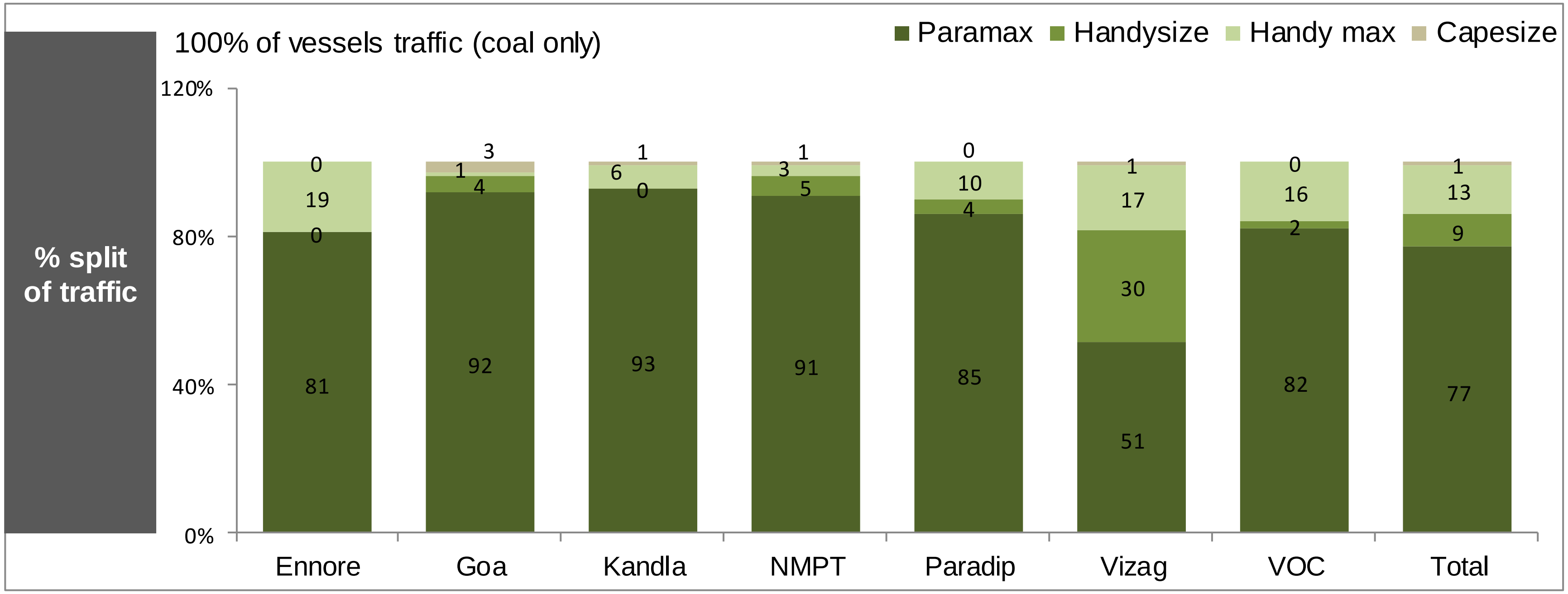
# of berths handling >20% of coal traffic		**10**	**3**	**9**	**5**	**2**	**5**	**5**	**NA**	**NA**
# of berths handling >60% of coal traffic		**8**	**3**	**5**	**2**	**2**	**4**	**1**	**NA**	**NA**
Considered for analysis		✓	✓	✓	✓	✓	✓	✓	Data not clarified	100% coal at barges
split of berths >60%		2 M 6 C	3M	3M 2C	1 M 1 C	2 M	2 M 2 C	1 M		

Figure 4.2.1: Distribution of coal traffic

Observations:

1. Paradip, Ennore and Vizag together handled 60% of total coal traffic
2. Highest coal traffic handled by Paradip.

4.2.2 Distribution of size of coal vessels calls across major ports FY 2014-15



Average draft		10 – 13.5	12 – 14	9.1 – 16.5	9.5 – 14	11 – 14.5	10 – 17	8.6- 12.8	
Average parcel	Capesize	0	74,393	101,785	21,000	32,985	110,666	0	87,714
	Handy max	44,598	35,805	37,508	31,916	35,006	34,577	41,324	38,233
	Handysize	0	10,006	0	14,714	14,639	18,936	6,869	17,629
	Panamax	62,287	66,844	46,905	53,789	54,985	40,546	51,305	53,796

Figure 4.2.2: Distribution of size of coal vessels calls

Observations:

- For handling coal at Indian ports, Panamax vessels are most frequent (77%) followed by Handy max vessels (13%)
- No capesize vessel brought coal to Paradip port which has highest coal traffic

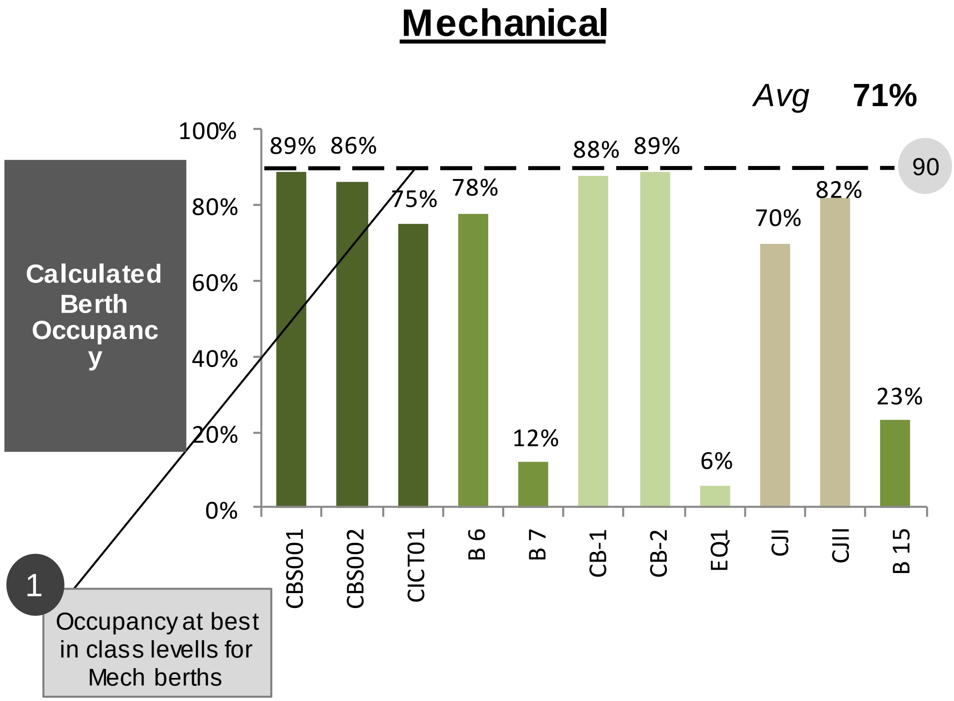
4.2.3 Benchmarking Procedures:

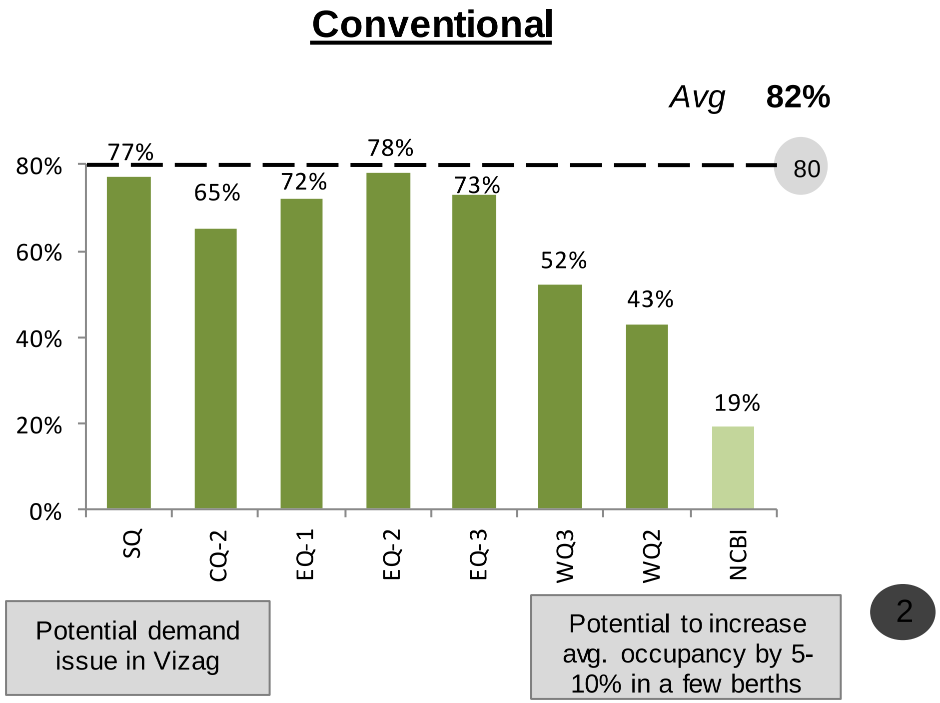
For 'like to like' benchmarking, details of procedures adopted including pre-treatment of data, normalization and benchmarking standards are given in the table below:

Metrics used for benchmarking	Metric standardized and redefined	Data analysis / consistency check	Normalization basis
Capacity utilization	**Definition 1:** Actual throughput delivered / max throughput possible with 100% occupancy at best demonstrated productivity (%) **Definition 2:** Actual throughput delivered / maximum possible output with 100% occupancy at benchmark productivity (%)	Best demonstrated performance calculated at each berth to calculate the max possible capacity	**Commodity:** Only berths with majority Coal traffic (> 60%) considered
Berth occupancy	**Original Definition:** **No. of days** when berth was occupied by a vessel **Revised Definition:** **No. of hours** when berth was occupied by a vessel	Calculation built up using all entries in vessel logs	**Mechanical and Conventional** berth benchmarked separately **Commodity**: Only berths with majority Coal traffic (>60%) considered
Berth productivity	**Definition:** Metric tonnes of coal handled per berth hour (working + idle time)	Only coal entries taken in case multi purpose berth	**Vessel:** Panamax, capesize vessels calculated separately Adjusted for share of coal traffic handled
NWT at berth	**Definition:** **No. of hours** at berth when no loading/unloading operations were performed on the vessel	Time at berth disaggregated, only idle time at berth taken	**Mechanical and Conventional** berths benchmarked separately
WT at berth	**Definition:** **No. of operational hours** at berth (loading + unloading)	Only operational time at berth considered	**Mechanical and Conventional** berth benchmarked separately

Table 4.3.1: Data clean up, re-analysis and normalization done to ensure 'like to like' benchmarking

4.2.4 Occupancy levels for Mechanized and Conventional Berths





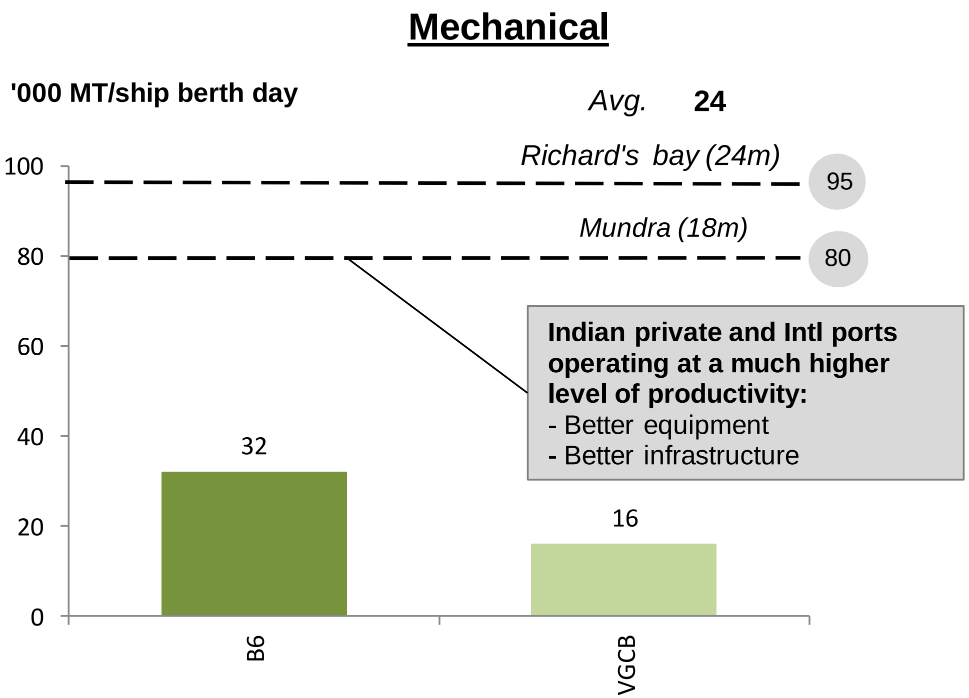
% of Panamax	64	99	63	31	45	81	82	56	54	81	13		58	59	32	56	67	18	28	100
% of coal cargo	100	100	100	99	93	100	100	100	100	100	100		75	80	67	79	60	65	62	100

Figure 4.2.4 (a): Occupancy level (Mechanized Berth)   Figure 4.2.4 (b): Occupancy level (Conventional Berth)

Observation:

1. Most berths operating at high occupancy levels
2. Further improvement scope exists in conventional berths, specially Vizag

4.2.5 Productivity across berths



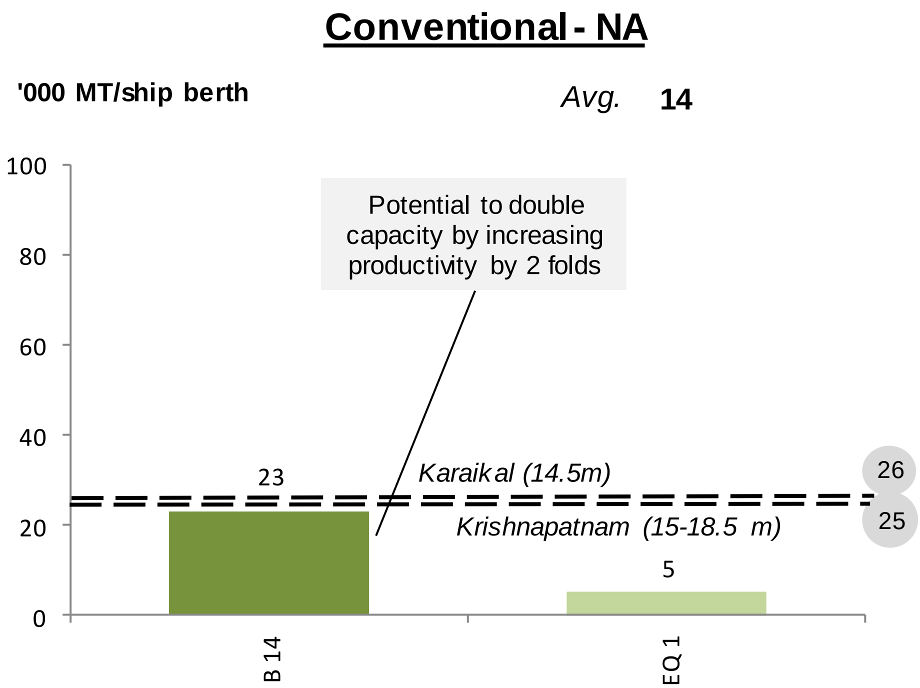


Figure 4.2.5 (a): Productivity across berth (Mechanical)

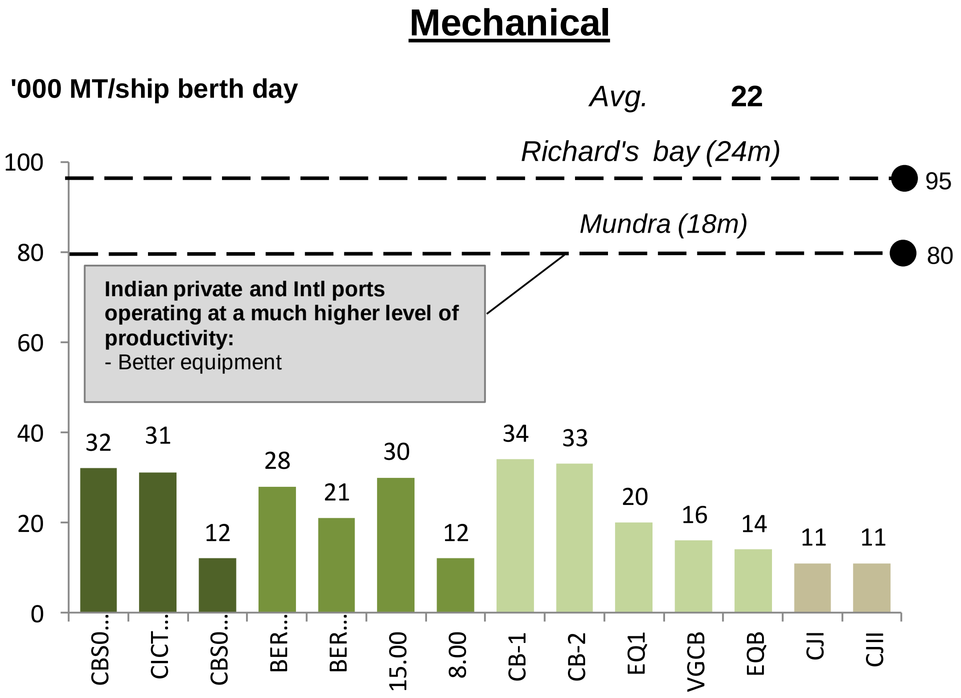
Figure 4.2.5 (b): Productivity across berth (Conventional)

Observations:

1. Berth Productivity were significantly below benchmarks, especially for Mechanized berths
2. Majority of berths were below Indian and International benchmarks

4.2.6 Productivity of Panamax vessel

Only Panamax vessels (77% of coal carrying vessels across ports)



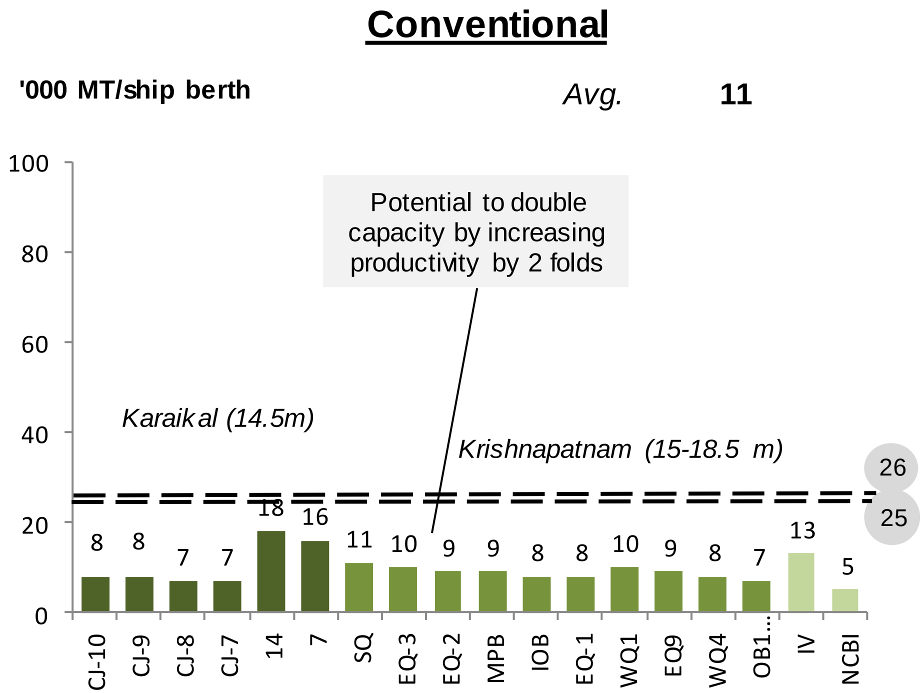


Figure 4.2.6 (a): Mechanical

Figure 4.2.6 (b): Conventional

Observation:

Productivity of coal carriers of Panamax size at major ports of India were much lower in comparison to International level and also in comparison to Indian private ports. The same is true for mechanical as well as conventional berths.

4.2.7 Potential improvements in case of adaptation of 'best demonstrated performance'

Ports	Current coal volume (MMT)	Current capacity utilization (%)	Current calculated Occupancy (%)	Current Productivity (MT/Ship berth day)	BDP Productivity (MT/Ship berth day	Benchmark productivity ('000 MT/Ship berth day)	Incremental annual throughput (MMT)
Ennore	24	71%	83%	24,715	30,698	~80 (M)	9
Paradip	35	60%[5]	77%	15,426	20,242	~25 (C) ~80 (M)	24
Vizag	16	40%[5]	34%	12,360	24,074	~25 (C) ~80 (M)	18
VOC	13	54%	57%	10,450	16,250	~25 (C) ~80 (M)	10
Mormugao	9	31%	45%	24,021	39,798	~25 (C) ~80 (M)	20
New Mangalore	7	37%	57%	24,006	30,823	~25 (C) ~80 (M)	15

Table 4.2.7: Berths handling >60% coal traffic (2014-15)

Potential to double capacities in most ports if benchmark levels can be reached

Observations:

- Improving productivity to achieve the benchmark productivity level alone can result in 96 MMT of incremental coal traffic from existing traffic of 104 MMT at major ports of India.
- Ports may chalk out plan to increase about 100% capacity of handling coal by achieving benchmark productivity.

4.3 Fertilizer Terminals

For comparison, ports which handled at least 3% of total fertilizer traffic of all major ports were considered

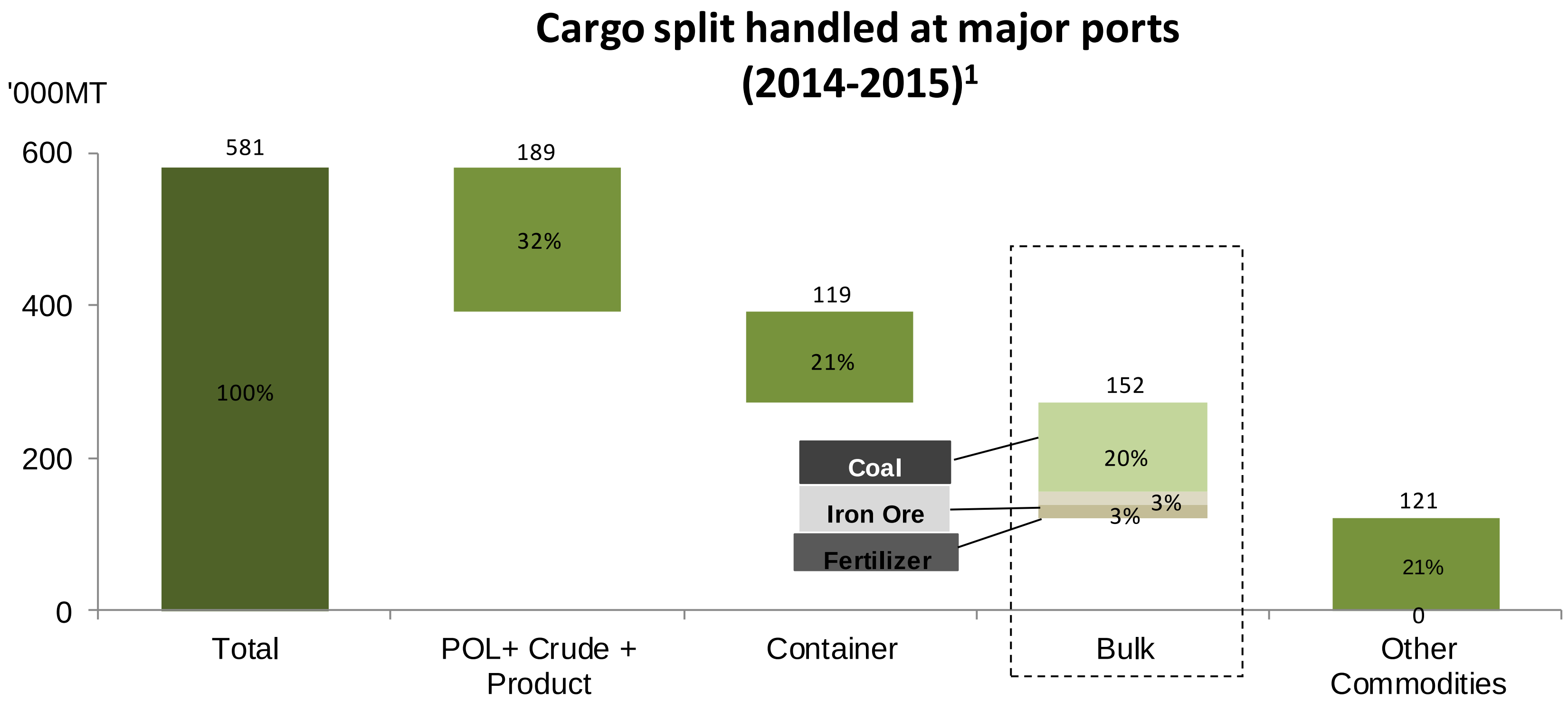
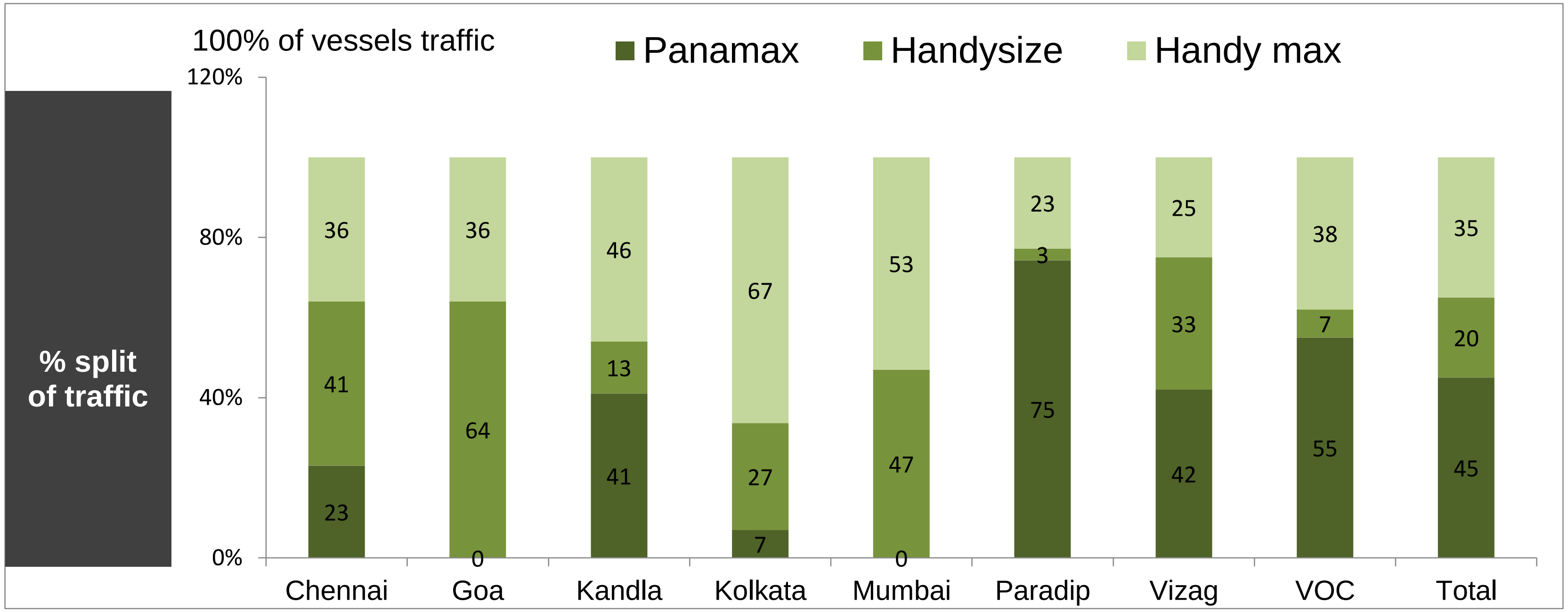


Figure 4.3: Cargo Split Handled at Major Ports

4.3.1 Panamax class constitutes ~45% of all dry bulk fertilizer vessel calls



Average draft		8.5 – 16.5	12 – 14	9.1 – 16.5	TBC	7.5 – 12	11 - 14.5	10 – 17	8.6 – 12.8	
Average parcel size	Handy max	22,215	21,115	28,975	10,029	31,568	28,608	29,147	24,830	27,039
	Handysize	16,121	15,486	15,469	7,744	22,277	26,479	12,032	19,068	15,810
	Panamax	35,736	0	31,887	9,600	0	52,877	39,033	47,690	46,449

Figure 4.3.1: Percentage of Split Traffic dry bulk fertilizer vessel calls

Observations: Panamax vessels are the most frequent vessels used to transport fertilizer at Indian ports, followed by Handy max vessels.

4.3.2 Berths handling for dry fertilizer running

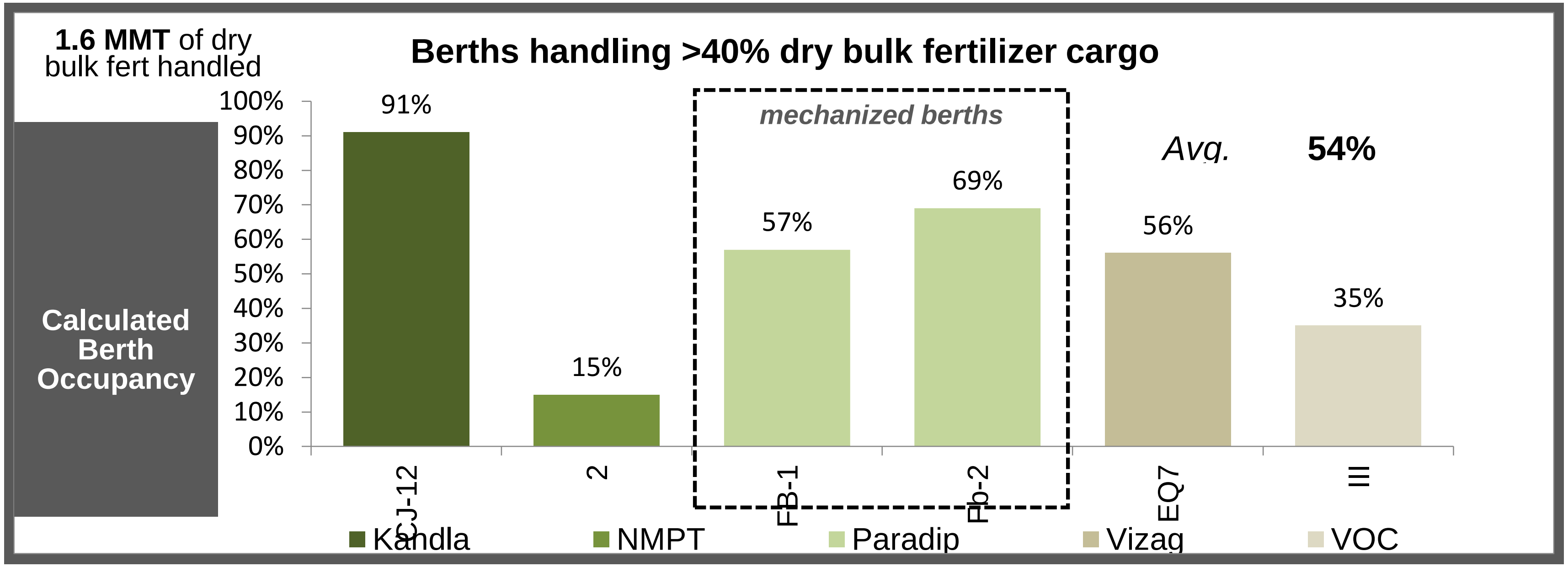


Figure 4.3.2: Berths handling more than 40% Dry Bulk Fertilizer Cargo FY 2014-15

Observations: Occupancy of berths handling at least 40% dry bulk fertilizer ranged between 15% to 91% with average being at the level of 54%.

