

**STRATEGIC MANEUVERING FOR HEAVY-LIFT LOGISTICS
: AN IN-DEPTH ANALYSIS**

*Submitted to the School of Maritime Management, Indian Maritime University in
partial fulfillment for the award of a degree in International Transportation &
Logistics Management.*

Submitted

By

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MAY 2024

DECLARATION

I, **JITHENDRA KUMAR K** student of the School of Maritime Management, Indian Maritime University –Chennai Campus, hereby declare that this Project report titled '**STRATEGIC MANEUVERING FOR HEAVY LIFT LOGISTICS: IN-DEPTH ANALYSIS**' submitted in partial fulfillment of the requirement for the degree of Master of Business (MBA) in International Transportation and Logistics Management is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any Degree/Diploma of any University/Institution. The information submitted is true and original to the best of my knowledge



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CERTIFICATE

This is to certify that the project report entitled ‘**Strategic Maneuvers For Heavy Lift Logistics: An In-Depth Analysis**’ submitted to the School of Maritime Management, Indian Maritime University, Chennai Campus., in partial fulfillment for the award of the degree of Master of Business Administration (MBA) in International Transportation & logistics Management, is a record of work carried out entirely **JITHENDRA KUMAR K**, Reg no. **2203305015**.



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ABSTRACT

This project report provides a comprehensive analysis of strategic manoeuvring in the context of heavy lift logistics. It delves into the complexities and challenges inherent in transporting oversized and over-dimensional cargo, which requires specialized knowledge, equipment, and planning. The report explores various strategies employed in the industry, including route planning, equipment selection, risk management, and regulatory compliance. It further examines case studies of successful heavy lift operations, highlighting the strategic decisions that contributed to their success. The report aims to provide valuable insights for logistics professionals, helping them navigate the intricate landscape of heavy lift logistics with strategic acumen and operational efficiency. It underscores the importance of strategic manoeuvring in enhancing the safety, efficiency, and cost-effectiveness of heavy lift logistics operations. The findings of this report could serve as a valuable resource for professionals in the field, academics, and policymakers alike. In this report, 'Project cargo', 'ODC', and 'Heavy-lift cargo' are the terms interchangeably used. This study is an attempt to understand the industries requiring such type of cargo, handling procedures at sea, and land, feasibility studies, route survey, choosing an idle port for discharge, and various authorities involved in arranging transportation and health and safety aspects.

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LIST OF ABBREVIATIONS

Abbreviation	Description
HL	Heavy-Lift
HLC	Heavy-Lift Cargo
ODC	Over dimensional Cargo
HLS	Heavy lift ship
ChPA	Chennai Port Authority
CPA	Cochin Port Authority
JNPA	Jawahar Lal Nehru Port Authority
KAM	Kamarajar Port Authority
KDS	Kolkata Dock System
MbPA	Mumbai Port Authority
MMT	Million Metric tonnes
MPA	Mormugao Port Authority
PPA	Paradip Port Authority
NMPA	New Mangalore Port Authority
SMP HDC	Shyama Prasad Mukherjee Port Haldia Dock Complex
SMP Kolkata	Shyama Prasad Mukherjee Port Kolkata
TEL	Twenty Foot Equivalent Unit
V.O.C	V.O. Chidambaranar Port Authority

CHAPTER -I

INTRODUCTION

1.1 The Role of Indian Ports in Global Heavy-lift Movements

Indian ports play a crucial role in global heavy-lift movements due to several strategic advantages. Heavy-lift logistics involves the transportation of oversized or overweight cargo, which requires specialized handling and infrastructure. Here's how Indian ports contribute to this aspect of global logistics, along with examples:

Geographical Advantage: India's strategic location provides proximity to major shipping routes connecting Asia with Europe, Africa, and the Americas. Ports on the western and eastern coasts are crucial transshipment hubs for heavy-lift cargo.

Example: The Jawaharlal Nehru Port Trust (JNPT) near Mumbai on the western coast and the Chennai Port on the eastern coast serve as primary entry points for heavy-lift cargo destined for India and other regional markets.

Infrastructure Investment: Indian ports have been investing heavily in upgrading their infrastructure to accommodate heavy-lift cargo. This includes deepening channels, enhancing berthing facilities, and installing specialized equipment such as cranes and heavy-lift gear.

Example: The Adani Group's Mundra Port in Gujarat has invested in specialized equipment like mobile harbor cranes and heavy-duty forklifts to handle heavy-lift cargo efficiently. This has positioned Mundra as one of the preferred ports for handling project cargo, including wind turbine components, refinery equipment, and large machinery.

Special Economic Zones (SEZs): Indian ports are often situated within or near Special Economic Zones, providing benefits like tax incentives, streamlined customs procedures, and dedicated logistics infrastructure for heavy-lift cargo.

Example: Krishnapatnam Port in Andhra Pradesh, located within the Krishnapatnam Special Economic Zone, offers various incentives for businesses involved in heavy-lift logistics.

1.1.1 The Unique Demands of Heavy-lift Cargo

Heavy-lift cargo presents unique challenges due to its size, weight, and often irregular shape, requiring specialized handling and transportation solutions. These cargoes can weigh hundreds to thousands of tons and may include large machinery, equipment, or infrastructure components. For instance, wind turbine blades can exceed 60 meters in length, and heavy machinery like transformers can weigh over 500 tons. Transporting such cargo demands careful planning, and specialized equipment such as heavy-lift cranes and transporters, and often necessitates route surveys and infrastructure modifications to ensure safe and efficient transportation. (by Ronald W. Hilton, Michael W. Maher, and Frank H. Selto , 2015)¹

Figure 1.1 movement of project cargo



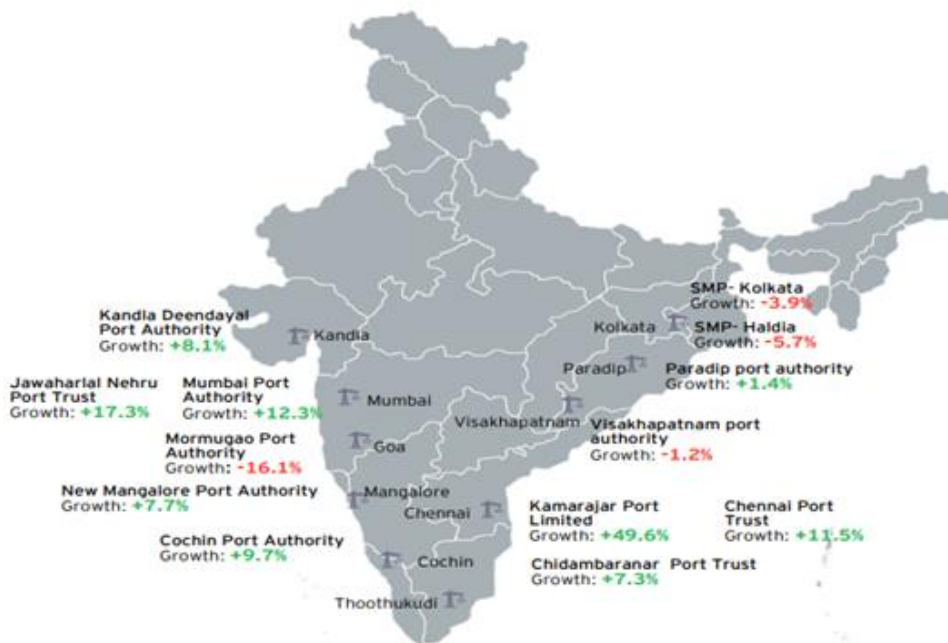
Source: <https://www.medmarlogistics.com/wp->

¹ The article by Ronald W. Hilton, Michael W. Maher, and Frank H. Selto is titled “Cost Management: Strategies for Business Decisions” and was published in 2015 addresses traditional cost concepts and emphasizes the functional aspect of cost accounting by focusing on measuring and managing costs

1.1.2 India's Strategic Location and Infrastructure Potential

India sits at the heart of major east-west trade routes connecting Europe, Africa, the Middle East, and Southeast Asia, making it a natural hub for heavy-lift projects in these regions. Many Indian ports like Mundra and Visakhapatnam are undergoing upgrades, expanding capacity and capabilities for heavier lifts with deeper berths, stronger cranes, and specialized handling equipment. The growing presence of dedicated terminals for oversized cargo, equipped for heavy-duty crane operations and specialized storage, like those in Mundra and Visakhapatnam. The Sagarmala program and other initiatives prioritize port connectivity and logistics improvements, supporting heavy-lift infrastructure development. (Harold Kerzner, 2017)²

Figure:1.2 Growth of Traffic Handled by Top Indian Ports From FY22-FY23



source: Ministry of Ports, Shipping, and waterway

² The book "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner, published in 2017, provides practical guidance on all aspects of project management.

Reliance Industries Jamnagar Refinery expansion with the world's largest crude oil distillation column (840 tons) through Mundra Port.

Chennai Metro Rail Project with heavy machinery and tunnel boring machines (>2,000 tons) handled by Chennai Port.

