A Study on Vizhinjam International Seaport
Emerging Transshipment Hub of Indian Sub-Continent

Submitted to the School of Maritime Management, Indian Maritime University in partial fulfilment for the requirements for the award of degree in

MBA-Port and Shipping Management

Submitted

By

UMA.B
Reg. No.2003304033

Under the supervision of

Dr. B. SWAMINATHAN
Associate Professor & Head, School of Maritime Management

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)
SCHOOL OF MARITIME MANAGEMENT
CHENNAI CAMPUS
2022

DECLARATION

I, **UMA.B (Reg. No. 2003304033),** student of School of Maritime Management, Indian Maritime University –Chennai Campus, hereby declare that this project report titled **Vizhinjam International Seaport Emerging Transshipment Hub of Indian Sub-Continent** submitted in partial fulfilment of the requirement for the degree of Master of Business Administration in Port and Shipping Management is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any Degree/Diploma of any University/Institution. The information submitted is true and original to the best of my knowledge.

UMA.B

(Reg. No. 2003304032)
Place: Chennai
Date: 25th May 2022

CERTIFICATE

SCHOOL OF MARITIME MANAGEMENT

INDIAN MARITIME UNIVERSITY, CHENNAI.

This is to certify that the project report entitled **"A Study on Vizhinjam International Seaport Emerging Transshipment Hub of Indian Sub-Continent"** submitted to the School of Maritime Management, Indian Maritime University, Chennai Campus., in partial fulfilment for the award of the degree of Master of Business Administration in Port & Shipping Management/ International Transportation and Logistics Management, is a record of work carried out entirely by **UMA.B,** Reg. No. **2003304033.**

Dr. B. Swaminathan
Project Guide
School Maritime Management
Indian Maritime University
Chennai campus

External Examiner:
Place: Chennai
Date: 25th May 2022

ACKNOWLEDGEMENTS

This endeavour would have been incomplete without proper assistance and guidance; hence I would like to thank and express my gratitude to all those people who have helped me in the completion of this project directly or indirectly.

I wish to thank my research guide **Dr. B. Swaminathan**, **Associate Professor, Head School of Maritime Management, India Maritime University,** for having suggested the area of research in the field of port operations and management. I am deeply indebted to him for his patient guidance and encouragement throughout my research work. His motivation and inspiration and above all for his confidence on my ability made me to achieve what is done so far.

I wish to thank the Head of Department Indian Maritime University, Chennai Campus and all Professors of Department of SMM, for having extended all the facilities for the successful completion of my research and project work.

Finally, I thank all the non-teaching staff and fellows of the university my cordial regards to the employees of the organization for their kind cooperation throughout the period.

EXECUTIVE SUMMARY

Title of Dissertation: **An Analysis of Vizhinjam International Seaport Emerging Transshipment Hub of Indian Sub-Continent.**

Degree: **Master of Business Administration, Port and Shipping Management.**

Vizhinjam International Seaport is a multi-purpose deep- ocean harborage design proposed by the Government of Kerala. About 60% of the Indian key transshipment loadings are handled from anchorages outside the Indian key by TEU force vessels. Colombo is the largest transshipment mecca for the ISC region and handles roughly 35% of the total ISC.4 % transshipment business handled by anchorages other than Colombo in the ISC region and the remaining.61 of ISC business is handled by harborage capitals outside of ISC. like Jebel Ali in Dubai, Salalah in Oman and Singapore. With the lack of deep draft anchorages and the weight handled in transshipment anchorages outside the ISC region, the cost of importing and exporting from India is fairly advanced than in other advanced nations.

Vizhinjam has a natural depth of18.4 m, which is original to world- class transnational anchorages located 1020 navigational country miles from the East-West International Sea Route. Vizhinjam Port has the implicit to capture transshipment weight from Colombo and out of ISC regions similar as Jebel Ali, Salalah and Singapore with the advantages of handling the largest vessel vessels (up to TEUs) and to attract in the vessels of the main line to directly call rather the transshipment from outside the country.

This project will concentrate on market analysis and port development needs for the Vizhinjam project, which is expected to be an emergent transshipment port in the Indian Peninsula.

LIST OF ABREVIATIONS

AMR	South American
ANZ	Australia & New Zealand
AP	Andhra Pradesh
APMT	A P Moller Terminals
BOOT	Build Own Operate Transfer
BOT	Build Operate Transfer
CAGR	Compounded Annual Growth Rate
CBM	Cubic Meter
CFR	Cost and Freight
CFS	Container Freight Station
CONCOR	Container Corporation of India
DFC	Dedicated Freight Corridor
DPW	Dubai Ports World
DWT	Dead Weight Tonnage
EAF	Eastern Africa
EIA	Environment Impact Assessment
EUR	Europe
FC	Financial Closure
FCL	Full Container Load
FEA	Far East Asia
FFE	Forty Foot Equivalent Unit
FOB	Free on Board
FY	Financial Year
GDP	Gross Domestic Product
GM	Greater Mumbai
GOI	Government of India
GoK	Government of Kerala
GRT	Gross Registered Tonnage
GSDP	Gross Domestic Product
ICD	Inland Container Depot
IGF	Intra Gulf
INR	Indian Rupee
INSA	Indian National Ship owner’s Association
IPA	Indian Ports Association
ISC	Indian Subcontinent
JNPCT	Jawaharlal Nehru Port Container Terminal
SEZ	Special Economic Zone

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

1.1 Background and Significance of the Study

The natural depth of Vizhinjam Port is greater than any other competing Indian port and roughly equal to world-class international ports. The current trend of larger container ships such as Maersk's 18,000 TEU Triple E class vessels which none of the existing Indian ports can service can be called directly to Vizhinjam Port due to its natural depth of 18.4 Mr. With the realization of Vizhinjam Port, India's ability to handle gateway and transshipment cargo can be enhanced and a strong supply chain network can be established.

India has a 5423 km long peninsular coastline which connects the main sea routes of East Asia, Europe and the Middle East. There are 12 major ports and 187 minor ports in India. As India's economy grows, it becomes inevitable that the development of ports for international trade will increase. India's GDP is expected to grow by 6.6% in the projected period of FY 2014-2044 and during this period India's gateway traffic is expected to grow by 7.5% from 7.3 million TEUs in FY2009 to 91 million TEUs in FY44 Maharashtra and Gujarat ports will continue to dominate container traffic with around 60% of traffic in FY44 FY2044.

The share of traffic on the Lower West Coast is expected to increase from 25% to 32% in FY2044. The west coast of India is the largest contributor with 50% of container traffic, with 2.5% of total gateway traffic being the Indian regional subcontinent, 66% of gateway traffic served by feeder. Therefore, the cost of importing and exporting from India is relatively higher than other developed countries.

1.2 Objectives of Study

- The objective of this research relates to transshipment hubs in India and to determine whether there is room for the development of a hub or a competitive container transshipment hub in India and their positioning and connectivity.
- It aims to find the potential of India's 12 major ports to increase its productivity by focusing on transshipment.
- This study also aims to determine whether these transshipment hubs have the potential to capture transshipment volumes shipped from Colombo and other nearby hubs and reduce reliance on these countries to ship goods internationally.

1.3 Methodology

- Data from primary sources such as journals and thesis research and secondary sources such as reports and articles from Indian Shipping Ministry, Port Association and other sources is analyzed.
- Data from various sources understand which area has strengths and weaknesses and what the result can convey about converting the port to a regional trans-shipment hub.
- SWOT analysis of potential transshipment hubs is conducted with relevance to the vital criteria of transshipment hub.

Figure 1.1 Vizhinjam Port Location with respect to International East-West Shipping Rout

1.4 Structure of the Report

CHAPTER I- Discuss about the importance of container shipping and transshipment hub to an economy, the geographical advantage of the port and role of government in this project.

CHAPTER II- Is an in-depth examination of the literature on how economic growth and the marine industry are intertwined, and how an increase in global logistics and performance measures might attract liner activity, particularly in India.

CHAPTER III- Deals with the Development of the Project and the Master Plan.

CHAPTER IV – A study about Phase-1 Vizhinjam Port Development.

CHAPTER V – In depth Analysis of Market Study and Present Container Traffic Multiple case studies and SWOT analyses of ports in western and eastern India. This chapter examines the eight ports' strengths, weaknesses in light of the six criteria identified in the literature review matrix, and it finishes by identifying possible transshipment hubs in the East and West regions.

CHAPTER VI – Summary of Conclusion

CHAPTER II

REVIEW OF LITERATURE

2.1 PORT COMPETITIONS

In India, the Kerala state government took the lead in constructing the greenfield harborage design by holding two flings, the first of which failed to acquire security concurrence from the Indian government and the second of which repudiated the award letter due to a disagreement brought by another endeavor.

Drewry Consultancy, UK, was commissioned to carry out market research for the proposed port project. Since the market study was carried out in the period 2008-2009, it was also reflected in the traffic forecasts of Vizhinjam Port. According to market research, Drewry indicated that Vizhinjam will only find its potential by attracting transshipment companies due to the small immediate hinterland.

Royal Haskoning carried out the technical advice and reviewed the project in a multi-purpose port Perfect Relationships , Allen and Overy and Trilegal they have supported IFC. The environmental and social impact assessment of the proposed project was carried out by the consultancy Royal Haskoning for the port and the consultancy LandT Rambol carried out by the social impact assessment for roads, railways and other associated facilities.

2.2 ONE BELT, ONE ROAD

The market research was undertaken by the consulting firm Drewry, and the report was delivered to the international financing corporation in November 2010. It comprised an analysis of container traffic, an analysis of bulk and non-bulk traffic, tariff and revenue estimates, and a port strategy.

In November 2012, the consulting firm AECOM in India conducted a comparative review of container transshipment ports. The annual productivity, total length of quays, average length of quays per quay, annual productivity per quay crane, and annual productivity per gross acre of competing international ports were compared to the three-tier development model.

A detailed report on the condition of the site, general planning process, functional requirements, port master plan, final port master plan, land use plan and capital expenditures and development programs implementation were prepared by the consulting firm AECOM, India. Indian economy's dependence on maritime transport is relatively low according to IMF and WTO data. (Pro.Ma shuo2004).