4.3.3 Productivity of Dry bulk fertilizer

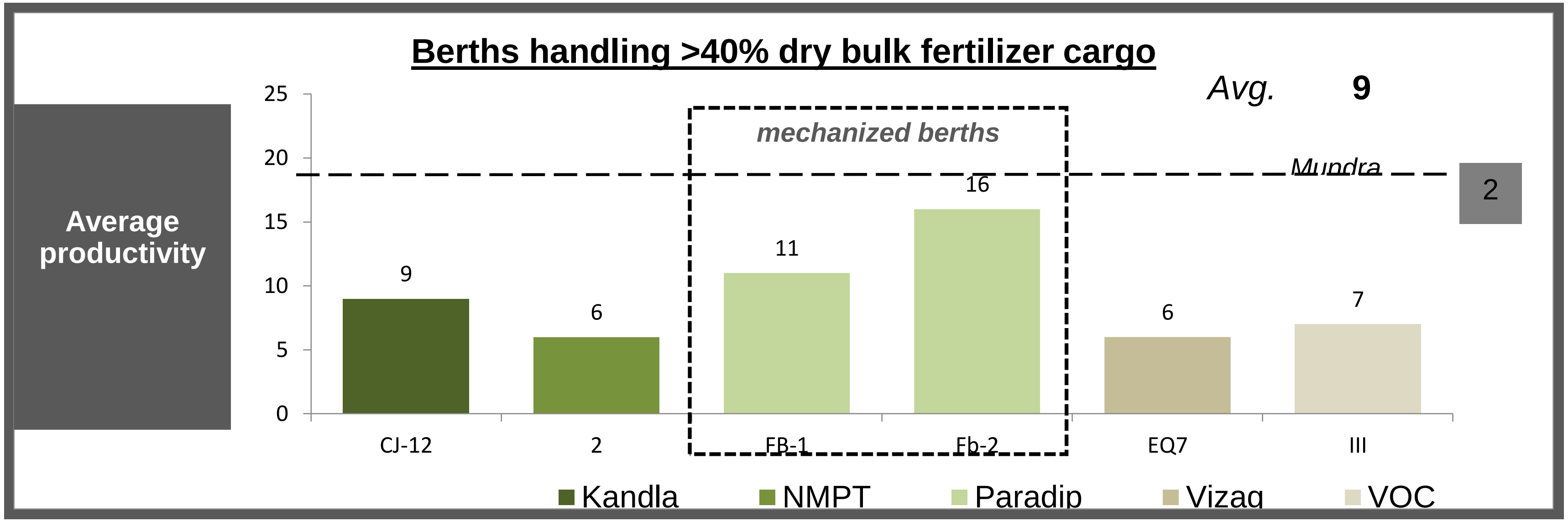


Figure 4.3.3: Ship day output of Dry bulk fertilizer

Observations:

- Productivity of Dry Bulk fertilizer in terms of output per day ranged between 6000 tonnes to 16,000 tonnes with average being 9,000 tonnes.
- No berth of major ports could achieve average productivity of Dry Bulk fertilizer which was registered by Mundra port.

4.3.4 Large scope for improvement as avg. BDP is 13000 MT/day

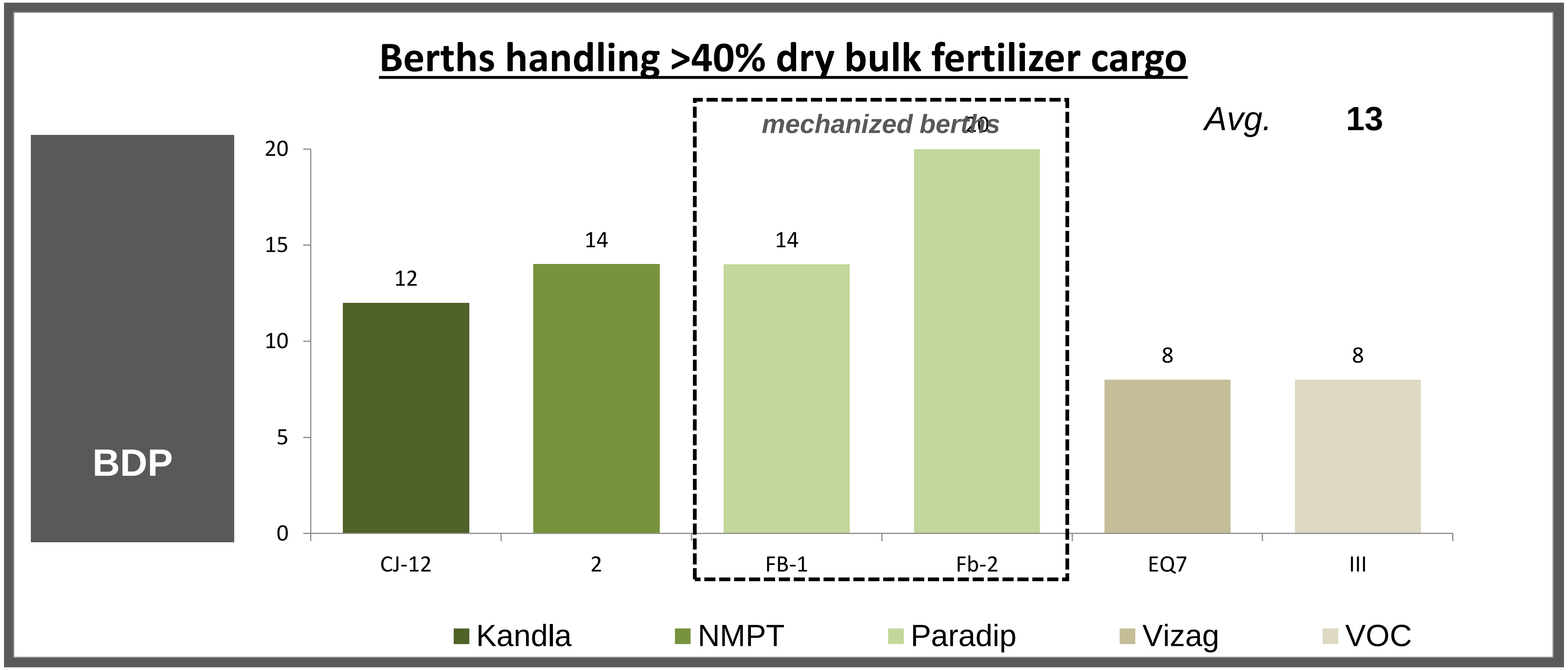


Figure 4.3.4: Berths handling more than 40% Dry Bulk Fertilizer Cargo

4.3.5 Low capacity utilization for Dry Bulk Fertilizer Cargo

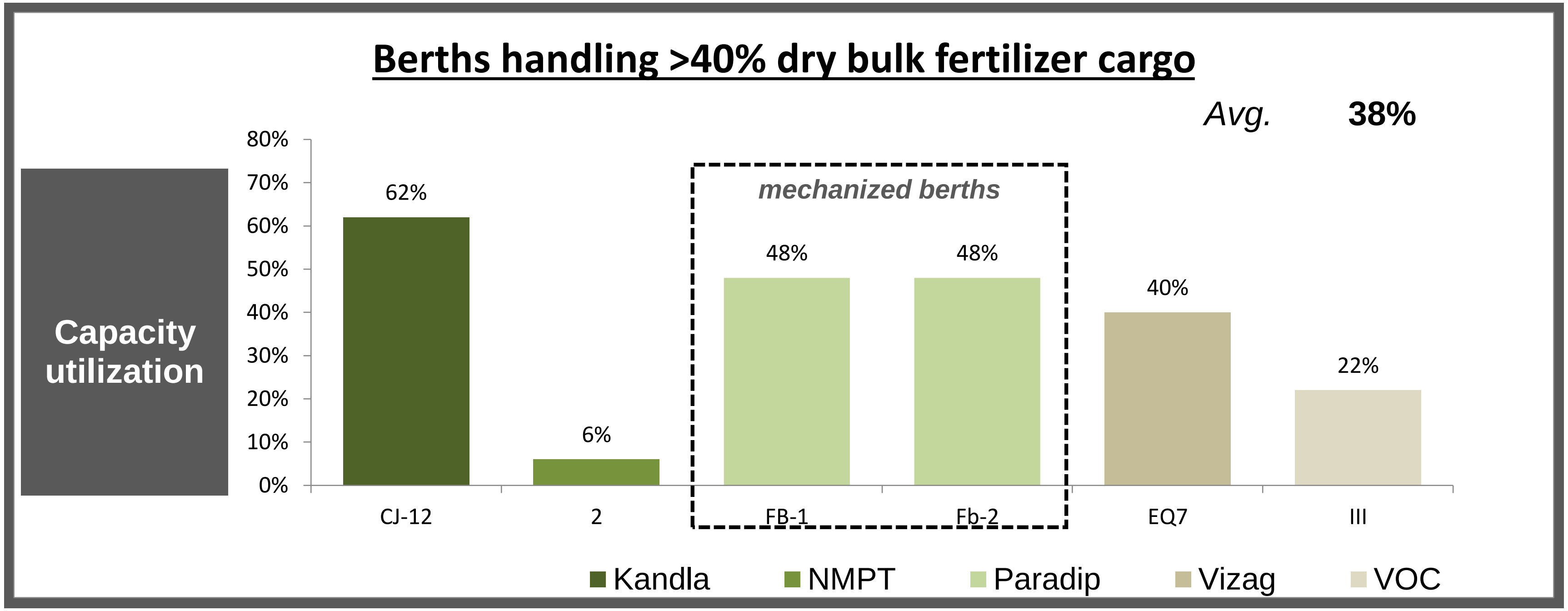


Figure 4.3.5: Berths handling more than 40% Dry Bulk Fertilizer Cargo

Observations:

- Capacity utilization of berths handling at least 40% Dry Bulk fertilizer ranged between 6% to 62% with average being 38%.
- Existing capacity may be increased significantly by achieving benchmark output per berth day. Higher capacity utilization coupled with improved productivity may lead to significant volume of incremental traffic.

4.4 POL

Liquid cargo 32% of overall traffic across 12 major ports FY 2014-15

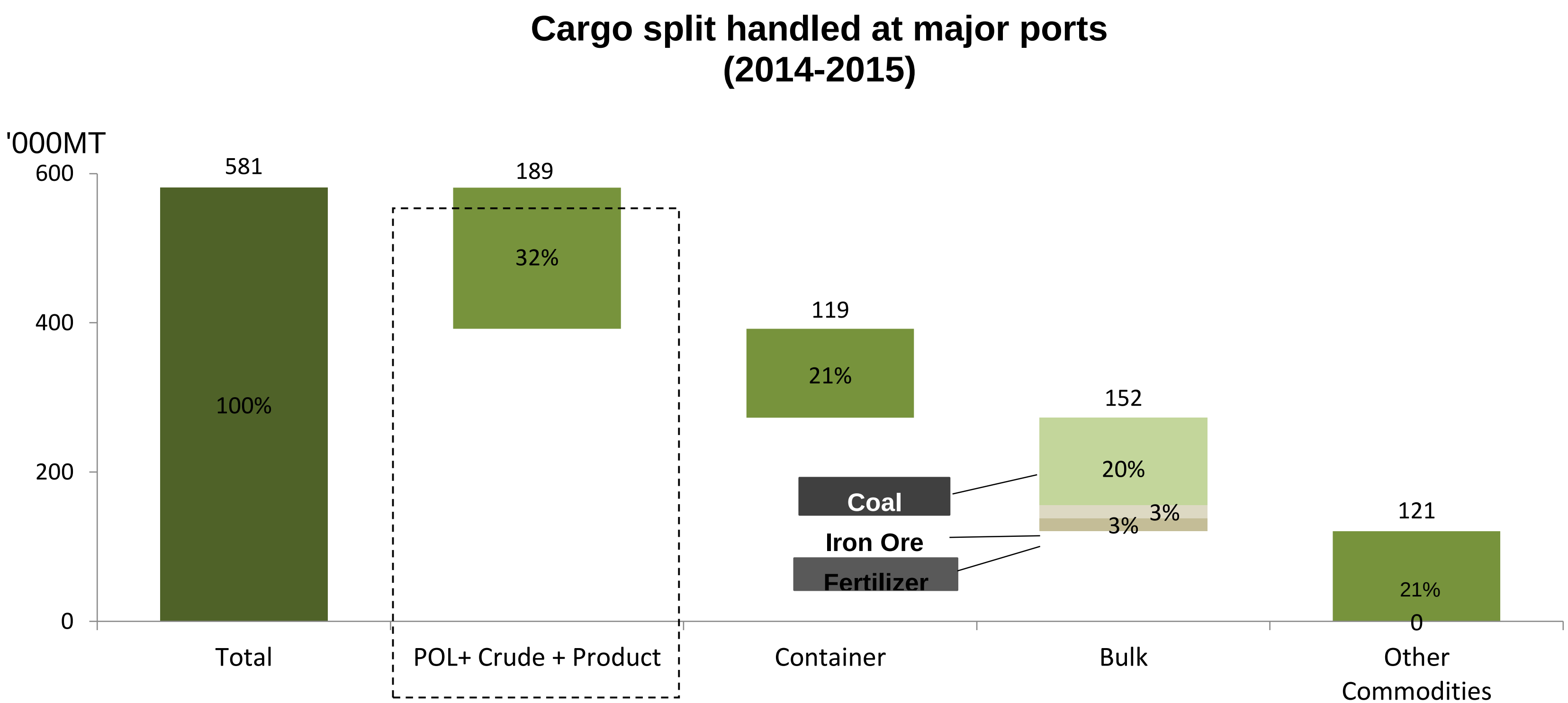
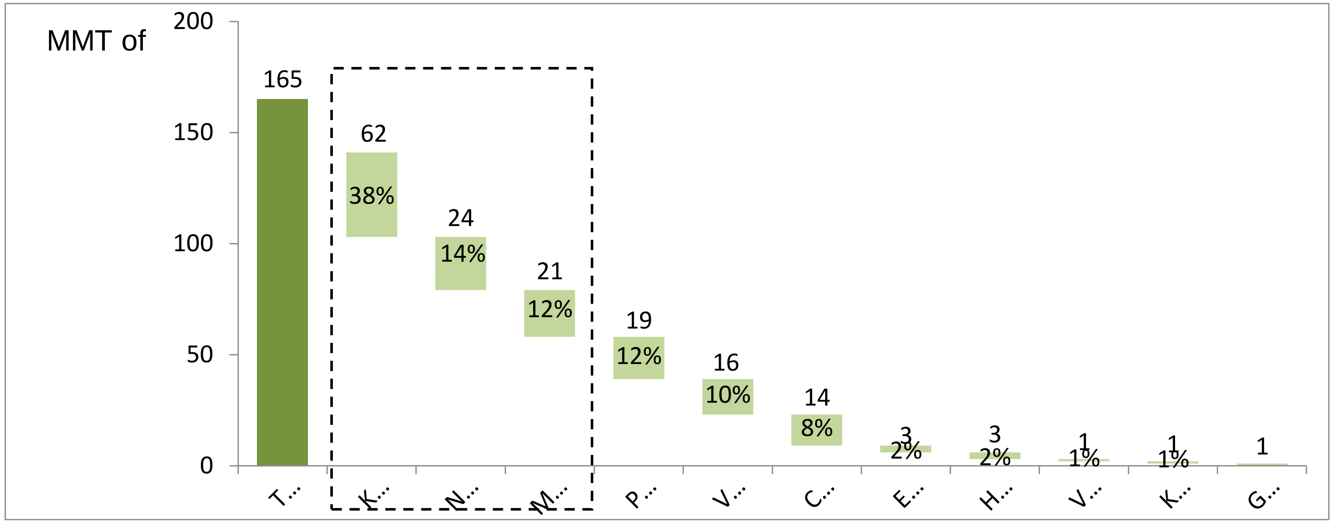


Figure 4.4: Cargo split handled at major ports

4.4.1 Distribution of Liquid cargo traffic across major ports FY 2014-15



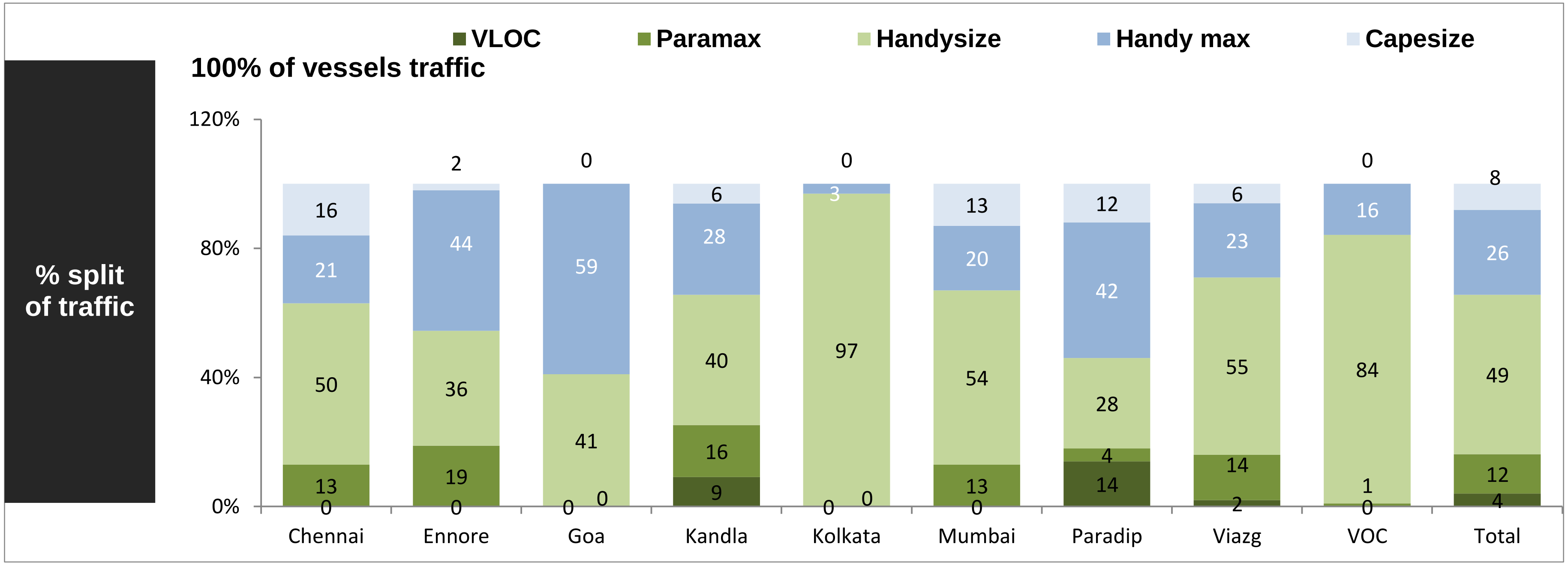
# of berths handling liquid cargo		**7**	**6**	**6**	**1**	**5**	**7**	**1**	**-**	**1**	**5**	**1**
Considered for analysis		✓	✓	✓	✓	✓	✓	✓	Data not clarified	✓	✓	✓

Figure 4.4.1:Major Port distribution of liquid cargo

Observation:

1. Kandla, NMPT and Mumbai together handled around 60% of the liquid cargo by the major ports
2. Liquid bulk traffic was highest at kandla

4.4.2 Handymax class constitutes ~50% of all liquid vessel calls



	Average draft	8.5 – 16.5	10 – 13.5	12 – 14	9.1 – 16.5	TBC	7.5 – 12	11 – 14.5	10 – 17	8.6 – 12.8	
Average parcel size	Capesize	133,068	35,681	0	102,902	0	86,643	98,062	111,838	0	122,905
	Handy max	21,639	15,434	7,609	24,659	7,119	19,025	14,343	18,585	10,915	20,608
	Handysize	7,359	4,961	6,406	7,651	4,627	6,588	13,255	7,180	7,427	7,905
	Panamax	40,063	24,061	0	57,330	0	50,544	32,923	33,392	16,990	51,880
	VLOC	0	0	0	249,780	0	0	257,612	208,419	0	228,264

Figure 4.4.2: Percentage of split traffic

4.4.3 Liquid berth occupancy

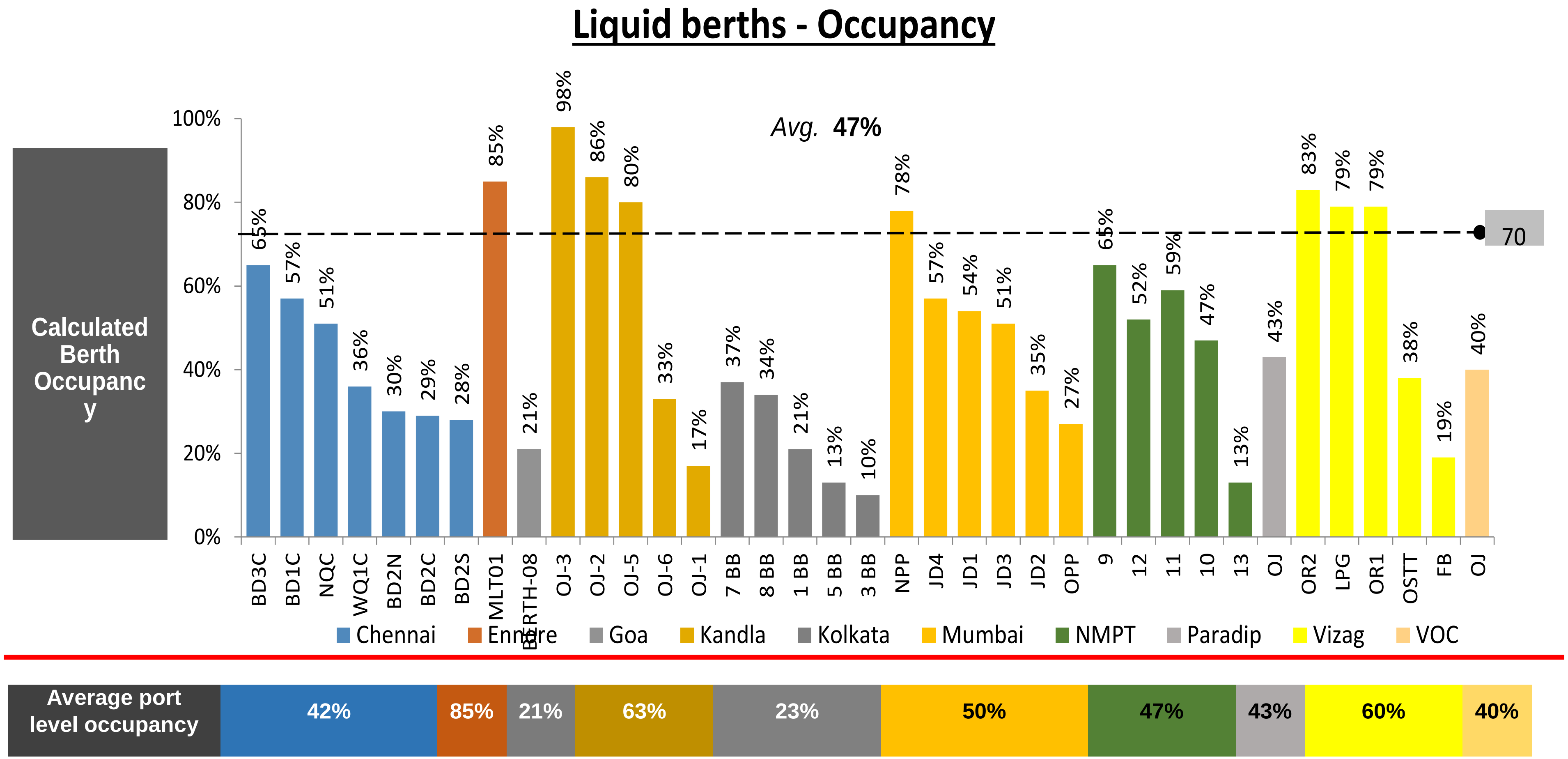


Figure 4.4.3: Liquid berths - Occupancy

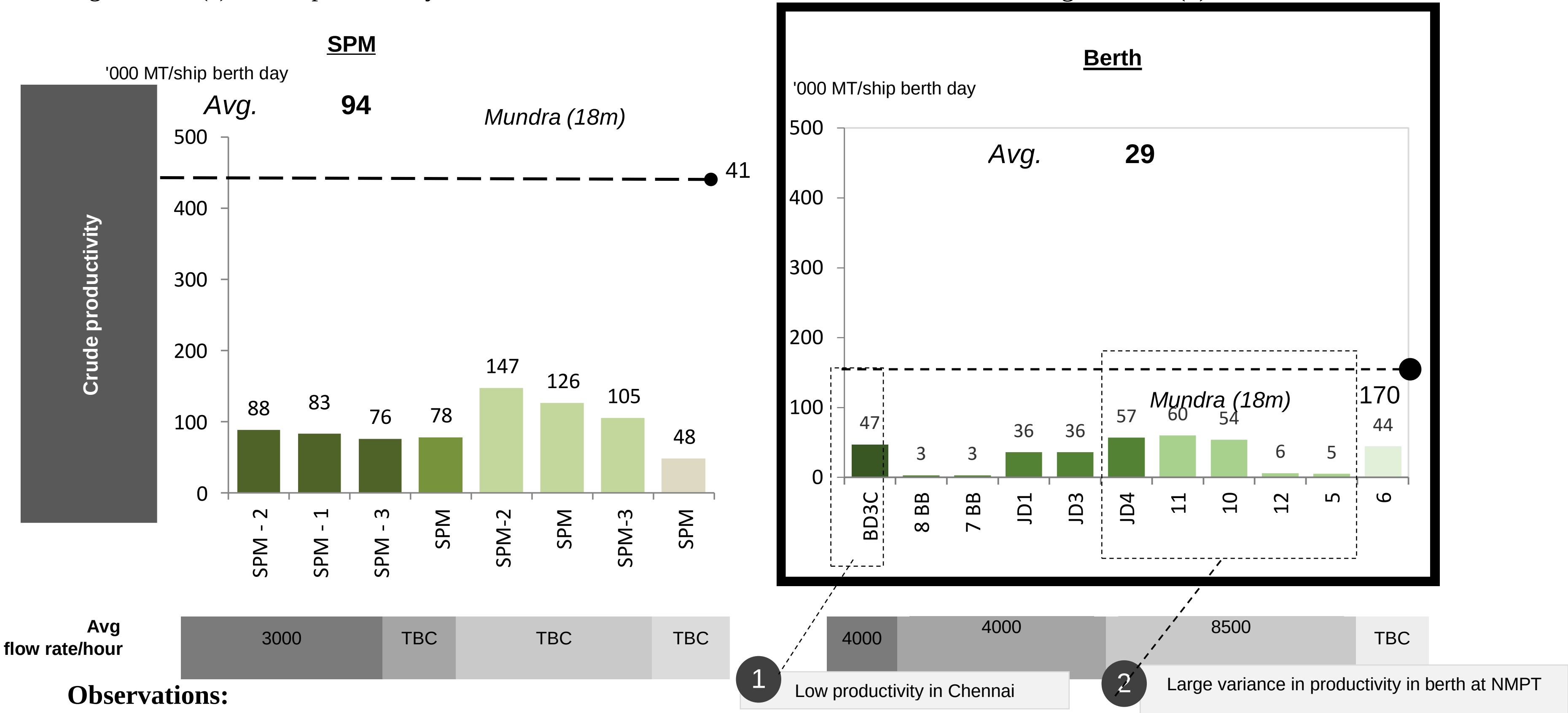
Observations:

- Average occupancy of berths handling Liquid Cargo at various ports was 47%. However, various ports registered different occupancy levels ranging between 21% at Goa to 85% at Ennore.
- Liquid berth operating at low occupancy levels – further scope for improvement
- Occupancy of berths handling Liquid Cargo varied for each port. Maximum variation is observed for Kandla port where occupancy level ranged between 17% to 98%.

4.4.4 Productivity of POL (Crude) at Major Ports FY 2014-15

Figure 4.4.4 (a): Crude productivity

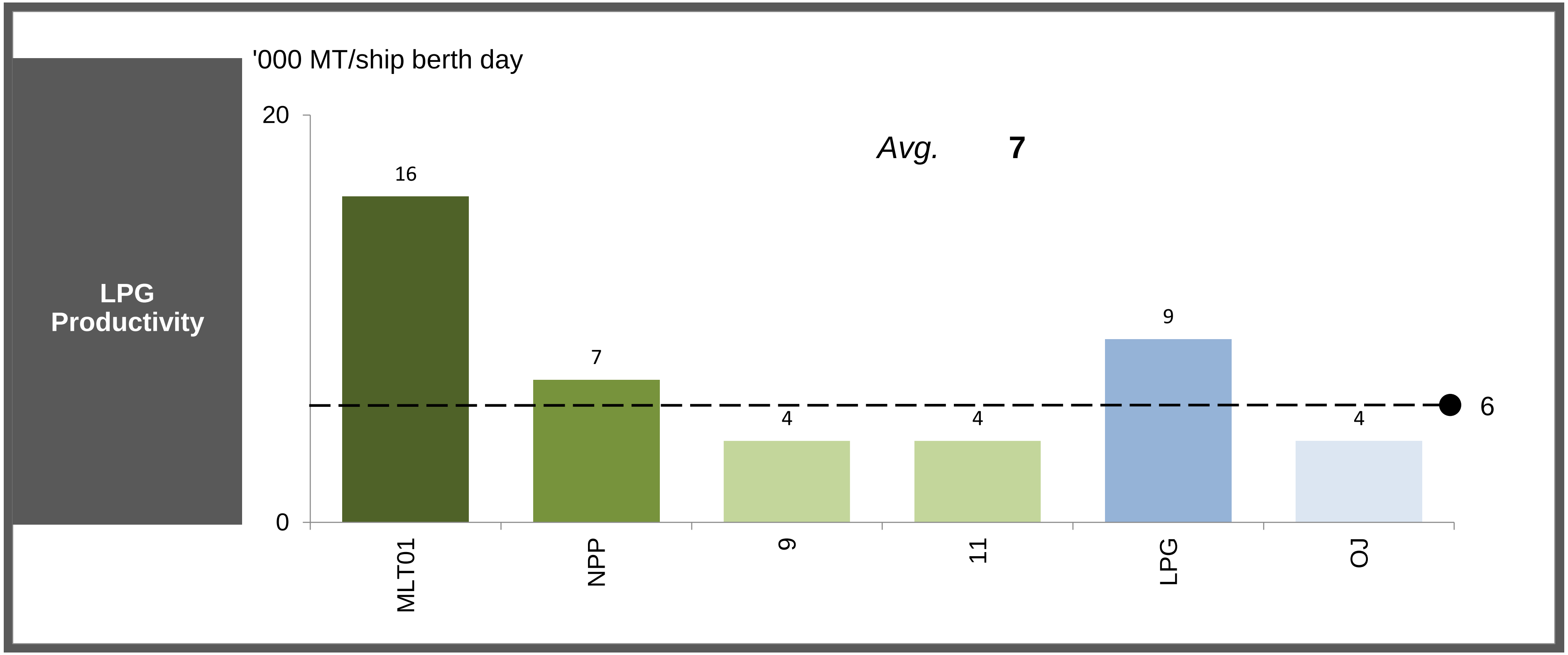
Figure 4.4.5 (b):



Observations:

- Ship berth day output at SPMs of major ports (Average 94,000 tonnes) was much less in comparison to the level achieved at Mundra port (414,000 tonnes).
- Similarly, output per ship berth day for Liquid Bulk at various berth of major ports at the level of 29,000 tonnes was much less than 170,000 tonnes registered by Mundra port.
- Variance of output per ship berth day for Liquid Bulk was maximum for NMPT.
- Possibilities of pipeline up-gradation and better storage facilities may be explored.