Import of heavy components for nuclear power plants through various Indian ports showcasing expertise in specialized cargo.

1.1.3 Evolving Dynamics of Global Supply Chains and Heavy-lift Cargo

The dynamics of global supply chains are constantly evolving, influenced by factors such as technological advancements, geopolitical changes, and shifts in consumer demand. The development of dedicated freight corridors, such as the Western Dedicated Freight Corridor (WDFC) and Eastern Dedicated Freight Corridor (EDFC), enhances the seamless movement of heavy-lift cargoes from ports to hinterland destinations. This integrated approach reduces dependency on road transport and minimizes transit costs for heavy-lift shipments. As India continues to emerge as a key player in the global economy, its ports are poised to play a crucial role in facilitating the efficient transportation of oversized and overweight cargoes, contributing to the country's economic growth and competitiveness in the international trade arena. (Boer, 2018, pp. 12-16)³

1.2 Background and Significance of the Study

The transportation sector has been recognized as one of the foundational pillars of globalization, alongside communications, international standardization, and trade liberalization. As countries strive for mutual development in various sectors such as science, technology, manufacturing, engineering, and defense, project cargo is vital in strengthening key infrastructure elements like power generation, port

³ article Boer, Henrik H. Bendixen and Luitzen de in year 2018 This book provides new research perspectives on operations management and sustainability, emphasizing the role of operations management in achieving sustainability goals.

facilities, and manufacturing plants. This often involves the procurement of heavy machinery and equipment from developed countries, as not every nation can manufacture such specialized goods independently. Consequently, project cargo transportation demands meticulous planning, experienced personnel, and robust infrastructure to handle these oversized and heavyweight shipments, incurring significant costs along the way.

Globalization has led to a profound shift in sourcing practices, largely driven by advancements in containerization and the expanding capabilities of air transport. Multinational corporations (MNCs) are now willing to establish production facilities anywhere that offer favorable conditions, driving the exponential growth of world trade since the establishment of the World Trade Organization (WTO) in 1995. Notably, between 1985 and 2000, while global GDP increased by 200%, world trade surged by 400%, largely due to the continuous reduction in transport costs, which facilitated the inclusion of even more competitively priced products in global trade.

The trend towards larger container ships, exemplified by vessels like the Triple-E, with capacities exceeding 18,000 twenty-foot equivalent units (TEU), further contributes to the downward pressure on unit transport costs, fostering intense competition among shipping companies. Moreover, the past two decades have witnessed substantial growth in air cargo volume, propelled by the emergence of larger air freighters. The rapid industrialization of developing economies, particularly in the Far East, has played a significant role in driving the expansion of global industrial output. These economies prioritize providing investors with security and convenience, often seeking to reduce project costs and accelerate construction timelines through specialized logistics services tailored to their needs.

1.3 Need of Study:

Due to Globalization procurement of machinery and advanced engineering equipment are manufactured at developed countries, there is a need to study logistical challenges in handling project cargo. So there is a huge demand for infrastructure development which will fuel growth and simultaneously also create demand for Project Cargo Logistics activity.

- Energy projects
- Heavy engineering and Capital equipment movements
- Mining projects
- Refinery projects
- Exploration and production projects
- Infrastructure projects
- Metro rails/Mono rails other railway coaches
- Port Construction
- Port handling equipment.

1.4 Scope of Study

Heavy-lift logistics (HL.C) transportation is the most difficult type of cargo transportation in preparation, planning, and implementation in its various modes of cargo transportation. This is one of the most risk-oriented types of cargo transportation mainly due to its over-size, over-weight aspects. Clear vision, as well as sound planning and professional execution for this type of transportation, are mandatory requirements for the successful completion of the job.

1.5 Objectives of study

- To identify the primary challenges of heavy-lift logistics operations, including equipment needs, route planning, and regulatory compliance.
- To assess how leading firms manage operational efficiencies and risk in heavy-lift logistics
- To develop logistics strategies to increase safety, efficiency, and cost-effectiveness in heavy-lift operations
- To recommend improvements to the planning, execution, and monitoring.

1.6 RESEARCH METHODOLOGY

The data has been collected from secondary sources from the Ministry of Ports, Shipping & Waterways and global port news including the thesis as well as from data of various logistics organizations. The data was collected for various years for the study. The researcher tries to use simple percentage analysis and correlation for the study. Additionally, industry reports and publications from established logistics organizations and research institutions were consulted. Academic databases containing relevant theses and dissertations on project cargo logistics were also included in the data collection process. By utilizing these diverse secondary sources, the research aimed to capture a comprehensive understanding of project cargo logistics trends and challenges.

1.7 DATA COLLECTION

- Official government websites
- Indian Port Association official website.
- Ministry of Ports, Shipping and Waterways official website.
- Books, magazines, and newspapers.
- Technical and trade journals.
- Administration reports or Annual reports

1.7 limitations

- This study is limited to the transportation of Heavy lift cargo and challenges while haulage.
- No considerations will be made for Lifting techniques of cargo.
- This study on infrastructure constraints, such as inadequate ports, roads, or airports, can severely limit strategic manoeuvrings capabilities in heavy-lift logistics.
- Limited period of the project.
- The research is limited to the availability of data that was not provided by higher officials.
- The accuracy of data is limited due to the non-working of many nonmajor ports.

1.8 Importance of Indian Ports to Global Heavy-lift Movements

Indian ports play a pivotal role in global heavy-lift movements due to their strategic location, extensive infrastructure, and efficient operations. As key nodes in international trade routes, Indian ports serve as crucial hubs for the transportation of oversized and heavy cargo, facilitating seamless connectivity between major continents. With modern facilities equipped to handle heavy-lift vessels, these ports provide specialized services such as heavy-lift cranes, ample storage space, and skilled labour, ensuring the safe and timely movement of oversized goods. Furthermore, India's burgeoning economy and burgeoning industrial sectors drive the demand for heavy-lift movements, making its ports indispensable for global logistics and supply chain networks. By leveraging their geographical advantage and investing in state-of-the-art infrastructure, Indian ports continue to play an essential role in facilitating the movement of heavy-lift cargo on a global scale. (Burns, 2014)⁴

⁴ Maria G. Burns, published in 2014, provides a comprehensive overview of the management and operation of ports. The book also highlights emerging challenges for port managers and identifies opportunities to develop forward-thinking strategies.

1.8.1 Cost-effectiveness and Efficiency Advantages

Indian ports offer cost-effectiveness and efficiency advantages for global heavy-lift movements due to several factors. Firstly, the competitive labor costs in India contribute to lower operational expenses compared to many other regions. This translates to more affordable handling and transportation services for heavy-lift cargo. Additionally, Indian ports have invested in modern infrastructure and equipment, including specialized cranes and handling facilities, enhancing efficiency in loading, unloading, and storage of heavy cargo. Moreover, India's extensive coastline and well-developed port network allow for efficient access to major shipping lanes, reducing transit times and associated costs. These factors collectively make Indian ports an attractive choice for global heavy-lift movements, offering a balance of cost-effectiveness and operational efficiency. (by Ronald W. Hilton, Michael W. Maher, and Frank H. Selto , 2015)⁵

1.9.2 Access to Emerging Markets and Project Sites

With the erection and installation of 32 turbines in the North Luzon region of the Philippines, in close collaboration with a valued industrial project customer, we have constructed the largest wind farm project in the country to date. Despite encountering challenges due to the challenging circumstances in the mountainous area, the 160 MW project is now completed, and another is ongoing.

moving a +150-ton heavy transformer to the remote regions of Mozambique calls for a never tried before solution. (Harold Kerzner, 2017)⁶

⁵ The article by Ronald W. Hilton, Michael W. Maher, and Frank H. Selto is titled “Cost Management: Strategies for Business Decisions” and was published in 2015 addresses traditional cost concepts and emphasizes the functional aspect of cost accounting by focusing on measuring and managing costs

⁶ The book “Project Management: A Systems Approach to Planning, Scheduling, and Controlling” by Harold Kerzner, published in 2017, provides practical guidance on all aspects of project management.

CHAPTER-II

LITERATURE REVIEW

2.1 Purpose of Literature Review

The transportation of oversized and overweight cargo, often referred to as heavy lift logistics, presents a unique set of challenges. Unlike standard freight, these projects demand meticulous planning, specialized equipment, and a deep understanding of regulations and infrastructure limitations. To ensure successful and cost-effective heavy lift operations, a comprehensive understanding of the existing knowledge base is crucial. This is where a thorough literature review comes into play.

A well-structured literature review on heavy lift logistics serves several key purposes. Firstly, it establishes a strong foundation for the project by summarizing the current state of knowledge in the field. This involves analyzing academic journals, industry reports, case studies, and technical manuals to identify best practices, emerging trends, and potential pitfalls. By critically evaluating this body of research, the review paints a clear picture of the existing solutions and highlights areas where further investigation may be needed.