The many factors influencing port development, such as water depth, competition from other ports, changes in local and international business models, port ownership, political pressure, and so on, are discussed in Professor Jeffry Blum's article, Port Infrastructure and Maritime Efficiency, and are relevant in the case of Vizhinjam Port.

2.3 PORT INTEGRATION

Indian Maritime Landscape A Background note, an article published in February 2008 by KPMG (one of the world's largest professional services firms and one of the big four auditors, along with Deloitte, Ernst and Young, and PricewaterhouseCoopers) details on the Indian maritime landscape sector, primarily focused on port development.

The Indian government has taken several policy initiatives to improve the Indian port sector. With a depth of 12 meters, the channel will allow vessels up to 10 meters draft a shorter passage, saving up to 424 nautical miles and a navigation time of up to 29.9 hours and will also avoid the circumnavigation of ships through Sri Lanka, which will result in savings on fuel costs and fixed expenses associated with extras for iodine trips. Vizhinjam Port will be the biggest beneficiary of the project with the potential to become a transshipment hub.

CHAPTER III

PROJECT DEVELOPMENT PLAN OF VIZHINJAM PORT

3.1 Overview of the project

Consultants conducted thorough Techno-Economic Studies for the development of Vizhinjam Port, which were provided in a variety of publications. This Chapter examines the Project Development Plan for Vizhinjam Port as a transshipment center in detail under the following headings:

- Salient features of Vizhinjam Port
- Port traffic
- Development needs and planning considerations
- Master Plan of Vizhinjam Port

3.2 Salient Features of Vizhinjam Port

Within one nautical mile of the shore, the location at Vizhinjam has a natural water depth of roughly 24 m and is also close to the international sea route. Vizhinjam is a good location for the establishment of an all-weather deep-water port due to these two major criteria. Additional benefits include, among other things, less littoral transit along the coast, which effectively relieves the port of maintenance dredging, unlike in most other Indian port locations.

The proposed Vizhinjam Port's proximity to the international shipping route would attract a fair share of the container transshipment traffic destined for India and beyond, which is currently handled by foreign ports in Salalah, Oman, Al Fujairah, UAE, Dubai, Colombo, Singapore, and West Port, Malaysia. As a result of the current situation, Indian exporters and forwarders incur significant foreign exchange outflows, in addition to added time, hazards, and expenses for transshipment at these foreign ports. The establishment of a container hub at the proposed location might thereby avoid significant foreign cash outflows while also increasing the worldwide competitiveness of Indian exports, particularly those from Kerala, due to transshipment through Vizhinjam Port.

3.3 Port Traffic

The port traffic proposed for the development of Vizhinjam Port is summarized in the following tables

Table 3.1 Container Traffic to Vizhinjam port (in Million TEU)

Year	Pessimistic	Moderate	Optimistic
Movement by Road / Rail			
2007	0.04	0.06	0.07
2012	0.09	0.15	0.16
2017	0.15	0.25	0.31
2022	0.22	0.37	0.47
2027	0.32	0.46	0.60
2032	0.38	0.56	0.74
2033	0.39	0.58	0.77
Movement by Feeder Vessels			
Year	**Pessimistic**	**Moderate**	**Optimistic**
2007	0.30	0.43	0.46
2012	0.62	1.05	1.14
2017	1.03	1.72	2.18
2022	1.56	2.56	3.31
2027	2.23	3.21	4.21
2032	2.66	3.89	5.21
2033	2.74	4.03	5.40

Table 3.2 : Hinterland Traffic

Year	Hinterland Traffic	
	General Cargo In million tones	Container Cargo in million TEUs
2007	0.45	0.01
2012	0.60	0.02
2017	0.97	0.02
2022	1.41	0.03
2027	1.87	0.04
2032	2.40	0.05
2033	2.48	0.06

3.4 Development Needs and Planning Considerations

The first stage in evaluating the conceptual layout designs for a greenfield port is to examine the facility needs in terms of berths, needed cargo handling facilities, navigational and operational factors, and so on. The next stage is to identify acceptable places within the specified region for the development of these amenities.

Water depths and widths in the approach channel, harbor basin, and at berths; quiet conditions inside the harbor; suitable stopping distance for boats of the biggest size entering the port; sufficient water area for easy manoeuvring of vessels and crafts throughout the year; and effective fenders and mooring systems are also envisaged.

3.4.1 Navigational and Operational Requirements

As a prerequisite for designing the layout of a port with the necessary facilities, it is necessary to establish the fundamental requirements for the design of the various components such as navigational and operational elements to handle different types of vessels anticipated to call at the port and for loading / unloading activities. These criteria are connected to the maritime environmental conditions at the terminals' location. They include the following features:

- Vessel type and dimension
- Protection against prevailing waves and winds
- Minimum vessel speed and stopping distance.

These criteria lead to:

- Navigational channel dimensions
- Manoeuvring area dimensions
- Berthing area dimensions
- Minimum vessel speed.

3.4.1.1 Vessel Size

A detailed Vessel Size Analysis was performed to determine the most appropriate vessel sizes, which is critical in the development of the Vizhinjam Port. The main dimensions of the design boats for various cargo kinds for Vizhinjam Port are summarized in following table.

Table 3.3 Vessel Size and Dimensions

Container Vessel (TEU)		**LOA (m)**	**Beam (m)**	**Draft (m)**
Main Line Vessels				
Short-Term	8,000	325	46	14.5
Medium-Term	10,000	345	50	15.0
Long-Term	12,000	365	60	17.0
Feeder Vessels				
Short-Term	1,000	160.0	25.0	9.0
Medium-Term	1,500	175.0	27.0	10.5
Long-Term	2,000	188.0	30.0	10.5
General Cargo Vessels (DWT)				
Short-Term	20,000	160	24.8	10.0
Medium-Term	40,000	209	30.0	12.5
Long-Term	40,000	209	30.0	12.5

3.4.1.2 Protection against Waves

To provide peace and quiet in the harbor basin and at the berths, as well as smooth loading and unloading operations, sufficient protection in the form of breakwaters against prominent wave orientations may be required. The following criteria will control the alignment and length of breakwaters:

- Predominant wave direction
- Water area requirement
- Number of berths requiring protection
- Stopping distance for the vessel.

3.4.1.3 Stopping Distance

The length of the protected approach channel up to the turning circle should be sufficient to provide all vessels with a safe stopping distance. It should be three to five times longer than the biggest vessel using the port.

3.4.1.4 Navigation Channel Dimension

The channel alignment has to be oriented considering the following aspects:

- The channel be oriented so as to avoid cross winds and currents.
- The channel be aligned in a straight line as far as possible.
- The channel be oriented so as to reach the deep-water contours in shortest possibledistance (this is to optimize the quantity of dredging).

The dimensions of the navigation channel to the terminal are determined by the vessel size, vessel behavior when sailing through the channel, environmental and marine variables (winds, currents, and waves), and channel bottom conditions. The primary goal of channel design is to determine the safe channel width and depth for the dimensions of the design vessel.

For channel design, a variety of American, British, and International Standards are available. Permanent International Association of Navigation Congress (PIANC), International Association of Ports (IAPH): Approach Channels – 'A Guide for Design,' Final Report of the Joint Working Group, June 1997.

3.4.1.5 Channel Width

The minimum width of a straight channel depends on the vessel's size and manoeuvrability, the kind of channel bank, the influence of other boats in the channel, and the effects of wind and currents. The needed width is divided into three zones: manoeuvre lane, ship clearance lane, and bank clearance. Additional channel widths must be allocated for concerns such as vessel speed, cross winds, cross currents, longitudinal current, substantial wave height and wave length, aids to navigation, type of sea bottom, depth of waterway, cargo hazard level, and traffic density.

The width of the channel is usually established by multiplying the beam of the greatest design vessel that enters the port by a factor of two. The needed width of the channel (two-way traffic) is calculated using all of these factors, with particular regard to the environmental conditions at the proposed site:

Basic manoeuvring lane	:	3.3 B
Wind effects	:	0.5 B
Cross currents (moderate: 0.5 to 1.5 kn)	:	0.8 B
Wave action	:	0.0 B
Aids to Navigation System	:	0.2 B
Bank Clearance (both sides sloping)	:	1.0 B
Bottom Surface	:	0.2 B
Depth of waterway	:	0.4 B
Cargo hazard level	:	0.6 B
Total		**7.0 B**

The proposed design vessel has a beam of 46 meters in the short term, 50 meters in the medium period, and 60 meters in the long term. As a result, a 320 m wide canal is suggested for Vizhinjam Port in the short term, 350 m in the medium term, and 420 m in the long term.

3.4.1.6 Channel Depth

To guarantee safe navigation, the channel depth should be significantly larger than the static draughts of the vessels using the river. In general, the channel depth is defined by:

- Vessel’s loaded draught;
- Trim or tilt due to the loading within the holds;
- Ship’s motion due to waves, such as pitch, roll and heave;
- Character of the sea bottom, such as soft or hard;
- Wind influence of water level and tidal variations; and
- Sinkage of the vessel due to squat or bottom suction.

Taking the aforementioned considerations into account, the under keel clearance is calculated to be 15% of the draught of the design vessel in the channel in sheltered places and 20% in unsheltered parts.

The depths necessary in the navigation channel at Vizhinjam Port are calculated and provided below based on the foregoing considerations.

		Outer Channel	Inner Channel
• Short-Term	:	17.4 m	16.7 m
• Medium-Term	:	18.0 m	17.3 m
• Long-Term	:	20.4 m	19.6 m

3.4.2 Berthing Requirements

Berth needs have been determined step by stage, taking into account throughput, package size, and cargo handling. The number of berths needed for various commodities is summarized in following table 3.4

Table 3.4: Requirement of Number of Berths / Berth Length

S. No.	Description	Short Term (2007 – 2012)	Medium Term (2012 – 2017)	Long Term (2017 – 2032)
Container Cargo				
1	Number of mainline berths	2	3	4
2	Number of feeder berths	3	5	7
3	Berth length required for main line vessels	720 @360 m/berth	1140 @380 m/berth	1600 @400 m/berth
4	Berth length required for feeder vessels + general cargo	700 @175 m/berth	950 @190 m/berth	1470 @210 m/berth
5	Berth length required	1245	1900	2860
6	Berth length provided*	1420	2090	3070

3.4.3 Cargo Handling Equipment

To meet traffic demand, the installation of mechanical cargo handling equipment on ship docks and in storage / stackyard areas for unloading / loading has been planned. In is offered a summary statement outlining the equipment intended for installation at various phases of development is shown in following table.