4.4.5 Productivity of LPG across berths of Major Ports FY 2014-15



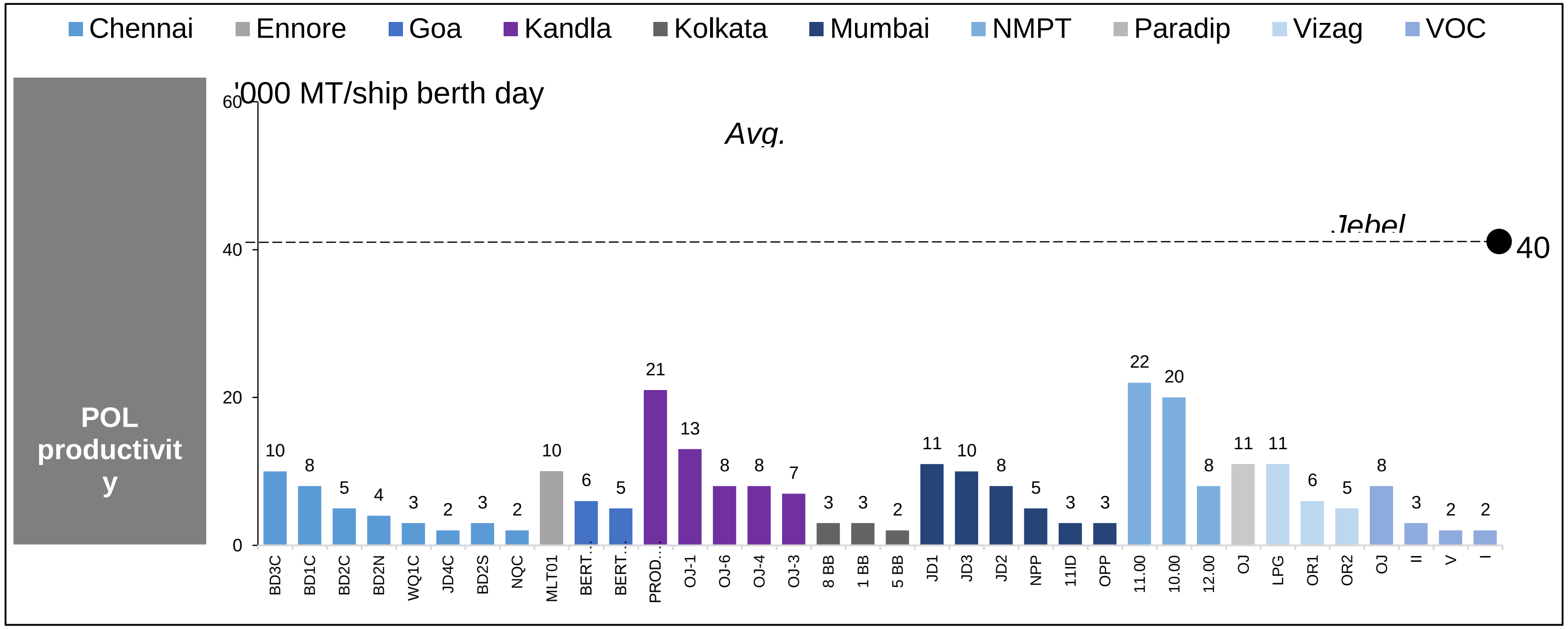
Avg flow rate	**1200**	**TBC**	**350**	**TBC**	**159**

Figure 4.4.5: LPG Productivity

Observations:

- Average ship berth day output for LPG at various major ports ranged between 4,000 tonnes to 16,000 tonnes with average at the level of 7,000 tonnes.
- Possibilities of pipeline up-gradation and better infrastructure facilities may be explored.

4.4.6 Productivity of POL (Product) across berths of Major Ports in 2014-15



Avg flow rate	1300	2100	500	700	TBC	TBC	1200	TBC	TBC	170
Best in class	2100									

Figure 4.4.6: POL Productivity & Avg flow rate

Observations:

- Average ship berth day output for POL at various berths of major ports showed large variation. Minimum and maximum productivity registered were 2,000 tonnes and 22,000 tonnes respectively. Even the maximum productivity is much less in comparison to 40,000 tonnes at Jabel Ali port.
- Improvement in productivity could lead to increase of capacity.
- Possibilities of pipeline up-gradation and better infrastructure facilities may be explored.

4.4.7 Productivity across berth significantly below benchmarks (IV)

Some ports require pipeline upgradation

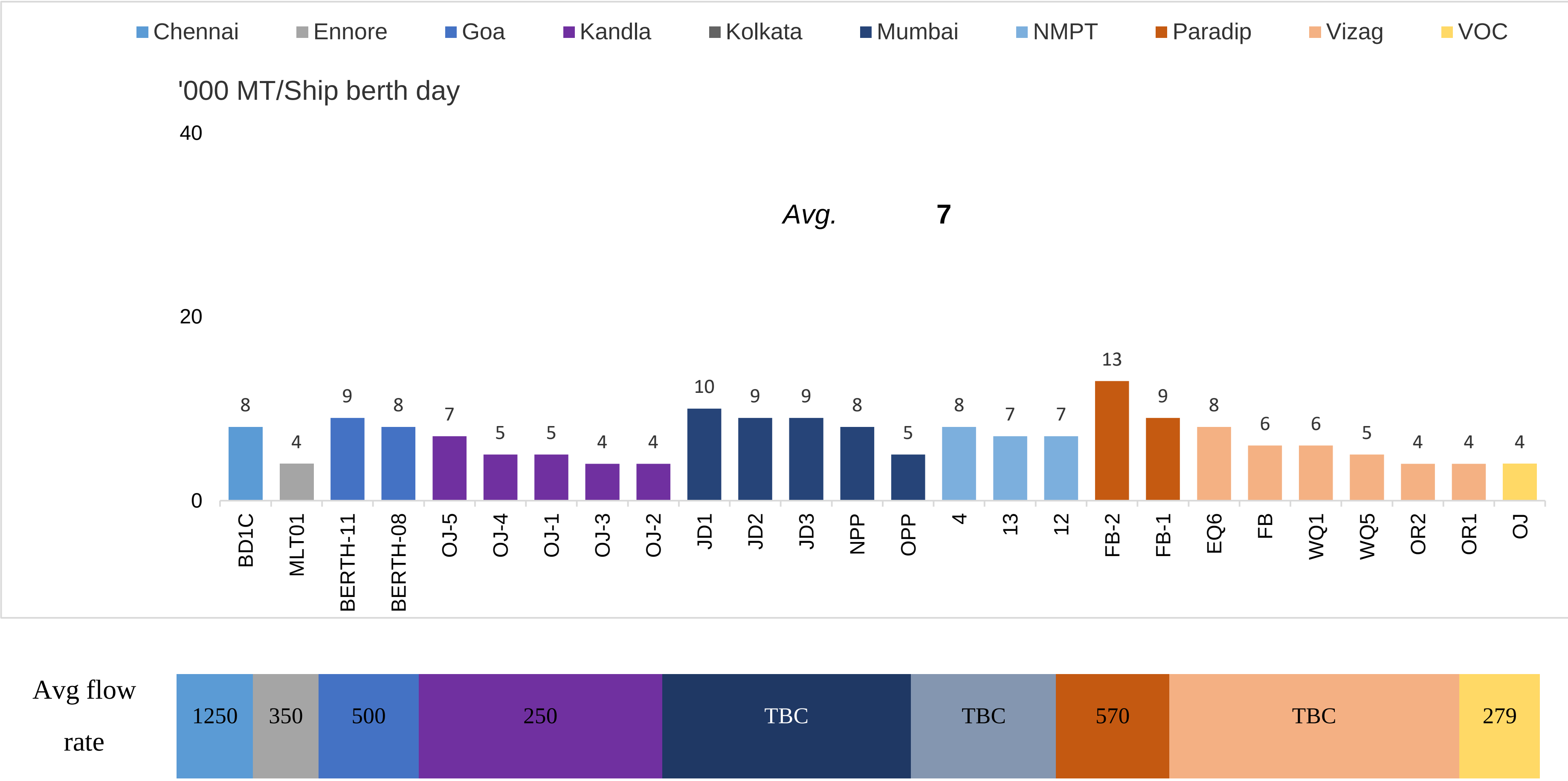


Figure 4.4.7 Productivity & Avg flow rate (other Liquids)

4.4.8 Potential to double volumes by replicating 'best demonstrated performance' consistently

With existing infrastructure – consistent performance						
Ports	**Current Liquid volume (MMT)**	**Current calculated Occupancy (%)**	**Current capacity utilization (%)**	**Current Productivity (MT/ day)**	**BDP Productivity (MT/ day)**	**Incremental annual throughput (MMT)**
Chennai	14	42%	42%	68,328	89,296	9
Ennore	3	85%	53%	10,743	17,171	1
Goa	1	21%	28%	5,376	8,603	1
Kandla	62	86%	35%	305,094	482,432	61
Kolkata	1	23%	14%	13,242	23,018	5
Mumbai	22	50%	31%	110,130	193,101	27
NMPT	24	41%	25%	159,206	261,822	43
Paradip	19	43%	15%	284,628	355,415	72
Vizag	16	60%	24%	117,575	189,248	32
VOC	1	40%	44%	4,301	8,594	1

Observations: Improving productivity to achieve the benchmark productivity level alone can result in incremental traffic of 252 MMT of Liquid Bulk traffic from existing traffic of 163 MMT.

4.5 Bulk Storage and Evacuation

Storage & evacuation data not regularly maintained in standardized formats

Metrics	Data Source	Vizag	Paradip	Kandla	Cochin	Morm -ugao	Ennore	Tuticorin	Kolkata	Mumbai	New Mangalore	Chennai
Storage Area by commodity	Storage maps/ allocation registers	✓	✓	✓	✓	✓	X	X	X	X	X	X
Trucks TAT	N/A in most ports, observation studies	Not maintained	Not maintained	Not maintained	✓	X	X	X	X	X	X	X
Rakes TAT	Rail indents of ports, N/A in some ports	✓	✓	Not maintained	✓	X	X	X	X	X	X	X

Data capabilities for tracking of bulk storage & evacuation to be covered as part of capability & maturity assessment

Storage & evacuation metrics to be addressed as part of deep-dive wherever applicable

4.5.1 Preliminary view of storage allocation by commodities across deep-dive ports

Coal

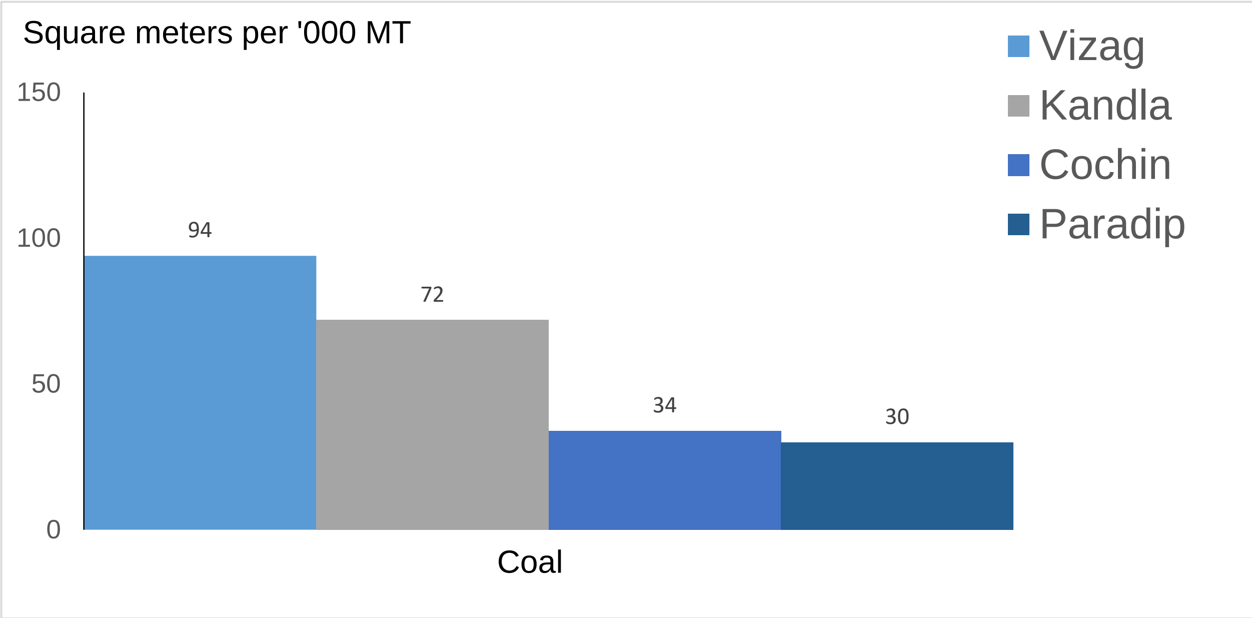


Figure 4.5.1 (a): Coal storage allocation across deep-dive ports

Dry Bulk

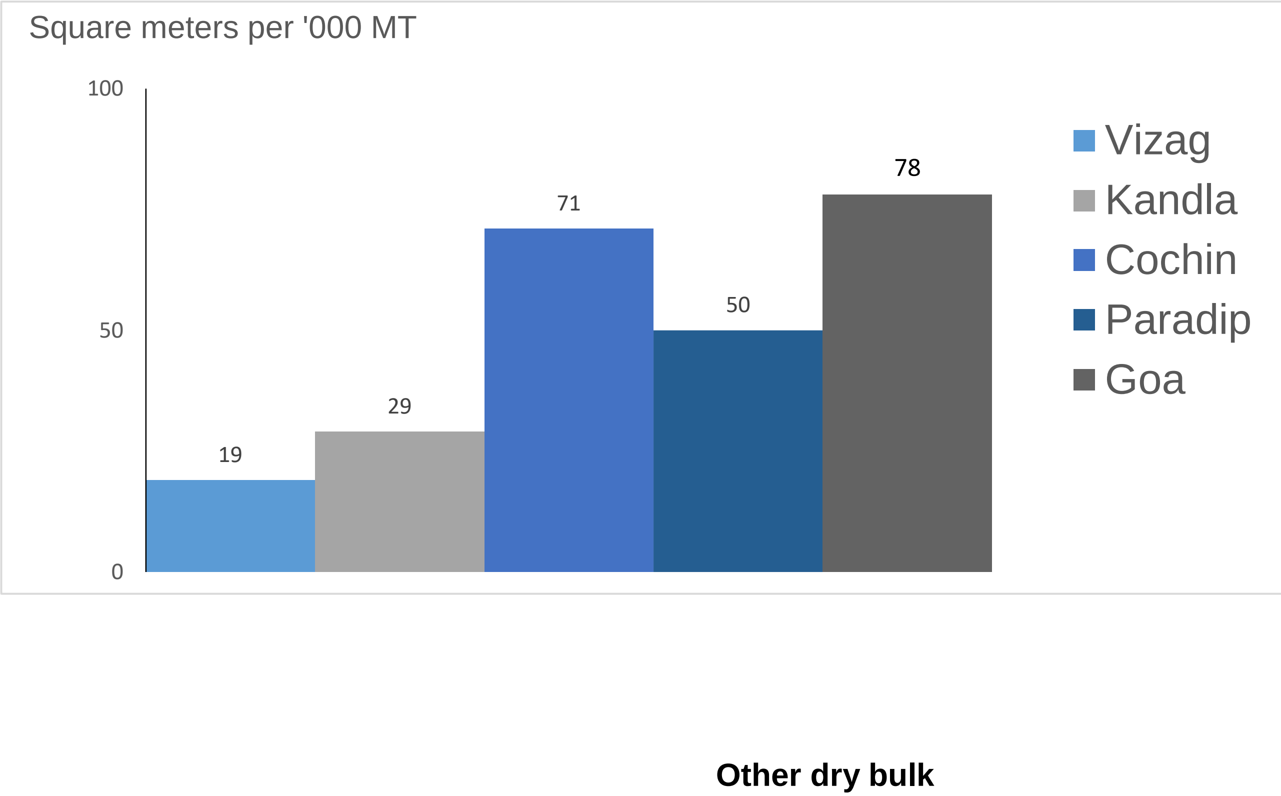


Figure 4.5.1 (b): Dry Bulk storage allocation across deep-dive ports

Break Bulk

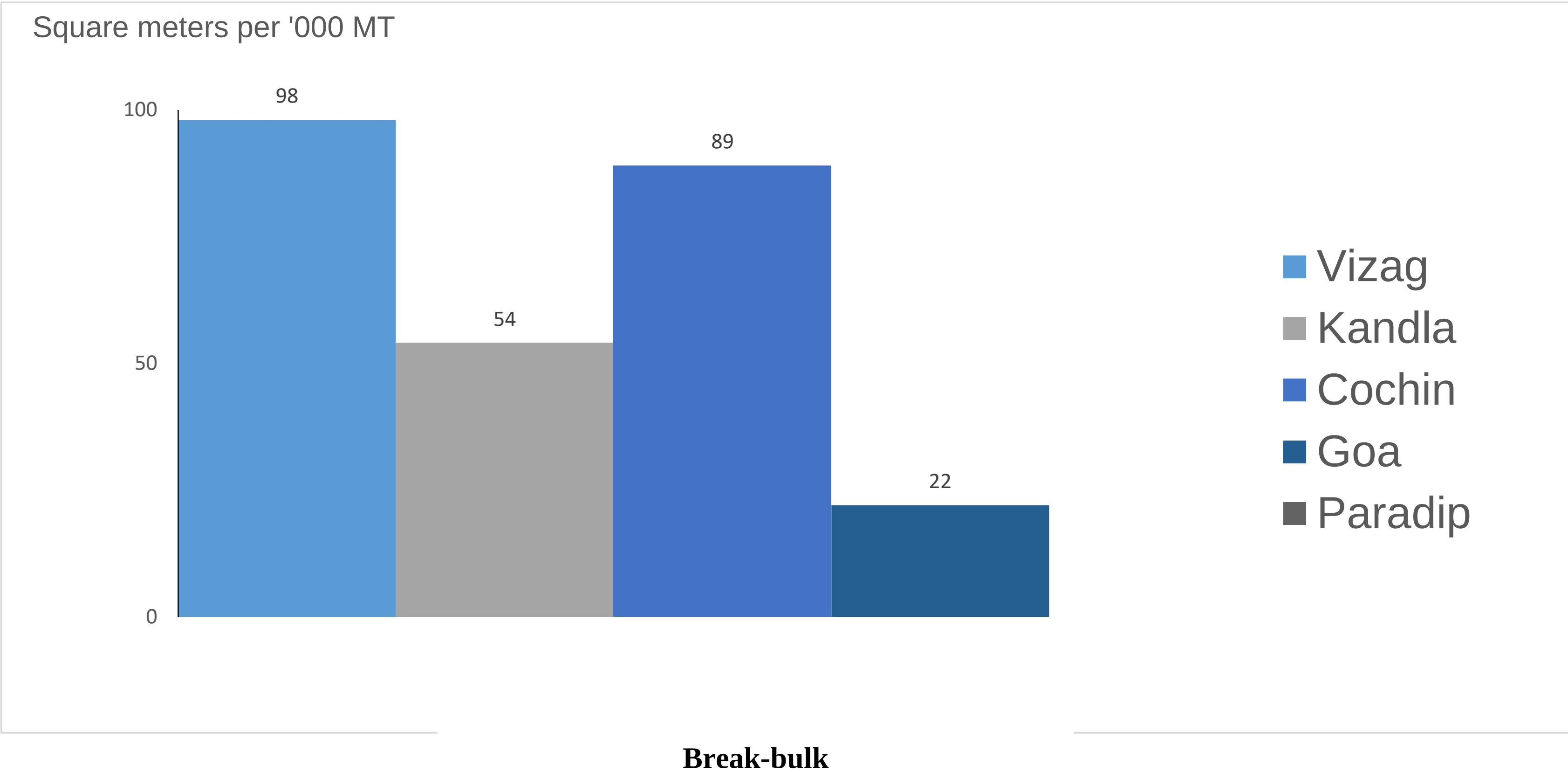


Figure 4.5.1 (c): Break bulk storage allocation across deep-dive ports

4.5.2 Rake turn-around times higher than private ports

Mechanized loading gives private ports and edge

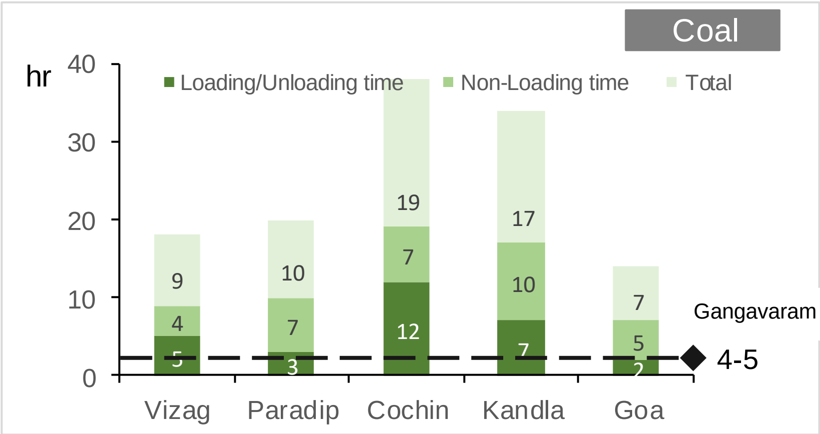


Figure 4.5.2 (a): TAT for rake loading across deep-dive ports - Coal

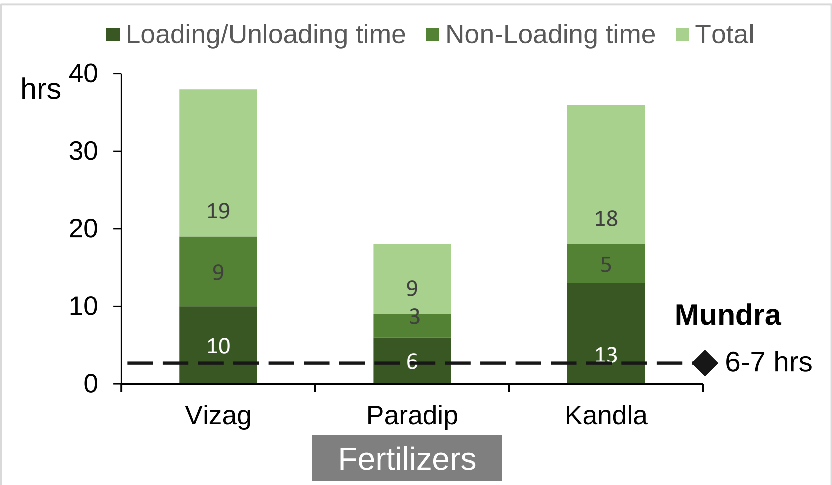


Figure 4.5.2 (b): TAT for rake loading across deep-dive ports - Fertilizers

Observations:

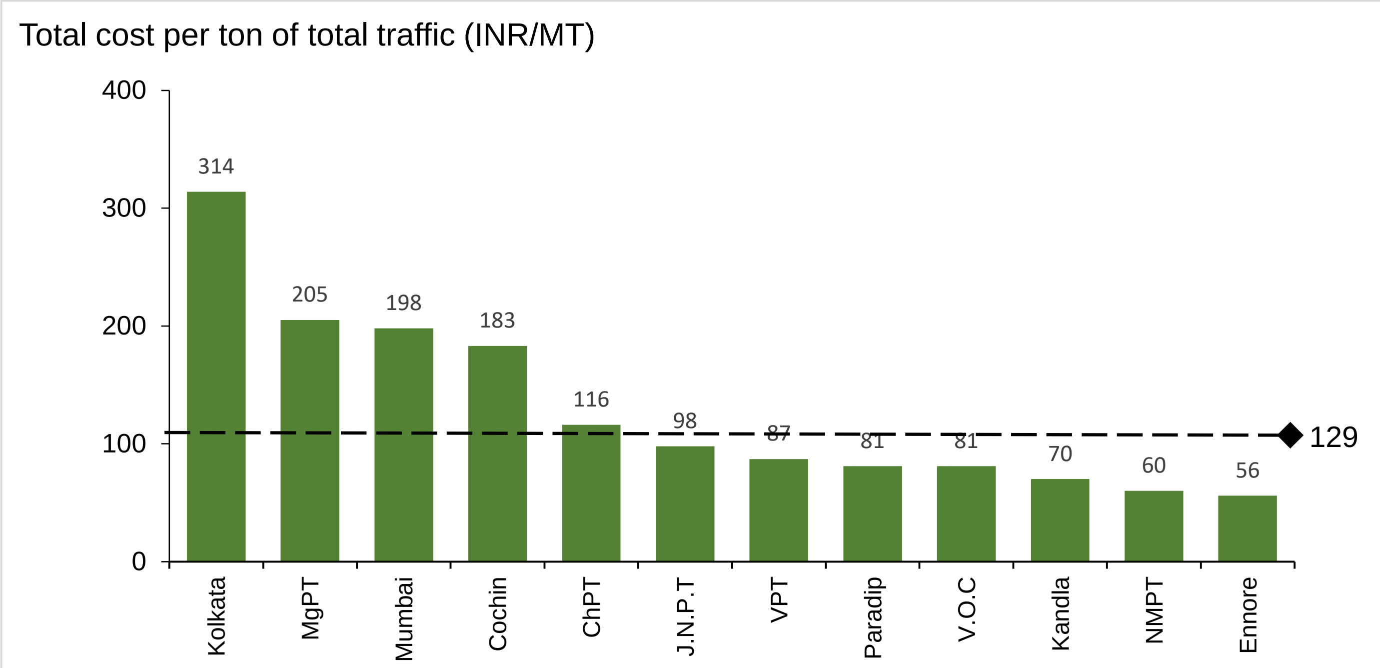
1. **High waiting times drives longer TAT in major ports**

2. **Longer TAT times makes ports less competitive than other private ports for rake availabilities**

3. **Mechanized loading in private ports allows for lower TATs**

4.6 Port Cost Benchmark

Total unit cost per ton traffic high for Kolkata, Mormugao, Mumbai and Cochin



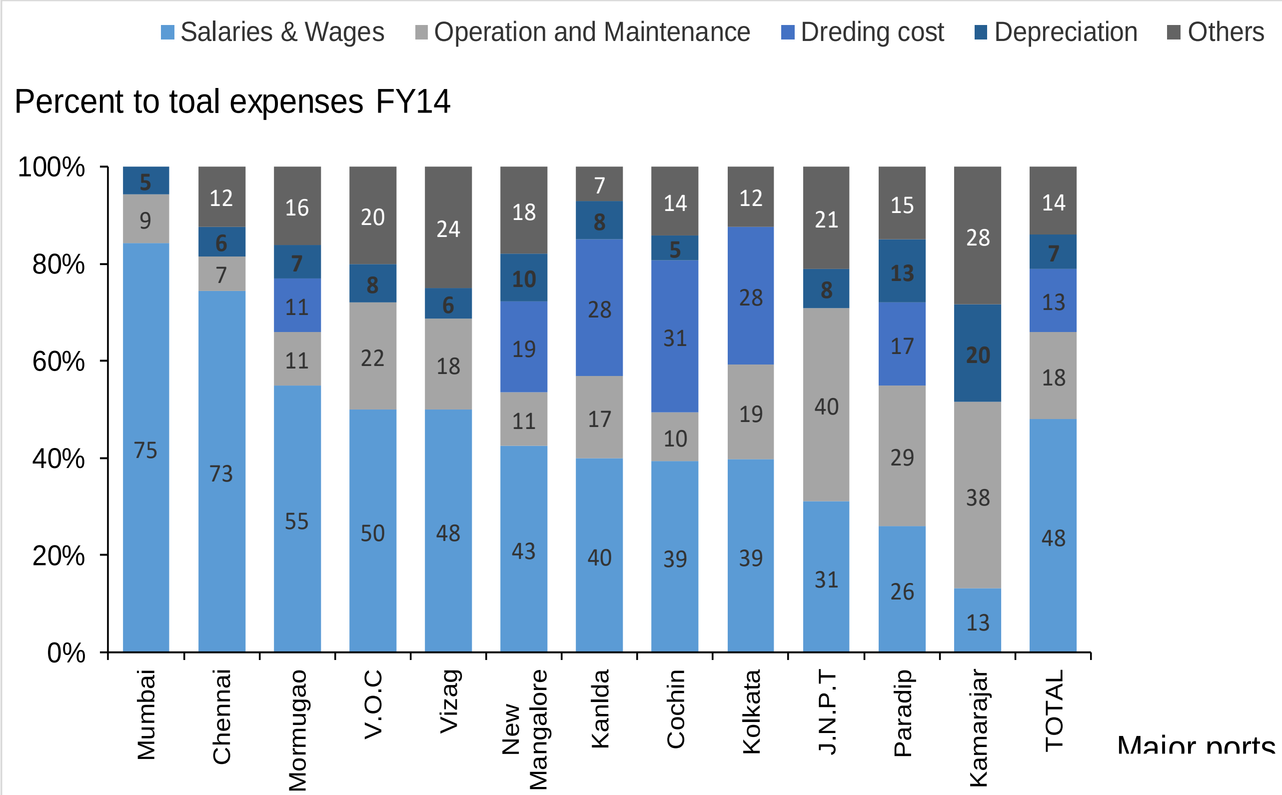
Total Traffic in 2013-14 (MMT)	41.4	11.7	59.2	20.9	51.1	62.3	58.5	68.0	28.6	87.0	39.4	27.3

Figure 4.6: Total cost per ton of total traffic

Observations:

- Cost per ton of cargo is highest for traditional ports with high manpower strength Kolkata, followed by MGPT, MbPT, Cochin and Chennai.

4.6.1 Labour, operation & maintenance and dredging accounts for ~80% of the operating expenditure across ports



Total OPEX base (Cr)	1170	594	241	231	508	236	609	383	1298	611	550	153

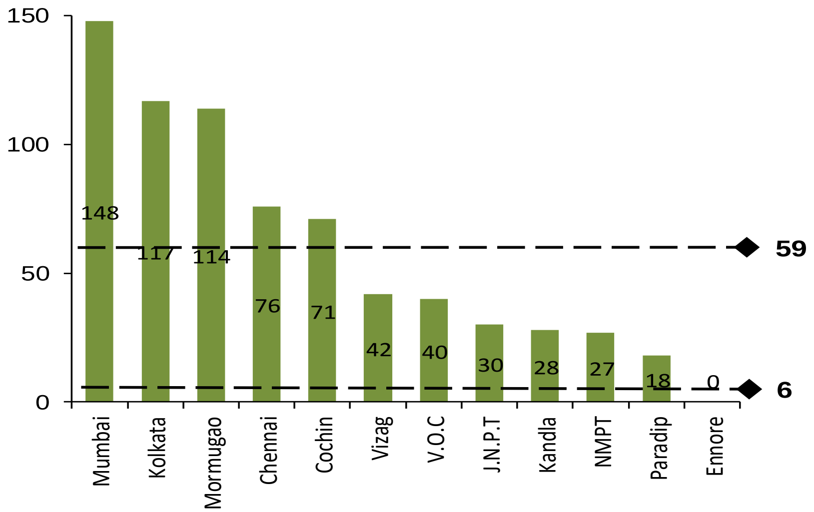
Figure 4.6.1: Percent to total expenses

Observations:

- Expenditure on salaries & wages 48% of total expenditure of all major ports, highest being Mumbai, followed by Chennai and Mormugao.
- Operation and maintenance expenditure (excluding salaries & wages) is only 18%, highest being JNPT followed by Kamrajar port and Paradip. Dredging cost constitute 13% of total expenditure of all major ports, highest being Cochin, followed by Kolkata and Kandla.