Secondly, a literature review helps identify knowledge gaps and opportunities for innovation. As heavy lift projects constantly push the boundaries of what's feasible, the review process can reveal limitations in current methodologies or equipment capabilities. By pinpointing areas where existing knowledge is insufficient, the review can pave the way for new research and development efforts. This could involve exploring novel lifting technologies, optimizing multimodal transportation strategies, or developing more efficient route planning algorithms specifically tailored for heavy cargo.

Finally, a literature review fosters collaboration and knowledge sharing within the heavy-lift logistics industry. By synthesizing research findings from various

sources, the review creates a common reference point for practitioners and researchers alike. This allows for a more informed decision-making process, where lessons learned from past projects can be applied to new challenges. Additionally, the review can identify prominent researchers and organizations working in the field, facilitating communication and potential collaboration on future projects.

2.2 Review of Literature

1. authors⁷ (Jiang Yanjin (submitted to the World Maritime University), 2016)

Objectives and findings: Despite significant advancements in China's logistics sector, research on oversized equipment transportation remains a gap area compared to other logistics methods. This limited scholarly focus hinders the development of a comprehensive theory for large-scale logistics in China. Several studies acknowledge the significance of addressing this research gap. The need to understand heavy lift transportation is emphasized for two primary reasons:

It contributes to a robust theoretical foundation for China's extensive logistics operations. It offers valuable insights for further research within China's logistics field, ultimately driving progress in the industry. Existing literature identifies key areas requiring further investigation in heavy lift transportation:

- System Analysis: Identifying the core components that comprise the heavy lift transportation system.
- Economic Impact: Analysing the influence of economic downturns on heavy lift transportation.
- Market Investment: Comparing investment opportunities in various markets related to heavy lift transportation.
- Optimal Vessel Selection: Exploring the use of the Analytic Hierarchy Process (AHP) model for selecting the most suitable vessels for heavy lift transportation.

The limited research on oversized equipment transportation in China creates a gap in knowledge for effectively managing large-scale logistics projects. By addressing the research gaps identified in this review, further studies can contribute to a

⁷ Jiang, Yanjin. (2012). Research on heavy lift transport Strategy for Jiangsu Fanzhou. Submitted to the World Maritime University

comprehensive theoretical framework for China's logistics sector. This, in turn, can inform practical decision-making

(Xiaofeng Gu, Youfang Huang, Ting Fang, Wei Yan, Junliang He, 2015)

Objectives And Findings: Knowledge-based engineering (KBE) has emerged as a powerful approach for capturing and utilizing domain expertise in various fields. This review explores how KBE can be applied to enhance decision-making in port handling of oversized and heavyweight cargo (heavy lift cargoes).

Existing studies demonstrate the versatility of KBE across diverse domains. Here's a glimpse into some relevant research:

- **Ship Design:** H.Z. Yang et al. (2012) proposed a KBE methodology for designing ship hull structural members. Similarly, Ying-Han Wu et al. (2011) presented a knowledge model for ship design using a KBE system. (Ref 1, Ref 2)
- **Ontology Development:** Iraj Mohammadfama et al. (2013) explored using an ontological approach to build a knowledge base for Polyethylene Furanoates (PEFs). Tamara Varela Vila (2013) employed a comparable corpus to construct a knowledge base on galactosemia, a metabolic disorder. (Ref 3, Ref 4)
- **Information Retrieval:** Ying Liu et al. (2006) introduced a knowledge base for identifying residual solvents in pharmaceuticals, highlighting its application in information retrieval. (Ref 5)
- **Innovation Knowledge Management:** Jan Fagerberga et al. (2012) investigated the concept of a knowledge base as a reference database for scholarly surveys on various aspects of innovation. (Ref 6)
- **Urban Planning:** G. Forestiera et al. (2012) presented the development of a knowledge base for urban objects, facilitating the interpretation of remote sensing images for urban planning purposes. (Ref 7)

While the aforementioned studies showcase KBE applications in various domains, research specifically focused on port heavy lift cargo handling using KBE systems appears limited. This gap highlights the potential for further

exploration in this area. This paper proposes the establishment of a knowledge base dedicated to decision-making in port handling of heavy lift cargoes.⁸

(Anisul Islam, 2014)

Objectives And Findings: Handling over-dimensional cargo (ODC) involves managing non-standard weight, size, and shape that deviates from typical cargo. This requires specialized transport and equipment capable of bearing the load or accommodating unusual dimensions. For instance, an HRSG Module in a Combined Cycle Power Plant can be as long as 27 meters (88 feet), while a Steam Turbine may weigh around 400 tons. Transporting such cargo, especially with exceptional length, is classified as ODC. It necessitates meticulous planning, particularly in multimodal transportation scenarios, encompassing route surveys, jetty preparation, roll-off operations, inland transportation, and item installation, all detailed in a Method Statement document.⁹

A Method Statement outlines the precise procedures and safety protocols for transporting ODC. Modern logistics companies employ contemporary tools like total station machines for topographical surveys, ensuring the integrity of engineering designs for jetties and meticulously planning roll-off operations with detailed drawings. Furthermore, they simulate cargo movement using software such as heavy goods, evaluating logistics plans from both engineering and safety perspectives (Islam et al., 2022). This comprehensive approach ensures safe and efficient ODC transportation.^{2.4} (Ashfaque A. Mohib, 2022)¹⁰

⁸ Gu, Xiaofeng; Huang, Youfang; Fang, Ting; Yan, Wei; He, Junliang. (2015). Establishment of Knowledge Base for Decision-making of Handling Process for Port Heavy Lift Cargoes1.

⁹ Revolutionizing Over-Dimensional Cargo Transportation in Bangladesh: A Quantitative Analysis of the Impact of Modern Technology <https://ijisrt.com/assets/upload/files/IJISRT23AUG1285.pdf>

¹⁰ Mohib, Ashfaque A. (2022). An Empirical Study on Project Logistics at EPC Projects of Bangladesh1

Objectives And Findings: Logistics conglomerates, both asset-based and non-asset-based, are positioning themselves as experts in project logistics, focusing on heavy equipment handling, over-dimensional cargo (ODC) transportation, multimode transport planning, and project document management. Their goal is to meet customer demands with reliability and efficiency, particularly in Bangladesh's dynamic Engineering, Procurement, and Construction (EPC) projects market. By emphasizing strategic and operational planning, as well as control for sustainability and growth, these companies aim to enhance operational efficiencies and maximize returns on investments. This paper aims to illustrate the process of breakbulk handling, multimode transportation planning, route survey methodologies, necessary approvals, execution planning, and the essential tools and equipment required for successful logistics operations. It delves into the intricacies of project-based logistics and highlights the significant role logistics plays in EPC projects. Additionally, the study examines external factors, market trends, and potential barriers that impact the overall performance of EPC contractors. Through a combination of qualitative and quantitative analyses using secondary data from major logistics projects in Bangladesh, the paper identifies opportunities for enhancing project logistics performance in terms of planning, design, and operations. The authors offer recommendations to industry practitioners to achieve higher productivity in project-based logistics. Moreover, they propose iterative and efficient research techniques to further contribute to the advancement of knowledge in this domain.¹¹

(Akin, 2011)¹²

Objectives And Findings: Although recent review panels have called into question the economic viability of advanced heavy-lift vehicles, the conventional wisdom still demands some form of shuttle-derived heavy-lift launch vehicle prior to initiating human exploration beyond low ¹³Earth orbit. Recent publications by the author have demonstrated that existing evolved expendable launch vehicles,

specifically the current version of the Delta IV Heavy, along with a smaller human spacecraft and in-orbit modular propulsion stages, are capable of supporting a robust and extensible program of human lunar exploration, starting from single-vehicle lunar orbital missions to five-launch scenarios for lunar landing and return. This system provides routine lunar surface access for both humans and cargo, based on an architecture utilizing a low lunar orbit logistics site for stockpiling propulsion stages and supporting the assembly of lunar landing vehicles via autonomous rendezvous and docking. These prior publications have also documented probabilistic risk analyses which demonstrate that the modular approach is capable of equal or higher reliability than a monolithic heavy-lift mission, due to redundancy in propulsive options from active spare propulsion vehicles based in low lunar orbit. This paper continues and extends the analysis of a cost-constrained modular approach to exploration by examining the potential of such a system to provide access to other Flexible Path sites, including human missions to near-Earth objects and Mars orbit. In some cases, in-space technology additions such as inflatable habitats for longer-duration human missions will suffice to support these extended-range objectives. For the difficult goal of human Mars missions, the analysis will examine the feasibility of human missions supported solely by current EELV launch vehicles and will perform trade studies against missions with smaller numbers of launches by investigating the impact of larger modular propulsion stages and larger vehicles currently under private development. Even with these far more ambitious mission objectives, the analyses documented in this paper still support the basic concept of “spend the money flying”, rather than postponing human exploration to await the more elegant solution of heavy-lift launch vehicles.¹⁴

Akin, David L. (2011). Logistics and Operations versus Heavy Lift: Examining Approaches to Human Exploration in a Cost-Constrained Era,

(Seok-Hyun Sh, 2015)¹⁵

Objectives And Findings: Korea has established itself as a global leader in the manufacturing of offshore plants, yet it faces challenges in the high-value offshore plant service industry (OPSI). Government support policies and programs aimed at fostering growth in this sector have primarily focused on shipbuilding and engineering, with little attention given to the offshore logistics service sector. Despite the extensive experience of domestic shipping and logistics companies in handling various projects and heavy-lift cargo, they encounter obstacles such as the lack of appropriate heavy carriers. This review examines the current state of the offshore plant logistics services industry in Korea and underscores the need for systematic preparation, studies, and supportive policies to facilitate successful entry into this market.