Table 3.5: Summary of Container Cargo Handling Equipment

S. No.	Cargo	Equipment Type	Rated Capacity	Nos. (Incremental)		
				2007 – 12	2012 – 17	2017 – 32
1	Containers	**Berth Equipment**				
		Quay Cranes				
		Post Panamax type	50 t	6	3	7
		Panamax type	40 t	6	7	6
		Stackyard Equipment				
		RTGs	40 – 50 t	30	20	55
		Toplift Trucks	20 t	10	8	10
		Reach Stackers	50 t	3	2	5
		Tractors	-	55	40	60
		Trailers	50 t	55	40	60

(Note: The number of equipment shown under medium and long term is additional.)

3.4.4 Storage Requirements

The storage yard serves as a barrier between the ship unloading and cargo evacuation systems. The storage room must be designed such that the maximum quantity of stuff may be stored in the smallest amount of space. The needed area is determined by various factors and varies from cargo to cargo. It is often determined by factors such as ship package size, ship arrival distribution, hinterland transport dispersion, and ship loading and unloading rates. In general, the pace of unloading is greater than the rate of evacuation. If the ship's storage capacity is insufficient, it will wait to offload the cargo.

The UNCTAD port development manual provides guidelines for calculating storage area dimensions based on yearly throughput and average parcel size. These rules limit the likelihood of ship interruptions due to a lack of stack yard availability to less than 1%.

Based on the foregoing, storage area needs have been calculated and provided in the table below.

Table 3.6: Storage Area Requirements for Container Cargo (Cumulative)

Description	Short Term (207-2012)	Medium Term (2012-2017)	Long Term (2017-2032)
Container Parking Yard			
Throughput ('000TEU)	620	1020	2250
Area (ha)	15	22	50
Container Freight station			
Storage Demand ('000TEU)	35	55	120
Area (ha)	2.1	3.4	7.5

Table 3.7: Storage Requirement for General Cargo (Cumulative)

Items		Short Term (2007-2012)	Medium Term(2012-2017)	Long Term (2017-2032)
Throughput ('000t)		624	972	2379
Storage Demand (T)	Open	6000	9000	22000
	Covered	6000	9000	22000

3.5 Master Plan of Vizhinjam Port

A port development plan must have a Master Plan outlining the development idea as well as a prospective plan outlining the overall developmental options to fulfil the final objectives. Functionally, the port must offer facilities for receiving / dispatching and effectively handling the anticipated cargo from / to the vessels (of various sizes) that will call at the port in the future. A Master Plan is typically designed for a time horizon of 15-20 years since any estimate of cargo throughput (and the corresponding development requirements, in terms of port operating demands) beyond this period may be inaccurate.

3.5.1. Harbor Layout Consideration

The following characteristics were taken into account when designing the harbor layouts:

- Bathymetry
- Wave incidence
- Required Tranquillity in harbour areas
- Littoral Drift Management
- Expansion in stages
- Environmental Impact.

A. Bathymetry and Sub-Sea Soil Conditions

Recent bathymetry measurements show that 10 m, 15 m, and 20 m contours occur at 350 m, 900 m, and 1200 m from the beach, respectively, towards the southern edge of the present fishing port. The findings of the shallow seismic survey and geotechnical studies demonstrate the existence of rock at various depths in the planned port construction region. In two or three spots, there are exposed rock areas. These factors influenced harbor layout, breakwater lengths, and their alignment with optimization concepts for breakwater construction and dredging needs. The layout was created by avoiding rock dredging as much as possible.

B) Wave Incidence and Tranquility

Near-shore wave simulations (model studies) revealed that the seas at Vizhinjam are exposed to waves from the west during the SW monsoon and from the SSW and S during the NE monsoon. Five months of the year, the primary waves come from the west and north-west, while the remaining seven months are from the south. As a result, the development harbor will include a north breakwater reaching up to 22 m depth contour for protection against waves from the S and SW, and a south breakwater extending up to 15 m depth contour for protection against waves from the SE. This breakwater protection will provide the needed peace and quiet at the berths and vessel manoeuvring area.

C) Littoral Drift Management

The net littoral drift on India's West Coast is not as severe as it is on the East Coast. The net long shore sediment movement is insignificant when pre-monsoon, monsoon, and post-monsoon seasons are included. During the monsoon season, however, there is a net drift of around 0.06 million m3 each year to the south. There will be no silt problem along the north breakwater due to the shift in sediment flow direction and the headland north of the Vizhinjam Fishery Harbor.

During the non-monsoon season, sediment deposition may occur along the south breakwater, while erosion may occur during the monsoon season. For the project, the exact sediment flow along the south breakwater will be thoroughly researched. There will be no silt in the canal because it is positioned at a contour of 17 to 20 m.

D) Environmental Aspects:

The harbor and port layout has been built in such a way that environmental management of various sorts and degrees of impact become location specific and hence cost feasible to supply. While planning the layout, social elements such as fishing, etc. are taken into account. The major cargo to the port is container transshipment, with some general cargo, which is separated, placed in another section.

3.5.2. Port Layout

Based on the present site circumstances at Vizhinjam, and in the absence of any naturally protected and suitably big water area nearby, the following two possibilities for port development are considered:

- By dredging onshore by creating a lagoon type harbour connected to sea through an entrance channel protected by short breakwaters on either side of it;
- By creating an outer harbour offshore protected by long breakwaters.

The length of the breakwaters would be short in the first option, but the amount of dredging would be substantial. The second alternative would need less dredging, but the breakwaters would be longer and would have to be erected in deep sea.

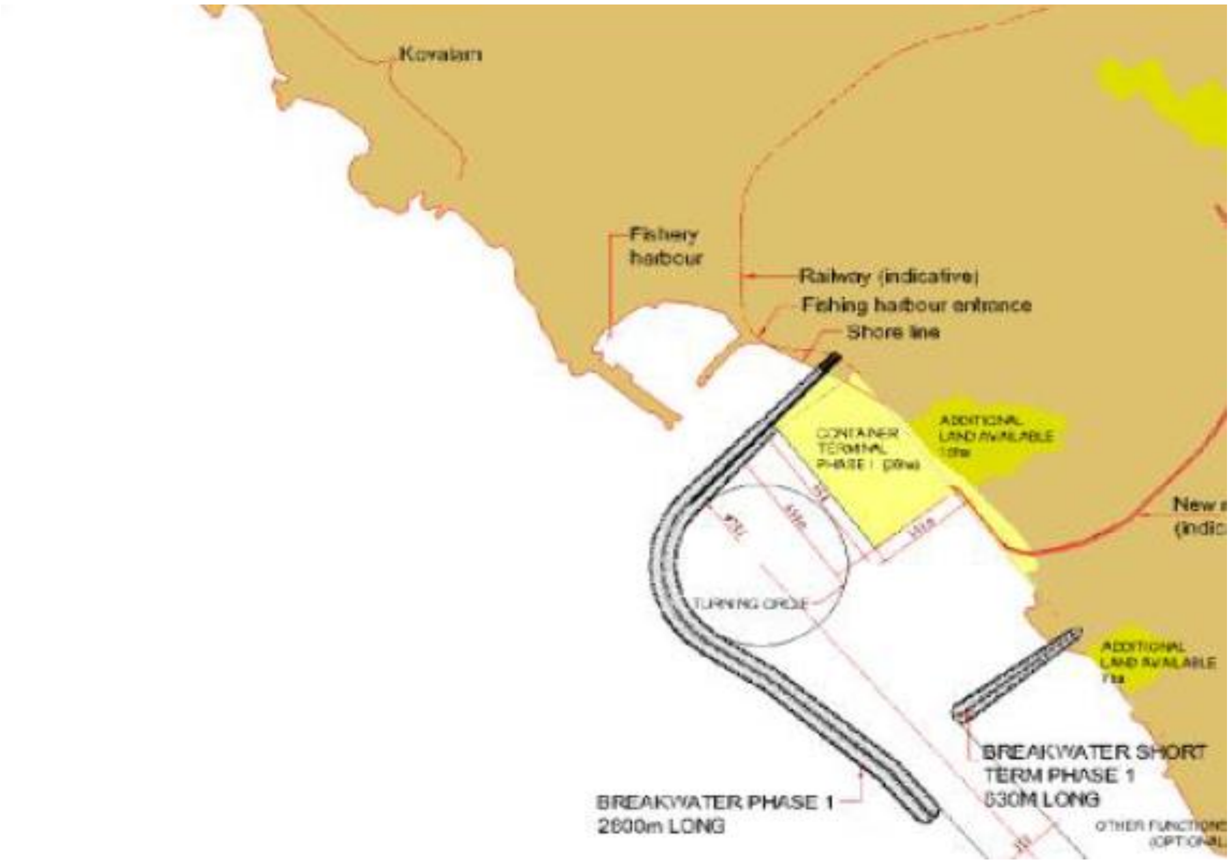


Figure 3.1 Port Concept Layout for Phase-1 Development

[Source: RH Project Preliminary Plan Report, 2010]

The decision between a lagoon type port and an offshore harbor would be based, among other things, on the optimization of dredging costs relative to breakwater building and the availability of land onshore to form the lagoon. It should be emphasized that in the case of Vizhinjam, there is no land accessible along the beach due to the existence of steep laterite cliffs along the coast and Deepwater close to the shoreline.

Based on the current site circumstances at Vizhinjam (namely, the absence of backup land behind the shoreline) and other planning factors, the second option is determined to be the only viable option for the building of Vizhinjam Port.