4.6.2 Labour cost is highest in legacy ports such as Mumbai, Kolkata and Goa

High labour cost per ton of traffic at Mumbai, Kolkata and Mormugao	Cochin, Mormugao and Kandla with high levels of non-cargo handling labour



# of employees	11699	6172	2138	5650	2284	4351	1507	1454	3165	1176	1845	43	

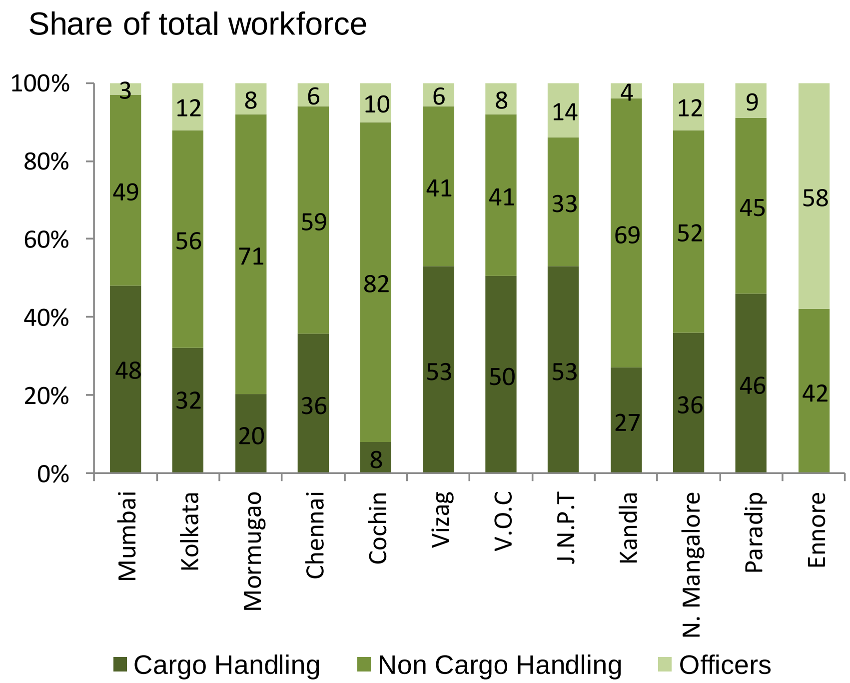


Figure 4.6.2 (a): Labour cost per ton of total traffic

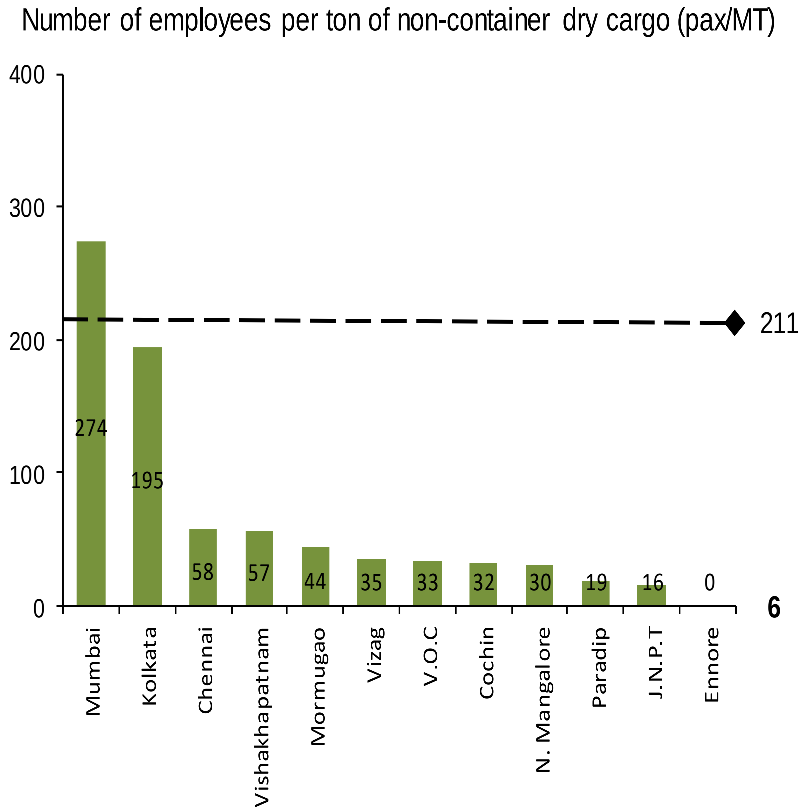
Figure 4.6.2(b): Share of total workforce

Observations:

- Labour cost per tonne of cargo is very much on higher side for legacy ports like MbPT, KoPT, MGPT, CoPT & Chennai.
- Non-cargo handling constitute around 50% and above of total workforce for most of the ports except JNPT, VPT, VOC.

4.6.3 Number of cargo and non cargo handling employees per MT

Indication of surplus cargo handling labour in Kolkata and Mumbai



Many legacy ports also with high levels of non-cargo handling labour

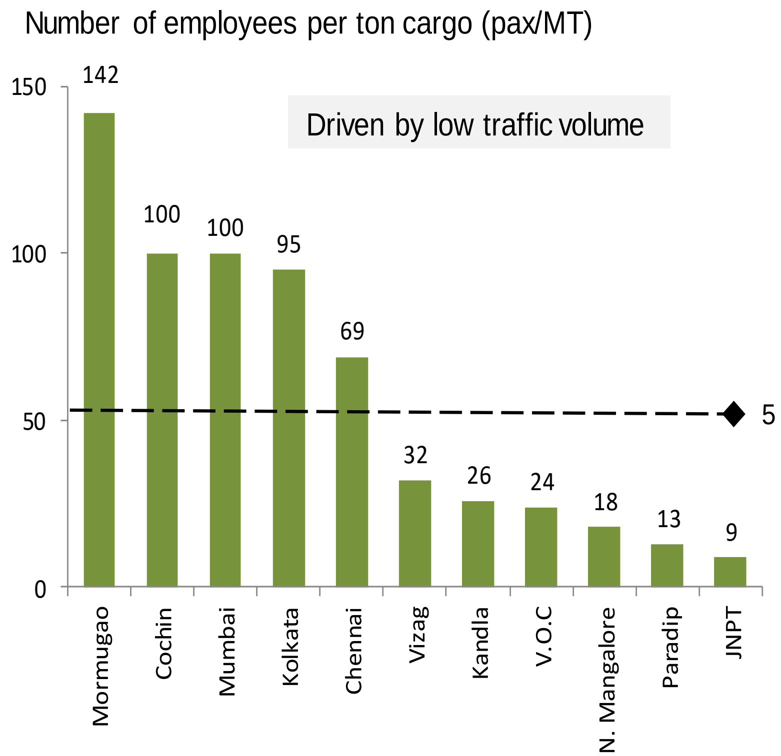


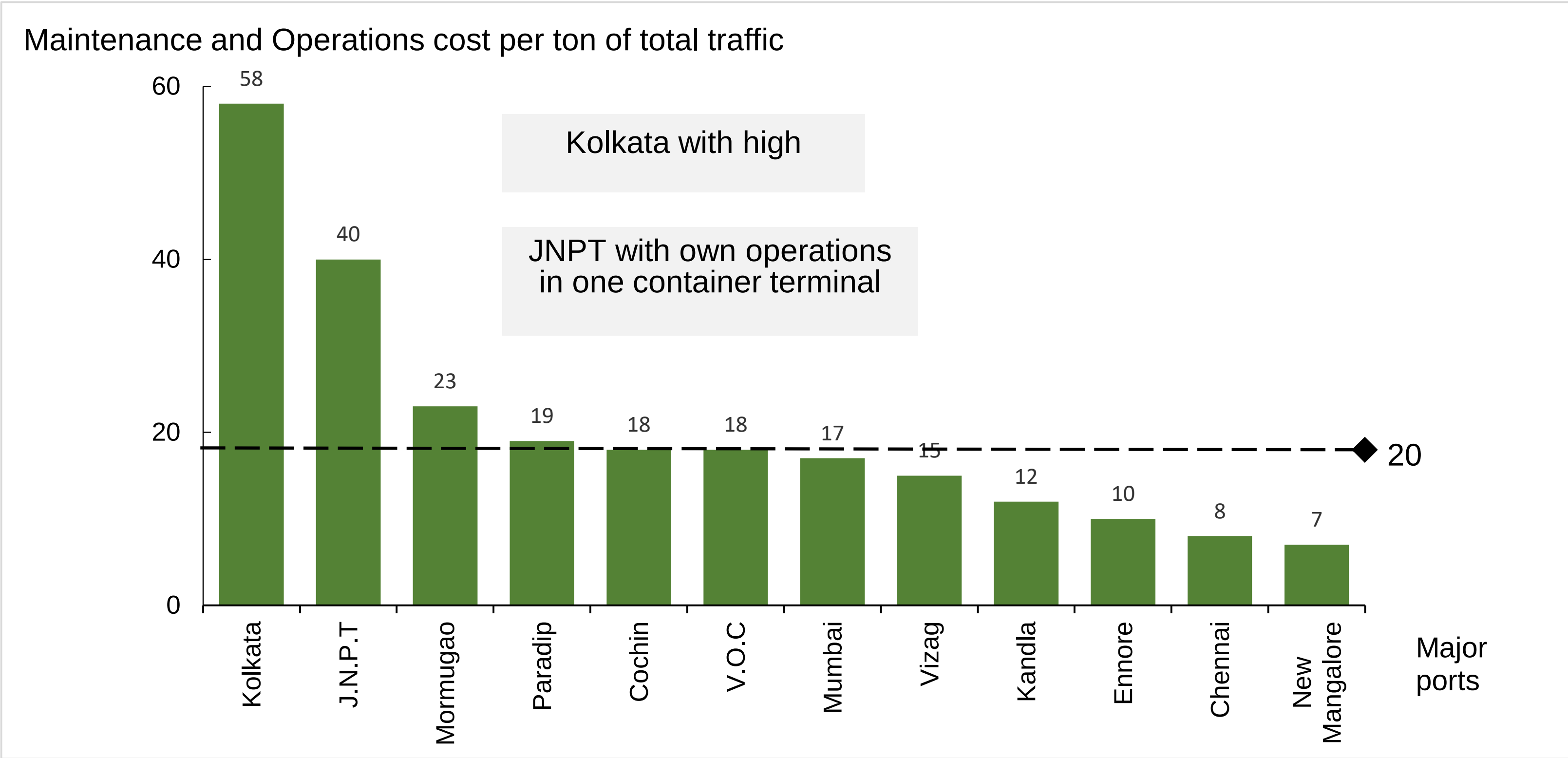
Figure 4.6.3 (a): No of employees per ton of non container dry cargo

Figure 4.6.3 (b): No of employees per ton cargo

Observations:

Mumbai port with highest workforce has highest number of employees per tonne of non-container dry cargo. Surplus cargo handling labour are there at MbPT and KoPT. Disproportionate no. of employees and traffic volume, resulted in highest no. of employees per tonne of cargo at older ports, highest being MGPT.

4.6.4 Maintenance & Operations cost per unit traffic



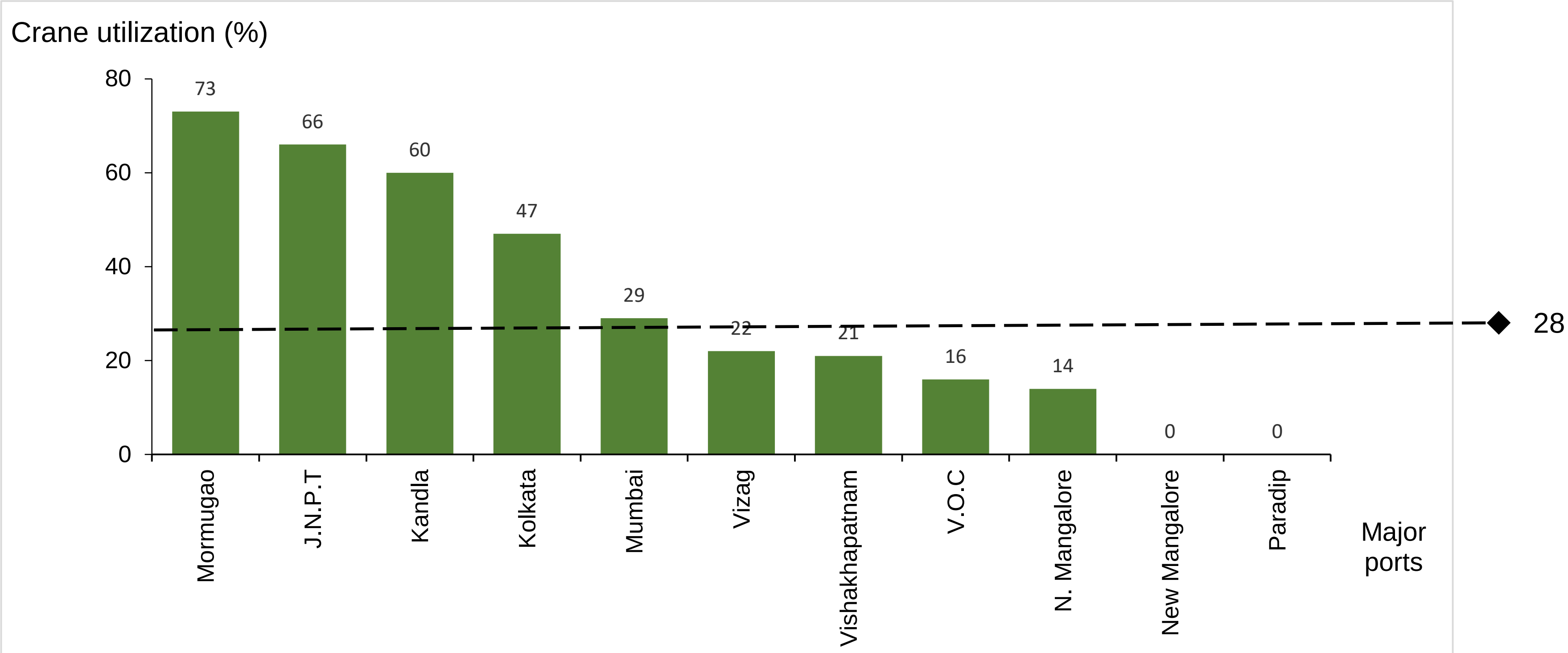
Total Traffic in 2013-14 (MMT)	41.4	62.3	11.7	68.0	20.9	28.6	59.2	58.5	87.0	27.3	51.1	39.4

Figure 4.6.4: Maintenance and Operations cost per ton of total traffic

Observations: Highest operation & maintenance expenditure at JNPT and low volume of traffic and large number of equipment at KoPT made the two ports having over 40% O&M cost per ton of traffic.

4.6.5 Port crane utilization high in Mormugao, J.N.P.T and Kandla

Low utilization of port berth cranes
across several ports



No. of cranes	**1**	**32**	**16**	**8**	**16**	**1**	**20**	**5**	**9**	**1**	**2**

Figure 4.6.5: Percentage of Crane utilization

Observations: Crane utilization was low (<-29%) for most of the ports. Moderate utilization is reported for Kolkata. Mormugao, JNPT and Kandla registered better utilization percentage (60% to 73%).

CHAPTER V – ANALYSIS (OBJECTIVE 2)

(Deep-Dive Analysis)

5.1 Jawaharlal Nehru Port Trust

5.1.1 Port performance dashboard – JNPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Container	24[1]	37	30[5]
Berth productivity	QC productivity (moves/hr)	Container	30[2]	17	25
Yard	RTGC moves per hour	Container	15[3]	6	10
	Yard throughout (TEU per Ha)	Container	25,000[4]	24,000	25,000
Evacuation	Truck gate processing time (min)	Container	23	91	46

1. Singapore benchmark for mainline vessels used; assumptions for normalization – package size of 2,000 TEU, QC productivity of 30 moves per hour, 3 quay cranes employed per vessel, 4 hours of non-working time due to customs rummaging, pilotage, repos of containers. 2. Singapore benchmark for QC cranes. 3. Singapore benchmarks for RTGCs; assumption for normalization; 2 RTGCs employed per crane for vessel operation (1 RTGC employed for yard operation). 4. Based on global benchmark – for an annual traffic of 1 Mn TEU 40 ha of yard space is assigned. 5. Calculated basis QC productivity improvement of 25 moves/hr.

5.1.2 Summary of suggestions – JNPT

#	Suggestions	Metric	FY 15 baseline	Target	Oper. Surplus Increase (INR cr)	Capex avoidance (INR cr)
JNPT 1.1	Reduce shift change losses to improve QC productivity	Time lost b/w shift changes	60 min	15 min	25	-
JNPT 1.2	Increase twin-lift ration	Twin lift ration	25%	38%	15	-
JNPT 1.3	Redesign operator incentive scheme	Moves/working hour	-	-	20	-
JNPT 1.4	Improve QC productivity through dual cycling	Dual cycles/ BD moves	-	-	12	-
JNPT 2.1	Dynamic deployment of RTGCs based on actual demand	RTGC moves/hr	6	10	6	-
JNPT 2.2	Ensure 100% yard integrity through real-time update of container location by RTGC operators	Incorrect location %	0.3	0.01	4	-
JNPT 2.3	Acquire additional RTGCs	RTGC/ QC ratio	1.9	3	4	-
# of suggestions identified = 7		**Operating surplus increase = 86 cr**			**Capex avoidance = NA**	

5.1.3 JNPT Reduce shift change losses to improve QC productivity

Suggestions Overview

Suggestions summary	Key action steps
Loss of quay crane productivity observed around shift change (~1 hour) **Improve the shift change process to minimize the productivity losse**s • Ensure work ends no earlier before scheduled shift ending • Bus for next shift staff reports before previous shift ends • Shorten the staff allocation for next shift • Move next shift staff to equipment on time	**Start monitoring performance at shift changes systematically down to individual quay crane level** • Shift-in-charge of previous and next shift to track and monitor the actual time loss during every shift change; and report **on daily basis** to **Deputy Mgr**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Shift-in-charge	*25 cr*	Time lost shift changes

5.1.4 JNPT Increase twin-lift ratio

Suggestions Overview

Suggestions summary	Key action steps
Twin-lifting can boost crane productivity for terminals where 20’ container constitute a large share of traffic (60-70% for JNPCT) Current twin-lift ratio is ~25% and there is potential to increase the twin-lifts of 20ft containers below 25ft through • Improve planning to optimize the twin-lift opportunities • Ensure execution according to plan with minimum leakage	**Conduct twin-lift leakage analysis at vessel level** • Starting from Week 21, for each vessel - Planning team: track twin-lift ratio planned, **separated by export & import** - Shift-in-charge: track the execution leakage of twin-lift and reasons and the actual twin-lift ratio executed, **separated by load & discharge** • Report to initiative team per vessel basis for review

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Head, Planning	*15 cr*	Twin lift ratio

5.1.5 JNPT Redesign operation incentive scheme

Suggestions Overview

Suggestions summary	Key action steps
Current productivity-incentive scheme is out-dated and not effective to raise operator motivation • Incentive as small share of overall compensation • Fixed amount based on terminal-wide performance **Re-design the incentive scheme** • Increase the incentive amount • Integrate individual QC op. performance • Refer to separate section under the '*diagnostic findings*' for the proposed scheme	**Track individual quay crane operator performance & attendance for 1-2 months to finalize the key incentive parameters (e.g. minimum monthly moves)** • Individual quay crane operator productivity (moves per hour) • Total number of moves performed • Actual # of hours worked / absent **Engage union to propose the new incentive scheme** **Pilot the new incentive scheme for 3 months before roll-out**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Dy. Chairman	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Traffic Manager	*20 cr*	

5.1.6 JNPT Redesign operation incentive scheme

Suggestions Overview

Suggestions summary	Key action steps
JNPT is currently not employing dual cycling • Significant potential to employ dual cycling given the large gateway traffic and parcel sizes • Has been successfully employed at GTI **Introduce dual cycling among QC and TT's through** • Advanced loading plans to smooth differences between loads and discharges across stacks • Better yard side planning • Service based TT dispatching	**Immediate steps** • Procure and install advanced NAVIS modules that provide support for dual cycling • Identify metrics for tracking, recording and reporting dual cycling performance **Medium-term** • Enable smooth flow of TT between import and export yard • Create loading plans that allow QC dual cycling • Employ service based TT dispatching

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Head, Planning	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Traffic Manager	*12 cr*	Dual cycles/ QC moves

5.1.7 JNPT Dynamic deployment of RTGCs based on actual demand

Suggestions Overview

Suggestion summary	Key action steps
JNPT RTGC utilization rate is lower (high idle time) than GTI despite of equipment shortage • Fixed deployment of 2 RTGCs in the export yard for export in-take for every shift despite actual in-gate volume • Separation of Import / Export yards prevent RTGC pooling **Improve RTGC deployment through** • Dynamic deployment of RTGCs to rebalance the equipment based on actual demand • Monitor idle RTGCs and develop deployment strategy	**Immediate steps** • Deploy the RTGCs for export intake based on the in-gate volume and proximity to the CY location **Medium-term** • Set up operation control tower, CCTVs in the yard and dedicate equipment dispatchers to monitor the RTGC idle time • Improve yard layout to allow pooling of RTGCs across Import & Export yards

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Head, Planning	***Operating surplus improvement : -***	**Metric to be tracked -**
Other stakeholders :	Traffic Manager	*6 cr*	RTGC moves/hr

5.1.8 JNPT Ensure 100% yard integrity through real-time update of container location by RTGC operators

Suggestions Overview

Suggestion summary	Key action steps
~30% containers are not in the planned location • Planning not able to optimize the stacking • Low RTGC productivity due to time taken to search containers • High cancellation of pickup line tickets due to wrong location **Ensure container location has 100% integrity** • Require real-time update of container location by RTGC operators (where RDT is available) • Assign housekeeping jobs to clean up the wrong location	**Immediate steps** • Enforce RTGC operators to update container location in real-time through RDT • Discuss with IT to explore system solution to track # of containers not in the planned yard location and any failed or late RDT update • Assign **housekeeping** job to clean up / prepare yard (e.g. consolidate minor stacks)

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Head, Planning	***Operating surplus improvement :*** -	**Metric to be tracked -**
Other stakeholders :	Traffic Manager	*4 cr*	Incorrect location %

5.1.9 JNPT Acquire additional RTGCs

Suggestions Overview

Suggestion summary	Key action steps
Current number of RTGCs is insufficient to handle targeted increase in QC productivity • RTGC to QC ratio is very low for JNPT (1.9 as against 4 at GTI) • No. of RTGCs insufficient even at the targeted RTGC productivity level of 10 GMPH **Acquire additional RTGC** • 9 additional RTGCs would need to be acquired assuming a RTGC productivity increase to 10 GMPH • Can be either purchased or hired on contract	**Immediate steps** • Finalize the mode of acquiring additional RTGCs-purchase or hire • Release the tender for purchase or hiring of additional RTGC • Identify the external vendor • Provide targets dates to the vendor for completion of the deployment of additional RTGCs

Ownership	Financial Impact	Tracking metrics
Initiative owner : Dy. Chairman Other stakeholders : Traffic Manager	***Operating surplus improvement :*** *4 cr*	**Metric to be tracked -** RTGC/ QC ratio

5.2 Paradip Port Trust

5.2.1 Port performance dashboard – PPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Conventional	70[1]	360	144
	Avg. vessel turnaround time (hours)	Coal – Mechanized	36[2]	97	42
	Avg. vessel turnaround time (hours)	POL	36[3]	83	50
Berth productivity	Gross productivity (gross MT/ day)	Coal – Conventional	20,000[4]	9,772	13,500
	Gross productivity (gross MT/ day)	Coal – Mechanized	66,000[5]	32,880	55,000
	Discharge rate (MT per hour)	POL	3500	2,167	2,500
Yard	Yard throughput (MT per sq. m)	Coal - Conventional	NA	33	40
	Yard throughout (MT per sq. m)	Coal - Mechanized	250[6]	172	230
Evacuation	Rake turnaround time (hours)	-	5.0	9.6	5.0

1. Average coal parcel size at conventional berths in Paradip = 50,000. Best in class productivity for full vessel = 20,000 (80% of 25,000 MT for Cape at Krishnapatnam port). Pre Berthing detention of 6 hours, other non working time including pilotage customs check etc at ~4 hours. 2. Panamax capable berth handling parcel size of ~55,000 MT. At panama parcel size, loading time would be ~30 hours. Additional PBD + other non working time = ~6 hours. 3. Average productivity of~2,500 MT / hour (varying by cargo type). Average Parcel size at Paradip = 75,000. Berth time = 30 hours. Additional 6 hours of time for non working time. 4. Gross productivity of 20,000 MT for cape vessels). 5. Average productivity of unloading 7,500 MT berths = 100,000 MT. Adjusting for equipment type and operation (Unloading ~20% lower than loading), target productivity of 66,667 MT.

5.2.2 Summary of suggestions – PPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
PPT 1.1	Modification of existing berthing policy and setup of penal berth charges linked to productivity	MT / hr	1.370	2,500	45	-
PPT 1.2	Generate additional demand	mn MT / month	1.8	3.0	90	-
PPT 2.1	Use IHP for export coal cargo and handle Haldia top-up vessels and smaller players	MT / month	0	375,000	40	-
PPT 3.1	Rationalisation of existing plots in MCHP and development of additional land (if required)	MTPA / sq.m + Impl. time for new land	172	230	27	-
PPT 3.2	Improve RRS monitoring to improve mntc. and reduce rake TRT Upgrade coal loading system at MCL	Rake TRT	2.25	1.75	41	-
PPT 4.1	Operate 8 HMCs across EQ 1-3, CQ1-2 berths to upgrade productivity	# of HMCs	4	8	36	-
PPT 5.1	Develop additional storage capacity and full rake sidings for conventional operations	Sq. m	0	200,000	24	-
# of suggestions identified = 7		**Operating surplus increase = 303 cr**			**Capex avoidance = NA**	

5.2.3 PPT Modification of existing berthing policy and setup of penal berth charges linked to productivity norms

Suggestions Overview

Suggestions summary	Key action steps
Productivity norms promoting higher productivity will drive end customers to increase vessel productivity rate.	Priority berthing rules productivity norms and penal charges to be informed and aligned with all customers
Prioritized berthing for high productive vessels to drive improved performance.	• Detailed norms for next 2 years • New berthing norms finalization and launch

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	CME	*45 cr*	Gross MT / day

5.2.4 PPT Generate additional demand for thermal coal from existing and new customers

Suggestions Overview

Suggestions summary	Key action steps
Improvement of productivity will release occupancy at MCHP which will require additional volumes from customers • Tangedco / NTECL / NTPL • APGENCO • KPCL • Other customers	Identify end customers for thermal coal Discuss with end customer to attract cargo from customers Key customers to target include APGENCO, MhGenCo, GujGenCo

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Dy. Chairman	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Traffic Manager	*90 cr*	mn MT / month

5.2.5 PPT Use IHP for export coal cargo and handle Haldia top-up vessels and smaller players

<u>Suggestions Overview</u>

Suggestions summary	Key action steps

• Use of IHP for handling thermal coal
• Link IHP with low productive vessels
  - Link 3 mMT coal cargo for TANGEDCO / NTECL
  - Link Haldia volumes with IHP
• Transfer smaller volume (< 1 mMT) cargo from MCHP to IHP
	Discuss and along with end customers on need to handle cargo at IHP
	
	Setup appropriate pricing structure to make handling cost equivalent across MCHP and IHP
	
	Setup productivity norms and berthing policy at IHP

Ownership	Financial Impact	Tracking metrics
Initiative owner : Dy. Chairman Other stakeholders : Traffic Manager	***Operating surplus improvement :*** *40 cr*	Metric to be tracked - MT / month

5.2.6 PPT Rationalisation of existing plots in MCHP and development of additional land

Suggestions Overview

Suggestions summary	Key action steps
• Drive MCHP land rationalization to increase productivity	Throughput levels defined for entire land parcel
• Land allocation done based on average throughput achieved by customer with smaller players to be shifted to IHP	New players to be allocated land based on norm of 250 MTPA / sq. mts
• Additional land parcel may be required to be developed to handle excess volumes - Depends on customer profile and volume from existing players	DPR for developing additional land parcel followed by tender for contracting out the required project
	Program monitoring of construction activities

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	CE, CME	*27 cr*	MTPA / sq. m

5.2.7 PPT Improve RRS monitoring to reduce rake TRT

Suggestions Overview

Suggestions summary	Key action steps
• Improve monitoring at MCHP receiving station to reduce turnaround time • Improve railway track maintenance • Potential need to hire double locos for rake movement on merry go round • Upgrade and maintain auto signalling system for MCHP • Upgrade of MCL end coal handling system (under construction by MCL)	• Setup team to regularly monitor and track performance • Regular track maintenance and cleaning to reduce slippage and speed loss for rakes • Alignment on use of double locos to increase speed of rakes within ports • Maintain auto-signalling system for MCHP • Liaising with MCL to track progress on coal loading system for rakes

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders : CE, Traffic Manager	*41 cr through additional capacity unlock*	Rake TRT (hours)

5.2.8 PPT Operate 8 HMCs across EQ 1-3, CQ 1-2 berths to upgrade productivity

Suggestions Overview

Suggestions summary	Key action steps
• Add 4 new HMCs across berths to increase productivity	• Commission new HMCs for operations

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :*** *36 cr*	Metric to be tracked - # of HMCs

5.2.9 PPT Develop additional storage capacity and full rake sidings for conventional operations

Suggestions Overview

Suggestions summary	Key action steps
• Developing new siding plots to ease volume storage on existing plots and accommodate growing cargo volumes	• Identify plot area for development • Float tender for clearing and land development and siding construction

Ownership		Financial Impact	Tracking metrics
Initiative owner :	CE	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Traffic Manager	*24 cr*	Addn. storage area

5.3 Cochin Port Trust

5.3.1 Port performance dashboard – CoPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	Container	24[1]	26 [18]	24 [18]
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	44 [20]	38 [20]
Berth productivity	QC productivity [berth productivity] (moves/hr)	Container	30[2]	27	27
	Discharge rate (MT per hour)	POL	4400	3600	3600
Yard	RTGC moves per hour	Container	15	11	11
	Yard throughout (TEU per Ha)	Container	NA	9,000	9,000
Evacuation	Rake turnaround time (hours)	Container	5.0		10

1. Average parcel size of 1000 TEU's, assuming a crane productivity of 30 moves per hour witch 2 cranes deployed and PBD and other NWT of 6 hours. 2. Average POL productivity of 40,000 MT per day at Jebel Ali.