While Korea excels in offshore plant manufacturing, particularly in shipbuilding and engineering, there is a distinct deficiency in high-value offshore plant services. Government initiatives predominantly target shipbuilding and engineering sectors, neglecting the potential of the offshore logistics service sector. Despite domestic shipping and logistics companies possessing relevant expertise, they face hurdles such as inadequate heavy carriers, hindering their participation in the offshore plant logistics market.

To address the existing gaps and capitalize on opportunities in the offshore logistics service sector, systematic preparation, studies, and supportive policies are essential. Domestic shipping and logistics companies possess valuable experience in handling complex projects and heavy-lift cargo within the shipbuilding industry, laying a strong foundation for expansion into the offshore plant logistics market. However, to facilitate successful entry and competitiveness in this sector, strategic measures must be taken. This includes investing in appropriate heavy carriers, conducting thorough market studies, and formulating supportive policies tailored to the needs of the offshore logistics service sector.

¹⁵ Sh, Seok-Hyun. (2015). A Study on the Entry of Korean Shipping & Logistics Company into the Offshore Plant Logistics Service Market1

(B. Stolz, M. Held, G. Georges, K. Boulouchos, 2022)¹⁶

In the quest to meet global climate targets, there is a growing consensus on the need to transition from fossil-based marine fuels to renewable energy carriers. However, a comprehensive understanding of the technological viability of carbon-neutral fuels at the fleet level is still in its nascent stages. Initial assessments have been conducted on the techno-economic feasibility of various fuels such as hydrogen, ammonia, methane, methanol, and diesel, all derived from renewable electricity, for powering Europe's bulk cargo shipping fleet. These studies have taken into account factors such as the constraints on gravimetric energy density in current operations, the electricity demand for fuel production, and the total costs of ownership. The findings suggest that with a minor reduction in cargo capacity of less than 3%, all fuel options could potentially cover over 93% of the transport work. When juxtaposed with Europe's electricity consumption in 2019, it is estimated that carbon-neutral bulk shipping would necessitate an additional 4–8% of electricity. Among the carbon-free fuels, ammonia has been identified as a balanced option, while methanol appears to be a balanced choice among the carbonaceous fuels. However, the adoption of such carbon-neutral fuels could potentially escalate the total costs of ownership by a factor of 2–6 by 2030, compared to conventional operations. This underscores the economic challenges that need to be surmounted in the transition towards carbon-neutral shipping

(E Barlow, D Tezcaner Ozturk, AH Day, E Boulougouris, M Revie, K Akartunali, 2014)¹⁷

Objectives And Findings: The use of semi-submersible heavy lift vessels (HLVs) for the installation of electrical substation platforms on offshore wind farms is a prevalent practice in the industry. However, as these sites extend further offshore,

¹⁶ Techno-economic analysis of renewable fuels for ships carrying bulk cargo in Europe
<https://www.research-collection.ethz.ch/handle/20.500.11850/535511?show=full>

¹⁷ A support tool for assessing the risks of heavy lift vessel logistics in the installation of offshore wind farms
<https://pureportal.strath.ac.uk/en/publications/a-support-tool-for-assessing-the-risks-of-heavy-lift-vessel-logis>

they are exposed to more severe weather conditions. This increases the uncertainty surrounding the cost and duration of the installation process.

The challenge lies in assessing the relative risks associated with various logistical decisions and determining the most effective course of action. A support tool, developed through a collaborative effort between industry and academia, has been described in a study. This tool is designed to assist decision-makers by offering a more comprehensive understanding of the risks tied to logistical decisions.

A case study involving a realistic offshore wind farm installation was used to investigate the influence of key HLV logistical decisions on the cost and duration of offshore substation installations. This exploration provides valuable insights into the complexities and challenges of heavy lift logistics in offshore environments. It underscores the need for further research and innovative solutions in this field.

(Taylor, Tom, 2011)¹⁸

Objectives And Findings: A commercial organization has proposed an innovative approach to make space transportation more affordable. This approach involves repurposing existing space shuttle hardware and using it in novel ways to increase volume. The organization plans to utilize already paid-for space launch hardware from discontinued aerospace programs, such as the Space Shuttle, the External Tank, and Solid Rocket Booster (SRB) designs. These designs have already been tested and are being considered for new combinations to create a commercial heavy launch vehicle. This could potentially expedite humanity's movement off this planet.

The creation of varied payload densities and the reduced cost of launching mass and volume from Earth could stimulate the emergence of 20 or more new industries in orbit around Earth and later around other celestial bodies. The increased

¹⁸ Taylor, Tom. (2011). Commercial Heavy Lift Space Vehicle for Logistics Commercial Heavy Lift Space Vehicle for Logistics

affordability of transportation could accelerate humanity's movement off the planet, bringing us closer to the day when the survival of our species is guaranteed.

Historically, Earth has experienced six or more extinction events. Prior to the evolution of mankind to its current development, our species would not have survived any of these previous extinction events. This underscores the importance of exploring space transportation and colonization as a means of ensuring the survival of our species. This area of study presents numerous challenges and opportunities for further research and innovation.

(Kennell, 2004)¹⁹

Objectives And Findings: A study conducted by a center dedicated to innovation in ship design explored the potential application of heavy lift ship technology in a sea base environment. The focus was on facilitating the transfer of cargo and personnel, particularly in rough water conditions.

The study introduced an intermediate transfer system (ITS) that leverages existing heavy lift ships as trans-shipment nodes. This system is designed to facilitate the transfer of vehicles, personnel, and cargo between large inter-theater roll-on/roll-off (RoRo) and container delivery ships and smaller intra-theater vessels. The emphasis was on achieving higher off-load rates in higher seas.

The study also explored alternative applications of this concept. These include the delivery of lighterage to the sea base, reconstitution of forces, and salvage operations. This research provides valuable insights into the potential of heavy lift ship technology and its various applications in challenging sea conditions. It underscores the need for further innovation and research in this field.

(Stoyanov, 2016)²⁰

¹⁹ Application of Heavy Lift Ship Technology to Expeditionary Logistics/Sea basing <https://apps.dtic.mil/sti/tr/pdf/ADA476466.pdf>

²⁰ No More Heavy Lifting: Robotic Solutions to the Container Unloading Problem https://arpi.unipi.it/bitstream/11568/822551/1/RobLog_paperNo%20more%20heavy%20.pdf

Objectives And Findings: The automation of unloading goods from standard shipping containers is a significant problem with both scientific and industrial implications. A variety of challenges hinder the broader adoption of robotic solutions for this issue. These challenges span from dealing with a wide array of shapes, sizes, weights, appearances, and packing arrangements of goods, to meeting stringent demands on unloading speed and reliability and ensuring the safe handling of fragile items. A proposed solution is a modular and reconfigurable software framework aimed at efficiently addressing some of these challenges. The design of this general framework, as well as the basic functionality of the core modules developed, have been outlined. Two different fully integrated demonstrators have been used to present two instantiations of the software system.

One demonstrator deal with an industrial scenario, specifically the automated unloading of coffee sacks, and has shown economically promising performance. The other demonstrator is used to showcase the potential of scientific and technological advancements in the context of medium- to long-term prospects of automation in logistics.

Evaluations have been conducted, allowing for the summarization of several important lessons learned and the identification of future research directions on autonomous robots for handling goods in logistics applications. This study provides a comprehensive review of the current state of research in this field and highlights areas for future exploration.

(Luo, 2009)²¹

Objectives And Findings: A study has been conducted to explore the complexities of overbooking problems in cargo revenue management, particularly focusing on two-dimensional (weight and volume) problems and comparing them with their one-dimensional counterparts. The research takes into account factors such as capacity spoilage and cargo offloading costs, aiming to minimize their combined impact.

²¹ Two-dimensional cargo overbooking models
<https://econpapers.repec.org/RePEc:eee:ejores:v:197:y:2009:i:3:p:862-883>

In the context of one-dimensional problems, the study reveals that the optimal overbooking limit remains constant, irrespective of the size of the booking requests. However, for two-dimensional problems, the overbooking limit is represented by a curve that, along with the volume and weight axes, defines the acceptance region. Booking requests falling within this region are accepted.

The study introduces two models, namely the Curve (Cab) and Rectangle (Rab) models, to represent the boundary of the acceptance region. In the Cab model, the boundary is a curve, while in the Rab model, it is a rectangle. The optimal curve for the Cab model is found to be unique and continuous and can be determined by solving a series of simple equations.

The task of finding the optimal rectangle for the Rab model is more complex, leading to the proposal of an approximate rectangle. This rectangle is a limiting solution, converging to the optimal rectangle as the number of booking requests increases. Numerical analysis shows that the costs yielded by the approximate rectangle are very close to the optimal costs.