The following table summarizes the maritime layout for Phase 1 development:

Fig 3.2 Summary of Phase-1 Marine Layout

S. No	Description	Unit	Value
1.	**Maximum Ship Size**		
	– Container Vessels	TEU	18,000
2.	**Breakwaters**		
	– Length of North Breakwater	m	3,040
	– Breakwater for fishery harbour extension	m	140
3.	**Number of Berths (Total length of berths in meters)**		
	– Container Berths	No.(m)	2 (800)
	– Cruise cum multipurpose cargo berth	No.(m)	1 (300)
	– Port Craft Berths	No.(m)	1 (100)
	– Coast Guard Berths	No.(m)	1 (120)
	– Navy Berth	m	500
	– Fishery Berths	m	500
4.	**Navigational Areas**		
	– Length of Outer Approach Channel	m	2,800
	– Width of Outer Approach Channel	m	400

S. No	Description	Unit	Value
	– Length of Inner Approach Channel (m)	m	1,200
	– Width of Inner Approach Channel (m)	m	300
	– Diameter of Turning Circle (m)	m	700

[Source: RH Project Preliminary Plan Report, 2010]

CHAPTER IV

Phase 1 Vizhinjam Port Development

4.1 Breakwater

There is a limiting wave condition at the berths for carrying out cargo handling activities to guarantee that there are no excessive movements of the ships that may impede the loading/unloading operations. This limit varies depending on the kind of cargo and the handling system. As a result, the breakwater structure and overall port plan should offer appropriate calm at the berths, allowing cargo handling to continue even when the offshore wave environment exceeds the limit for ships moving in and out of the harbor. The maximum permitted wave conditions for cargo handling activities at the berth are determined by ship size, cargo type and technique, and wave assault direction. Beam waves force the vessel to roll and have a greater impact on cargo handling operations than head waves.

The following table summarizes the limiting wave heights (Hs) for various wave orientations for cargo handling activities. These figures are based on IAPH3 recommendations and relate to the worst wave periods in each direction.

Fig 4.1 Type of ships and limiting wave height

S. No	Type of ship	Limiting wave height (H_s)	
		Head or stern (0°) (m)	Quadrant (45°- 90°) (m)
1.	Container Vessels	0.5	0.3
2.	Multipurpose Vessels	1.0	0.8

[Source: RH Project Preliminary Plan Report, 2010]

The Phase-1 breakwater alignment was designed to optimize operational duration by successfully blocking all of the larger South-West monsoon waves and giving enough protection from rest of the year waves.

4.2 Dredged Depth at Port

Approach channel depth is a critical characteristic in approach channel design. The bathymetry and natural depth of the Vizhinjam port site are quite good. The water depth in the canal section is approximately 15 to 18m below CD. This will reduce the original capital dredging cost.

The depth of the channel is controlled by the vessel's laden draught; trim or tilt owing to loads within the holds; ship motion due to waves, such as pitch, roll, and heave; soft or hard sea-bottom nature; wind; effect of water level and tidal changes; and the rise in draught of the vessel due to squat or bottom suction.

The dredging depths at the port entry channel and manoeuvring zones will be determined by the design ship's fully laden draught. The following dredging depths (after rounding off) are offered at various portions of the harbor for the design ships based on PIANC rules.

Fig 4.2 Dredging depth and Manoeuvring

Ship Size	Approach Channel outside Breakwater (Loaded draft+30%)	Inner channel and Maneuvering area (Loaded draft+15%)	Depth at Container berths (Loaded draft + 15%)
18,000 TEU (16.0m draft)	20.8	18.4	18.4

[Source: RH Project Preliminary Plan Report, 2010]

Thus, the unsheltered outer approach channel will have a minimum dredging depth of 20.8m CD, but the inner approach channel area, turning circle, and harbor basin will have a water depth of 18.4m CD. The berthing pockets will be dredged to a depth of 18.4m CD. These dredge depths can also accommodate the 18,000 TEU ships. The vessel navigation research proved the appropriateness of the depths offered at various nautical regions.

4.3 Container Berths

The Phase-1 development has two 400-meter container berths for a total continuous berth length of 800 meters, which can handle two 12,500 TEU cargo boats. The berths have been planned to accommodate the expected traffic. These docks will be intended to accommodate 18,000 TEU boats. These berths have a dredged depth of -18.4m CD.

Four quay container cranes will be installed at each berth.

Figure 4.3 below summarizes the primary container terminal features of Phase 1. The crane rail (35m rail gauge), circulation lanes, and hatch cover lay-down space are all proposed for the Quay apron area. The apron area is expected to be 70m wide. However, the crane rail gauge is maintained open, giving the contractor choice in selecting the sort of quay cranes that best fit his needs.

Fig 4.3 Phase-1 Container Terminal Elements

Development Phase	Phase-1
Total Berths	2
Berth Length (m)	800
Berth Capacity (TEUs)	900,000

[Source: RH Project Preliminary Plan Report, 2010]

4.4 Fishery Berths

The Phase-1 expansion includes more fisheries berths for the local fishing population. The planned port north breakwater has a total berth length of roughly 500m along the protected seaward side. A 140m long breakwater offers the necessary peace and quiet for the fishing vessels. Access to the fisheries berths will be given from outside the port, and the planned additional port activities will not interfere with fishery berth access. At the base of the proposed north breakwater, adequate landside amenities such as an auction hall are also envisaged.

4.5 Cruise cum Multi-purpose Cargo Berth

It is intended to offer one 300m berth for cruise and multifunctional cargo handling operations. The berth is envisioned on the northern breakwater's leeside. It is planned that the pre-processing of passengers, resort, retail areas, and car parking be situated outside of the main port in the cruise terminal area. Passengers will be taken from that location to the cruise berth, where final processing, embarkation, and de-embarkation will occur. The DPR solely accounts for berth construction and no additional facilities other than space allocations. These amenities can vary greatly depending on the cruise operator chosen and their business model, and hence have not been approximated.

According to Drewry projections for Phase-1 construction, the multi-purpose cargo envisaged at the proposed port is roughly 100,000 Tons split over three product kinds (break-bulk). No specialized berths are planned due to the port's predicted low volume of multi-purpose cargo. These breakbulk boats are expected to berth along a segment of the cruise berth and use vessel-owned equipment for loading/unloading operations at the berth. These supplies will be stored in the area behind the Coast Guard Navy facility. Because of the close vicinity of this storage location, transportation by road will be as convenient as possible.

4.6 Port Craft Berths

Port boats such as tugs will have access to 100m of berth length. For Phase-1 needs, the 100m berth will be able to handle port vessels. Additional port craft berths would be necessary over the master plan horizon, for which the cruise berth might be used occasionally. Alternatively, a pontoon berthing solution might be operated on an as-needed basis. The placement of these port craft berths was carefully chosen to give a sheltered site while also being at an optimal distance from all berthing places and having a provision for a pilot office space close to the berths.

4.7 Coast Guard & Navy Berth

Phase-1 will have a dedicated 120m coast guard berth. The navy has a total berth length of 500m. The first 200m of the berth with ramp loading capability is supplied on the leeside of the north breakwater at the northern border of the container berth, while the other 300m berth is given west of the port on the leeside of the north breakwater to segregate the activities as required by the IN.

4.8 Container Yard

The first phase of construction includes about 40 hectares of Container Yard and accompanying infrastructure. The container yard is close to the berths, allowing for easy container movement from the yard to the apron. The container yard was designed for efficient handling operations, with separate spaces for full, empty, and reefer containers. There are additional dedicated circulation channels from the quay to the yard and throughout the yard.

In Phase 1, the container yard will be operated by Rubber Tired Gantry (RTG) Cranes, with the option of upgrading to Electric RTG's in the future. Empty containers will be handled by side pick cranes. The container yard provides versatility by allowing terminal operators to select a different container handling operation mode, such as RMG.

The number of ground slots has been specified in order to fulfil the maximum berth capacity. Equipment and Internal Transfer Vehicle (ITV) storage has been provided on the container yard's northern side. The majority of the terminal roadways will be two-way. The truck lanes beneath the RTG and beneath the quay crane will be one-way.

The movement from the quay apron to the yard will be anti-clockwise, but the movement from the yard to the gate/railyard will be clockwise. Furthermore, the yard has been designed so that transshipment cargo is kept closer to the berths than gateway freight.

In order to provide the needed storage capacity, the container yard will have a width of roughly 400m and a total of 5,710 Twenty Foot Ground Slots (TGS). Utility paths have been constructed and built into the yard to provide minimal interruption during phased construction and quick conversion of diesel RTGs to ERTGs. Reefer support operations such as Reefer Wash Down, Reefer Service, and Genset Repair Building have their own section.

4.9 Container Freight Stations (CFS) & Warehousing

CFSs that are strategically placed are an essential component of a modern container port. CFS offers consolidation and distribution services for small consignments exported or imported in LCL containers. Though CFS facilities are primarily designed to handle LCL containers, a high number of FCL containers also pass through CFS for a variety of reasons that benefit both exporters and importers.

The CFS should ideally be positioned within 5 to 15 kilometers of the port, in a location with direct access to the port. The CFS is intended to be built on the land lot being acquired at Kottukal, which is approximately 4 kilometres from the Project site and lies on each side of the NH47 bypass route. This 41.5-hectare site will be used for CFS, warehousing facilities, and housing colonies for port officials, coast guard, and naval personnel. The proposed NH 47 bypass will divide the overall land area in half. The current/planned path of the NH 47 bypass would bypass the Thiruvananthapuram capital city via the Punnakkulam warehousing region.

4.10 Truck Terminal

The planned port's truck terminal is located towards the end of the proposed road alignment and is labelled as Truck Terminal Area - 1, while the one located northwest is near the proposed rail alignment and is marked as Truck Terminal Area - 2. The truck terminal is located on 19.94 Ha of land.

The proposed truck port lies in Mukkola, on each side of the route linking Vizhinjam and Poovar, and it is also next to the proposed NH 47 bypass. The road and railway alignments both pass near to the proposed location of truck terminals. The road alignment for Vizhinjam port effectively terminates at the proposed NH 47 bypass, which is just next to the truck terminal-2 access.

4.11 Gate Entry/ Exit Complex

The entry/exit gate is designed to be a two-step gate. A pre-gate will be built on the main terminal road, including parking and services for trucks and cars. Only approved cars will be permitted to exit the pre-gate area and access the main terminal. The main terminal gate has been installed at the port's eastern end.