5.3.2 Summary of suggestions – CoPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
CoPT 1.1	Incentivize and increase reliability of rail movement of containers between Coimbatore and Cochin	Traffic from Coimbatore (TEUs)	0	40,000 – 50,000	5	0
CoPT 1.2	Reduce checkpoint delays for containers moving by road from Coimbatore to Cochin	Traffic from Coimbatore (TEUs)	0			0
CoPT 1.3	Relaxation of cabotage on coastal goods – bulk and containers	Mainline services	2	4	2	0
CoPT 1.4	Reduce nautical depth maintained to 13.5m	Dredging Cost	~120 cr	~100 – 120 cr	0 – 20 (conditional on draft of future mainline services)	0
CoPT 2.1	Develop coastal movement of rice & wheat from North India with FCI and 3rd party logistics players	Food-grain vol	0.1 Mn MT	1 Mn MT	8	0
CoPT 2.2	Attract fertilizer imports through investment in mechanized bagging plant	Fertilizer vol	40k MT	400k MT	2	0
CoPT 3.1	Set up POL quality testing facility at the berth to reduce non-working time for imports		9,100	10,300	0	100
	# of suggestions identified = 7	**Operating surplus increase = 17-37 cr**			**Capex avoidance = 100**	

5.3.3 CoPT Pilot for improving rail connectivity from Coimbatore to ICTT

Suggestions Overview

Suggestions summary	Key action steps
Large market in Coimbatore can be tapped through rail • Reliability and low cost key customer requirements **Pilot outline :** • Guaranteed service of 2-4 trains per 6 months • Rake schedule aligned with mainline vessel schedule • Incentives on THC and rail traffic by DP world and CONCOR **Higher volume to increase absolute profits for CONCOR** • Port authority to make-good loss contribution to CONCOR v-s-a-vis current rate and profit • Maximum downside of ~1.3 cr for Nil volume increase	Pilot program finalization and agreement from DP World and CONCOR on key pilot parameters • Rail tariff reduction by CONCOR • THC incentive by DP World Set up BD team jointly with DP World to attract customers from Coimbatore region to ICTT via rail Pilot kick-off with 3 rakes a week; ongoing monitoring of volumes achieved Ongoing interaction with CHAs and liners to further reduce freight rate given higher parcel sizes

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager	***Operating surplus improvement :*** *5 cr*	Metric to be tracked - Traffic from Coimbatore (TEUs)

5.3.4 CoPT Requirements for easing the delays and costs for road transport to ICTT

Suggestions Overview

Suggestions summary	Key action steps
High cost of road transport from Coimbatore to Cochin resulting in traffic being diverted to Tuticorin Port **Potential to reduce delays and costs through technology and process improvements solutions** • Technology to minimise cycle time for various checks • Negotiation of trucker's union rates based on reduced time per trip	**Recommendation to Ministry for regulatory changes** • Proposals for automation of checks at inter-state check-post - Drive through weigh-bride - OCR for scanning container seal vehicle registration number - Credit system for payment of penalties on excess weight - Revisit truck weight limits for OD containers **Recommendations for engaging with unions** • Negotiate lower trucking rates with truckers union

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM	***Operating surplus improvement :*** 5 cr (jointly with initiative 1.1)	Metric to be tracked - Traffic from Coimbatore (TEUs)

5.3.5 CoPT Proposal for extended cabotage relaxation for coastal cargo

Suggestions Overview

Suggestions summary	Key action steps
Low parcel sizes make calls at Cochin unviable for mainline vessels • Volumes limited to oversees gateway cargo of Cochin's primary hinterland **Potential to attract more mainline services by providing larger traffic potential** • Coastal traffic of ~60,000 TEUs per annum is currently not available to foreign vessels due to cabotage • Relaxation of cabotage on coastal on coastal containers can make calls at Cochin more economical	**Recommendations to the Ministry of Shipping on extension of cabotage waiver** **Identify liners with existing services passing Cochin Port without a call** **Liaise with liners/vessel agents to demonstrate benefit of increased volume potential** • Attract additional mainline service potentially a Far East service, with the added benefit of coastal volumes at Cochin

Ownership	Financial Impact	Tracking metrics
Initiative owner : Chairman	***Operating surplus improvement :*** 2 cr	Metric to be tracked - Mainline services

5.3.6 CoPT Mechanization to attract FCI food-gain traffic from North India/ Andhra Pradesh

Suggestions Overview

Suggestions summary	Key action steps
High volumes of food-grain being transported to Kerala by rail; coastal movement costlier than rail today • Coastal transport 9% costlier than rail due to high labor handling and bagging cost in Cochin **Potential to attract 1.6 million tonnes of FCI food grains for Kerala's consumption** • Food grains to be transported from North India to Kandla / JNPT via rail and then to be transferred to Cochin via sea • Bulk transport will provide a cost saving of 10% over rail	**Engage FCI to secure minimum yearly volume commitments to facilitate investments** **Contract with vessel agents to charter and deploy coastal bulk service** **Setup a mechanized berth for efficient handling of food grains with minimum labor involvement** **Contract with 3PL player to setup silos for storage on behalf of FCI**

Ownership		Financial Impact	Tracking metrics
		Operating surplus improvement :	Metric to be tracked -
Initiative owner :	TM	8 cr	Food-grain vol (Mn MT)

5.3.7 CoPT Mechanized bagging plant to attract fertilizer imports

Suggestions Overview

Suggestions summary	Key action steps
High VRC and labor handling costs make Cochin an unattractive port for fertilizer imports • VRC is ~2x of Tuticorin and NMPT • Slow handling adds to cost by increasing berth hire charges	**Setup a business development team to identify and attract fertilizer imports**
	Benchmark the vessel related charges borne by importers at different ports and reduce VRC accordingly
Potential to attract 400 thousand MT of imports by mechanizing handling and reducing VRC • Labor handling to be eliminated by establishing conveyor belts and mechanized bagging	**Setup mechanized bagging plant for quicker unloading and discharge with minimum labor involvement**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	TM	***Operating surplus improvement :*** 2 cr	Metric to be tracked - Fertilizer vol (Mn MT)

5.3.8 CoPT Enable BPCL to set up POL quality testing facility within port premises

Suggestions Overview

Suggestions summary	Key action steps
Reduction in idle time at POL berths on account of quality testing of POL imports • Currently, testing done in BPCL refinery (~17km from the berth) leading to time lost in transit through the city. **Enable BPCL to setup testing facility within port to reduce city transit time** **Savings in time of about ~2 hours per import vessel** • Productivity to increase by 500 MT/day • Reduction in berth occupancy by 4 percentage points	**Facilitate land allocation and usage** • Setting up of amenities like electricity lines etc **Monitor BPCL implementation of project:** • Align milestones for setting up testing facility with refinery expansion timelines • Progress on setting up of equipment in lab **Monitoring of idle time at berth on account of quality testing** • Incentivize HPCL and IOCL to minimize idle time by using BPCL lab for testing

Ownership	Financial Impact	Tracking metrics
Initiative owner: Mgr – Oil Jetty Other stakeholders: Shift-in-charge	***Operating surplus improvement :*** 0 cr	Metric to be tracked - Berth productivity (MT per ship-berth day)

5.4 Chennai Port Trust

5.4.1 Port performance dashboard – CHPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Container	32[1]	38	36
	Avg. vessel turnaround time (hours)	POL	43[2][-]	84 [19]	52 [6][6]
Berth productivity	QC productivity [berth productivity] (moves/hr)	Container	30[3]	25	25[7]
	Discharge rate (MT per hour)	POL	7000	2700	7000[6]
Yard	RTGC moves per hour	Container	15[4]	10	12
	Yard throughout (TEU per Ha)	Container	NA	45,000[7]	34,000[8]
Evacuation	Truck gate processing time (hours)	Container	1	6.1	3.5

1. Singapore benchmark for mainline vessels used; assumptions of normalization- package size of 2,500 TEU, QC productivity of 30 moves per hour, 3 quay cranes employed per vessel, 4 hours of non-working time due to customs rummaging, pilotage, repos of containers 2. Achievable discharge rate of ~2,700 MT/hour (varying by cargo type). Average Parcel size at Chennai= 1,00,000. Berth time = 37 hours. Additional 6 hours of time for non working time. 3. Singapore benchmark for QC cranes. 4. Singapore benchmark for RTGCs; assumptions for normalization: 2 RTGCs employed per crane for vessel operation (1 RTGC employed for yard operation). 5. Based on global benchmark- for an annual traffic of 1 Mn TEU 40 ha of yard space is assigned. Calculated basis QC productivity improvement of 25 moves/hr. 6. To be achieved post up-gradation of pipeline; to be completed by 2017. 7. Current level is optimal given occupancy is low at ~50%. Calculated for DPW terminal; yard space is adequate for PSA terminal. 8. Yard throughput to improve on assigning new yard space area to DPW terminal. 9. Measured for container terminal gates.

5.4.2 Summary of suggestions – CHPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase	Capex avoidance
CHPT 1.1	Monitor & incentivise yard productivity of private terminals	Yard throughput	80 trailers/hr	120 trailers/hr	0	-
CHPT 1.2	Provide additional yard space to DPW	# of ground slots	3940	4400	0	-
CHPT 1.3	Frontload pre-gate processing & entry of trailer details to CFS	Surveyor verification	365 sec	300 sec	0	-
CHPT 1.4	Automate container verification by installing cameras	Surveyor verification	120 sec	80 sec	0	-
CHPT 1.5	Discount charges on rake operations for Bangalore ICD	Vol. of rail evacuated	0.07 Mn TEU	0.5 Mn TEU	0	-
CHPT 2.1	Facilitate construction of new POL- products pipeline between Chennai and Ennore storage areas	POL product traffic vol	3 Mn MT	5 Mn MT	9	-
CHPT 3.1	Match Chennai port charges to Krishnapatnam for edible oil	Port charges per MT	INR 132	INR 97	2	-
CHPT 3.2	Start edible oil rakes between Chennai and Madurai	# of rakes per month	0	8	1	-
CHPT 4.1	Attract fertilizer imports through investment in mechanized bagging plant	-	-	-	2	-

# of suggestions identified = 9 Operating surplus increase = 14 cr Capex avoidance = NA

5.4.3 CHPT Monitor and incentivise yard productivity of private terminals

Suggestions Overview

Suggestions summary	Key action steps
Port to monitor & incentivise yard productivity • Implement system for monitoring critical yard performance metrics – trailer throughput & gate closure times • Leverage new TAMP guidelines to investigate if tariff incentives can be given based on yard productivity	**Create a joint team of port and terminal to monitor yard throughput** • Team to comprise of ATM and GM of operations from the terminals **Create MIS for monitoring gate closure times and trailer throughput per hour** **Formulate tariff structure to provide productivity based incentives under TAMP guidelines**

Ownership		Financial Impact	Tracking metrics
Initiative owner : Manager	Traffic	***Operating surplus improvement :*** *(~50 cr value protection through traffic retention)*	Metric to be tracked - Yard trailer throughput
Other stakeholders:	Terminal CEOs		

5.4.4 CHPT Provide additional yard space to DPW

Suggestions Overview

Suggestions summary	Key action steps
Current yard space availability for DPW is low • No buffer yard available (~17 Ha of yard space; highest slot density among all Indian terminals) **Additional yard space available adjacent to the terminal** • Option 1: Space provided by altering current Concession agreement • Option 2: Space swapped with DPW's existing land parcel near CFS	**Finalize land parcel to be handed over to DPW** **Finalize changes to agreement (if required)** • Add higher productivity/ minimum guaranteed traffic norms **Clear land parcel to be handed over to DPW of existing infra – roads, buildings**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Chairman	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		***NIL***	# of CCTPL ground slots

5.4.5 CHPT Frontload pre-gate processing & entry of trailer details to CFS

Suggestions Overview

Suggestions summary	Key action steps
Pre-gate processing & entering of container details happen at terminal gate • Pre-gate takes ~ 120 sec	**Align with CFS on completing pre-gate information entry at the CFS itself**
Process can be moved to CFS • CFS to enter all details of container and trailer • CFS to share the information with the terminal • Only verification of details like container, trailer no. will be verified at the gate	**Co-ordinate between the CFS & terminals to ensure information sharing on container, trailer details**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		***NIL***	Gate processing time

5.4.6 CHPT Automate container verification by installing cameras

Suggestions Overview

Suggestions summary	Key action steps
Surveyor verifies the container, container seal at the terminal gate • Surveyor verification takes ~120 sec	**Align with the customs on use of camera system for container verification**
Entire verification process can be automated by installation of camera system • The camera to capture image of the container in multiple angles • The images will be compared to repository of images real time	**Identify vendor(s) for installation of camera system**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		***NIL***	Surveyor verification time

5.4.7 CHPT Discount charges on rake operations for Bangalore ICD

Suggestions Overview

Suggestions summary	Key action steps
Logistics cost of rail higher than road for Bangalore ICD • ~INR 2,500 per container difference in logistics cost	**Align with CONCOR on passing on benefits of waiver of port charges to end customer**
Additional charges on CONCOR for running rakes from Bangalore to be waived • Port charges – service charge, haulage charge etc. • Railway charges – congestion charge	**Take up with railways for waiver of port congestion surcharge on CONCOR for Chennai port**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		***NIL***	Evacuation through rail

5.4.8 CHPT Facilitate construction of new POL-products pipeline

Suggestions Overview

Suggestions summary	Key action steps
Chennai likely to lose POL product cargo to Ennore due to shifting of storage spaces near Ennore	**Align with Ministry & Ennore port on potential pipeline development**
• Ennore does not have adequate capacity • Long vessel TAT in Ennore due to POL vessels	**Pitch to all potential investors (IOCL, BPCL, HPCL)**
Develop a POL product pipeline from Chennai port to the storage facilities	**Facilitate environmental & land clearances**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Chairman	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		9 cr	

5.4.9 CHPT Reduce the port charges at Chennai to match the prices at Krishnapatnam for edible oil

Suggestions Overview

Suggestions summary	Key action steps
Krishnapatnam's port charges for edible oil ~Rs 35 per MT lower • Krishnapatnam benchmarks port charges against Chennai's charges **Reduce port charges – benchmark against Krishnapatnam's charges**	**Set up team for benchmarking port charges with competitors**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		2 cr	Port charges for edible oil

5.4.10 CHPT Start edible oil rakes between Chennai and Madurai

Suggestions Overview

Suggestions summary	Key action steps
At present, edible oil volumes for Madurai cluster factories is handles by VOC	**Bring customers on board for running the rake**
Run edible oil rakes to Madurai • Would provide Chennai with a cost advantage as VOC does not have rail connectivity	**Take necessary approvals from railways & customs for running the rake**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:		1 cr	# of edible oil rakes

5.4.11 CHPT Facilitate investment in mechanized fertilizer bagging plant

Suggestions Overview

Suggestions summary	Key action steps
Chennai port has a volume share of <10% of hinterland fertilizer import • Private ports have higher productivity due to mechanized handling	**Bring customer on board for usage & potential investment in bagging plant**
Develop mechanized bagging plant through private investment • Attract investment in fertilizer bagging facility	**Provide shed on a long lease for construction of the plant**

Ownership		Financial Impact	Tracking metrics	
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked	-
Other stakeholders:		2 cr	# of edible oil rakes	

5.5 Vishakhapatnam Port Trust

5.5.1 Port performance dashboard – VPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – conventional	70[1]	218	90
	Avg. vessel turnaround time (hours)	Coal – Mechanized	45[2]	238	84
	Avg. vessel turnaround time (hours)	Container	24	36	24
	Avg. vessel turnaround time (hours)	POL	24[3]	139	72
Berth productivity	Gross productivity (gross MT/day)	Coal – conventional	18,000[4]	7,180	13,500
	Gross Productivity (gross MT/day)	Coal – Mechanized	100,000[5]	15,756	40,000
	QC productivity [berth productivity] (moves/hr)	Container	100	43	100
	Discharge rate (MT per hour)	POL	2500	1,022	1,500
Yard	Yard throughout (MT per sq. m)	Coal – conventional	NA	11	20
	Yard throughout (MT per sq. m)	Coal – Mechanized	100[6]	53	70
	RTGC moves per hour	Container	30	24	27
	Yard throughout (‘000 TEU per Ha)	Container	24	37	40
Evacuation	Rake turnaround time (hours)	-	5.0	13.6	5.0

1. Average coal parcel size at conventional berths in Vizag = 44,000. Best in class productivity for full vessel = 18,000 (Post lighterage operation of panama vessel). Pre berthing detention of 6 hours, other non working time including pilotage customs check etc at ~4 hours. 2. Current average parcel size of ~63,000 MT. Cape capable berth should operate at 100,000 MT/ day. For a 150,000 MT vessel, time should be 1.5 days. Additional PBD + other non working time = ~9 hours. 3. Average productivity of ~2,500 MT/hour (varying by cargo type). Average parcel size at Paradip = 75,000. Berth time = 30 hours. Additional 6 hours of time for non working time. 4. Gross productivity of 18,000 MT (post lighterage panama operations). 5. Average productivity of unloading 7,500 MT berths = 100,000 MT. 6. Berth and equipment capable of handling ~18 MMT.Total land after reallocation = ~180,000 sq. m. Hence, expected yard throughput of 100 MT/ sq. m.

5.5.2 Summary of suggestions – VPT

#	Suggestions	Metric	FY 15 baseline	Target		Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
VPT 1.1	Set up new Business Development team to convert customers for VPT	Volumes from new customers	0	2 mn		19	-
VPT 1.2	Reconfigure cargo handling volumes of existing customers along S. Central railway from low to high productive berths	# of rakes in South Central Railway	1100	1300		5	-
VPT 2.1	Allocate additional land to high productive berths to drive higher productivity	Timeline for implementation	NA	NA		20	-
VPT 2.2	Revisit storage cost in PPP BOT to make them competitive	Timeline for implementation	NA	NA			
VPT 3.1	Setup dashboard and regularize weekly meetings to track performance. Subsequently use inputs to set productivity norms	Timeline for implementation	NA	NA		5	-
	# of suggestions = 5	**Operating surplus increase = 40 cr**				**Capex avoidance = NA**	

5.5.3 VPT Setup new Business Development team to convert customers

Suggestions Overview

Suggestions summary	Key action steps
Setup a new Business Development team which will • Actively reach out to potential customers • Market the port facilities • Liaise with stakeholders (PPP, Stevedores) and bring additional customers / volumes to the port	**Setup new team** • Members include officers drawn from Traffic department, Account department • Members with sales background to be included **Identify list of customers to be targeted** • Develop database of complete hinterland and potential customers • Actively reach out to customers

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Business Dev. Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:	Traffic Manager	10 cr	New customer volume

5.5.4 VPT Reconfigure cargo handling volumes of existing customers along S. Central Railway from low to high productive berths

<u>Suggestions Overview</u>

Suggestions summary	Key action steps
Increase average productivity of port by increasing share of cargo handled at high productive berths out of total cargo handled for the same customer • Phase I focus on customers along S. Central Railway • Phase II focus on other customers	Identify list of customers handling coal at conventional and mechanized berths and end railway destination along S. Central Railway Pitch to customers net cost / ton and cargo evacuation performance across different berths

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Business Dev. Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:	Traffic Manager	5 cr	Coal for conv / Coal for mech

5.5.5 VPT Allocate additional land to high productive berths to drive higher productivity

Suggestions Overview

Suggestions summary	Key action steps
Allocate additional land parcel to constrained high productive berths to increase productivity and free up port capacity	Align with PPP BOT players on land requirement Seek legal opinion for interpreting contract clauses Identify land parcel of requisite size that can be provided Finalize financial conditions of handling land Prepare note to be shared with VPT Board and forwarded onwards to Secretary Ports for approval

Ownership		Financial Impact	Tracking metrics	
Initiative owner :	Civil Engineer	***Operating surplus improvement :***	Metric to be tracked	-
Other stakeholders: BOT	Traffic Manager, PPP	20 cr	Timeline for implementation	

5.5.6 VPT Revisit storage cost in PPP BOT to make them competitive

Suggestions Overview

Suggestions summary	Key action steps
Modify existing storage charge norms put in place for PPP BOT berth	Identify procedural changes with TAMP to identify appropriate way of changing storage structure Align storage cost changes to original projected storage costs and with current operating conditions

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Civil Engineer	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:	Traffic Manager, PPP BOT	Support Rs 20 crs in VPT 2.1	Timeline for implementation

5.5.7 VPT Setup dashboard and regularize weekly meetings to track performance. Subsequently use inputs to set productivity norms

Suggestions Overview

Suggestions summary	Key action steps
Setup a dashboard monitoring system to track port performance at a weekly level **Regularize meetings with key stakeholders with defined agenda to discuss performance and identify areas of further improvements** **Set productivity and performance norms and incorporate it as part of berthing policy**	• Finalize dashboard metrics • Firm up requirement specification • Initiate development of dashboard with IT vendor • Regularize fortnightly meeting cadence • Identify productivity norms and change incorporate norms

Ownership		Financial Impact	Tracking metrics
Initiative owner :	IT Director	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders:	Traffic Manager	5 cr	Berth cargo productivity (e.g. Coal)

5.6 Mumbai Port Trust

5.6.1 Port performance dashboard – MbPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	Container	NA	194 [41]	-
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	82 [35]	70 [35]
Berth productivity	QC productivity [berth productivity] (moves/hr)	Container	NA	-	-
	Discharge rate (MT per hour)	POL	3500	3,500	4,100
Yard	Yard throughout (TEU per Ha)	Container	23	-	-
Evacuation	Gate in/out truck turnaround time (mins)	-	2	10	6

5.6.2 Summary of suggestions – MbPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus	Capex avoidance
MbPT 1.1	Install quick release systems on berths	Mooring time per vessel	30 minutes	9 minutes	3	-
MbPT 1.2	Policy change to mandate usage of testing lab at JD	TAT for sample approval	45 minutes	30 minutes	3	-
MbPT 1.3	Bring JD 5 plans of creating tank farms forward and implement low performance penalties	Average flow rate	3200 T/hr crude & 400 T/hr other products	4100 T/hr crude & 800 T/hr other products	32	-
MbPT 4.1	Installation of higher capacity shore crane will help increase productivity by ~20%	Berth productivity	11 (ship crane) / 13 (gantry crane)	13 (ship crane), 16 (gantry)	4	-
MbPT 4.2	Use of 2nd OCT berth for steel handling	Berth productivity	11 coils per hours	13 coils per hour	16	670
# of suggestions identified = 5		**Operating surplus increase = 58 cr**			**Capex avoidance = 670**	

5.6.3 MbPT Install quick release systems on berths

Suggestions Overview

Suggestions summary	Key action steps
POL volume to go up by 33% on MbPT • Due to increase in capacity by BPCL, HPCL and increase in production by ONGC of Bombay high **Reduce high non-working time** • Significantly high non-working time currently due to inefficiencies in altfast and cast away **Reduction of mooring time will lead to an increase in productivity by 6%** • QRS will lead to reduction in mooring time by 70% per vessel	**Install quick release systems on all berths on JD** • Draft technical specifications QRS and required berth strengthening • Float tender for QRS manufacturers • Finalize 3rd party vendor and install them on all berths

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Shift-in-charge	3 cr	Mooring time

5.6.4 MbPT Policy change to mandate usage of testing lab at JD

<u>Suggestions Overview</u>

Suggestions summary	Key action steps
POL volume to go up by 33% on MbPT • Due to increase in capacity by BPCL, HPCL and increase in production by ONGC of Bombay high	**Discussion with the stakeholders at HPCL, ONGC and IOCL to discuss the proposal for a testing facility at JD**
Reduce high clearance time due to delay in approval from testing lab • BPCL has a testing lab at JD, however, ONGC and HPCL send the samples to pirpau	**Proposal to set up a centralized/shared facility at JD – joint investment** **Agreement from all concerned parties for investment allocation and testing benchmarks**
Reduction of testing time will lead to an increase in productivity by 3% • Setting up testing lab at JD will reduce logistics time from JD to pirpau by 30 minutes per vessel	**Allocate space/building for setting up lab at JD**

Ownership		Financial Impact	Tracking metrics
Initiative owner :	Traffic Manager	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders :	Shift-in-charge	2 cr	TAT sample approval

5.6.5 MbPT Bring JD 5 plans of creating tank farms forward and implement low performance penalties

Suggestions Overview

Suggestions summary	Key action steps
Low flow rate in loading/unloading POL • Tank farms on JD not operations • Pressure loss due to 7.5 KM pipeline transfer **Low flow rate impacts working time and therefore overall productivity** **Increase in flow rate will lead to an overall productivity increase by 25-30%** • Leasing out tank farms will lead to maintaining high pressure • Low performance penalty will encourage 3rd parties to maintain high flow rate	**Discuss the proposal of leasing tank farms and performance penalty with BPCL and HPCL** **Issue circular for change in rates due to low performance penalty and effective applicable date** **Operationalizing tank farms** • Discuss terms and conditions of shared investment and leasing rates as well as performance penalty • Seek relevant environmental approvals required • Tender for 3rd party to create/install tank farms and finalise a vendor • Construction and operationalization of tank farms

Ownership		Financial Impact
Initiative owner :	Traffic Manager	***Operating surplus improvement :***
Other stakeholders :	Shift-in-charge	32 cr

5.6.6 MbPT Installation of higher capacity shore crane will help increase productivity by ~20%

Suggestions Overview

Suggestions summary	Key action steps	
Install multi purpose gantry crane to increase productivity • Heavier capacity ~35.5 MT as • Sufficient load bearing capacity, the berth already supported quay cranes • Rail track already in place **Increase berth hire charge for use of new cranes** • Charge over the built in berth hire charge for quicker discharge	**Create a core team to oversee immediate crane installation** **Increase in berth hire charges to be discussed/finalized by core team post crane installation**	-

Ownership		Financial Impact	Tracking metrics	
Initiative owner :	CME/TM	***Operating surplus improvement :***	Metric to be tracked	-
Other stakeholders :	Shift-in-charge	20 cr	Berth productivity	

5.6.7 MbPT Use of 2nd OCT berth for steel handling to unlock additional capacity

Suggestions Overview

Suggestions summary	Key action steps
Short term – Use of ship/wharf crane to load steel directly on to the trailer • Converts point to spread load without disturbing berth's load bearing capacity **Short term – Use of steel plates fixed on berths to serve as coil "pads"** • Distribute coil load evenly on to berth • Maximum no. of coils that can be safely placed will have to be clearly specified **Long Term – invest in OCT strengthening to handle additional load**	**Nominate a team to work out the technical details for implementation** • Work out timelines for steel plate installation at berth • Commission test vessel call

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME/TM	***Operating surplus improvement :***	Metric to be tracked -
Other stakeholders : Shift-in-charge	20 cr	Berth productivity

5.7 Kandla Port Trust

5.7.1 Port performance dashboard – KPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Conventional	72[1]	138	100
	Avg. vessel turnaround time (hours)	Coal – Mechanized	34[2]	135	60
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	124	110
Berth productivity	Gross productivity (gross MT/day)	Coal – Conventional	18000[4]	10000	12000
	Gross Productivity (gross MT/day)	Coal – Mechanized	75000[5]	16000	25000
	Discharge rate (MT per hour)	POL	3500	2200	3000
Evacuation	Rake turnaround time (hours)	Coal	6[7]	18	

1. Average coal parcel size at conventional berths in Kandla = 50,000. Best in class productivity for full vessel = 18,000 (Post lighterage operation of panama vessel). PBD and pilotage of ~6 hrs. 2. Current average parcel size of ~86,000 MT. Panamax/Minicape capable berth should operate at 75,000 MT/day. For a 86,000 MT vessel, time should be ~28 hrs. Additional PBD + pilotage = ~6 hrs. 4. Gross productivity of 18,000 MT (post lighterage operations). 5. Average productivity 75000MTPD. 7. BDP for rake loading is ~ 6 hrs.

5.7.2 Summary of suggestions in KPT I/II

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
KPT 2.1	Increasing crane throughout by optimizing grab sizes to commodities	Crane productivity at CJ 1-5	10MT/lift	NA	5	0
KPT 2.2	Bunching of TIL ELL cranes in fewer berths to increase crane density on the berths	Productivity at CJ 10	10,000MT	13,000MT	5	0
KPT 2.3	Improving performance of own MHC by optimizing boom length and grab volume	13MT/lift	13MT/lift	17 MT/lift	5	0
KPT 2.4	Increase crane density by adding 4 100T MHCs	Crane productivity of own MHC	8,500MT	12,000MT	50	0
KPT 3.1	Reduce tug fuel consumption	8,500MT	160 Ltr per hour	140 Ltr/Hr	3	0

Summary of suggestions in KPT II/II

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
KPT 3.2	Improve night navigation by using advanced navigational aids	% of movement at night	30%	45%	5	0
KPT 3.3	Reducing fertilizer rake loading time by adding automated bag loader	Rake TAT	18 hrs	6 hrs	10	0
KPT 4.1	Increase overall dry bulk productivity by instituting berth productivity norms	Berth productivity for dry berths	7,300MT	9,000MT	5	0
KPT 4.2	Reduce non-working time by instituting hot seat changes	Avg. shift break period/day	3 hrs/day	1 hr/day	15	0
KPT 4.3	Reduce non-working time changing shift schedule	Avg. break period/day	3 hrs/day	1.5 hr/day	10	0
KPT 4.4	Increase overall liquid productivity by instituting berth productivity norms	Berth productivity for liquid berths	220 TPH	300 TPH	5	0
	# of suggestions identified = 11	**Operating surplus increase = 123 cr**			**Capex avoidance = NA**	

5.7.3 KPT Increasing crane throughput by optimizing grab sizes to commodities

Suggestions Overview

Suggestions summary	Key action steps
Grabs need to be optimized to the densities of the major commodities handled **Currently only one size grabs are used for all ELL cranes regardless of the material handled**	1. Identify optimal grab sized basis commodities 2. Float tenders 3. Issue POs 4. Create a usage chart showing ideal grabs to be used for each commodity types 5. Set up process to change the grabs during the pre-commencement time of a ship to match with her cargo type 6. Review performance periodically

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : Traffic dept	**Operating surplus improvement :** 5 cr	Metric to be tracked - Crane productivity at CJ 1-5

5.7.4 KPT Bunching of TIL ELL cranes in fewer berths to increase crane density on the berths

Suggestions Overview

Suggestions summary	Key action steps
Currently, 25T TIL cranes are located in cargo berths 9,10. However, these berths are strong and can be made more productive by adding 100T mobile harbor cranes. Option to be explored: • Consolidate 3 TIL cranes in CJ-10 and free up CJ-9 for 100T MHCs	1. Assess feasibility of changing track gauge of the cranes 2. Finalize the option 3. Shift the crane

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : Traffic & Civil	**Operating surplus improvement :** 5 cr	Metric to be tracked - Berth productivity at CJ-10

5.7.5 KPT Improving performance of own MHC by optimizing boom length and grab volume

Suggestions Overview

Suggestions summary	Key action steps
Currently, the two Italgru MHCs operate with 18cbm grab making them similar in effect to 25T ELL cranes which use 16 cbm grabs **To optimize the performance of the MHCs, the following needs to be done :** • Place the MHC at the minimum possible distance from the waterfront • Design grabs for the actual lifting radius • Optimize grabs for the commodities handled	1. Finalize the minimum distance at which the MHC can be loaded 2. Identify the key commodities to be handled by MHCs 3. Design the optimal grab sizes 4. Get concurrence from the OEM for grab change 5. Float tender 6. Issue PO 7. Review performance improvement periodically

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : Traffic & Civil	**Operating surplus improvement :** 5 cr	Metric to be tracked - Crane productivity of own MHCs

5.7.6 KPT Increase crane density by adding 4 100T MHCs

Suggestions Overview

Suggestions summary	Key action steps
One of the key reasons behind lower productivity of berths in Kandla is low crane capacity. To improve the productivity and to bridge the gap with completion, it is proposed to add 4 100+ ton mobile harbor cranes to two berths between berths 6 & 10 (CJ 6 expected to be operational within a year). It is further proposed that the cranes be introduced under PPP model with suitable business safe guards	1. Finalize berths where 100 T MHCs need to be added 2. Finalize PPP terms by leveraging the models followed at Vizag (enforcing mandatory use of MHCs for the berths where they are allocated) 3. Put in place parity pricing for own 63 T MHCs, ELL cranes of deep draft berths if any (as per decision from initiative # 3) 4. Float PPP tender & award contract 5. Monitor performance improvement

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : Traffic & Civil	**Operating surplus improvement :** 50 cr	Metric to be tracked - Crane productivity of own MHCs

5.7.7 KPT Reduce tug fuel consumption

Suggestions Overview

Suggestions summary	Key action steps
Tug fuel costs ~30cr annually. Following results in high fuel consumption: 1. No contractual obligation for hired tugs to meet a set norm (not captured in the contract, though used for bid evaluation) 2. Fuel usage is not monitored daily 3. Actions that will reduce tug fuel cost are rarely enforced Own Tags consume more fuel due to age of the tags. Shifting movements needs lesser fuel compared to sailing, thus own tags should be used for shifting	1. Add corrigendum to tug hire contracts with fuel consumption norm 2. Install flow meters in hired tugs (enforce in hired tugs during contract renewal) 3. Institute process to track fuel consumption daily 4. Maintain records of engine maintenance, hull cleaning and propeller cleaning for hired tugs; enforce corrective measures whenever fuel consumption goes beyond norm

Ownership	Financial Impact	Tracking metrics
Initiative owner : DC Other stakeholders :	**Operating surplus improvement :** 3 cr	Metric to be tracked - Avg. fuel consumption/hr

5.7.8 KPT Improve night navigation by using advanced navigational aids

Suggestions Overview

Suggestions summary	Key action steps
Only buoys are used as navigation aid. At night, pilot has to navigate just by looking at the buoys. These move around causing uncertainty in identifying channel boundary resulting in lesser % of movements at night compared to day. • It is proposed to adopt a tablet based navigation system that pilots can plug into the AIS of the ships. This will reduce dependence of the buoys for night navigation and will improve safety & % of night movements.	1. Finalize the scope of project 2. Float tender 3. Issue PO & award contract 4. Conduct training for pilots on using the new system

Ownership	Financial Impact	Tracking metrics
Initiative owner : DC Other stakeholders :	**Operating surplus improvement :** 5 cr	Metric to be tracked - % of movements at night