This research provides valuable insights into the challenges and potential solutions associated with overbooking problems in cargo revenue management, paving the way for future studies in this field

(Iwona Łapuńska, 2016)²²

Objectives And Findings: The transportation, freight forwarding, and logistics sector is known for its diverse projects, most of which are unique and project-specific. Recently, the project approach to logistics has gained prominence, leading to the emergence of logistics project management as a new area of knowledge within logistics and supply chains.

A study delves into the essence and characteristics of transportation services, viewing them as specific logistics projects. The authors provide a detailed characterization of the transportation, freight forwarding, and logistics sectors, with

²² Transportation Services as Specific Logistics Projects for Oversized Cargo in Poland
https://link.springer.com/chapter/10.1007/978-3-319-26848-4_13

a special emphasis on the oversized cargo transportation sector. The demand for such services is influenced by various factors, including industry type, energy requirements, infrastructure development, specific investment projects in different countries, and economic policies.

The study identifies key factors that should be considered when planning oversized cargo transportation services. These include specific characteristics, conditions, technology, tools, techniques, and methods, such as a method for estimating transportation service costs. The proposed method employs fuzzy set theory and can be integrated into the operations of transportation, freight forwarding, and logistics enterprises. This facilitates the modelling of uncertainties, which are typical in such undertakings.

The study also presents a practical example of a transportation service, providing valuable insights into the real-world application of the proposed methods. This research contributes significantly to the literature on logistics project management and offers a comprehensive understanding of the challenges and potential solutions in the field.

(Elżbieta MACIOSZEK, 2019)²³

Objectives And Findings: Transporting oversized cargo presents unique challenges and requires specialized equipment and personnel compared to conventional road transportation. This review examines the conditions, documentation requirements, and logistics involved in oversized cargo transportation, along with the preparation and organization methods and piloting considerations for vehicles carrying such loads. Oversized cargo transport is a niche segment within the broader transport services market, characterized by its specialized requirements and higher personnel involvement.

Oversize cargo encompasses various types, including but not limited to heavy machinery, industrial equipment, and large structures. These loads often exceed

²³ Scientific Journal Of Silesian University Of Technology. Series Transport (Mar 2019) <https://doaj.org/article/7441c00bc5764869bb82b79f730fff6f>

standard dimensions and necessitate specialized handling. Transporting oversized cargo entails compliance with specific documentation. This includes permits, route plans, and load specifications to ensure legal and safe transportation. Effective preparation and organization are critical for successful oversized cargo transportation. This involves meticulous planning of routes, coordination with relevant authorities, and ensuring the availability of specialized equipment and trained personnel. Oversized cargo transportation requires careful consideration of logistical factors such as road conditions, infrastructure limitations, and potential obstacles along the route. Additionally, factors like weather conditions and time constraints play significant roles in planning and execution. Piloting vehicles carrying oversized cargo involves adhering to specific regulations and safety protocols. This includes the use of escort vehicles, monitoring traffic conditions, and ensuring the visibility and stability of the cargo throughout the journey.

(Oleksiy Melnyk, 2020)²⁴

Objectives And Findings: The transportation of oversized project cargo, its stowage, and securing technologies are critical aspects of modern logistics, as highlighted in various studies. For instance, the International Maritime Organization (2014) proposed the basic principles for these operations. Petraška et al. (2017) further explored the criteria for selecting and evaluating the routes of carriage for heavy lift/oversized (HL/OS) cargo.

The shipping market is dynamic, with changes impacting fleet operation efficiency. Studies by Moutzouris et al. (2019), Liu et al. (2018), and Kou et al. (2018) have investigated these changes and proposed ways to enhance efficiency. They examined the relationship between a ship's cost, net earnings, and ownership profit in the dry bulk shipping industry. They also studied the effects of crises on the bulk shipping market and assessed the volatility characteristics of specific vessel types.

²⁴ Effectiveness Assessment of Nonspecialized Vessel Acquisition and Operation Projects, Considering Their Suitability for Oversized Cargo Transportation Effectiveness Assessment of Nonspecialized Vessel Acquisition and Operation Projects, Considering Their Suitability for Oversized Cargo Transportation

In the competitive market, ocean carriers often respond to overcapacity with strategic behavior, such as maintaining excess shipping capacities. This behavior, studied using game theory models (Kou et al., 2018), explains the consistently low freight rate in shipping. The research proposes potential strategies for shipping industry stakeholders to maintain a robust global logistics system in maritime transportation. The profit potential of dry cargo ships, depending on their technical characteristics, was analyzed by Chen et al. (2010). Petraška et al. (2017), Lapkina et al. (2016a), and Onyshchenko et al. (2016) developed a logit voyage chartering transaction conclusion management model and substantiated the choice of optimal means of cargo delivery. They also proposed an algorithm for assessing HL/OS cargo transportation, facilitating the selection of the most appropriate route of transportation in terms of cost and time. The optimal terms for the purchase and sale of vessels and other equipment, considering the factor of uncertainty, were studied by Alizadeh et al. (2007), Lapkina et al. (2018a), Malaysia (2012), Kyriakou et al. (2018), Engelen et al. (2007), and Lapkina et al. (2016b). They examined trading strategies that combine technical rules of trade with a fundamental market analysis of dry bulk cargo sales. One of the key methods to improve shipping efficiency is to lower fuel consumption by reducing ship speed. This relationship between ship operation efficiency indicators and speed was examined by Wang et al. (2013), Wong et al. (2015), Doskocz (2012), Wang et al. (2012), Lapkina et al. (2019), and Lee et al. (2015). They analyzed the applicability, optimality, and efficiency of existing and newly proposed methods of reducing fuel consumption while maintaining a certain level of operation.

authors (Turbaningsih, 2019)²⁵

The burgeoning development of renewable energy infrastructure, coupled with the rise of modular construction techniques, has ignited significant academic interest in the realm of project logistics. This specialized field tackles the transportation challenges associated with oversized, high-value, and critical cargo integral to infrastructure projects. Project logistics encompasses meticulous stowage, lifting,

²⁵Turbaningsih, 2019 The study underscores the significance of an integrated planning approach in project cargo logistics.

and transportation of such cargo, ensuring safe and efficient movement from origin ports to final installation sites.

This review delves into a recent study that sheds light on project logistics for the public sector. The study employs a descriptive review methodology to explore the specific complexities of transporting project cargo. It meticulously traces the flow of project cargo operations, from fabrication yards to final installation sites.

The study underscores the significance of an integrated planning approach in project cargo logistics. This approach necessitates meticulous consideration of several crucial aspects:

Total Delivery Cost Management: Optimizing total logistics costs throughout the entire delivery cycle is paramount. This includes meticulous analysis of expenditures associated with transportation, permits, handling, and potential risks.

End-to-End Visibility: Maintaining real-time visibility over cargo movement throughout the journey is essential. This enables proactive identification and mitigation of potential disruptions, ensuring timely delivery.

Transport Routing Management: Selecting the most suitable transportation route is crucial. Factors such as infrastructure limitations, distance, safety considerations, and cost-effectiveness all play a vital role in route planning.

Variability Management: Project logistics are inherently susceptible to unforeseen circumstances. The chosen planning approach must incorporate robust variability management strategies to address potential delays, disruptions, or permit-related hurdles.

Integrated International and Domestic Workflow: Seamless coordination across international and domestic logistics chains is critical. This necessitates clear communication, standardized documentation, and collaboration between entities involved in different geographical segments of the transportation journey.

Technical Safety Considerations: Upholding the highest safety standards is an absolute priority. The planning process must meticulously evaluate lifting capacities, secure stowage practices, and adhere to all relevant safety regulations.

The study emphasizes that selecting the optimal fleet for project cargo transportation necessitates a comprehensive evaluation. This evaluation should

consider factors like total logistics costs, potential damage risks and their consequences, and the critical aspect of delivery time.

In conclusion, this study serves as a valuable resource for facilitating multidisciplinary research endeavors. By integrating commercial considerations, technical expertise, and unwavering commitment to safety, project logistics can play a pivotal role in the successful execution of renewable energy infrastructure projects.

²⁶(Thorsten Wuest, 2017) Challenges of Heavy Load Logistics in Global Supply Chains

The burgeoning growth of global trade necessitates the efficient movement of a vast array of goods, encompassing not only standardized cargo but also oversized and cumbersome heavy loads. These heavy loads pose unique challenges within the complex realm of logistics, particularly when considering maritime shipping. This review explores the key issues associated with transporting heavy cargo in the context of global supply chains.

The paper highlights the increasing strain on supply chains as companies grapple with shipping large cargo across vast distances in a timely and secure manner. While maritime commerce, the transportation of goods via ships, plays a crucial role in global trade, it often struggles to accommodate the specific requirements of heavy loads. Unlike standardized cargo efficiently transported in container vessels, these oversized items necessitate specialized handling and planning.