It will have a gate canopy with three entry and exit lanes, as well as one bypass lane and one traffic lane on either side. The bypass lane is intended for use by out-of-gauge container trucks or broken bulk vehicles. The traffic lane will be utilized by port personnel and other users. In Phase 1, gate operations will be limited to a single shift.

With just 16% of gateway container traffic, the planned port is basically a transshipment container facility. The proportion of gateway traffic arriving through road vehicles is expected to be 70%. The gate lanes have been designed to handle this volume of traffic. The gate complex has adequate queue space planned. Near the entrance complex, space has been set aside for customs and other regulatory activities. Container scanning (Radiation, for example) can be accommodated within the gate complex if necessary.

Each container gate lane will include a weigh bridge to measure and analyze truck axle weights in order to enforce axle load highway restrictions.

4.12 Rail and Road Connectivity

Rail Vikas Nigam Limited (RVNL) intends to build a coastal bridge from the north breakwater side to link to the port. Electrified railway lines (two live and one service lines for Phase-1) with container handling facilities utilizing Reach Stackers in Phase-1 development, upgradeable to RTG's or Rail Mounted Gantry's (RMG's) in future stages to accommodate traffic.

The planned port is largely a transshipment container facility, accounting for around 16% of gateway container traffic. The proportion of gateway traffic travelling by rail is considered to be 30%. The number of rail lines has been increased to suit this volume of traffic. Container stacking will take place along the service line prior to transport to the container yard. Within the railway yard, the port will provide switching and yard services.

The road entry is planned from the Mulloor end, while the main terminal access is proposed from the east along the middle of the terminal. The property for the proposed path of the 45m road corridor is owned by VISL.

CHAPTER V

MARKET STUDY AND PRESENT CONTAINER TRAFFIC ANALYSIS OF THE REGION

5.1. Kerala Economic Outlook

Kerala has a gross domestic output of $26.4 billion and is one of India's most prosperous states. The state's industrial performance accounts for a considerable portion of the nation's output. Agriculture is the principal source of income for over half of Kerala's population, and cash crops are mostly grown in Kerala.

Kerala produces a lot of coconut, rubber, pepper, cardamom, ginger, banana, cocoa, cashew, arecanut, coffee, and tea. Kerala also grows spices such as nutmeg, cinnamon, and cloves. Kerala accounts for 92% of the country's rubber production, 70% of coconut production, 60% of tapioca production, and nearly 100% of lemon grass oil production.

Kerala agriculture has the highest gross income per net planted area in the world. Kerala has a 585-kilometer coastline with one major port at Cochin and 17 minor ports. The Kerala government is promoting coastal shipping by developing ports, which would benefit the state's highly packed roadways while also saving money on transportation.

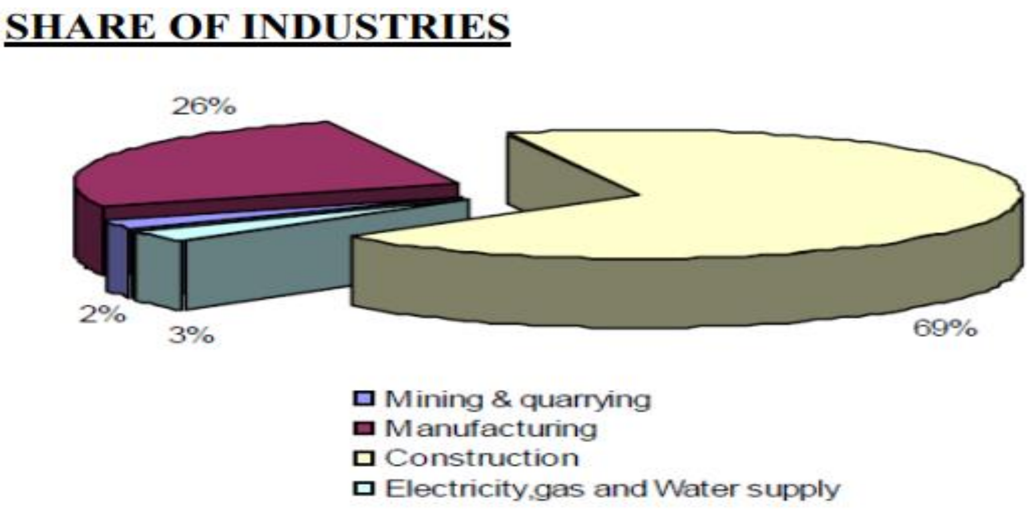
Kerala's major businesses include coir, cashew nut processing, seafood, tourism, and information technology. Sea foods, coir products, coffee, tea, cashew kernels, and spices are major export goods, whereas fertilisers and raw materials, iron, steel, and machinery, raw cashew nut, food grains, and newsprint are major import commodities.

Fig 5.1 Key Industries

District	**Industries**
Thiruvananthapuram	Handlooms
Kannur	Handlooms, Power, Bedi
Allepey	Coir products
Idukki	Agriculture and Forest Based
Thrissur	Power Looms, Handlooms, textile, Timber, tile
Palakkad	Power Looms, sericulture
Kollam	Cashew Processing units, Minerals and Mining
Kozhikode	Rubber
Wayanad	Minerals and Mining
Kottayam	Rubber, food products, engineering
Ernakulam	Information Technology

[Source: RH Project Preliminary Plan Report, 2010]

Fig 5.2 Share of Industries



Source: Ministry of Statistics and Programme Implementation-mospi.nic.in

Kerala exports cashew, coir and coir products, tea, marine goods and spice oils, pepper, and oleoresins. Kerala accounts for more than 60% of India's cashew exports. Due to a decrease in domestic raw cashew output, raw cashew is imported from African countries. Cochin is Kerala's main international commercial gateway.

5.2 Infrastructure

A. Road Network in Kerala

Kerala has a total road length of 173,592 kilometres, with a road density of 446 kilometres per 100 square kilometres. The Thiruvananthapuram district is well connected to the rest of the country via road, rail, and airport. National highway NH 47 runs roughly 8 kilometres through Thiruvananthapuram, practically parallel to the seashore. NH47 connects Salem to Kanyakumari and, through NH 47A, to Cochin Port. It is connected to Mumbai through NH 17 from Cochin to the north. The nearest major urban centres on the NH 47 are Thiruvananthapuram in the north and Nagercoil and Kanyakumari in the south. It is also connected to key towns in Kerala like as Thrissur, Palakkad, Kollam, and Alappuzha, as well as Tamil Nadu's Coimbatore and Salem.

B. Railways in Kerala

It is a handy mode of transportation in Kerala, connecting sites both within and beyond the state, with an extensive network of 2000 railway stations. Long-distance trains connect the state to major cities in India, including Kolkata, Coimbatore, Chennai, Hyderabad, Mumbai, and New Delhi. The total length of the rail route is approximately 1,148 km, which includes 13 Railway lines. Kerala's railways link it to other states. A railway line parallel to NH 47 connects key towns including Thrissur, Palakkad, Kollam, and Alappuzha. The current railway line goes north-south and links to Mumbai through Konkan Railway.

5.3 Key Container Traffic & Growth Factors:

As a developing country, the expansion of the container sector in India is primarily dependent on the rising penetration of containers into the general cargo market and the country's economic growth. The privatization of port infrastructure has aided the container industry's expansion. Tuticorin port, operated by a multinational port operator like as PSA, has yet to realize its full potential due to a lack of hinterland infrastructure and a poor near hinterland. JNP diverted traffic away from Mumbai's gateway port (MbPT) by improving facilities and increasing efficiency.

With the deregulation and liberalisation of the 1990s, India's worldwide trade development has been spectacular, with a significant increase in goods commerce. Merchandise behemoths such as Wal-Mart, Tesco, automakers, textile manufacturers, and others have outsourced their manufacturing and sourcing to nations such as India, resulting in increasing container traffic at Indian ports. The following are the important growth reasons for container trade in India:

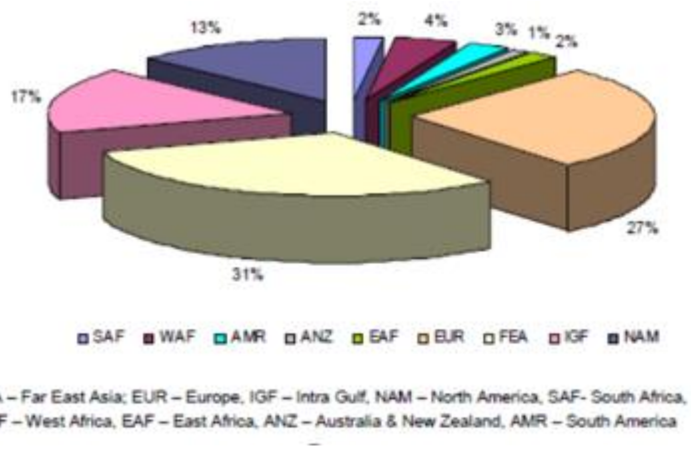
• There is a significant increase in ready-made clothing, textiles, handicrafts, leather items, auto components, electrical and electronic goods, engineering goods, processed and packaged food, and agricultural exports.

• Infrastructure development, such as new container ports, inland container depots (ICDs), rail, and road;

• Increased container penetration in the break bulk cargo segment, which aids in the expansion of container commerce.

• Foreign investment and industrial/manufacturing sector expansion

Fig 5.3 Trade lane wise Market Share



[Source: RH Project Preliminary Plan Report, 2010]

Far East Trade:

Far East Trade is India's largest and fastest expanding trade channel, accounting for 32% of cargo and having an import to export ratio of 0.56. Import freight accounts for over 64% of the traffic on this line. This lane accounts for around 43 percent of India's total container imports. Imports from Far East Asian nations into India have steadily increased in recent years. The key nations engaged in this trade route are China, South Korea, Malaysia, Singapore, Thailand, Japan, and Indonesia. Cotton yarn, textiles, food items, steel, stones, and seafood are key export commodities, whereas machinery, chemicals, electrical & electronic goods, steel, car & auto components, newspaper, paper, and fabrics are major import commodities.

Europe Trade:

The second largest commerce route in India, accounting for 27% of total containerized freight. The most important exports are textiles, clothing, steel, food products, and chemicals, whereas the most important imports are paper and chemicals. The key nations engaged in this trade channel are Western Europe, Scandinavian countries, and Russia.