5.7.9 KPT Reducing fertilizer rake loading time by adding automated bag loader

Suggestions Overview

Suggestions summary	Key action steps
Currently the siding KPT is considered private costing Rs 10-15 more/ ton resulting in fertilizer cargo being loaded outside. This takes ~18hrs vs competition TAT of ~6 hrs. causing low rake availability • The siding within KPT must be converted to public siding a sin other major ports • KPT needs to set up a fertilizer bag loading plant next to the fertilizer bagging plants on PPP basis • Existing fertilizer bagging plants may be connected to this plant through moveable conveyor belts as is feasible	1. Coordinate with rail ministry to convert the private siding within KPT into public siding 2. Design the proposed rake loading plant 3. Float tender 4. Issue contract

Ownership	Financial Impact	Tracking metrics
Initiative owner : CE Other stakeholders :	**Operating surplus improvement :** 10 cr	Metric to be tracked - Fertilizer rake TAT

5.7.10 KPT Increase overall dry bulk productivity by instituting berth productivity norms

Suggestions Overview

Suggestions summary	Key action steps
Upgrade norms for cargo berths for planned equipment upgradation • 2 govt cargo else 12KTPD productivity & 1 for coastal cargo else 10KTPD productivity • Project cargo providing ad-valorem wharfage to be admitted under 24 hr priority group, else 12KTPD productivity • 1 berth for 12KTPD productivity (up from 10) & 1 berth for 10KTPD productivity (up from 6) • 3 berths on first come first serve mode with a minimum productivity of 500KT (up from 300KT) for all commodities except timber (300KT for timber due to safety issue)	1. Issue proposal for berth hire change 2. Align with port users 3. Issue circular notifying the change 4. Enforce the new norms

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM Other stakeholders :	**Operating surplus improvement :** 5 cr	Metric to be tracked - Avg. berth productivity

5.7.11 KPT Reduce non-working time by instituting hot seat changes

Suggestions Overview

Suggestions summary	Key action steps
Currently, the shift change time takes between 30 min to 1 hour; however, this can be resolved by instituting hot seat shift change	1. Finalize the plan with unions (to add 30 min to shifts/ give one hour over time) 2. Move the proposal 3. Issue circular notifying the change 4. Enforce and track the hot seat changes

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM Other stakeholders : ME	**Operating surplus improvement :** 15 cr	Metric to be tracked - Avg. shift break period

5.7.12 KPT Reduce non working time by changing shift schedule

Suggestions Overview

Suggestions summary	Key action steps
Currently, KPT operates under 3 shifts whose timings are as given below: • First shift – 8 AM to 4 PM, Second shift – 4 PM to 12 AM, Third shift – 12 AM to 8 AM **The issue is that the lunch and dinner breaks come in between and 30 min breaks extend to 1-1.5 hours** • By realigning the shifts as per standard practice (6 AM – 2 PM, 2 PM – 10 PM, 10 PM – 6 AM), the extra break time can be reduced	1. Finalize the plan with unions 2. Move the proposal 3. Issue circular notifying the change to labor commissioner, other stakeholders 4. Change timings of bus to match with the shifts 5. Enforce the shift time change

Ownership	Financial Impact	Tracking metrics
Initiative owner : Secretary Other stakeholders : TM, CME	**Operating surplus improvement :** 10 cr	Metric to be tracked - Avg. break duration

5.7.13 KPT Increase overall liquid productivity by instituting berth productivity norms

Suggestions Overview

Suggestions summary	Key action steps
The productivity of liquid berths at KPT is lower than benchmarks and BDP at KPT due to the incentive structure which does not create pressure for the customers to empty vessels at maximum possible rate • Establish norm at 300 TPH; ship will be unberthed and moved to the back of the queue if doesn't meet the norm for 2 shifts • One berth to be dedicated to edible oil ships and awarded to the ship promising maximum productivity	6. Finalize the plan with unions 7. Move the proposal 8. Issue circular notifying the change to labor commissioner, other stakeholders 9. Change timings of bus to match with the shifts 10. Enforce the shift time change

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM Other stakeholders :	**Operating surplus improvement :** 5 cr	Metric to be tracked - Berth period for liquid berths

5.8 Kolkata Port Trust

5.8.1 Port performance dashboard – KOPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Conventional	55[1]	96	60
	Avg. vessel turnaround time (hours)	Coal – Mechanized	37[2]	67	45
	Avg. vessel turnaround time (hours) [pre-berthing waiting time (hours)]	Container (with/without HMC)	34[3]	62/77	55/65
	Avg. vessel turnaround time (hours) [pre-berthing waiting time (hours)]	POL	36	49	49
Berth productivity	Gross productivity (gross MT/day)	Coal – Conventional	18000[5]	10000	13000
	Gross Productivity (gross MT/day)	Coal – Mechanized	52000[6]	12200	25000
	QC productivity [berth productivity] (moves/hr)	Container (with/without HMC)	100[7]	23	25
	Discharge rate (MT per hour)	POL	3500	3330	3330
Yard	RTGC moves per hour	Container	10[9]	7	10
	Rake turnaround time (hours)	-	7[10]	22	14

1. Average coal parcel size at conventional berths in Haldia = 20,000. Best in class productivity for full vessel = 18,000 (Post lighterage operation). PBD and pilotage of ~6 hrs. 2. Current average parcel size of ~20,000 MT. Handymax capable berth should operate at ~52,000 MT/day. Additional PBD + pilotage = ~28 hrs to adjust for long approach channel. 3. Average parcel size at Kolkata = ~650 TEUs. PBD + Pilotage = ~28 hrs, adjusted for long approach channel and Indian BDP = ~ 100 TEUs/Hr. 5. Gross productivity of 18,000 MT (post lighterage operations). 6. Handymx capable berths should operate at ~52,000 MT/day. 7. BDP is ~100 moves/Hr for Indian pvt ports. 9. BDP is ~10 moves. 10. BDP is ~1-2 hrs. Adjusted for Concor inspection at Kolkata junction.

Op.

5.8.2 Summary of suggestions in KoPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex Avoidance
KoPT 1.1	Increase crane density at berths 2,8 by adding HMCs, hardstand 100 sqm behind to add storage capacity	Berth productivity	4500 TPD	13000 TPD	30	-
KoPT 1.2	Increase crane density at berths 2,8 by adding HMCs, hardstand 150 sqm behind to add storage capacity	Berth productivity	4500 TPD	13000 TPD	30	-
KoPT 1.3	Reduce non-working time by reducing shift change time, marine wait time	NWT/ship (conv. Dry)	21 hrs	15 hrs	20	-
KoPT 1.4	Increase capacity of mechanized coal export berth 4, use excess capacity for coastal imports if exports do not pick up	TPH at berth IV	750 TPH	1500 TPH	20	-
KoPT 2.1	Making transloading option attractive by reducing overall cost and creating a combined package	Transloading tonnage	0	5MMT	5	-
KoPT 3.1	Increase container handling capacity by adding HMC to berth 3 in KDS, NSD	Average berth productivity	16 TEUs/Hr	25 TEUs/Hr	5	-
KoPT 3.2	Reduce NWT by instituting hot seat changes and reducing marine wait time	Avg. time lost in shift break and due to marine delays	4 Hrs/day	1.5 Hr/day	6	-

Summary of suggestions in KoPT (2/2)

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex Avoidance
KoPT 4.1	Improvement of truck traffic during night by facilitating night payment and customs clearance	% of truck movement at night	30%	45%	NA	-
KoPT 4.2	Reduce rake turnaround time at KDS by improving railway infrastructure	% of TEUs transferred by rake	6%	15%	NA	-
KoPT 5.1	Reduce dredging cost by encouraging contractors to deploy techniques to improve dredger's dredging time and by using Eden channel as primary channel for navigation	Cost Reduction	350 Cr	150 Cr	200	-
KoPT 6.1	Reduce loco hiring cost by relocating 2 good quality locos to from KDS to HDC instead of leasing new ones	Cost reduction	24	19	5	-
KoPT 6.2	Reduce tug operation cost at HDC by scrapping own tugs and replacing them by hired tugs	Cost reduction	59 Cr	49 Cr	8	-
KoPT 6.3	Reduce security cost at KDS by reducing security cover for areas with lower activity	Cost reduction	31 Cr	27 Cr	3	-
# of suggestions identified = 13	**Operating surplus increase = 332 cr**			**Capex avoidance = NA**		

5.8.3 KOPT HMC for berths 2,8; hardstand 56 sqm

Suggestions Overview

Suggestions summary	Key action steps
Currently only berths 4A, 4B and 12 have mobile harbor cranes. The volume within the impounded dock can be increased to 34MMT till the gate capacity is hit and further by 3MMT by moving edible oil ships outside the gate. Currently berth productivity is limiting the volume at Haldia and hence it is proposed to add MHCs to berths 2,8,9 and 13. Adding MHCs to berths 2,8 with hardstanding of 100K sqm land behind berth 8 is phase 1. HDC, KoPT has already initiated the process.	1. Issue work order for hardstanding of 100000 sqm behind berths 8,9 2. Establish berth norm of 13,000 tpd once the cranes are commissioned

Ownership	Financial Impact	Tracking metrics
Initiative owner : Other stakeholders : Shift-in-charge	**Operating surplus improvement :** 30 cr	Metric to be tracked - Berth productivity

5.8.4 KOPT HMC for berths 9, 13; hardstand 150 sqm

Suggestions Overview

Suggestions summary	Key action steps
Currently only berths 4A, 4B and 12 have mobile harbor cranes. The volume within the impounded dock can be increased to 34MMT till the gate capacity is hit and further by 3MMT by moving edible oil ships outside the gate. Currently berth productivity is limiting the volume at Haldia and hence it is proposed to add MHCs to berths 2,8,9 and 13. Adding MHCs to berths 9, 13 with hardstanding of 100K sqm land behind berth 13 is phase 2.	1. Issue tender to add cranes to berths 9, 13 and to hardstand 1L sqm behind berth 13 2. Finalize tender, issue LOI 3. Commission cranes as per LOI issued 4. Issue work order for hardstanding of 100000 sqm behind berths 13 5. Establish berth norm of 13,000 tpd once the cranes are commissioned

Ownership	Financial Impact	Tracking metrics
Initiative owner : Other stakeholders : Shift-in-charge	**Operating surplus improvement :** 30 cr	Metric to be tracked - Berth productivity

5.8.5 KOPT Reduce non-working time by reducing shift change time, marine wait time

Suggestions Overview

Suggestions summary	Key action steps
Currently a ship spends ~3 days at conventional berths during which ~21 hrs (30%) is non working time **Principal components of NWT are:** • Shift time change (14 hrs) • Waiting for tide (6 hrs) **Proposal is to reduce both these components using 3 steps:** 1. Institute hot seat changes for crane operators 2. Enforce less time wastage in ground operations by instituting norms 3. Reduce marine waiting time	1. Measure ship-wise non working time under different segments 2. Define hot seat change and productivity norm policies 3. Align with stakeholders 4. Roll out policies 5. Convert berths 5, 6, 7 into waiting berths in a phased manner 6. Institute anticipatory vessel calls 7. Procure 2 30T tugs for shifting operation alone

Ownership	Financial Impact	Tracking metrics
Initiative owner : GM - Traffic Other stakeholders : GM – Marine	**Operating surplus improvement :** 20 cr	Metric to be tracked - NWT/ship

5.8.6 KOPT Increase capacity of mechanized coal export berth 4

Suggestions Overview

Suggestions summary	Key action steps
Currently, mechanized coal berth, berth 4 operates at 750 TPH (FY 15 baseline). With the addition of new stacker reclaimer, there is potential to increase this further to 1500 TPH. To do this, it is recommended that productivity norm be instituted with necessary penalty conditions. Once the productivity of the berth is increased, the spare capacity can be used either to export further coal or to import coastal cargo	1. Set berth productivity norm 2. Align with stakeholders 3. Roll out policies

Ownership	Financial Impact	Tracking metrics
Initiative owner : GM – Engineering	**Operating surplus improvement :** 15 cr	Metric to be tracked - TPH at berth 4

5.8.7 KOPT Making transloading option attractive by reducing overall cost and creating a combined package

Suggestions Overview

Suggestions summary	Key action steps
End to end cost to customer with transloading at Haldia currently works out to ~ Rs 2200/ton compared to Rs 1800/ton via Dhamra and ~Rs 2000/ton via Paradip The key drivers are: 1. High transloading cost (Rs 550/ton) 2. High shore operations cost (Rs 400/ton) Due to high cost, it is expected that while Haldia may get traffic due to current congestion at all east coast ports, it will lose share considerably once Dhamra phase 2 comes up	1. Contract out two berths within dock with lower handling cost 2. Tie in outside terminal 2 with transloading once that becomes operations 3. Provide on priority berthing for transloading daughter vessels at these berths 4. Create joint package for transloading so that customer needs only to make one payment for ship to rake operations

Ownership	Financial Impact	Tracking metrics
Initiative owner : GM – Administration	**Operating surplus improvement:** 24 cr	Metric to be tracked - Transloading tonnage

5.8.8 KOPT Increase container handling capacity by adding HMC to berth 3 in KDC, NSD

Suggestions Overview

Suggestions summary	Key action steps
Currently, KDS has a total container handling capacity of 6.5L TEUs. As per the projection, this limit is expected to be hit by 2016-17. Hence increase of container capacity becomes necessary. Addition of HMC to NSD 3 is proposed to increase handling capacity by 0.6L TEU	1. Issue tender for having HMC at NSD 3 with right of first refusal to BKCT 2. Demolish shed behind NSD23 3. Award contract

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : CE	**Operating surplus improvement :** 5 cr	Metric to be tracked - Berth productivity

5.8.9 KOPT Reduce NWT by instituting hot seat changes and reducing marine wait time

Suggestions Overview

Suggestions summary	Key action steps
Hot seat changes need to be introduced for BKCT, stevedores and marine staff to reduce NWT during recess and shift change	1. Implement hot seat changes with BKCT and Marine department 2. Implement hot seat changes with private stevedores 3. Effective communication between Traffic and Marine dept for prompt shifting by using non working berths and waiting buoys and immediate response from Marine dept

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM & HM Other stakeholders :	**Operating surplus improvement :** 6 cr	Metric to be tracked - Avg. berth productivity

5.8.10 KOPT Improvement of truck traffic during night by facilitating night payment and customs clearance

Suggestions Overview

Suggestions summary	Key action steps
Provide 24/7 customs clearance and payment of port charges facility to ensure equal distribution	1. Speak with customs to provide night shift 2. Implement night shift for port staff to collect port charges or a 24/7 complete e-payment facility

Ownership	Financial Impact	Tracking metrics
Initiative owner : TM Other stakeholders :	**Operating surplus improvement :** NA	Metric to be tracked - % of trucks moving out at night

5.8.10 KOPT Reduce rake turnaround time at KDS by improving railway infrastructure

Suggestions Overview

Suggestions summary	Key action steps
Reduce rake TAT ~40% by improving rail infrastructure through installing gantry crane, providing additional loco and maintenance of yard sidings	1. Initiate contract with PSA for rail mounted gantry crane 2. Level surface around rake loading area 3. Install gantry for loading at both sidings simultaneously 4. Provide additional loco (transferred from Haldia) 5. Maintenance of EJC yard

Ownership	Financial Impact	Tracking metrics
Initiative owner : CE & CME Other stakeholders :	**Operating surplus improvement :** NA	Metric to be tracked - % of TEUs moved by rakes

5.8.11 KOPT Dredging cost reduction

Suggestions Overview

Suggestions summary	Key action steps
KoPT incurs expenditure of ~INR 385 Cr, pa for maintenance dredging of Haldia approach channel. The dredging is primarily at two bars – Auckland (70% of dredging) and Jellingham (30% of dredging). To reduce the cost of dredging, two initiatives are proposed : • Use barge loading mechanism to improve utilization of the dredger • Adopt Eden channel to circumvent Auckland channel	1. Operationalization of Eden channel 2. Define pilot boarding plan for Eden channel during rough weather 3. Study the impact of stoppage of dredging at lower Auckland bar 4. Stop dredging at upper part of lower Auckland bar 5. Issuance of contract that will be attractive to international dredging companies

Ownership	Financial Impact	Tracking metrics
Initiative owner : GM - Administration	**Operating surplus improvement :** 200 cr	Metric to be tracked - Dredging cost run rate

5.8.14 KOPT Reduce loco hiring cost by relocating 2 good quality locos to from KDS to HDC

Suggestions Overview

Suggestions summary	Key action steps
Currently, KDS uses 2 WDS6 type locomotives hired from RITES on lease contract including maintenance • 2 year contract starting May 2015 with 85% guaranteed availability at INR ~5Cr per annum HDC has 12 own engines available in Haldia with a maximum of 6 engines used per shift Shifting of 2 engines from Haldia to Kolkata proposed to save on hire costs in the medium term	• Shift 1 BHEL and 1 SAN locos from HDC to KDS • Issue tender for operation and maintenance of the locos • Award contract • Discontinue RITES contract

Ownership	Financial Impact	Tracking metrics
Initiative owner : Sr. Dy. TM, Railways Other stakeholders :GM-Engineering, HDC	**Operating surplus improvement :**	Metric to be tracked - Rail cost

5.8.12 KOPT Reduce tug operation cost at HDC by scrapping own tugs and replacing them by hired tugs

Suggestions Overview

Suggestions summary	Key action steps
HDC has 9 tugs of which 7 tugs presently which have passed economic life. It is proposed that tugs be hired instead of purchased for replacement. This can result in two streams of saving : • Reduction in number of tugs: 8 hired tugs sufficient to run operations for current vol. (1 for HOJI, 2 each for HOJI and 3 for dock operations) instead of 9. • Reduction in operating cost: Savings in overtime, maintenance cost etc by converting 6 port owned tugs to hired ones	• Create plan to phase out tugs • Issue tender for hired tugs • Award contract • Scrap existing tender

Ownership	Financial Impact	Tracking metrics
Initiative owner : GM Marine, Haldia	**Operating surplus improvement :**	Metric to be tracked - Cost reduction

5.8.13 KOPT Reduce security cost at KDS by reducing security cover for areas with lower activity

Suggestions Overview

Suggestions summary	Key action steps
Currently, KoPT spends ~31 Cr on CISF security. This is based on the survey that was done in 2004. Analysis of past deployment data reveals that the actual deployment is different and varies between 75% to 85% of strength needed as per the survey. Further, the activities at several parts of the docks have reduced thus reducing security need. In view of this, KoPT needs to initiate a resurvey and aim to reduce atleast 70 personnel.	• Initiate security resurvey • Issue notice to CISF to reduce manning basis survey • Add manpower to port security organization to man area taken over from CISF • Deploy PSO in the non-CISF area

Ownership	Financial Impact	Tracking metrics
Initiative owner : Security Advisor	**Operating surplus improvement :**	Metric to be tracked - # of CISF staff

5.9 VOC Port Trust

5.9.1 Port performance dashboard – VOCPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Conventional	63[1]	454 [89]	300 [50]
	Avg. vessel turnaround time (hours)	Coal – Mechanized	36[2]	171 [18]	120 [18]
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	Container	23[3]	41 [7]	41 [7]
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	114 [22]	114 [22]
Berth productivity	Gross productivity (gross MT/day)	Coal – Conventional	45,000[4]	18,000	28,000
	Gross Productivity (gross MT/day)	Coal – Mechanized	75,000[5]	11,000	15,000
	QC productivity [berth productivity] (moves / hr)	Container	30	21	21
	Discharge rate (MT / hour)	POL	3500	2000	2000
Yard	Yard throughput (MT / sq. m)	Coal – Conventional	NA	13.8	13.8
	Yard throughput (MT / sq. m)	Coal – Mechanized	*Evacuation directly to TNEB's yard*		
	RTGC moves per hour	Container	15	12	12
	Yard throughput (TEU per Ha)	Container	25000	84,000	84,000
Evacuation	Truck turnaround time (hours)	-	*NA*		
	Rake turnaround time (hours)	-	*NA*		

1. Average coal parcel size at conventional berths in VOC = 55,000. Best in class productivity for full vessel = 25,000. Pre berthing detention of 6 hours, other non working time including pilotage customs check etc at ~4 hrs. 2. Panamax capable berth handling parcel size of ~55,000 MT. Loading time would be ~30 hrs. Additional PBD + other non working time = ~10 hrs. 3. Average parcel size of 1000 TEU's, assuming a crane productivity of 30 moves per hour with 2 cranes deployed and PBD and other NWT of 6 hours. 4. Assuming 2 cranes of grab size of 125 MT, cycle time of 4 minutes, Grab efficiency of 60% (Top cargo only) and NWT of ~6 hrs/day. 5. Assuming 2 cranes of grab size of 125 MT, cycle time of 2 minutes, Grab efficiency of 50% and NWT of ~4 hrs/day. 6. Average POL productivity of 40,000 MT per day at Jebel Ali.

5.9.2 Summary of suggestions in VOCPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
VOC 1.1	Incorporate specific productivity norms in berthing policy	Berth productivity at Berth IX (MT/day)	~18,000	28,000	~9 Cr	-
VOC 1.2	Installation of MHCs at berths III and IV	Berth productivity at Berths III & IV (MT/day)	~11,000	17,000	~10 Cr	-
VOC 1.3	Mechanization of evacuation on berth IX	Berth evacuation (MT/day)	~12,000	25,000	Nil (~9 Cr enabled)	-
VOC 2.1	Consolidation and improvement of spare capacity on TNEB berths	Productivity on CJ I & II (MT/day)	~11,000	28,000	~65 Cr	-
VOC 2.2	Short-term agreement with DBGT for us of berth VIII for copper concentrate vessels	Cu. conc. volume on berth VIII (Mn MTPA)	~0	0.3	~6 Cr	-
# of suggestions identified = 5		**Operating surplus increase = ~99 cr**			**Capex avoidance = NA**	

5.9.3 VOC Incorporate specific productivity norms in berthing policy

Suggestions Overview

Suggestions summary	Key action steps
High pre-berthing delay at Berth IX for vessels requiring 12.8m draft • Imperative to increase productivity in order to unlock additional capacity to and absorb increasing demand **Currently, two MHCs are available at berth IX but utilization is low** • Productivity can be improved from ~18,000 to 25,000 MT/day through deployment of two MHCs on each vessel **No formal performance parameters are mentioned in the berthing policy**	**Amendment of berthing policy to include performance parameters and norms** • Minimum berth productivity of 28,000 MT/day to be achieved on coal at berth IX • Berth IX to be available only for 3 shifts per vessel by which time draft is required to be below 10.4m. Vessel to be subsequently shifted to berths III & IV • Two MHCs to remain available at berth IX to facilitate achievement of

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager	**Operating surplus improvement :** 9 cr	Metric to be tracked - Berth productivity on berth IX (MT per ship-berth day)

5.9.4 VOC Installation of MHCs at berths III and IV

Suggestions Overview

Suggestions summary	Key action steps
Low productivity at berths III and IV due to high reliance on vessel gear • Productivity of ~11,000 per day at each berth • Potential to unlock capacity of ~1.6 Mn MT through use of 100 MT capacity MHCs **Inability to handle gearless vessels at berths III & IV** • Bottleneck at berth IX due to 100% discharge of cargo from gearless vessels at berth IX alone	**Tender for two additional MHCs on PPP basis** • Ensure compliance with current agreement with Imcola i.e. minimum 70% utilization of MHCs at berth IX **Fix tariff for use of new MHCs** • Tariff per ton handled to be set • No levy for notional gangs to be considered **Sale of existing wharf cranes of low capacity as scrap** **Update berthing policy to prescribe minimum productivity norms at berths III & IV**

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME	**Operating surplus improvement :** 10 cr	Metric to be tracked - Berth productivity on berth III & IV (MT per ship-berth day)

5.9.5 VOC Mechanization of evacuation at berth IX

Suggestions Overview

Suggestions summary	Key action steps
Current evacuation rate of ~17,000 MT/day, matching the discharge rate at the berth **Discharge rate is poised to increase ~50% to 25,000 MT/day** • Evacuation rate required to increase to prevent congestion on the berth • Congestion on the berth would potential hamper the movement of MHCs and slow down the discharge rate	**Tender to be floated and awarded for mechanization of evacuation at berth IX** • Construction of conveyor belts for a distance of ~3km between berth and coal yard • Design capacity of ~2,000 MT/hour • 4-5 hoppers required for ship to shore operations

Ownership		Financial Impact	Tracking metrics
Initiative owner :	CME	**Operating surplus improvement :**	Metric to be tracked -
Other stakeholders:	Shift-in-charge	0 cr	Berth evacuation (MT/day)

5.9.6 VOC Consolidation and improvement of spare capacity on TNEB berths

Suggestions Overview

Suggestions summary	Key action steps
Low productivity at CJ I & II currently, due to reliance on vessel gear as well as limitation of demand • Adequate area for installing shore cranes not available • TNEB daily requirement of coal is ~18-22k per day; productivity of both berths maintained at an average of ~11,000 MT/day to align with daily intake requirement	Engage with TNEB to re-negotiate terms of agreement for ownership and operation of CJ I & II • Explain value proposition for TNEB and quantify potential savings in logistics cost
	Construct branch-out conveyor to connect CJ I to Port's existing coal yard
Potential to maximise capacity of the berths through overhaul of infrastructure and re-structuring of agreement with TNEB to handle additional volumes of coal	Sequential strengthening and widening of CJ I & II and installation of two MHCs on each

Ownership	Financial Impact	Tracking metrics
Initiative owner : Chairman Other stakeholders: Shift-in-charge	**Operating surplus improvement :** 32 cr	Metric to be tracked - Berth productivity on berths CJ I & II (MT per ship-berth day)

5.9.7 VOC Short-term agreement with DBGT for us of berth VIII for copper concentrate vessels

Suggestions Overview

Suggestions summary

Low berth occupancy of ~55% on DBGT berth no. VIII

- Envisioned as container berth
- Low volumes attracted in the absence of quay cranes scheduled to arrive by end of 2016
- Deep draft berth with 12.8m draft available

Potential to use spare capacity to ease bottleneck at berth IX in the short term

- Handling of non-container cargo at berth VIII to free up capacity at berth IX
- To be used until quay cranes are delivered

Key action steps

Negotiate short-term agreement for use of berth VIII based on pre-agreed parameters

- Permissible cargo i.e. copper concentrate (proposed)
- Customers identified
- Tariff and revenue share
- Operating norms
- Productivity norms

Execute contract with DBGT to utilize berth VIII for general port cargo

Ownership

Initiative owner : Traffic Manager

Other stakeholders : Shift-in-charge

Financial Impact

Operating surplus improvement :

6 cr

Tracking metrics

Metric to be tracked -

Copper concentrate handled at berth VIII (Mn MT per annum)

5.10 Mormugao Port Trust

5.10.1 Port performance dashboard – MPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Mechanized	45[1]	144[6]	80
	Avg. vessel turnaround time (hours) [pre-berthing waiting time (hours)]	Container	12[2] [0]	25 [6]	16[7] [2]
Berth productivity	Gross productivity (gross MT/day)	Coal – Mechanized	75,000[3]	27,550[6]	33,000
	HMC productivity (moves/hr)	Container	25[4]	13	18
Yard	Yard throughput (MT / sq. m)	Coal – Mechanized	1000[5]	810[6]	1000
	Yard throughput (TEU per Ha)	Container	*Common yard shared between container and general cargo*		
Evacuation	Truck gate processing time (min)	-	23	50[8]	23
	Rake turnaround time (hours)	-	*Constrained by rake availability due to single rail line connecting the port*		

1. Assumption: Panamax capable berth handling parcel size of ~50,000 MT/day; current average parcel size of ~75,000 MT. For a Panamax vessel time should be 1.5 days. Additional PBD + other non working time = ~9 hrs. 2. Assumptions package size of 300 TEU, HMC productivity of 25 moves per hour (Ko{PT benchmark), 2 hrs of non-working time due to customs rummaging pilotage, repos of containers. 3. Average productivity of unloading 7,500 MT berths = 75,000 for panama vessels. 4. Benchmark from PSA operated HMC in Kolkata Port. 5. Evacuation capacity is 10MT (avg. 8.5 rakes/day), total coal storage land = 10,000 sqm at JSW. Hence, expected yard throughput of 1000 MT/ sq. m. 6. Constrained by evacuation capacity, storage space is 10,000 sq. m time. 8. Does not include parking time, loading/unloading time for trucks, only gate processes considered.

5.10.2 Summary of suggestions in MPT

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
MPT 1.1	Implementation of hot seat shift change	Hrs	1.5	0.25	4	-
MPT 1.2	HMC operator performance improvement	Cycles/hr Moves/hr	20 13	30 25	7	-
MPT 1.3	Addition of HMC on general cargo berths	# of HMCs	1	2	1.5	-
MPT 2.1	Enhance draft for JSW coal berth to increase cargo handling capacity	Draft (m)	14.5	19.8	25	-
MPT 2.2	Development of 10 MTPA new coal terminal	Timeline for implementation	-	-	100	-
MPT 3.1	SVRS announcement and redeployment of MOHP employees	Target # of VRS accepted	-	100	6	-
# of suggestions identified = 6	**Operating surplus increase = 143.5 cr**			**Capex avoidance = NA**		

5.10.3 MPT Implement hot seat shift change for HMC

Suggestions Overview

Suggestions summary	Key action steps
Loss of HMC crane productivity observed around shift change (~1-1.5 hour). Improvement required in shift change process to minimize the productivity losses • Ensure work ends no earlier before scheduled shift ending • Next shift staff reports before previous shift ends • Move next shift staff to equipment on time	• Booking through mobile/tab and transport arrangements for operators • Start monitoring idle time at shift changes systematically • Shift-in-charge of previous and next shift to track and monitor the actual time loss during every shift change; and report on daily basis to Sr. DTM

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager	**Operating surplus improvement :** 4 cr	Metric to be tracked - Time lost b/w shift changes

5.10.4 MPT Improve HMC operator performance

Suggestions Overview

Suggestions summary	Key action steps
• HMC operator productivity performance is low compared to other major ports • Operators are not motivated to perform better, as the current incentive scheme doesn't promote greater productivity **Hence, the operators have to be trained by best performing operators from other major ports. Performance linked incentives have to be initiated. Operators performance has to be monitored on regular basis**	• Training from expert operators has to be provided • Performance monitoring and feedback on regular basis • Incentive based on performance scheme has to be introduced

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager	**Operating surplus improvement :** 7 cr	Metric to be tracked - Cycles/hr, movevs/hr

5.10.5 MPT Addition of HMC on general cargo berths

Suggestions Overview

Suggestions summary

- Currently one HMC is being shared between two general cargo berths
- >Berth productivity can be increased up to 30% by adding one HMC on GCBs

Hence, one 100+ ton mobile harbor crane needs to be added to GCB berths. It is further proposed that the cranes be introduced under PPP model with suitable business guards.