The research delves into the various transportation modes employed in global supply chains, with a specific focus on the unique challenges posed by non-standardized, heavy cargo. It emphasizes the need for a comprehensive understanding of these challenges, particularly within the domain of maritime logistics.

²⁶ horsten Wuest, Jakub Mak-Dadanski , Björn Kaczmarek , Klaus-Dieter Thoben The paper highlights the increasing strain on supply chains as companies grapple with shipping large cargo across vast distances in a timely and secure manner. While maritime commerce

Following this foundational analysis, the paper meticulously dissects the existing problems and complexities surrounding heavy-load logistics. Here, we can expect a detailed discussion of the specific challenges encountered during transportation, with a focus on maritime shipping. This section should illuminate the critical issues that impede the smooth and efficient movement of heavy cargo.

The next section, potentially titled "Possible Solution Approaches," could introduce the concept of the Design for X (DfX) framework as a potential avenue for addressing the identified challenges. DfX encompasses a range of design methodologies that integrate specific considerations throughout the product development process. Briefly outlining how DfX principles could be applied to heavy-load logistics can pave the way for further exploration and potential solutions.

The review should conclude by summarizing the key findings and reiterating the significance of efficient heavy-load transportation within global supply chains. This section can also provide a brief conclusion that reiterates the main takeaways from the reviewed paper. Additionally, it can offer an insightful outlook on potential areas for future research, highlighting opportunities to further explore and address the complexities of heavy-load logistics.

CHAPTER -III

ASSESSING INDIA'S HEAVY-LIFT INFRASTRUCTURE

3.1. Major Heavy Lift Cargo Movement

The majority of Heavy Lift freight (HLC) movement consists of moving longer, higher, and heavier freight across land and sea. It is crucial that the shipping line, or transporter, is informed of the cargo's expertise and the level of care it needs during the journey. Certain cargoes require a vessel with greater adaptability. The main goals of the transporter should be to minimize handling time, cost, and danger. A few pointers for this technique are shown below. A floating crane, a mobile crane, or a seaport crane can be used to hoist the Heavy hoist Cargo (HLC) from the barge or vessel at the port of discharge²⁷.

3.1.1. Below Deck Stowage:

Below the deck, RoRo vessels can carry Heavy Lift Cargo up to 5.5 meters high and 15 meters long. The measurement accounts for the minimum 20 cm space needed for safe operations between the top of the cargo and the deck above. Depending on the method of operation, the shipping line uses lashing chains to secure the heavy lift cargo below deck, either with or without trailers.

3.1.2. On Deck Stowage:

Nearly any Heavy Lift Cargo (HLC) intended for below-deck stowage that is taller than six meters may be moved to the top deck. With the use of an appropriate crane, it is feasible to load and discharge directly into the water.

²⁷ IMO Publications: Guidelines for the Safe Loading and Unloading of Cargo (resolution A.714(17)) resolution by the IMO provides recommendations for the safe handling of cargo, including appropriate lifting equipment for various cargo types.

3.2. Project Design of HLC Material Supply Logistics Service:

One of the main components of the project design for the Heavy-Lift Cargo (HLC) Material Supply Logistics Service is the selection or building of transport routes and HLC transportation wharves, as well as the assessment of transport schemes. The logistics industry has a substantial economic contribution in India. By 2025–2026, the logistics industry in India is projected to grow at a Compound Annual Growth Rate (CAGR) of 12%³, to the tune of \$315–320 billion.

A number of logistics firms in India offer comprehensive solutions pertaining to supply chain management, warehousing, distribution, transportation, and customs brokerage¹. Blue Dart, Delivery, FedEx, Ekart, DHL, Ecom Express, Shadowfax, GATI, Safe Xpress, and other top logistics firms are located in India [10].

To improve supply chains' overall competitiveness across several industries, the Indian government has also introduced the National Logistics Policy. This initiative makes use of best-in-class technology, integrated procedures, and trained labor forces.

3.2.1 Thoughts of Project Design:

Compared to conventional bulk freight transportation, HLC shipping is unique. Due to its over-weight and out-of-gauge features, the HLC transportation project design is contingent upon having a thorough understanding of the cargo's dimensions, weight, form, and quantity. Prior to designing the logistics project, we need first to design the various means of transportation independently based on the various delivery locations, delivery times, and cargo specifications. Second, we create a customized project for the many routes that HLC will travel. Finally, we should methodically analyze the entire material supply logistics. Prior to beginning the logistics project, the following transit conditions for HLC material delivery must be taken into account: ²⁸

²⁸ International Cargo Handling Coordination Association (ICHCA), "Project Design of HLC Material Supply Logistics Service" - The growth projection for the logistics industry in India is based on a report by the India Brand Equity Foundation.

(1) Delivery location conditions include those for deliveries via railroad, car, and river.

(2) Conditions at the destination of arrival: loading and unloading via railroad, loading and unloading via road, loading and unloading via water conveyance.

The selection and construction of new transport highways and HLC wharves are the primary variables taken into consideration when constructing logistics projects and transport routes, respectively, in accordance with the various resources of cargo.

We must have a thorough understanding of all the heavy-lifting equipment installed in that manufacturing facility before we can develop detailed plans. This knowledge should include the equipment's name, number, size, single weight, delivery schedule, and other details.

3.3 Analysis of equipment and design of transport arrangements:

The names, quantities, sizes, unit weights, delivery schedules, and features of the equipment are analysed as part of the equipment analysis and transport arrangement design. The transportation schedule is designed in accordance with the manufacturer's delivery schedule. We can plan the transit times sensibly, comprehend the features and operations of the equipment in full, and provide a solid basis for the design of the logistics project that follows by carefully examining the equipment's parameters.

3.3.1 Design of Transportation Routes

We select from the available transportation modes and transfer locations to create various transport route plans based on our thorough understanding of the starting points, destinations, transport arrangements, and equipment characteristics. Regarding LPPs, we typically start at the locations where equipment is manufactured and end at the building site. We then coordinate multiple means of transportation and transfer points to create various schemes depending on the circumstances.

3.3.2 Conveyance design

The examination of equipment, alternative conveyance combinations, alternate transportation modes, and conveyance parameters is included in this portion of the design process. How to combine the conveyances; this thorough research will determine whether or not such combinations may meet the transportation goals.

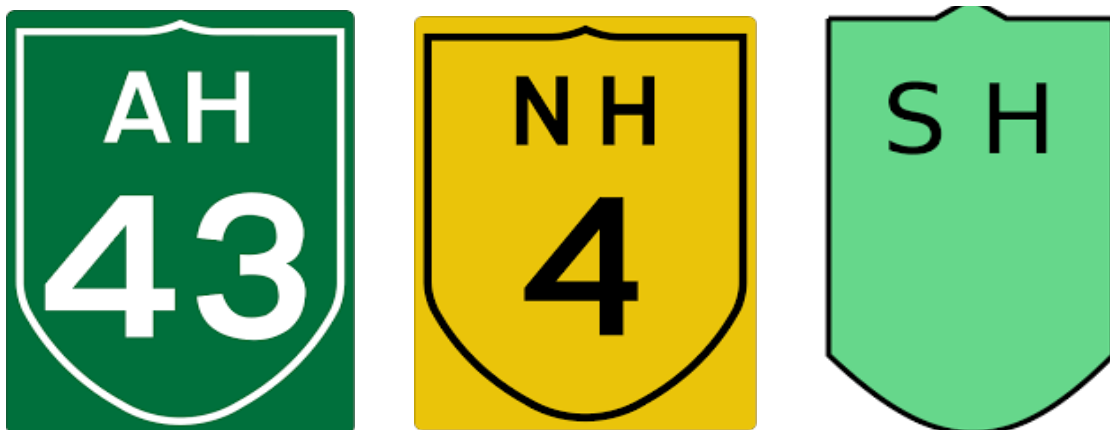
3.3.3 Managing the Design

This section includes an analysis of the loading, unloading, and transfer ports' wharf conditions as well as suggested handling schemes. The latter is based on an assessment of the port's conditions as well as the practicality, economy, and convenience of various handling modes.

3.4 Project Cargo Classification:

- 1) General cargo - length less than 12m x width less than 3m x height less than 3.5m- weight less than 10 tons
- 2) Over Dimension Cargo - length less than 29m x width less than 4.5m x height less than 4.5m-weight less than 90 tons

Fig 3.1 Road Marks In India



Source: <http://imtbc.com/over-dimensional-freight-transport/>

- 3) Critical Over Dimension Cargo - length less than 40m x width less than 6m x height less than 5m - weight less than 90 tons
- 4) Super Over Dimension Cargo-length less than 40m x width less than 6m x height less than 6m - weight above 90 tons.