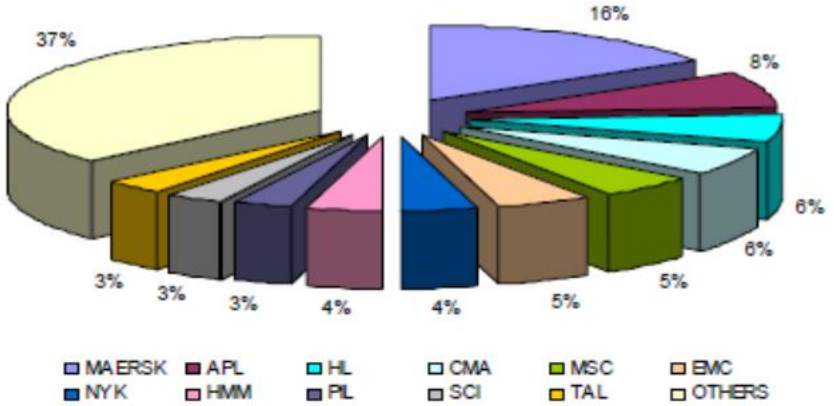
North America Trade:

Export cargo for US East Coast ports accounts for around 43 percent of overall NAM trade volumes. Textiles, apparel, and chemicals are the most important goods exports, while paper, paper-related items, equipment, and chemicals are the most important imports.

Intra Gulf

The fourth largest trade channel in Indian container commerce. Export volumes account for 28 percent of IGF commerce. The largest export commodities are frozen food, processed agricultural products, tea, and general cargo, whereas the key import commodities are paper, food items, scrap, and chemicals. The key players in this trade are the UAE, Saudi Arabia, Persian Gulf nations, and Sri Lanka in the Indian subcontinent.

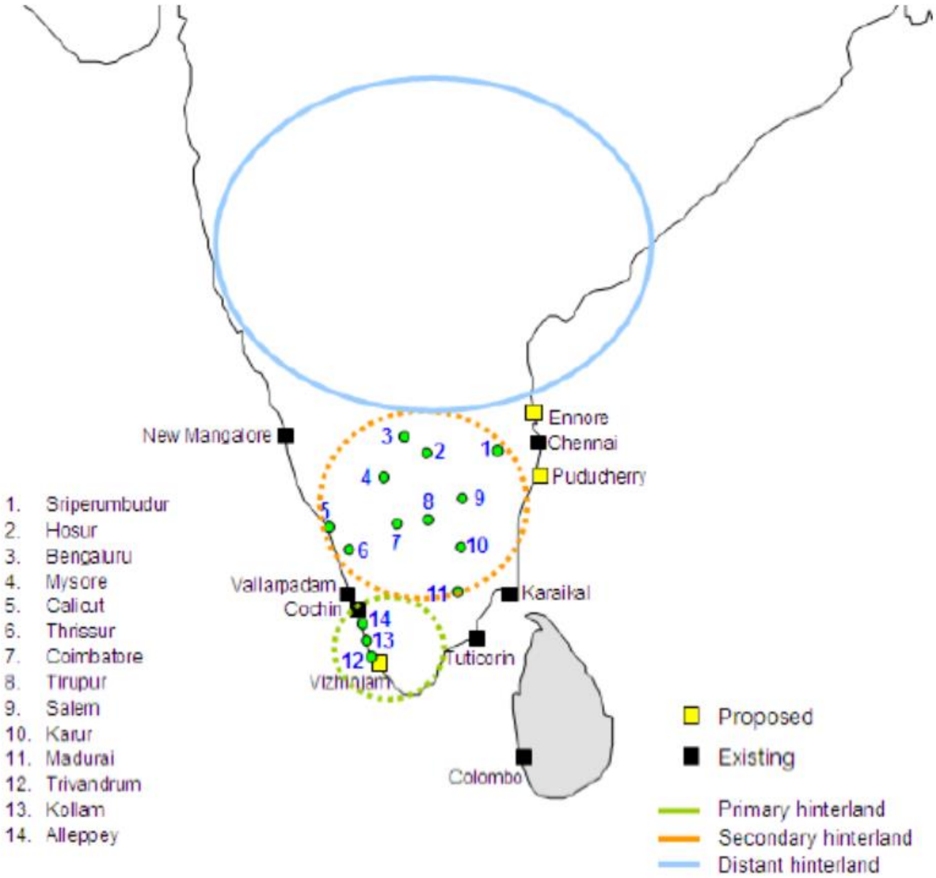
Fig 5.4 Major container shipping lines in South Indian ports.



5.3.Hinterland and Key Cargo Centers

The hinterland of Vizhinjam port is classified as primary, secondary, and remote. Sorting the hinterland aids in discovering markets for the intended port. Primary hinterland includes cargo centres in Kerala and neighboring parts of Tamil Nadu. The principal hinterland of Vizhinjam would be overlapping with the hinterland of Cochin and Tuticorin port. The hinterland supplied by the New Mangalore and Chennai ports, namely southern Karnataka and Tamil Nadu, is classified as secondary hinterland. The remote hinterland includes Maharashtra, other portions of Karnataka, Tamil Nadu, and Andhra Pradesh serviced by JNPT, as well as other ports on the West Coast.

Fig 5.5 Existing and proposed ports and key cargo centers:

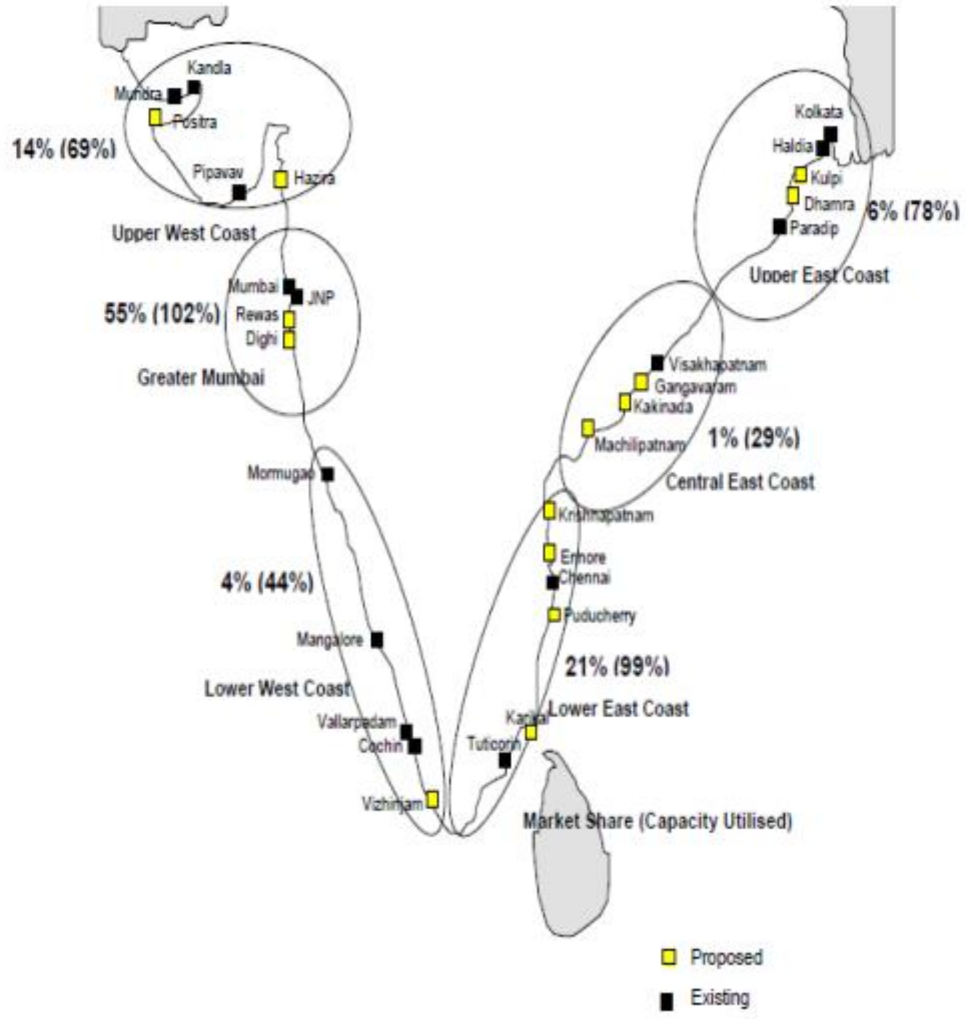


[Source: RH Project Preliminary Plan Report, 2010]

5.4 Competing Domestic Ports

The Indian government's liberal privatization strategy for infrastructure development including the private sector via BOT (Build, Operate, and Transfer) resulted in a mix of government and private container handling ports/terminals. Privatization strategy has resulted in the building of additional terminals at Jawaharlal Nehru Port (JNP). As containerization spreads into the general cargo and break bulk industries, ports are striving to capitalize on the trend. Mundra Port is one such case.

Fig 5.6 Existing and proposed container handling ports in India.