Key action steps

- Commission new HMC for operations
- Mandatory usage of HMCs when available

Ownership

Initiative owner : CME/ Traffic

Financial Impact

Operating surplus improvement :

1.5 Cr (Value realization from HMC)

Tracking metrics

Metric to be tracked -

5.10.6 MPT Enhance draft for JSW coal berth to increase cargo handling capacity

Suggestions Overview

Suggestions summary

- JSW steel to import coal in capes. The current draft at their terminal in MPT can't support capes
- If draft is not changed, ~3.5 MTPA will be shifted to Krishnapatnam

Hence the draft has to be increased at MPT to secure the current volume and gain more volume from JSW vijayanagara plant

Key action steps

- Receive bids for contract
- Award contract for capital dredging
- Capital dredging commencement
- Continue annual maintenance dredging

Ownership

Initiative owner : CE

Financial Impact

Operating surplus improvement :

25 Cr

Tracking metrics

Metric to be tracked -

draft

5.10.7 MPT Development of 10 MTPA new coal terminal

Suggestions Overview

Suggestions summary	Key action steps
Goa hinterland has rich pipeline of coal based industries – power plants & steel plants. • MoU are signed for ~8,000 MW power capacity and ~70 MTPA steel production Current coal handling capacity at MPT is not sufficient to cater to this future demand. Hence development of a new coal handling terminal has to be initiated after the rail line doubling bottlenecks are eliminated.	• Complete master plan • Float RFP for new terminal • Finalize bids, award contract • Project construction, completion

Ownership	Financial Impact	Tracking metrics
Initiative owner : CE	**Operating surplus improvement :** **100 Cr**	Metric to be tracked - # of trucks per day

5.10.8 MPT Doubling of MPT railway line to Hospet

Suggestions Overview

Suggestions summary	Key action steps
• Current rail line handles up to 13.5 MTPA • Future productivity by 2020 is up to 30 MTPA The current rail line doubling at MPT is essential for catering the volume demand of port in future.	• Follow-up with ministry & railways on land acquisition for rail line doubling

Ownership	Financial Impact	Tracking metrics
Initiative owner : Chairman	**Operating surplus improvement :** Linked to new terminal development	Metric to be tracked - # of rakes per day

5.10.10 MPT SVRS announcement and redeployment of MOHP employees

Suggestions Overview

Suggestions summary	Key action steps
MOHC continue to be dysfunctional as mooring dolphins can handle the future iron ore export demand at MPT • 435 employees under MOHC payroll would be having no duties in future of which 165 retiring in next 5 years Hence, remaining 270 needs to be either redeployed to other departments to reduce over time or to be given SVRS.	• Estimate exact staff requirements for cost centres with high overtime payments • Applications to be invited from employees for redeployment & SVRS ➢ Don't include employees, retiring in next 5 years, under either schemes • Announcements of SVRS and selection of redeployment

Ownership	Financial Impact	Tracking metrics
Initiative owner : HODs	**Operating surplus improvement :** **6 Cr**	Metric to be tracked - OT salary # of idle MOHC employees

5.11 New Mangalore Port Trust

5.11.1 Port performance dashboard – NMPT

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Conventional	68[1]	79 [15]	79 [15]
	Avg. vessel turnaround time (hours)	Coal – Mechanized	36[2]	57 [17]	57 [17]
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	Container	23[3]	38 [1]	28 [1]
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	74 [24]	74 [24]
Berth productivity	Gross productivity (gross MT/day)	Coal – Conventional	45,000[4]	17,600	17,600
	Gross Productivity (gross MT/day)	Coal – Mechanized	75,000[5]	28,400	28,400
	QC Productivity [berth productivity] (moves/hr)	Container	30	17	25
	Discharge rate (MT per hour)	POL	1700	900	1000
Yard	Yard throughput (MT per sq. m)	Coal – Conventional	100	66	66
	Yard throughput (MT per sq. m)	Coal – Mechanized	240	66	66
	Yard throughput (TEU per Ha)	Container	25000	16,200	11,000
Evacuation	Truck turnaround time (hours)	-	*NA*		
	Rake turnaround time (hours)		*NA*		

1. Average coal parcel size at conventional berths in NMPT = 60,000. Best in class productivity for full vessel = 25,000. Pre berthing detention of 6 hours, other non working ime including pilotage, customs check etc at ~4 hours 2. Panamax capable berth handling parcel size of ~75,000 MT, loading time would be ~30 hours. Additional PBD + other non working time = ~10 hours. 3. Average parcel size of 1000 TEUs, assuming a crane productivity of 30 moves per hour witch 2 cranes deployed and PBD and other NWT of 6 hours. 4. Assuming 2 cranes of grab size of 125 MT, cycle time of 4 minutes, Grab efficiency of 60 % (Top cargo only) and NWT of ~6 hours per day. 5. Assuming 2 cranes of grab size 125 MT, Cycle time of 2 minutes, grab efficiency of 50% and NWT of ~4 hours per day. 6. Average POL productivity of 40,000 MT per day at Jebal Ali.

5.11.2 Summary of suggestions - NMPT

#	Suggestions	Metric	FY 15 baseline	Target		Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
NMPT 1.1	Increase container cargo by attracting customers from Mysore and adjoining areas	TEUs / year	~65k	145-175k		~18 crore	NA
NMPT 1.2	Improve service level for containers by increasing yard space, number of reach stackers and implementing yard planning	Moves / Hours	17	25			NA
NMPT 2.1	Setup an LNG terminal at NMPT on a PPP basis	LNG volumes	0	2 Mn MT		~30 crore	NA
NMPT 3.1	Setup a mechanized fertilizer handling berth with silo storage and a bagging plant	Mechanically handled fertilizer cargo	0	1 Mn		~4 crore	NA
NMPT 4.1	Reduce overtime costs by migrating to a three shift deployment for tugs, pilot launches and mooring boats	Overtime costs	~5 crore	~50 lakh		~3 crore	NA
# of suggestions identified = 5		**Operating surplus increase = 55 cr**				**Capex avoidance = NA**	

5.11.3 NMPT Increase container cargo by attracting customers from Mysore and adjoining areas

Suggestions Overview

Suggestions summary	Key action steps
Attract containerized cargo from Mysore and adjoining area • Cargo from Mysore to gain logistics cost saving of ~10,000 Rs/TEU by shifting to NMPT • Cargo currently transhipped at Colombo via Chennai • NMPT is closer then Chennai by ~220 Kms • Simultaneously need to attract additional feeder operators	**Form a business development team to engage with customers** **Build a customer database** **Conduct trade meets at Mysore, Hassan, Bidadi** • Communicate steps taken to improve container handling at NMPT • Engage with feeder operators to start operations at NMPT

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager Other stakeholders : NA	**Operating surplus improvement :** 18 cr	Metric to be tracked - TEUs / year

5.11.4 NMPT Improve service level for containers

Suggestions Overview

Suggestions summary	Key action steps
Sub optional container handling infrastructure at NMPT • Absence of a dedicated container berth and quay cranes limit productivity to 17 GMPH • Absence of sufficient yard space and reach stackers • Need to improve infrastructure and service level by increasing productivity to 25 GMPH	Install and MHC for handling containers (Decision to be based on adequate container volumes) Allocate 20,000 Sqm additional yard space Invite a private party to operate 3 additional reach stackers Implement yard planning by maintaining a centralized database

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager Other stakeholders : NA	**Operating surplus improvement :** 18 cr (Enabled)	Metric to be tracked - Moves per hour

5.11.5 NMPT Setup a LNG terminal at NMPT

Suggestions Overview

Suggestions summary	Key action steps
Captive demand of 2 MMTPA of LNG in Mangalore • Demand from MRPL, OMPL, MCF, Tannir Bhavi Power plant and smart city • ONGC has signed an MoU with port to conduct feasibility study • Port to demand a conclusive reply from ONGC with timelines • Port to conduct open bidding in absence of ONGC's interest	**Push ONGC to complete feasibility study and provide a conclusive answer** • Demand timelines, milestones and financial commitment **In absence of ONGC's interest, port to conduct open bidding** • Terminate MoU with ONGC • Draft tender document and conduct bidding

Ownership	Financial Impact	Tracking metrics
Initiative owner : CE Other stakeholders : CE, TM	**Operating surplus improvement :** 25 Cr	Metric to be tracked - LNG Volume (MMTPA)

5.11.6 NMPT Setup a mechanized berth for handling fertilizer

Suggestions Overview

Suggestions summary	Key action steps
Inefficiency in fertilizer handling due to double handling • Fertilizer moves from berth to transit shed and then to outside godowns • Lack of space for storage and bagging inside the port • Mechanizing the handling by establishing ship offloaders, silos and mechanized bagging plant	**Identify location to setup silos and bagging plants** • Mechanize discharge • Mechanized silos for storage • Silos to discharge fertilizer into hoppers for bagging plants **Attract customers by marketing the reduced cost of handling**

Ownership	Financial Impact	Tracking metrics
Initiative owner : CME Other stakeholders : CE, TM	**Operating surplus improvement :** 4 Cr	Metric to be tracked - Mech handled fertilizer (MMTPA)

5.11.7 NMPT Reduce overtime costs for marine equipment by migrating to three shift deployment

Suggestions Overview

Suggestions summary	Key action steps
Migrate to a shift deployment for tugs, mooring boats an pilot launches • 2 shift deployment leads to overtime payments for 4 hours per day to all mooring staff • Outsourcing of mooring activities to release manpower for creating a third shift • Deployment of one tug during night shifts	**Outsource mooring activities to release manpower** **Migrate to a three shift deployment for tugs, pilot launches and mooring boats** • Deploy two tugs and pilot launches during day shifts and one each in the night shift

Ownership	Financial Impact	Tracking metrics
Initiative owner : Dy. Conservator Other stakeholders : Harbor Master	**Operating surplus improvement :** 4 Cr	Metric to be tracked - Overtime costs

5.12 Kamarajar Port Trust

5.12.1 Port performance dashboard – KPL

Bucket	Metric	Commodity	Best in class Benchmark	Baseline	1 Yr Target
Overall port performance	Avg. vessel turnaround time (hours)	Coal – Mechanized	26[1]	60	40
	Avg. vessel turnaround time (hours) [pre-berth waiting time (hours)]	POL	36	39	33
Berth productivity	Gross productivity (gross MT/day)	Coal – Mechanized	75,000[3]	28800	50000
	Discharge rate (MT per hour)	POL	1700	410	820
Yard	Yard throughput (MT per sq. m)	Coal – Mechanized	70[5]	58	70
Evacuation	Truck turnaround time (hours)	*NA*			

1. Average coal parcel size at mechanical berths in Ennore = 60,000. Best in class productivity for full vessel = 75,000 TPD for a panamax. PBD and pilotage of ~6 hours. 3. Current average parcel size of ~60,000 MT. Panamax capable berth should operate at ~75,000 MT/day. 5. Berth and equipment capable of handling ~10 MMT. Total land after reallocation = ~144,000 sq. m. Hence, expected yard throughput of 100 MT / sq.m.

5.12.2 Summary of suggestions - KPL

#	Suggestions	Metric	FY 15 baseline	Target	Op. Surplus Increase (INR cr)	Capex avoidance (INR cr)
KPL 1.1	Improve productivity at existing coal terminals to increase cargo handling capacity and implement governance mechanism	Gross MT / hour	1,300	2,000	~40	NA
KPL 2.1	Requirement of additional cargo to fill capacity at Chettinad terminal	mn MT	9.2	13.0		
KPL 3.1	Modification of existing empty Iron Ore berth to handle coal and serve hinterland demand	Timeline for completion			~100	NA
KPL 4.1	Improve productivity at liquid terminal through reduction in pigging and sampling time	Gross MT / hour	412	800	~8	NA
# of suggestions identified = 4		**Operating surplus increase = 148 cr**			**Capex avoidance = NA**	

5.12.3 KPL Improve productivity at existing coal terminals to increase cargo handling capacity and implement governance mechanism

Suggestions Overview

Suggestions summary	Key action steps
Setup port governance system • Implement new data recording templates • Setup of a governance forum to drive operational improvement • Setup audit function to look into terminal performance improvement • Activate marketing function and integrate with terminal operations Drive operational improvements: • Setup productivity norms and penal charges for as many berths as implementable	Roll out of new data recording templates Setup of data tracking team in KPL Operationalize monthly forum to drive port performance Setup and define role of audit team Roll out new productivity norms and penal berth charges

Ownership	Financial Impact	Tracking metrics
Initiative owner :Director Operations & Traffic Manager Other stakeholders :Terminal Operators	**Operating surplus improvement :** 20 cr	Metric to be tracked - Berth productivity

5.12.4 KPL Requirement of additional cargo to fill capacity at Chettinad terminal

Suggestions Overview

Suggestions summary	Key action steps
Drive operational improvement: • Pricing strategy to attract additional customers to KPL	Attract additional customer volumes

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager Other stakeholders :Terminal Operators	**Operating surplus improvement :** 20 cr	Metric to be tracked - MMT

5.12.5 KPL Modification of existing empty Iron Ore berth to handle coal and serve hinterland demand

Suggestions Overview

Suggestions summary	Key action steps
Empty SICAL iron ore berth to be converted into import coal terminal	Tender of existing terminal and award of contract for modifying and operating new terminal Commissioning of modified berth

Ownership	Financial Impact	Tracking metrics
Initiative owner : Corporate Strategy Manager	**Operating surplus improvement :** 100 cr	Metric to be tracked - Timeline for completion

5.12.6 KPL Improve productivity at liquid terminal through reduction in pigging and sampling time

Suggestions Overview

Suggestions summary	Key action steps
Reduction in sampling time and pigging time through to reduce non working time and reduce overall TAT and increase productivity	Use of existing sampling laboratory with HPCL by all oil companies Use of alternate pipeline network to reduce time loss per vessel due to pigging

Ownership	Financial Impact	Tracking metrics
Initiative owner : Traffic Manager Other stakeholders :Terminal Operators	**Operating surplus improvement :** 8 cr	Metric to be tracked - MT / hr

CHAPTER VI - SUGGESTIONS AND CONCLUSIONS

This is stated that this research encompasses a unique exercise of exploring solutions after deep dive analysis into the real productivity issues in Major Ports by taking into consideration the aspirations of stakeholders and it is what distinguishes from other research studies. These solutions are vividly described under various heads.

6.1 Technology upgrade

(a) **Barge based dredging (Kolkata)** - The current navigation channel to Haldia Dock System passes through two major sand bars—Auckland and Jellingham, which currently limit the draft of the channel. The bars, which are currently at approximately 4.5m (Auckland) and 4m (Jellingham) below chart datum, need dredging around the year for maintenance. Barge based technology for dredging can be used at Jellingham bar. This technology, as per initial studies, can complement the two techniques that KoPT has already successfully deployed (side casting and short dumping) and result in substantial operational savings

(b) **Dual loading of vessels (Paradip)** - Dual loading will help in saving non-working time of the vessel as the second idle berth is used for de-ballasting of vessels. Due to dual loading, more than 50% reduction in non-working time and 33% reduction in time spent at the berth for vessel could be achieved. Dual loading of vessels will help in lowering working time, Reduction in non-working time at berth due to lesser number / simultaneous hatch changes, Higher berth productivity for port could be achieved and savings for customer through reduced TRT.

(c) **Night navigation system** implementation (Kandla)- Currently, only buoys are used as navigation aid. During night, the pilot has to navigate just by looking at the buoys. The buoys move around the mooring causing uncertainty in identifying channel boundary. This has resulted in lesser number of movements at night compared to day. It is therefore suggested to use Navigation aids to make night navigation easier and safer, thereby increasing the % of movements at night.

(d) **Quick release system** implementation (Mumbai) - the non-working time at Mumbai port is significantly higher in comparison to the 12 major ports in India. In order to reduce the mooring time, installation of ‘Quick Release System’ can be a potential solution. Benefits of installing quick release system (QRS) are - reduction in mooring time, reduction in overturning movement, reduction in mooring crew’s exposure to risk, benefit for oil companies due to faster turnaround time for vessels and less labor and no tugs required in operations.

6.2 Process optimization

(a) **Evacuation time reduction** (JNPT) - The Vehicle Booking System is suggested to be implemented at JNPT as it will help streamline the flow of trailers in JNPT. In JNPT, moving export containers from CFS to Port gate takes 8-10 hours due to heavy congestion of trailers near the port gates. The high evacuation time results in increased logistic costs for customer and affects ease of doing business. Vehicle Booking System is designed to decrease the waiting time of trailers.

(b) **Hot seat change** implementation (JNPT, Kandla, Goa, Haldia etc) - Currently, the shift change time takes between 30 minutes to 1 hour per shift per day. However, this can be resolved by instituting hot seat shift change. It is proposed to implement hot seat changes by finalizing the plan with unions to add 30 minutes to each shift, or give one-hour overtime.

(c) **Hatch change optimization** (Paradip)- Absence of norms for number of hatch changes and draft checks results in little control over non-working time for the vessels. In order to improve berth performance, there is a need to put in place a stringent set of productivity norms and penal charges so as to optimize the hatch change.

(d) **Twin lift** optimization (JNPT) - Strong yard planning is recommended to support maximization of export twin-lift ratio. Twin-lifting can boost crane productivity for terminals where 20' container constitute a large share of traffic (60-70% for JNPCT). Current twin-lift ratio is ~25% and there is potential to increase the twin-lifts of 20ft containers below 25t through improved planning to optimize the twin-lift opportunities and ensuring execution according to plan with minimum leakage.

6.3 Pricing & incentive alignment

(a) Liquid norms in Kandla & JNPT - Currently, there is low incentive for customer tank farm operator to increase throughput because of the tariff structure. Incentive can be created through establishing targets for berth performance, and penal actions may be implemented if these performance targets are not achieved. Lack of incentives for customers in Kandla Port to discharge liquid cargo at the maximum rate had led to a situation where customers found it cheaper to store edible oil in a vessel than hire additional tank for storage. The norms at Kandla port were revised to incentivize faster discharge of liquid cargo. The norms made idle stay at berth costlier, encouraged sharing of pipelines and encouraged customers to shift to larger parcel sizes.

(b) **SoR** revision for to incentive HMC utilization (Paradip, Kandla) - Add new HMCs to lead to improved productivity of vessels. Productivity norms should be set to increase productivity and reduce non-working time. Norms have to be set for both HMC operations and vessel operations.

(c) **Trans-loading package** in Kolkata - Transloading option should be made attractive by reducing overall cost and creating a combined package. Transloading cost can be reduced by eliminating cargo loss by installation of weighbridge inside yard (already planned), reducing shore handling through licensing/ BOT-mechanized berths, combined discount from both JITF and port-end to be provided. It will be critical to map transloading to cheaper sub-contracted/BOT berth to ensure cost-effective transloading

(d) **Bulk productivity norms across ports** - Berth productivity norms for cargo berths needs to be upgraded per the planned equipment upgrade. These norms are necessary to ensure that the planned upgraded equipment is put to full use for achieving higher productivity.

6.4 Equipment upgrade

(a) **Cranes:** 20 new MHCs & 15 RTGCs – New MHCs and RTGCs need to be installed across ports to fully utilize the capacity at the berths.

(b) **Conveyor:** Upgrade agreed with captive customers (VOC, Ennore) – At VOC constructing a branch-out conveyor to handle non-TNEB coal evacuation to the port's storage yard can help in increasing productivity. At Ennore, the conveyor system at the NCTPS plant of Tangedco leads from the berth to the yard and then directly to the co-located plant. The low conveyor discharge rate is leading to low berth productivity. Detailed on ground study of conveyor operations can led to identification of the key issues in the conveyor system. Initiatives can be formulated to optimize the conveyor operations.

(c) **Grabs**: New grabs procured to match crane capacities (Kandla) - Grab is a factor of the lifting capacity of the crane as well as density of the commodity. Optimal grab size will help lift maximum possible cargo in one movement. Optimizing grab size per respective commodity density will ensure maximum productivity for each commodity.

(d) **Dumpers**: ~300 additional dumpers (Paradip) - PPT does not have adequate dumpers to meet the higher productivity requirement of HMCs for evacuating cargo from wharf. Dumper evacuation from wharf to yard should match the HMC productivity rate. Considering the current TRT of trucks and different queue waiting times, 300 additional dumpers are proposed to be added.

6.5 Barge based dredging successfully piloted in Kolkata

KoPT established that a dredger can dredge with a normal barge moored alongside. The potential monetary impact of this initiative is about Rs 60-80 crores. This implementation of a cutting edge dredging scheme is a first in India, driven completely by Indian companies. The pilot has the potential of serving as an economic model for dredging inland waterways. The benefits of the study are as follows:

6.5 (a) Higher utilization of dredger

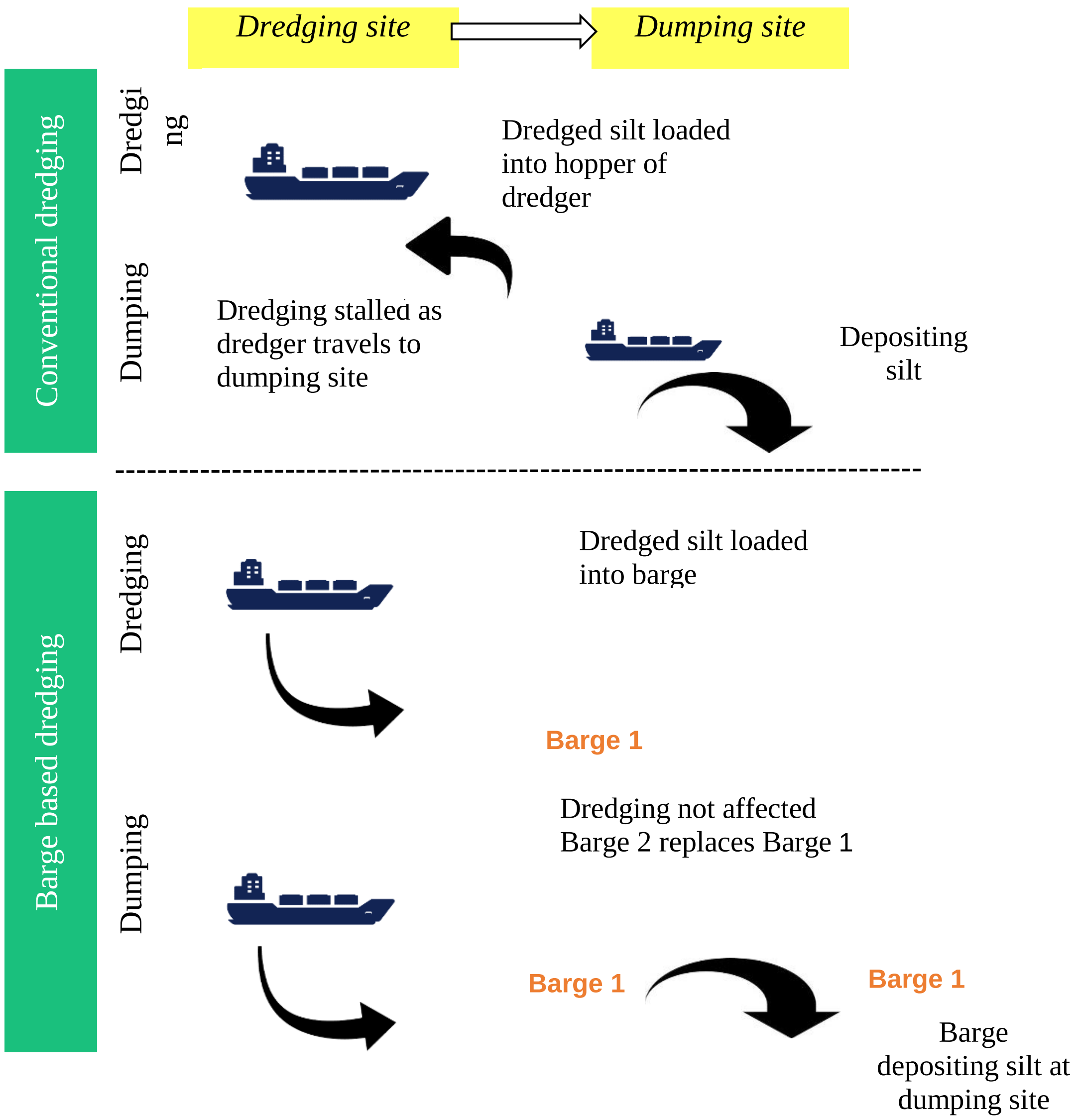


Figure 6.5 (a): Barges deployed for carrying dredged silt to dumping site

6.5 (b) Potential monetary impact of Rs 60-80 Cr

6.5 (c) Best in class dredging model used for the first time by Indian companies- Collaboration between KoPT, DCI, IIT Madras & Ocean Sparkle

6.5 (d) Provides an economic model for dredging inland waterways

6.6 Dual-loading of ships implemented at Paradip resulting in achievement of 2X normal berth productivity:

Paradip port achieved record productivity levels of around 4,500 tonnes per hour through dual loading as compared to 2-2,500 tonnes per hour under normal operations. Due to dual loading, more than 50% reduction in non-working time and 33% reduction in time spent at the berth for vessel could be achieved. The key features of the dual loading operations at Paradip are as follows:

6.6 (a) Utilization of ship loaders maximized through dual loading: During dual loading both loaders service one-ship simultaneously

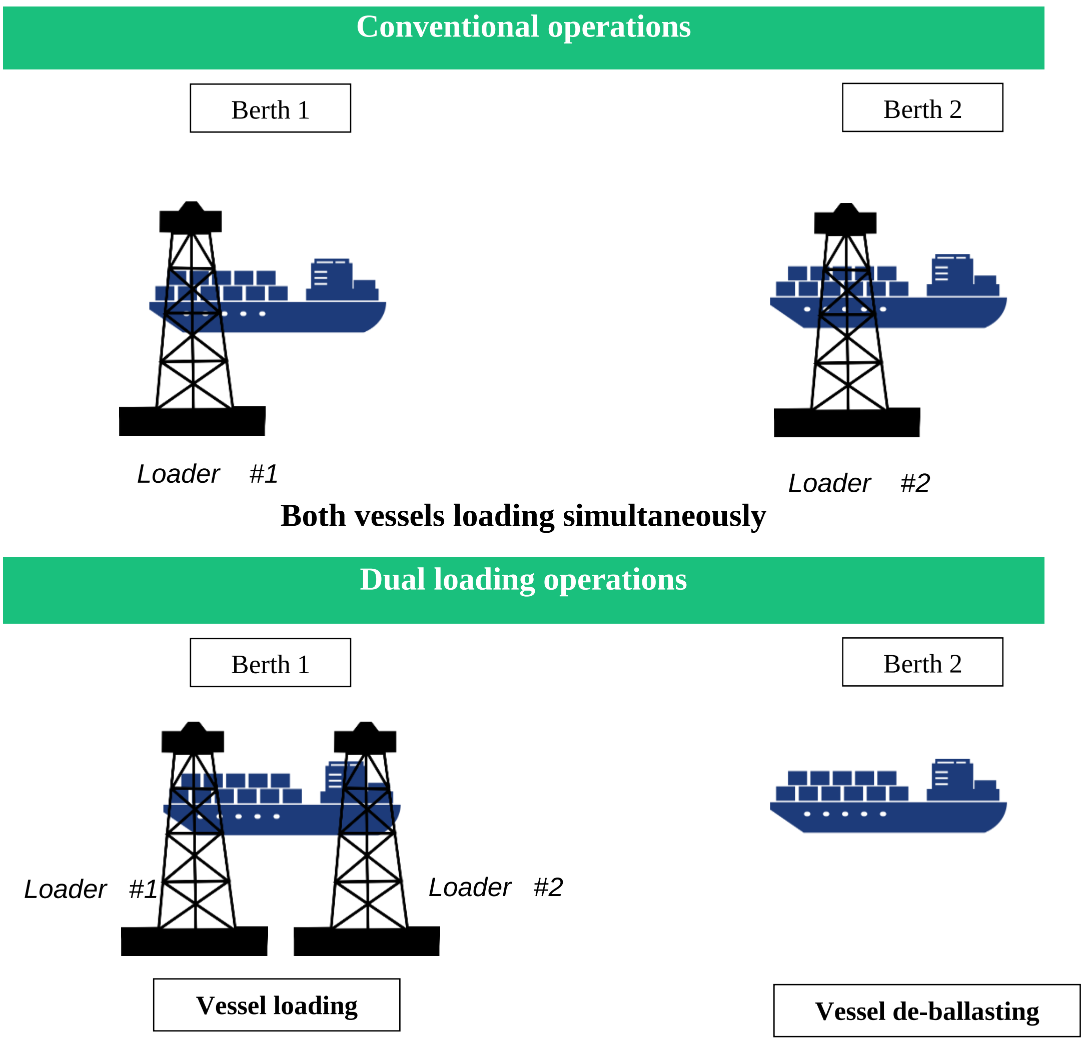


Figure 6.6 (a):Utilization of ship loaders maximized through dual loading

6.6 (b) There is Gross productivity of 4,233 tonnes per hr

6.6 (c) Reduction of non-working time by >50% at berth compared to other Panamax ships

6.6 (d) Reduction of ~33% in time spent at berth for vessel compared to other Panamax ships

6.7. Liquid norms designed in Kandla to encourage customers to shift to larger vessels

The productivity of liquid berths at KPT lower than benchmarks and BDP at KPT due to the incentive structure which does not create pressure for the customers to empty vessels at maximum possible rate. It is therefore proposed to establish norm at 300 TPH; ship will be unberthed and moved to the back of the queue if doesn't meet the norm for 2 shifts. One berth to be dedicated to edible oil ships and awarded to the ship promising maximum productivity

6.7 (a) Parcel size based norms drafted for Kandla Port are as given in the Figure 6.7

	Cargo	Parcel size			
		< 10K Tons	10 – 20K Tons	20 – 30K Tons	> 30K Tons
Disincentive Threshold (TPH)	Edible Oil	450		500	
	Chemical	300		450	

Figure 6.7 (a): Parcel size based norms drafted for Kandla Port

6.7 (b) Penalty structure:

- Extra 3 hour slots penalized telescopically at 3X, 4X, 5X berth hire
- Clause for de-berthing – after 12 hours

6.7 (c) >50% improvement due to norm rollout

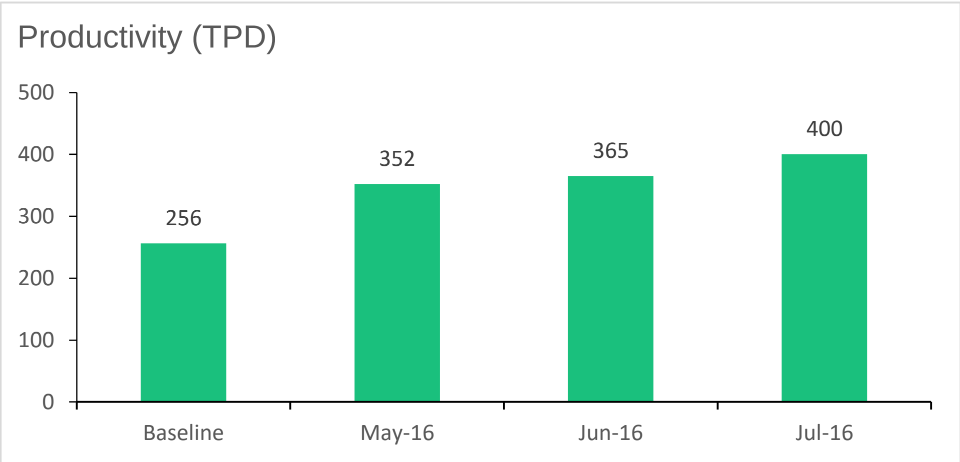


Figure 6.7 (c):>50% improvement due to norm rollout

6.8. JNPT evacuation initiatives showing improvements

The initiatives taken till date have shown improvement in evacuation time taken at JNPT, however, we need further efforts to reach near best-in-class benchmarks

6.8 (a) Initiatives undertaken to improve evacuation are:

Change in gate policy

- Container entry limited to maximum 4 days before day of vessel berthing - Change container intake duration from 5.5 days prior to vessel arrival to 4 days prior to vessel arrival to improve evacuation and reduce congestion.

- Yard operations synchronized to ensure no vessel shutouts - Coordinate with all terminals to avoid undue gate shut outs and provide additional yard storage area to GTI to ensure minimization of gate shut-outs

Vehicle booking system

Architecture finalized; pilot rolled out - In JNPT, moving export containers from CFS to Port gate takes 8-10 hours due to heavy congestion of trailers near the port gates. The high evacuation time results in increased logistic costs for customer and affects ease of doing business. The pilot Vehicle Booking System was designed to decrease the waiting time of trailers. For factory stuffed containers, the terminal entry and parking entry time slot is to be booked before the container leaves for the port. The container is allowed inside the port only during the booked slot. Similar process is also followed for CFS stuffed containers. The Vehicle Booking System has helped streamline the flow of trailers in JNPT

6.8 (b) Parking yard creation

Yard to streamline truck flow into terminal gates and reduce queuing - Yard is required to be put in place for physical evacuation of un-cleared trucks so that they do not obstruct the path of trucks behind them in the queue. Yard and gate infrastructure is required to work in tandem with the berth, supporting a seamless flow of traffic from berth to gate. Hence, potential bottlenecks at yard and gate should be addressed to support the increased productivity at the berth.