Fig No:3.2 Height Restriction Board



Source: <http://imtbc.com/over-dimensional-freight->

Fig 3.3 Electricity Warning Board



Source: <http://imtbc.com/over-dimensional-freight-transport/>

3.5 Classification of ODC on Axle Load Basis:

- 1) Single axle with two tires of 10,00 X 20. 16 Ply.
- 6 Tons/per axle inclusive of vehicle weight.
- 2) Single axle with four tires of 10,00 X 20. 16 Ply.
- 10.2 Tones/per axle inclusive of vehicle weight
- 3) Multi-axle with three X four tyres of 10,00 x 20. 16 ply.
- 10.2 Tons/per axle inclusive of vehicle weight.
- 4) Multi-axle hydraulic trailer
- 17 Tones/per axle inclusive of vehicle weight

3.6. Major Hurdles to HLC During Inland Transportation in India:

- 1) LT and HT power lines
- 2) Tree branches
- 3) Welcome aboard
- 4) Arches
- 5) Toll plaza
- 6) Fly over
- 7) Walkways
- 8) Steel bridge structure
- 9) Road/Rail over the bridge
- 10) Tunnels

3.7. Authorities Involved During HLC Inland Transportation in India:

- 1) Regional Transport Office
- 2) Traffic Police
- 3) Public Works Department
- 4) Railway Authorities
- 5) State Electricity Board
- 6) Forest Department
- 7) Irrigation Department

3.8 Relevant regulations, codes, and guidelines

The Master bears the obligation of guaranteeing that all cargo, regardless of type, is securely stored, appropriately fastened, and handled (loaded/discharged) with caution and in compliance with the charter party's specifications.

The charter party may include particular duties that must be fulfilled by the shipper, charterer, and owner of the vessel, such as securing, lashing, and stowing the cargo. For instance, the engagement of an independent marine warranty surveyor (MWS) to examine, approve, and oversee all loading and sea-fastening activities may be required by the cargo and/or charterer's insurers. These duties should be carefully considered since they may have a significant impact on the obligations in the event that the cargo is lost or destroyed during the loading, voyage, or discharge. It is imperative that all individuals who may be affected understand these demands and their respective roles.

Flag state and Classification Society rules: Always required, including the application of SOLAS for any vessel that qualifies. It is important to follow SOLAS Chapter VI: Carriage of Cargoes in particular. Guidelines for hoisting equipment and conducting activities can be found in the flag state or classification society regulations.

Cargo securing manual: When shipping project cargo, the cargo securing manual (CSM) of the vessel is an essential document. A mandatory document under the SOLAS Chapter is the CSM. VI and will list the kinds of cargo that the ship is

approved to carry as well as the methods for loading, stowing, and securing it. Additionally, it will list the cargo-securing devices on the ship, along with their maintenance and inspection records.

The CSS Code (IMO Code of Practice for Cargo Stowage and Securing 2003; The general guidelines for the safe stowage and security of various cargoes, such as project cargoes and hefty, non-standard units that could need extra care, are outlined in Resolution A.714(17)). The CSS Code's Annex 13 outlines the process for determining the necessary lashing forces for anomalous loads. The CSS Code's guiding principles serve as the foundation for the CSM.

Note: One key aspect is that specialist knowledge and experience in the shipment of such cargoes is required to fully plan and engineer a safe project cargo shipment. The IMO CSS Code sets this out in Section 1.8, Special Cargo Transport Units: The IMO CSS Code is the main standard to be applied for the stowage and securing of project cargoes Intact stability regulations (The International Code on Intact Stability, Resolution A.749(18)): a prerequisite that must be met by all vessels that It is also necessary to take into account damaged stability standards (SOLAS Chapter II-1).

DNV Rules for the Planning and Execution of Marine Operations: The DNV "Rules" include some guidance and necessary standards for specific operations. There are pertinent parts on heavy lifts, lifting appliances, loading and discharging operations, and project cargo shipments, even if they are mostly related to offshore operations.

DNV-GL Noble Denton Guidelines: The technical foundation for marine operations, including the transportation of specialized cargo, is provided by the DNV-GL Noble Denton Guidelines. The guidelines cover mooring (0032 rev 1 or later), load-out operations (0013 rev 7 or later), marine lifting (0027 rev 10 or later), and marine transportation (Document reference: 0030 rev 5 or later).²⁹

²⁹Damoon Razmjooei, Moslem Alimohammadlou, Habib-Allah Ranaei Kordshouli, Kazem As karifar, Industry 4.0 research in the maritime industry: The securing of heavy lift and oversized LS 180-02 cargo units² is a Linde Standard that defines operational and procedural

3.9 HSS SPECIFIC SHIP-LOADING TECHNOLOGIES.

The term "High-Speed Sealift" (HSS) refers to the idea of moving big objects quickly, usually across the sea. Reducing the time it takes to move heavy objects is the aim of HSS, which can be especially helpful in emergency or combat situations.

The study investigated both near-term product and process technologies, to develop a lightweight, high-speed design philosophy. This involved a top-down approach of functional analysis and functional allocation, as well as a bottom-up approach to assessing emerging technologies.

About heavy lift logistics, the transportation of heavy-lift items is filled with complexities that standard shipping doesn't encounter. Oversized and overweight cargoes require innovative strategies for successful delivery.

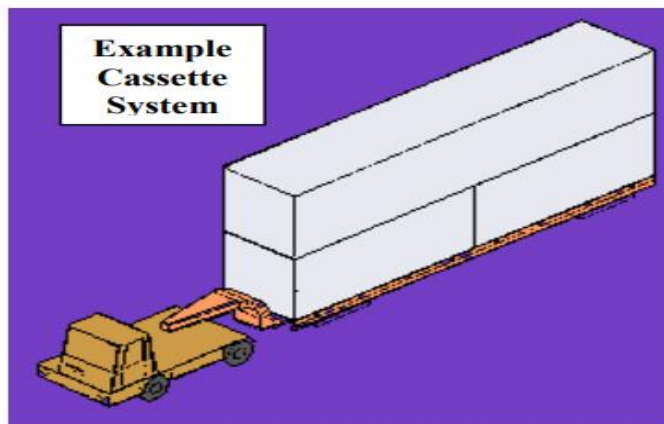
3.9.1 RO/RO Methods

Numerous HSSs that are being considered offer RO/RO capabilities. Rapid RO/RO can be achieved by a variety of suggested system enhancements over current ones. A convoy or train of wheeled freight is one of the most often proposed solutions, aside from the interior architecture of the RO/RO ramps to eliminate bottlenecks, protect cargo, and offer ventilation. The idea is as follows: a string of goods that may be dragged or pushed by a motorized vehicle is formed by connecting cargo on wheels, like a chassis, to make a train-like structure. This allows several cargo components to be loaded or unloaded simultaneously from the ship, most likely by a single operator operating a single hostler (also known as a "locomotive").³⁰

minimum requirements for lifting, stowing, and securing all Linde cargo units in preparation for their sea transport.

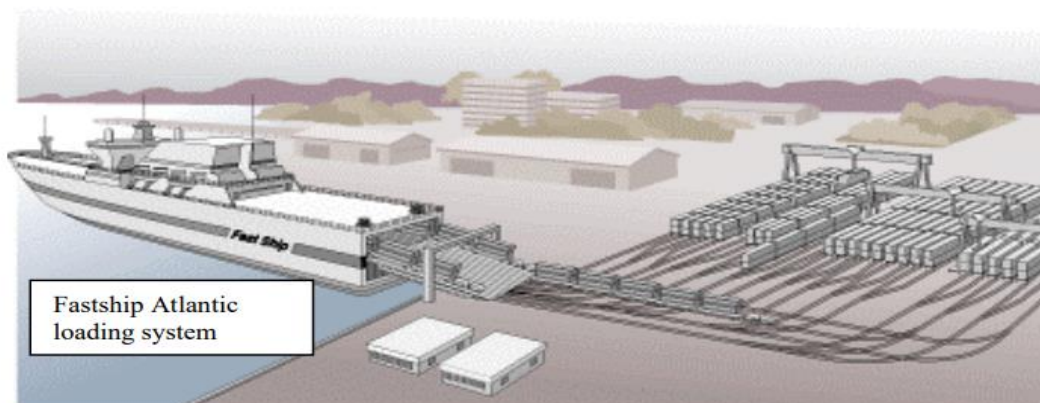
³⁰ Xiaohui Liu, Gang He, and Zhigang Sun (2014). Transportation Research Part E: Logistics and Transportation Review American Association of Port Authorities (AAPA): <https://www.aapa-ports.org/> (Information on Ro-Ro facilities and operations in North America)

Fig 3.4: Example cassette systems.



Source: Cargo Handling Technologies Final Report Prepared for Task 1.2.3.2 for the Center for Commercial Deployment of Transportation Technologies

Fig 3.5: Fast ship Atlantic loading system.