Source:Drewry Research

Table 5.1 Competing Port Facilities

Competing Port Facilities									
Ports	**Landlord**	**Terminal Operator**	**Throughput (Teu)**	**Estimated Capacity (Teu)**	**Capacity Utilization (%)**	**Quay Length (m)**	**No.of Quay Cranes**	**Yard Area (ha)**	**Water Depth Range (m)**
Upper West									
Kandla	**Public**	**ABG/PSA**	**138**	**300**	**46%**	**545**	**2**	**40**	**10**
Mundra	**Private**	**DPW**	**718**	**900**	**80%**	**632**	**6**	**32**	**15-17.5**
Mundra	**Private**	**MPSEZ**	**60**	**500**	**12%**	**631**	**4**	**24**	**15-17.5**
Pipava	**Private**	**APMT**	**182**	**750**	**24%**	**735**	**6**	**25**	**12.5**
Greater Mumbai									
Mumbai	**Public**	**GoI**	**92**	**500**	**18%**	**656**	**2 & Ships Gear**	**4**	**8.8-9.1**
JNPT	**Public**	**GoI**	**1063**	**1200**	**89%**	**680**	**8**	**35**	**12 – 13.5**
NSICT	**Public**	**DPW**	**1427**	**1200**	**119%**	**600**	**8**	**30**	**12-13.5**
GTI	**Public**	**APMT / CONCOR**	**1462**	**1400**	**104%**	**712**	**10**	**52**	**12-13.5**

Lower West									
Mormugao	**Public**	**MPT**	**14**	**50**	**28%**	**902**	**1 Mobile crane and Ships Gear**	**5**	**14**
Cochin	**Public**	**DPW**	**260**	**500**	**52%**	**414**	**2**	**7**	**10.7**
New Mangalore	**Public**	**GoI**	**29**	**50**	**58%**	**1,313**	**3 Mobile Cranes and Ships Gear**	**10**	**7 – 10.5**
Lower East									
Chennai	**Public**	**DPW**	**1143**	**1200**	**95%**	**885**	**7**	**18**	**13**
Tuticorin	**Public**	**PSA / SICAl**	**439**	**400**	**110%**	**370**	**2**	**8**	**11.9**
Central East									
Vishakapatnam	**Public**	**DPW/ULAI**	**90**	**200**	**45%**	**449**	**2**	**10**	**10.2**
Upper East									
Kolkata	**Publi**	**ABG /**	**302**	**300**	**101%**	**449**	**2**	**34**	**8.3**

	c	**PSA**					**Mobile Cranes and Ships Gear**		**– 12.2**
Haldia	**Public**	**GoI**	**127**	**300**	**42%**	**218**	**Ships Gear**		
Paradip	**Public**	**GoI**	**2**	**50**	**4%**	**250**	**Ships Gear**	**2**	**11.5 - 12.2**

[Source: RH Project Preliminary Plan Report, 2010]

Table 5.2 SWOT analysis of port facilities in Lower west & Lower East India

Lower West Coast	**Strengths**	**Weaknesses**
Mormugao	• Plans to develop a new cruise cum container berth. • State government providing incentives to various industries, whichcould boost container traffic.	• Limited container volumes and capacity – no known future expansion plans for this traffic all boxes are handled at general cargo berths only. • Small immediate hinterland limits growth prospects for containertraffic.

New Mangalore	• Exim trade is again unbalanced with more of importthan export • Land and water front available for development of dedicated container terminal • Good road and rail links and connectedto • Goa and Mumbai by Konkan Railway. Exim trade is only 74% balanced indicating more Of export than import	• Competition from Ports inMumbai. • Limited container traffic inthe immediate • Hinterland Competition from new developments atCochin.
Cochin	• Major trade and commercial hub of Kerala, providing significant volumes • Privatization of existing container terminal expected to result in higher growth in container	• Large common hinterland shared by Chennai And Tuticorin • Inadequate rail connectivity hampering cargo movement from secondary hinterland. • Kerala state is not one of the favored destinations for new investments, thus limiting future cargo

	traffic. • Plans to develop deep draft container terminal at Vallarpadam, which will be competing with Colombo for transshipment traffic	growth in immediate hinterland • Frequent strikes and labour unrest results in delays and congestion
Vizhinjam	• Natural draft of up to 23 meters and	• The rail and road network has to be developed.
	can accommodate ships with displacements of up to 300,000 tons, with little or no dredging • Closer to the main international shipping lanes than any other current port in India. • Requires very little maintenance dredging, due to its sheltered location. • No mangrove,	• The port is 8-10 NE km away from N.H.47 connecting Salem to Kanyakumari and the southern railway BG line (Thiruvananthapuram-Nagercoil) • Connectivity development may cause some relocations Issues • Too far from main cargo hinterland of north west India, can initially cater to only peninsular India's cargo. • Greenfield development will be quite expensive, affecting economic viability

	sand dunes and fishing zones within the region.	of the project.
	can accommodate ships with displacements of up to 300,000 tons, with little or no dredging • Closer to the main international shipping lanes than any other current port in India. • Requires very little maintenance dredging, due to its sheltered location. • No mangrove, sand dunes and fishing zones within the region.	• The port is 8-10 NE km away from N.H.47 connectingSalemto Kanyakumari and the southern railway BG line (Thiruvananthapuram-Nagercoil) • Connectivity development may cause some relocations Issues • Too far from main cargo hinterland of north west India, can initially cater to only peninsular India’s cargo. • Greenfield development will be quite expensive, affecting economic viability of the project.
Lower East Coast	Strengths	Weaknesses
Chennai	• Traditional gateway port in the region. • DPW as terminal operator • Large local hinterland,	• Still need to improve overall productivity • Not very cordial relationship between port labour and terminal operator • Draft not adequate to

	well- served by CFS facilities. Good road and rail links with hinterland. • Existing industries like Auto, textile, IT & Electronics in expansion mode thus promising increasing container volumes • Second container terminal by PSA to provide additional handling capacity. • Plans to develop a new mega container terminal.	handle main line vessels • Congestion in Chennai city resulting in major delays • in evacuation of containers. Chennai has restriction on Truck movement during day time. • Delay in implementation of elevated corridor project
Ennore	• Adequate land and waterfront available for future expansion. • Proximity to Chennai provides	• Will have to compete with Chennai for container Traffic • Rail and road network needs to be augmented for
	access to strong hinterland and other supporting infrastructure like	handling containers • Delay in project implementation

	CFS, CHA's, warehouses etc. • Away from the city congestion, good alternate to Chennai port. • 15m draft for handling modern container vessels	
Tuticorin	• Good geographical location, offering minimum deviation from main East-west shipping route • Experience and expertise of PSA Corp. • Sethu Samundram canal expected to boost coastal traffic. • Planning to develop a second container terminal to provide additional capacity	• Draft inadequate to handle mainline vessels • Weak immediate hinterland, thus largely dependent on common secondary hinterland Expected increase in competition from Cochin. • Will have to make huge investments in dredging to increase the existing draft at the port.
	• Proposed draft of 14.5 can facilitate handling of post-	• Small immediate hinterland, generating limited

Puducherry	panamax container vessels,, giving completive edge over Tuticorin. • Proximity to Southern Tamil Nadu hinterland. • Away from the city congestion can provide an alternate to Chennai port	container traffic. • Intense competition from Chennai and proposed Ennore container terminal. • Large common secondary hinterland shared by multiple ports • Lack of supporting infrastructure like CFSs, CHAs, and logistics players could result in lower market share. • Needs to develop last mile rail and road connectivity to effectively evacuate container traffic.
	• Proposed draft of 14.5 can facilitate handling of post-panamax container	• Limited container traffic generated in the immediate hinterland • Intense competition from
Karaikal	vessels,, giving completive edge over Tuticorin. • Proximity to Southern Tamil Nadu hinterland	Chennai and proposed Ennore container terminal • Large common secondary hinterland shared by multiple ports. • Lack of supporting infrastructure

		like CFSs, CHAs, and logistics players could result in lower market share.

[Source: RH Project Preliminary Plan Report, 2010]

5.5 Container Ship Size Limitations at competing ports

To obtain greater economies of scale, shipping firms are deploying huge boats of 14000-18000teu on major commercial routes. Because of the port's draught availability and other support facilities, it serves as a hub port or direct call port for these ultra-large boats. The table below provides an estimate of the ship size limitation, in terms of TEU for each competitive port.

Table 5.3 Container Ship Size limiting to Competing Ports

Port	**Maximum Vessel Size*(Teu)***	**Maximum Water Depth Alongside *(M)***	**Maximum Crane Outreach *(Rows)***	**Status**
Aden	**8,500**	16	18	Sufficient water depth to handle largest vessels afloat, but not cranes
Chennai	**5,000**	13.4	20	Large cranes but limited by draft
Chittagong	**2,000**	9.1	13	Panamax cranes but ship size limited by draft

Cochin	**4,500**	12.5	13	Near Panama x draft
Dubai	**11,000**	15	22	Large cranes, but draft means very largest ships could not call fully loaded
Colombo	**10,000**	15	19	
Fujairah	**9,500**	15	18	
JNPT	**6,500**	13.5	20	Confirmed by port. Large cranes but limited by draft
Kandla	**1,500**	10.7	n/a	No gantries
Karachi	**5,000**	13.5	20	Only one crane of 20 rows outreach
Khor Fakkan	**9,500**	15	20	
Kolkata	**2,500**	12	13	
Mundra	**8,000**	17.5	20	Maximum ship size as per

				port"s website. Draft and crane size suggests vessels larger than 8,000 teu might be feasible
Pipavav	**6,000**	12.5	18	
Port Klang	**10,000**	16	22	Draft and cranes are sufficient for largest ships afloat but port states that 120,000 dwt is the maximum ship size which can be accommodated
Port Qasim	**5,000**	11	18	Fully loaded Panamax could not access due to draft limitations
Salalah	**13,500**	16	22	Based on estimated "true" size of "Emma Maersk" class vessels
Singapore	**13,500**	16.7	22	
Tanjung Pelepas	**13,500**	16	22	

Tuticorin	**5,000**	10.7	13	Fully loaded Panamax could not access due to draft limitations

[Source: RH Project Preliminary Plan Report, 2010]

5.6 Gateway container traffic forecast for Vizhinjam Port

The traffic generated by the port's hinterland is referred to as gateway traffic. The projected Vizhinjam port's hinterland may be categorized into three categories: principal, secondary, and remote.

Table 5.4 Gateway of Container traffic forecast for Vizhiniam

Primary	**Secondary**	**Distant**
Kerala	Tuticorin	Bangaluru
	Tirupur	Chikamagalur/Hasan
	Coimbatore	Mangalore
	Salem	Chennai
	Karnataka	Hosur
	Tamilnadu	Karur
		Mormugao

[Source: RH Project Preliminary Plan Report, 2010]

To attract container traffic, Vizhinjam port would have to compete with ports in the secondary and remote hinterland. The remote hinterland of the Vizhinjam port has the highest level of industrialization, investments, infrastructure development, and container traffic, followed by the secondary and then primary hinterland.

5.7 Advantages and disadvantages of Vizhinjam Port

Advantages

• **Proximity to key shipping route**: Vizhinjam lies only 7 nautical miles from the main Asia-Eur commerce channel, which is one of the world's busiest container shipping routes, with high container traffic flowing east-west.