6.8 (c) 27% reduction in border compliance time –

Border compliance time for export includes overall container handling time at the port from the time of entry till the vessel sailing. This export dwell time at JNPT has reduced by 26% to just 77 hours in June 2016 due to implementation of vehicle booking system and simplifying gate clearance processes.

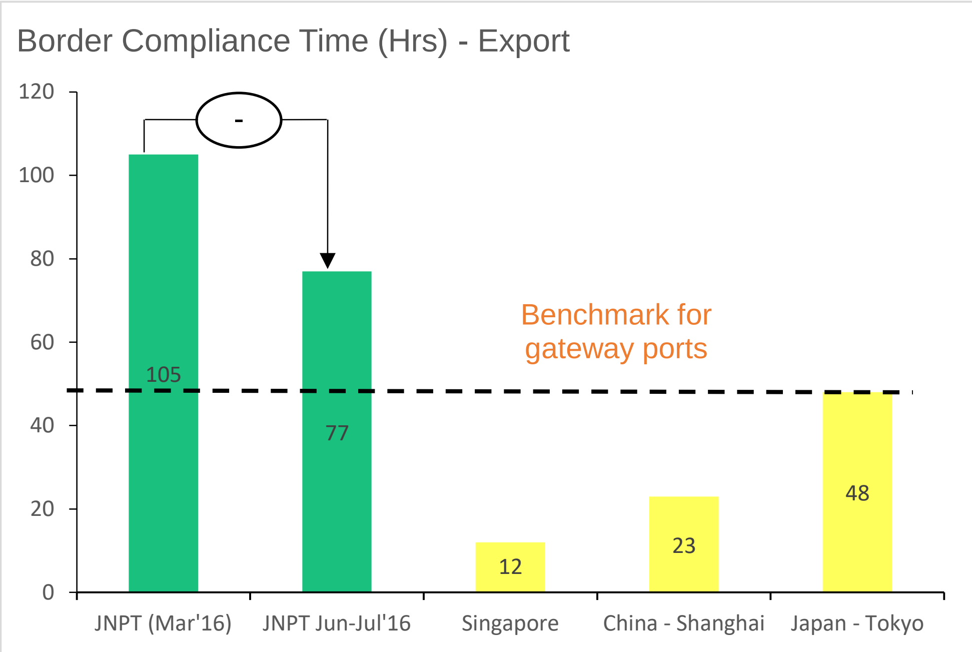


Figure 6.8 (c): 27% reduction in border compliance time

6.9 Likely Reduction Turnaround Times across ports

High turnaround time ultimately affects the customer who needs to bear higher vessel charter costs and working capital costs. This has severely undermined overall competitiveness of the ports. Reducing turnaround times would reduce costs for the customers thus benefiting the economy. This research focused on reducing vessel turnaround times in high occupancy berths. This has been achieved through a combination of productivity improvement, reduction in idle time and streamlining of vessel schedules. During the project period, the turnaround time across 8/10 Major Ports reduced significantly. Six of the Major Ports – VOC, Vizag, Haldia, Paradip, Kolkata & Kandla had turnaround time greater than 6 days. All of these six ports have successfully reduced their turnaround time by more 25%.

Vessel TAT (in days)	FY 15-16	FY 16-17	YTD FY 17-18	Reduction
VOC	8.1	5.5	4.3	***47%***
Vizag	6.1	3.8	3.7	***40%***
Haldia	7.5	7.8	5.1	***32%***
Paradip	7.5	4.5	5.2 (4.3)	***31%***
Kolkata	6.3	4.8	4.5	***27%***
Kandla	6.5	4.8	4.8	***26%***
Mumbai	3.9	4.5	3.2	***17%***
Ennore	4.5	7.0	3.9	***13%***
NMPT	2.6	2.8	2.4	***8%***
JNPT	2.0	2.0	2.0	***2%***
Cochin	2.2	2.3	2.2	***2%***
Chennai	2.5	2.5	2.8	***-8%***
Goa	3.5	5.3	7.5	***-117%***

Figure 6.9: Likely Reduction Turnaround Times across ports

6.9 (b) There would be Sharp jump in productivity across high occupancy berths- The benchmarking study of ports' performance identified significant scope for improvement in productivity levels. The average productivity for Major Ports was almost ~60% lower than the best in class benchmarks for conventional berths and ~120% lower in mechanized berths. The focus of the project was to unlock capacity in the high occupancy berths with significant cargo potential. The key capacity constrained berths were the mechanized and conventional coal handling berths in Paradip & Haldia, the edible oil berths and dry bulk berths in Kandla, the container terminal in JNPT. The productivity of conventional & mechanized coal berths in

Haldia have improved by 95% and 58% respectively. The coal berths in Paradip have also witnessed improvement in excess of 40% in their productivity levels. The edible oil & chemical handling oil jetties in Kandla have improved productivity in excess of 70%.

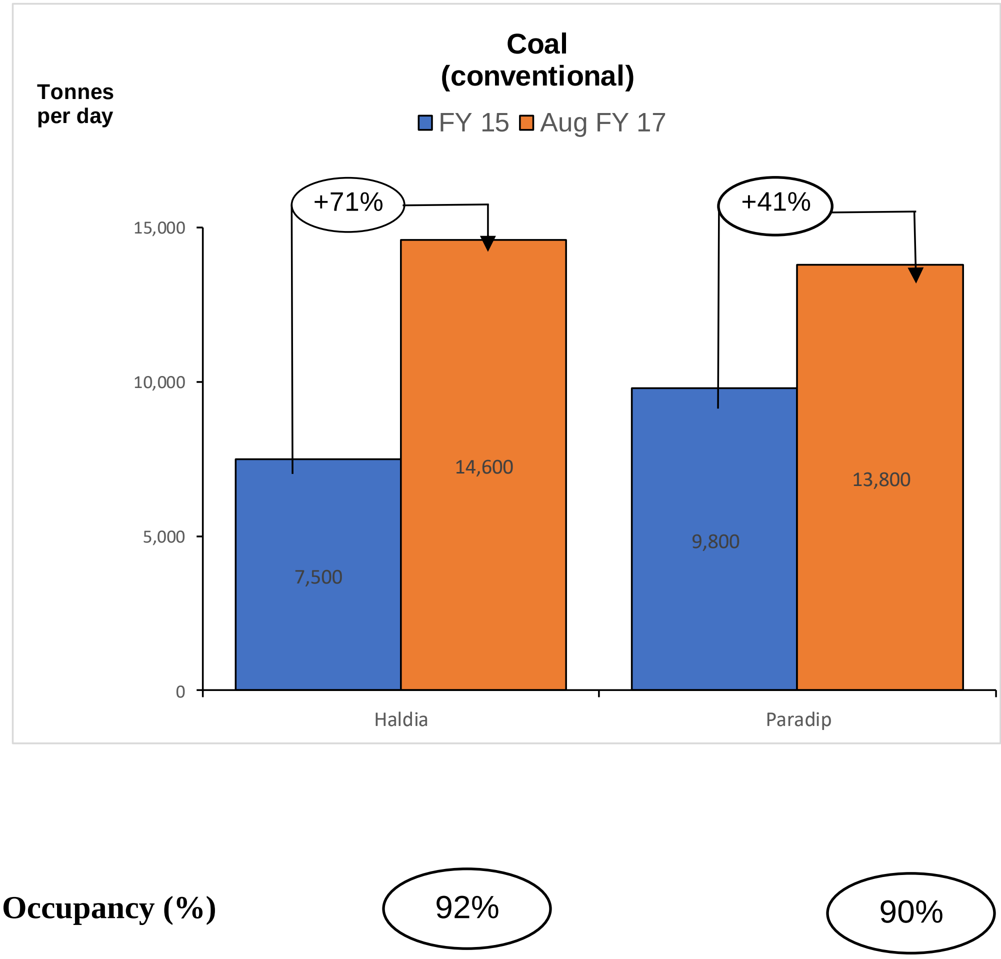


Figure 6.9 (b): There would be Sharp jumpin productivity across high occupancy berths

6.9 (c) Sharp jump in productivity across high occupancy berths

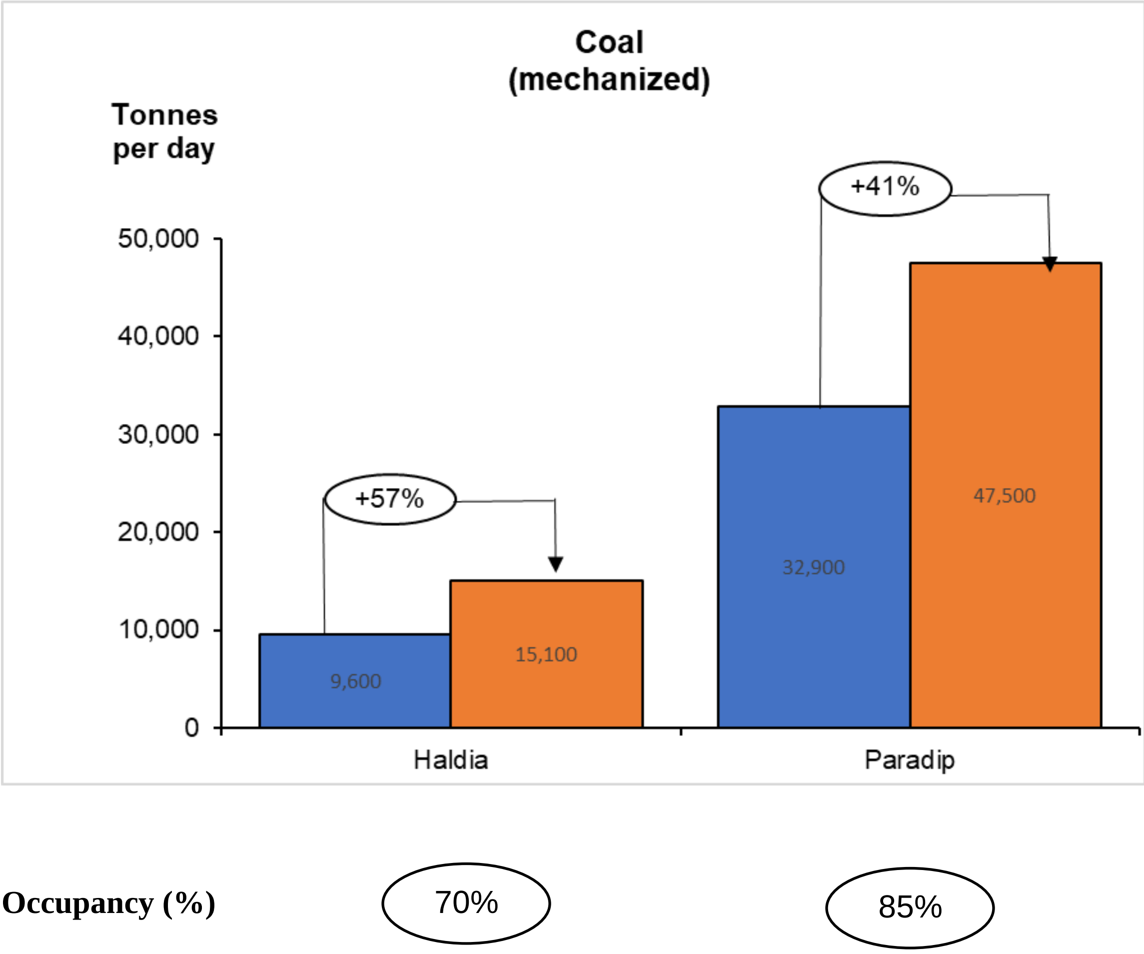
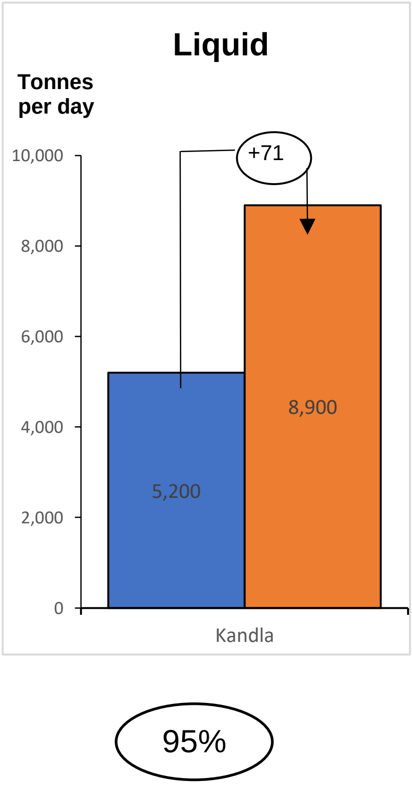


Figure 6.9 (c): Sharp jump in productivity across high occupancy berths

6.9 (d) Sharp jump in productivity across high occupancy berths- This study will able to unlock a capacity of around 80 MTPA so far across Major Ports solely through productivity improvement with minimum capital investment. Nearly all of this capacity unlock has come from capacity constrained berths in Major Ports. The key capacity constrained berths – dry bulk handling berths in Paradip, Kandla & Haldia, liquid handling berths in Kandla have witnessed capacity addition of 5 MTPA or more. The biggest chokepoint in Major Ports was in dry bulk handling berths in ports. These berths were suffering from a high occupancy of >80% and needed capacity unlock to service more cargo.



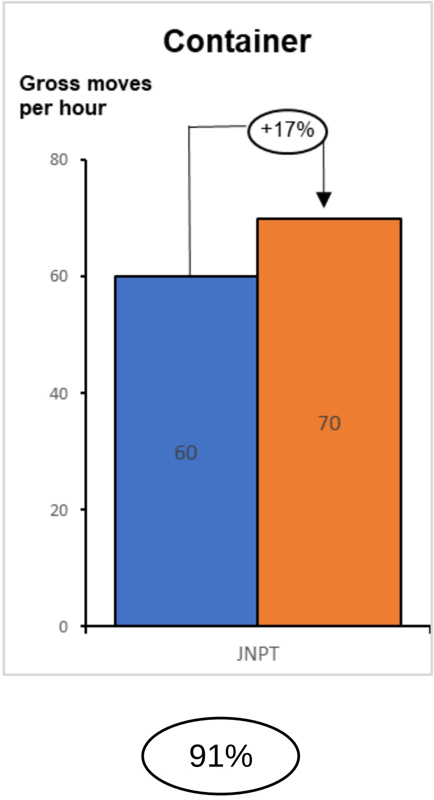


Figure 6.9 (d): Sharp jump in productivity across high occupancy berths

6.10 >Rs 3,500 Cr value creation

	Impact of productivity improvement	Rationale for estimation of value created
(a)	~ 80 MTPA Capacity unlocked	Capacity unlock calculated basis port wise commodity wise improvement in productivity
(b)	~ Rs 650-700 Cr Annualised operating surplus	Additional operating surplus expected on utilization of ~80 MTPA of added capacity[1] and savings in dredging cost (150cr)
(c)	>Rs 2000 cr Potential capex avoidance	Estimated capex required to develop new berths to handle ~80 MTPA of additional cargo[2]
(d)	Rs 400-500 cr Logistic cost savings	Savings on vessel chartering costs due to lower vessel turnaround time[3]
(e)	Rs 550-650 cr Inventory cost savings	Lower inventory holding & financing cost due to improved turnaround time for cargo[4]

Figure 6.10: >Rs 3,500 Cr value creation

1. Assumption – INR 80 per MT revenue for ports from cargo handling with 80% capacity utilization. 2. Assumption: 80 MTPA capacity unlock avoids 7-8 new berth construction with Rs 300-350 capex required per berth. 3. Assumption: USD 4,000 per day of average charter rates for vessels; reduction in TAT to translate lower charter days requirement for customers. 4. Assumption: 10% cost of capital for funding working capital (inventory) incurred by customers

6.11. High value initiatives need to be completed in time - The berthing policy has been put into effect by the Ministry of Shipping. The Major Ports should ensure that berthing norms along with the incentives and penalties are effectively enforced. The ports would also need to revise the norms regularly based on the actual productivity achieved in the port.

S. No	Initiative	Current Status	Action required
1	Berthing policy implementation	- Berthing policy rolled out by Ministry	- Need successful rollout of berthing norms basis new policy - Process for revising norms based on performance
2	Tangedco conveyor upgrade	- Conveyor upgrade in Ennore & VOC agreed with Tangedco	- Need to expedite tender process of Tangedco
3	Container evacuation implementation	- Solutions identified – Vehicle Booking System, Parking yard	- Need to implement KPIs for trade on evacuation performance - Need to onboard customs & railways
4	Mormugao dredging project	- Dredging ongoing for Mormugao	- Need to expedite dredging (~45% dredging work completed)

Figure 6.11: High value initiatives need to be completed in time

6.12 Focus on mechanization of port berths to enhance port capacity-

Mechanization of berths is an effective lever for unlocking capacity in the existing conventional berths in the Major Ports. The mechanization of berths includes installation of new cranes (MHCs, shore cranes) at berth and installation of new conveyor systems for evacuation. The non-mechanized berths with high occupancy or potential for attracting large cargo volumes were shortlisted for mechanization. Further, feasibility of mechanization was checked based on strength of berth, availability of yard space and evacuation. 28 berths across Major Ports have been identified for mechanization. The ports should expedite mechanization of the following berths.

List of berths to be mechanized

Port	Proposed berths	Status & next steps
Paradip	**EQ 1-3**	Mechanization process on going
Vizag	**EQ 6** **WQ 8,9**	Mechanization is in progress Port to take mechanization after EQ 6 is complete
Haldia	**2,3**	Port to put conveyor belts on the wo berths
VOC	**CJ I, II**	Installation of MHCs ongoing
NMPT	**2**	Port to start with fertilizer bagging plant initially and then to proceed to full scale mechanization as volume picks up
Ennore	**SIOT 01**	Tender awarded
Cochin	**Q7** **Q8/ Q9**	Berth allotted to M/s Malabar cements with agreement to mechanize berth for handling cement Port to replace current 40T HMC with 100T HMC to provide better service for steel
Goa	**10, 11**	Port has initiated process of procurement of cranes
Chennai	**JD2** **BD2**	Port to commence mechanization Port to go for full mechanization for fertilizers in phased manner
Kandla	**CJ14** **CJ 6-9**	Port to certify on paper that full rake can be loaded at CJ 14 in case it is going ahead with CJ14 for fertilizer berth Tender Process ongoing
Mumbai	**OCT 1-2**	Port to proceed with mechanization post resolution of the issue with concessionaire

6.13. Way forward: Few ideas to drive further efficiency unlock

Pricing is an important lever for ports to achieve higher volumes and productivity. Strategic use of pricing can help the ports balance multiple objectives - secure sufficient returns for the port, ensure competitiveness of the port, optimally utilize assets by achieving high productivity.

Beyond capital projects

Operations	Organization	Policy	IT
Timely implementation of recommendations (Rs 400 cr of pending value	Design a new organization to suit the new Land Lord operating model	Resolving current PPP Concessions and long term TAMP reform	Standardized and integrated ERP system across ports
Mechanization of 28 berths across Major Ports	Plug critical capability gaps – Business development, Pricing, Vendor management	Revision of MCA for PPP concessions	Upgradation of PCS systems
Successful Rollout of berthing norms basis new policy		Policy for Port land and Storage Charges	IT centre of Excellence in IPA/ Ports
Strategic Use of pricing (SoR) – to drive productivity and attract cargo			Move toward digital port – Adoption of latest IT tools & Technologies

Figure 6.13: Way forward : Few ideas to drive further efficiency unlock Beyond capital projects

APPENDIX - Survey of Major Indian ports

Survey 1: To Rank Key Performance Metrics

Dear Sir/Madam,

Survey is being conducted to determine the important KPIs at various Major Ports of India and rank the same.
We estimate the survey to take approximately 10 minutes to complete.

Please be assured that we will ensure complete confidentiality. The survey is entirely anonymous, and results will be collated and used only in an aggregate form.

Thank you very much for your participation!

	Circle the following KPI in degree of importance as per your perception							
SrN	**KPIs**	**Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree**						
1	Vessel turnaround time (days)		**1**	**2**	**3**	**4**	**5**	
2	Non-working time at berth (days)		**1**	**2**	**3**	**4**	**5**	
3	Berth output (MT per day)		**1**	**2**	**3**	**4**	**5**	
4	Berth utilization (%)		**1**	**2**	**3**	**4**	**5**	
5	Waiting time outside port (days)		**1**	**2**	**3**	**4**	**5**	
6	Equipment utilization (%)		**1**	**2**	**3**	**4**	**5**	
7	Quay crane/gang output (MT per shift		**1**	**2**	**3**	**4**	**5**	
8	Containers: Truck turnaround times		**1**	**2**	**3**	**4**	**5**	
9	Cargo dwell times		**1**	**2**	**3**	**4**	**5**	

10	Equipment maintenance cost per MT handled		**1**	**2**	**3**	**4**	**5**	
11	Maintenance dredging cost per m3 excavated		**1**	**2**	**3**	**4**	**5**	
12	Employees / MT handled		**1**	**2**	**3**	**4**	**5**	
13	Gang size per shift		**1**	**2**	**3**	**4**	**5**	
14	Fuel/energy cost per MT handled		**1**	**2**	**3**	**4**	**5**	
15	Containers: RTG moves per hour		**1**	**2**	**3**	**4**	**5**	
16	Containers: QC:RTG:Truck ratios		**1**	**2**	**3**	**4**	**5**	

Survey 2: Customer Satisfaction Survey

Dear Sir/Madam,

The survey is being conducted to assess the satisfaction level of the stakeholders and also to identify and prioritize areas of improvement for the port.

We estimate the survey to take approximately 30 minutes to complete.

Please be assured that we will ensure complete confidentiality. The survey is entirely anonymous, and results will be collated and used only in an aggregate form.

Thank you very much for your participation!

Section 1. Introduction

In this section we would like to understand your profile and overall experience while dealing with the port. Please answer the following information before you start this survey, and remember that all information will be handled completely anonymously.

1) Which of the following types of main port stakeholders do you work for (or have worked for in the past 2 years)
   a) Vessel operator
   b) Vessel handling agent
   c) Bulk cargo handling agent
   d) Container freight station
   e) Private berth operator, e.g. dedicated coal berth
   f) End user – importer/ exporter
   g) None of above

Terminate if respondent selects option g.

2) Which of the following commodities represent your largest business interest at (Name) Port?
   a) Containers
   b) Dry bulk
   c) Liquid bulk
   d) Project Cargo

3) <u>Generally</u>, which of the following terminals do you work with? (Please select up to four terminals)
   a)
   b)
   c)
   d)

4) Apart from (Name) Port, do you frequently work with any other international port? Please mention up to three
   a)
   b)
   c)

5) What is your role in the company?

a) Senior management, i.e. CEO, COO, VPs etc
b) Operations
c) Business development
d) Others, please specify

6) How often does the port interact with you to resolve your issues?
a) Once a week
b) Once a fortnight
c) Once a month
d) Once a quarter
e) None of the above

7) How strongly do you believe that your overall business experience with port has improved in past six months?
a) Strong improvement
b) Somewhat improvement
c) No improvement
d) Somewhat deterioration
e) Definitely deterioration

8) Generally, how do you access information about any changes/ new procedures/ clarifications in the port operating procedures?
a) It is present over internet
b) It is provided to me as hard copy
c) I have to discuss with port officers
d) I have to discuss with my colleagues
e) I am generally not aware about any changes/ new procedures/ clarification

9) Do you believe that the port is trade friendly?
a) Yes
b) Probably yes
c) Probably no
d) No

10) What are the Top Two improvements required in port ecosystem (Including - terminal, port, transporter, CFS, CHA, Customs, Banks, Infrastructure, Law & Order, Skill, IT Systems OR any other related areas)?

1.
2.

11) What are the Top Two achievements of port ecosystem (Including - terminal, port, transporter, CFS, CHA, Customs, Banks, Infrastructure, Law & Order, Skill, IT Systems OR any other related areas)?

Section 2. Documentation

12) Does preparation and approval of EXIM documentation take a lot of time for you?
a) No, it is fairly straight forward
b) It takes manageable time
c) Yes, it takes a lot of time
d) Not applicable

13) Generally, for a frequent exporter, how long does it take to prepare customs mandated documents?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+
   f) Not applicable for me

14) How long does it generally take to receive all customs approvals for export?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+
   f) Not applicable for me

15) Generally, for a frequent importer, how long does it take to prepare/collect customs mandated documents?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+
   f) Not applicable for me

16) How long does it generally take to receive all customs approvals for import?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+
   f) Not applicable for me

17) For the other international ports that you deal with, how long does it generally take to secure customs approval? Please provide up to three -

Name of Port	Document Approval time by Customs (Hours)

18) Can you collect, prepare and submit export related customs documents electronically?
   a) Mostly all the documents
   b) Some of the documents
   c) Rarely any document
   d) Never, all documents are manually collected and prepared

19) Can you collect, prepare and submit port related documents electronically?
   a) Mostly all the documents
   b) Some of the documents
   c) Rarely any document
   d) Never, all documents are manually collected and prepared

20) How frequently do you have to manually transfer documents from shipping lines to customs and vice versa?
   a) Always
   b) Sometimes
   c) Never

21) How frequently do you have to manually transfer documents from ports to customs and vice versa?
   d) Always
   e) Sometimes
   f) Never

22) How frequently do you have to manually transfer documents from ports to shipping lines and vice versa?
   g) Always
   h) Sometimes
   i) Never

23) Generally, which documents are manually processed? (Include documents submitted /approved /obtained manually by agencies or involving manual movement by handling agents/ other stakeholders)

Name of Agency	Manually Processed Documents
Customs	
Port	
Shipping line	

24) How long does it take to prepare all documents required by shipping lines?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+
   f) Not applicable for me

25) How long does it take to prepare all documents required by shipping lines?
   a) <1 Day
   b) 1-2 Days
   c) 2-3 Days
   d) 3-4 Days
   e) 4 Days+

26) How can the Government improve documentation procedures/ approval?

Section 3. Cost

27) Are all handling charges, duties and taxes to import and export clearly understood and consistently levied?
   a) Clear and consistent
   b) Clear but not consistent
   c) Generally consistent, but I am not clear how to verify if I paid as per rules
   d) I am not clear and they are not consistent
   e) I do not manage EXIM cost related matters

28) Which of the following EXIM charges need further clarity?
   a) Port charges
   b) Customs duties
   c) Other taxes
   d) All EXIM charges are clearly understood
   e) None of the above, please specify

29) Do you receive receipts for <u>all expenses</u> incurred for export/ import transaction?
   a) Yes
   b) No

30) Do you receive receipts for <u>all expenses</u> incurred inside of port premises?
   a) Yes
   b) No

Section 4. Border handling time at Port

31) How long does it <u>generally</u> take for the truck to get into the port entry queue from the time it leaves CFS/ parking yard?
   a) 1-2 Hours
   b) 2-4 Hours
   c) 4-6 Hours
   d) 6 Hours +
   e) I do not deal with truck movements in and out of the port

32) How long does it <u>generally</u> take for the truck to enter the port premises once it reaches the port gate queue
   a) < 15 Minutes
   b) 15 – 30 Minutes
   c) 30 – 60 Minutes
   d) 60 – 90 Minutes
   e) 90 Minutes +
   f) I do not deal with truck movements in and out of the port

33) What is the typical truck turnaround time in the port

a) < 60 Minutes
b) 60 – 90 Minutes
c) 90– 120 Minutes
d) 120 – 180 Minutes
e) 180 Minutes +
f) I do not deal with truck movements in and out of the port

34) On a scale from most to least satisfied, please rate your **satisfaction level** of the following attributes with ports in general?

Scale from 1 to 5: 5 is the very satisfied and 1 is the very dissatisfied. Not applicable option also provided.
[Depending on the importance of various capabilities selected above, the sequence and number of questions will vary]

Turnaround time

- How satisfied are you with pre-berthing delays?
- How satisfied are you with the vessel turnaround times at the port?

35) What is the typical vessel turnaround time for the other international ports that you deal with? Please provide up to three -

Name of Port	Most Frequently Handled Cargo Type for You	Most Frequently Handled Cargo Size	Turn Around Time (Hours)

Section 5. Port operations

36) On a scale from most to least satisfied, please rate your **satisfaction level** of the following attributes with ports in general?

Scale from 1 to 5: 5 is the very satisfied and 1 is the very dissatisfied. Not applicable option also provided.
[Depending on the importance of various capabilities selected above, the sequence and number of questions will vary]

Availability of berths suitable for your purposes

- How satisfied are you with the berths available at the port, incl. number and draft?
- How satisfied are you with the availability of berths upon arrival?
- How satisfied are you with the time it takes for the port to assign you a berth?

- How satisfied are you with the time it takes to evacuate your cargo from port?
- How satisfied are you with the time it takes for your cargo to reach to yard once it enters the port are?

Thank you very much for participating in the survey!

Please provide any other feedback that you may have for the port –

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PROFILE OF THE AUTHOR

Shri A. Janardhana Rao obtained Master's Degree in Commerce and Law Degree from Andhra University. After completing F.I.C.W.A, he did his MBA from International Management Institute of India, New Delhi. He also did his Intermediate in Company Secretaryship and later he did Diploma in Labour Laws with Administrative Law from Annamalai University, Chennai. Currently, he is pursuing PhD in Ports & Shipping from the University of Petroleum and Energy Studies, Dehradun.

Shri Rao has a rich experience working in various capacities in MMTC Ltd. and Bharat Earth Movers Ltd. Presently, he is holding the post of Managing Director, Indian Ports Association, an apex body formed by the Major Ports of India since August 2008. At the age of 30 years, he became the youngest Head of Department of a Major Port. He served as Financial Adviser & Chief Accounts Officer of Kandla Port Trust for seven years, He was elevated and posted as Dy. Chairman of Cochin Port Trust where he served the Port for five years, and finally at the age of 42 years, he became the Chairman of Kandla Port Trust. He visited Ports far and wide in the world namely Europe, U.S., Singapore, South Africa, Iran & Euro-Asia. He was either Chairman or a member of several Committees of national importance. Major projects of port development were formulated and executed under his expertise and guidance in different Ports.

Illustratively, ICTT, LNG Project, SBM in Cochin, Bulk Terminals, Container Terminals, Satellite Port Tuna-Tekra in Kandla, PCS, ERP, Container Scanners for Major Ports in IPA apart from many Port infrastructure projects have been executed by him.

He also served as an Adviser (Sagarmala) for the Sagarmala Division of Ministry of Shipping during December 2015 to September 2016.

He is closely involved in policy decision making process in the maritime sector in the country. He is also instrumental in bringing out a vision document for Indian Port Sector viz. Maritime Agenda-2010 by the Ministry of Shipping. He is associated with various working groups on Ports & Shipping for the National Transport Development Policy Committee in formulating long term policy for transport sector of the country as a whole. He is involved in the conceptualizing, launching and in the implementation of a National Maritime Programme viz. “Sagarmala – a Coastal & Port led Development of India”.

He is instrumental in all path breaking initiatives being taken by Ministry of Shipping, GOI. He is an expert in all Port matters. With his vast, rich and varied experience, he attained respectable stature in Indian Ports Sector. He is Chief Editor of port sector magazine ‘Indian Ports’ and also a member of Editorial Advisory Board of ‘Maritime Gateway’ magazine.

Although he started as a Finance executive, he gained insights in all other disciplines of management especially in Port Management, having served more than 26 years in Ports. He excelled in every post that he worked. He is solely a task and result oriented person and always delivers results related to any field.

He believes in decision making on time after evaluating the pros and cons and alternatives in any given situation. With his problem solving approach, he never fails in undertaking any complex issues. He has always excelled in executing all projects on time with precision. His vision is to build an ideal Port Sector in the county with international standards.

Research Paper Publication

"A Systematic Review of Literature on Bench-marking with an Aim to Probe Scope of the Applicability at Major Seaports of India” published in SCMS journal of Indian Management.

"GST in India - Impact on India's Growth and International Trade" published in FINANCIA - A Cross Functional International Journal of Finance UPES ISSN- 2456-9763

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