• **Draft:** Vizhinjam is a natural deep draught port with one of the world's largest natural draughts among cargo handling ports. Natural draughts save money on dredging and upkeep. Vizhinjam can accommodate cargo ships with up to 18000 TEU.

Disadvantages

• **Location:** The port lacks a large hinterland volume to launch liner services.

• **Port Competition:** For hinterland trade, Vizhinjam would face stiff competition from ports like as Chennai, Cochin, and Tuticorin.

• **Supporting infrastructure:** Infrastructure such as CFS, warehouses, and so on that are required to support container traffic at the port.

5.8 Vizhinjam Port-Competition from Colombo Port and Vessel Traffic Forecast

Colombo is the projected Vizhinjam port's major competitor in the Indian subcontinent's transhipment container traffic sector. Colombo is the ISC region's major transhipment centre, positioned on the key east-west shipping lanes extending from Europe to the East and Far East, Europe to Australasia through Singapore, and from India's West Coast to the East Coast with an 8-hour departure from the main sea route. The three container handling terminals at the port of Colombo are Jaya Container Terminal (JCT), South Asia Gateway Terminal (SAGT), and Unity Container Terminal (UCT), with a handling capacity of around 4.2 million TEU, which can be increased to 15-16 million TEU per year with the development of the South Harbour.

Over the previous ten years, the port's throughput has increased at an 8 percent CAGR. Transhipment traffic from India accounts for about 75% of total container volumes at the Port of Colombo. With port congestion in transhipment cargo from the ISC region, the port lost market share in the mid-2000s. Hub ports outside the ISC zone, such as Singapore, Salalah, and Jebel Ali, benefited greatly from Colombo's loss of market share. The port recovered market share with the completion of the South Asia Gateway Terminal and an increase in draught.

Colombo Port – SWOT Analysis

Strength

Outstanding position for a major East-West trading axis.

• Successful private investor introduction.

• Specific plans to enhance capacity.

• Competitive transportation tariffs.

• Has had rapid development during the last decade.

• Significant captive container traffic produced from its hinterland;

• Rapid market share gain after capacity was enhanced.

Weakness

• The port has a higher nation risk than some competitors.

• The port has just one entry channel and a single turning basin, which can cause delays in arrivals and departures.

• Labor issues can have an impact on port productivity.

• Old port, infrastructure, city constraints.

Opportunity

• Due to the geographic position of big Indian ports, Colombo is an excellent transhipment choice for shippers.

• Increased trade in ISC, which has an immediate impact on traffic at Colombo.

• The proposed Colombo Port Expansion Program (CPEP) can improve container traffic by increasing capacity and shortening vessel turnaround times.

• The proposed Colombo Port Expansion Program (CPEP) can improve container traffic by increasing capacity and speeding up vessel turnaround times; and

• Congestion at Indian ports favours Colombo.

Threats

- Tariffs are lower in the ports of Kelang and Tanjung Pelepas.
- Deep draught port development in the ISC, notably in India.

CHAPTER VI

CONCLUSION AND SUGGESTION

Vizhinjam port will be India's deepest, with a natural depth of 20m and the ability to handle mega boats with a capacity of 18000teu. The first phase of the project will have an 800m berth with a 3180m break water space and a 500m container yard. A 500m fish landing centre, a contemporary 300m cruise port to boost tourism-related activities, and permanent base stations for the Indian Navy and Coast Guard are also part of the Master Plan. Vizhinjam obtains a monetary advantage of 500 crore Indian rupees from the armed forces for supplying the facilities, which has also sped up the environmental clearance process from the Central government.

The Union Ministry of Environment and Forests has granted the Vizhinjam project environmental and coastal control zone clearance. The Rs.4010 crore project is scheduled to be undertaken through a public-private partnership and on a Build, Operate, and Transfer basis. The Kerala government would build the breakwaters, approach canals, roads, and rail lines, as well as offer backup land for the port. The BOT operator will construct the port infrastructure, including berths and cargo yards, as well as cranes and other superstructures.

In many PPP projects, the BOT operator is tasked with creating the approach channel, dredging, reclamation, and providing navigational aids, among other things. In certain circumstances, the bidder is also responsible for rail and road. However, the Kerala government has rationally split the areas of duty between the private and public sectors. The total engagement of the private or governmental sectors in port operations will result in a monopoly, which is not beneficial for the port's efficiency. The size of container ships has steadily increased during the last decade. The trend of building larger and larger ships will continue in the future years due to the economies of scale.

The biggest ships in service, Maersk EEE Class container ships with a capacity of 18,270 teu, have a 30% operational cost advantage over the traditional kind. The expansion of the Panama Canal, which, when completed, will be able to accommodate boats up to 12000 teu, is another reason for the trend toward bigger vessels. As ships grow in size, they require deeper berths and approach channels, larger capacity cranes, and faster turnaround times. Maersk's debut trip of "McKinney Moller" made just 13 limited port visits in its Europe–Asia service, while Maersk's EEE class boats did not touch at any South Asian ports.

Deeper ports and approach channels, closeness to international shipping routes, large capacity cranes with outreach reaching up to 22 rows across the ship's beam, and quicker run-around time with superior container handling capabilities are significant factors for such ships to stop at a port.

In South Asia, Colombo and Vizhinjam are the two ports that are anticipated to be developed as mega container transhipment hubs. Colombo and Vizhinjam are near to international shipping lines, with just a 22-25 nautical mile detour. The additional deep berths proposed as part of the Colombo South harbour development will have a depth of 16-18m, allowing mega container vessels to dock. Vizhinjam, on the other hand, offers deeper berths and approach channels up to 20m deep, with reduced dredging and approach channel maintenance costs.

Because Vizhinjam is a non-major port, it has the authority to set its own tariffs based on a competitive market environment. Approximately 75% of trade flowing through Colombo originates in Indian ports. Five major port operators, including Gammon Infrastructure Projects, the Hyundai-Con-Cast consortium, Essar Ports, Adani Ports, and the Srei-OHLa consortium of Srei Infra and the Spanish construction company ObrasconHuarte Lain, have responded to the global tender floated by Vizhinjam International Seaport.

Bibliography

1.Vacca I, Salani M, Bierlaire M. Optimization of operations in container terminals: Hierarchicalvs integrated approaches. Proceedings of the Swiss Transport Research Conference, STRC; Zurich, Switzerland. 2010.

2. Tu-Chang K. Development of a container terminal simulation model and its application in and analysis of terminal 18, port of Seattle [PhD thesis]. University of Washington; 1992.

3. Henesey L. Multi-agent container terminal management [PhD thesis]. Karlshamn: Blekinge Institute of Technology; 2006.

4. Kim KH, Günther HO. Container terminals and cargo systems. Springer-Verlag Berlin Heidelberg; 2007.

5. Steenken D, Voß S, Stahlbock R. Container terminal operation and operations research- A classification and literature review. OR Spectrum. 2004; (26):3–49.

6. Vis IFA, Koster R. Transshipment of containers at the container terminal: An overview. European Journal of Operational Research. 2003; (147):1–16.

7. Stahlbock R, Voß S. Operational research at container terminals: A literature update. OR Spectrum. 2008; (30):1–52.

8. Kim KH, Park YM. A crane scheduling method for port container terminals. European Journal of Operational Research. 2004; 156(3):752–68.

9. Murty KG. Yard crane pools and optimum layouts for storage yards of container terminals. Journal of Industrial and Systems Engineering. 2007; 1(3):190–9.

10. Günther HO, Kim KH. Container terminals and automated transport systems. New York: Springer, Berlin Heidelberg; 2005.

11. Crainic TG, Kim KH. Intermodal transportation. In: Barnhart C, Laporte G, editor. Handbook in OR & MS. Amsterdam: Elsevier. 2007; 14:467–537.

12. Kanniga E, Srikanth SMK, Sundhararajan. Optimization solution of equal dimension boxes in container loading problem using a permutation block algorithm. Indian Journal of Science and Technology. 2014 Jun; 7(S5):22–6.

13. Georgijevic M, Bojanic V, Bojanic G. Modelling and application challenges in the container terminal Operations. Available from: http://seth.asc.tuwien.ac.at/proc12/full_paper/Contribution178.pdf

14. Pesenti R, Ukovich W, Castelli L, Longo G. Quantitative models and methods for locating logistics nodes in maritime transportation. Quaderni di TrasportiEuropei: Study on Location of Logistic Nodes. 1998; (8-9):47–58.

15. Gudelj, Krčum M, Twrdy E. Models and methods for operations in port container Terminals. Promet- Traffic and Transportation. 2010; 22(1):43–51.

16.OEC (2019b) Nepal. Available at: https://oec.world/en/profile/country/npl/.
Onwuegbuzie, A. J. and Frels, R. (2016) 7 Steps to a Comprehensive Literature Review. London: Sage Publications.

17.Pham, T. and Yeo, G.-T. (2019) 'Evaluation of Transshipment Container Terminals' Service Quality in Vietnam: From the Shipping Companies' Perspective', Sustainability, 11(5), p. 1503. doi: 10.3390/su11051503.

18. Port News (2018) Bangladesh to use Colombo port as transshipment hub. Available at: http://en.portnews.ru/news/265672/.

19. Press Information Bureau (2019) Ships built in India to get priority in chartering under revised guidelines of Shipping Ministry. Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=188683.

20. Projects Today (2007) Vallarpadam ICTT: Work on road and rail links to commence soon. Available at: https://www.projectstoday.com/News/Vallarpadam-ICTT-Work-on-road-and-rail-links-to-commence-soon.
Quartz (2019) Is Nepal falling into a Chinese debt trap? Available at: https://qz.com/india/1466287/is-nepal-falling-into-chinas-belt-and-road-debt-trap/.

21. Reda, O., Harraz, N. and El-Tawil, A. (2016) 'Terminal Operations in Container Transshipment Hubs : Literature Review and Research Directions', in The International Conference of Engineering Sciences & Applications (ICESA 2016). Aswan, Egypt.
Reuters (2018) Nepal says China to allow access to ports, ending Indian monopoly on transit.

Available at: https://www.reuters.com/article/us-china-nepal-ports/nepal-