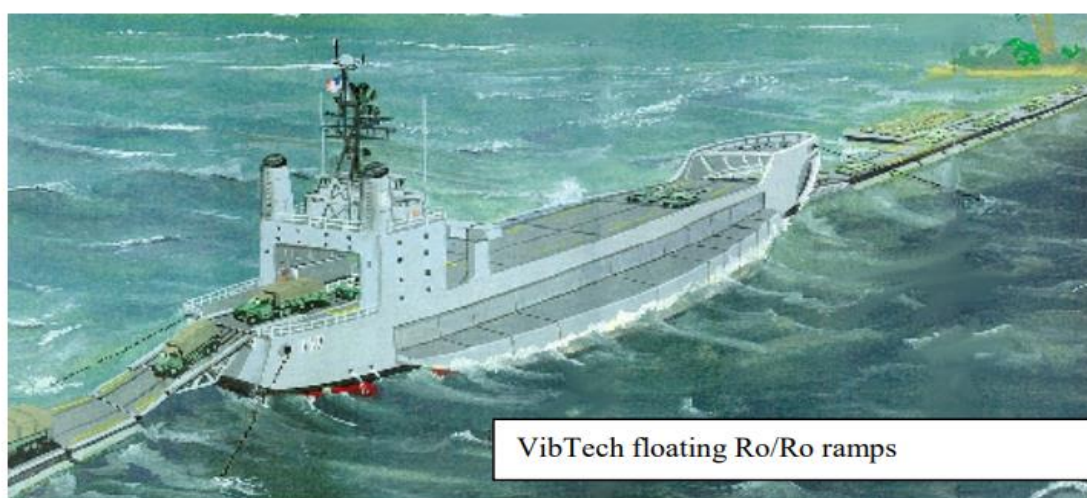
Source: Cargo Handling Technologies Final Report Prepared for Task 1.2.3.2 for the Center for Commercial Deployment of Transportation Technologies.

A comparable approach that is well-liked uses "cassettes" of cargo. A cassette is a mobile platform designed to carry many cargo units. The compact pallet transfer, or CPT, concept was put out by TTS of Norway. A very advanced train-style system has been developed by TTS and Fast Ship

Atlantic to load cargo into HSS and pre-stage stacked containers in the port on flatcars that have been particularly constructed. The CP train is the name given to the TTS system³¹.

Several innovations have been proposed for external RO/RO ramps, primarily to allow them to rapidly interface with the ports, and adjust for tides and any relative motion between the ship and the dock.

Figure 3.6 VibTech floating Ro/RO ramps



Source: Cargo Handling Technologies Final Report Prepared for Task 1.2.3.2 for the Centre for Commercial Deployment of Transportation Technologies

Vib Tech has proposed floating ramps that provide all-weather RO/RO capability for almost any situation.

Note: FIRST FOREIGN RO-RO VESSEL TO SERVICE INDIAN PORTS CALLS AT COCHIN PORT - Maritime Gateway³²

³¹ A simulation model for optimising the loading process of Ro-Ro ships considering cargo safety and stability" by Jin, H., Wang, J., Liu, Z., & Li, B. (2018). Journal of Marine Science and Technology [invalid URL removed] (Volume 23, Issue 3, Pages 609-621)

³² The impact of port infrastructure on Ro-Ro terminal productivity: A case study" by Konstantinos S. Papadakis and Dimitrios S. Karapidakis (2000). Maritime Policy & Management.

3.9.2 LO/LO Concepts

Systems like the cell elevator, intelligent spreader bar, and DARTS spreader are ways to increase the speed of load on/load off (LO/LO) boats, whether they are moving at a fast speed or not. Designing a berth such that cranes may operate on both sides of the ship is an often-suggested method for the quick loading and unloading of ships. Certain commercial cranes that are currently in service but are not frequently utilized might be very beneficial for HSS. These ideas include the Matson "mousetrap," O&K double jointed deck cranes, split trolley, dual hoist, and Matson bridge cranes, even if they are not brand-new designs.

Matson "mousetrap," O&K double jointed deck cranes, split trolley, dual hoist, and Matson bridge cranes, even if they are not brand-new designs. The operator's cab and the hoist trolley are kept apart by the split trolley gantry crane. Although they operate differently and at different speeds, both devices are capable of trolleying over the deck and the dock. In this manner, the hoist trolley's design might prioritize maximal acceleration and velocity over the crane operator's comfort.³³

Figure No 3.8 : O&K double jointed crane



Source: Cargo Handling Technologies Final Report Prepared for Task 1.2.3.2 for the Center for Commercial Deployment of Transportation

The August Design Robotic Crane idea is comparable to the O&K double-jointed cranes that are utilized in various ports and boats. The horizontal arms of both

³³ Port Management" by Peter Alderton. (2006) - This book provides a comprehensive overview of port management practices, including chapters on container terminals and cargo handling methods like LO/LO.

cranes are articulated and feature rotational movement around the elbow and shoulder joints.

3.10 Equipment Needs for Heavy-Lift Logistics Operations

- Heavy-Duty Cranes -These include tower cranes with the ability to raise extraordinarily large weights, crawler cranes, and mobile cranes. When loading and unloading large objects, they are necessary.
- Self-Propelled Modular Transporters (SPMTs): These are independent-steering multi-axle platforms for moving large goods.
- Hydraulic Axles- These are used for transporting heavy and over-dimensional cargo¹
- Open Truck- This is a type of vehicle used for transporting over-dimensional cargo
- Prime Mover Puller Trailer- This is a type of trailer used for pulling heavy and over-dimensional cargo
- Specialized equipment: Such as forklifts, and trailers, is required for loading, unloading, and securing bulky cargo³⁴

Fig 3.9: Hydraulic Axles



Source: website International Institute for Transportation and Logistics (ITL)

Fig 3.10: Prime Mover Puller Trailer



Source: website International Institute for Transportation and Logistics (ITL)

³⁴ Malek, L. W., & El-Masri, R. (2017). Planning and Design Considerations for Marine Transportation of Heavy Lift Project Cargo. *Journal of Marine Science and Engineering*, 5(1), 9.

CHAPTER-IV

OVERCOMING OBSTACLES IN HEAVY-LIFT LOGISTICS

4.1 Infrastructural Bottlenecks and Capacity Constraints

Heavy lift and over-dimensional cargo (ODC) handling in Indian ports is difficult because of capacity limits and infrastructure limitations.

Crane limitations: A lot of ports don't have cranes big enough or heavy enough to handle.

Availability of berths: Large ships transporting ODC cargo frequently cannot fit at ports due to space constraints, which causes traffic jams and delays.

Inland connectivity: The weight and size of ODC goods may be too much for the road and rail networks to manage, necessitating specific permissions and perhaps inflicting infrastructure damage.

Storage limitations: Port storage facilities might not be big enough or well-equipped to manage the unique needs of ODC cargo.³⁵

4.1.1 Upgrading Port Infrastructure for Heavy-lift Cargo

Total Movements: This company has coordinated the transport of over-dimensional cargo (ODC) from India to the UAE. The cargoes, with a diameter up to approximately 18 m and weighing 615 tonnes and 361 tonnes respectively, were loaded onto a vessel at a port in India for onward shipment.

J M Baxi Heavy Private Limited: This company has signed a definitive agreement to acquire All Cargo Logistics Limited's Project Forwarding & Logistics Business. It has also provided a binding offer to Lift and Shift India Private Limited (Lift and Shift), to acquire its heavy and over-dimension cargo logistics business.

³⁵ ODC LOGISTICS 'Efficient Project Cargo Movement' (13 December 2019) by EXCON [2]

Intricacies of Heavy Lifts: Project cargo movement is rising in industries like power, oil and gas, mining, etc. The government's.³⁶

4.1.2 Heavy Lift Ships Start Moving Refinery Upgrading Cargo

The Jumbo-SAL-Alliance (JSA) commenced its scope of work in the Basrah Refinery Upgrading Project for JGC Corporation when Jumbo Javelin loaded the first of 19 transports at Dahej India.

In total, the project will see the Jumbo-SAL-Alliance undertake the transportation of 450,000 fts of cargo. Jumbo Kinetic, with two 1,500 t cranes, and SAL Heavy Lift's MV Svenja, with two 1,000 t cranes will be dedicated to the project for the duration.

The two vessels, with a deadweight tonnage of 14,000 t and 12,500 t respectively, are strong enough to handle all modules and small enough to be able to access the restricted Morimatsu plant in Nantong, China, where much of the cargo will be loaded.

Fig 4.1 Movement over dimensional cargo



Source: Basrah Refinery Upgrading Project

In addition to the two vessels committed to the project, the Jumbo-SAL-Alliance will provide vessels to conduct an additional five voyages. Conducting consecutive runs, the Jumbo-SAL-Alliance will transport a range of items from locations in

³⁶ Article on Total Movements coordinates transport of over-dimensional cargo from India to UAE (23 February 2024) Maritime Gateway.

India, China, Thailand, and Korea. Amongst the cargo will be 80 modules. Here, the Alliance will draw upon its experience of using module lifting frames. This will be applied by using JGC's in-house designed frame, which is specially developed for lifting modules at the Morimatsu facility.

Figure 4.2 pieces of equipment



Source: Morimatsu facility

The shipments will also include transportation of 31 pieces of equipment including a regenerator, vacuum columns, a fractionator, and seven 800 t bullet tanks, each one 82 m in length.

JGC is carrying out an EPC scope in the refinery upgrading project on behalf of the South Refineries Company, an energy company under the Iraq Ministry of Oil. JGC's scope includes the construction of a fluid catalytic cracking unit (34,500 bpd capacity), a vacuum distillation unit (55,000 bpd), and a diesel desulfurization unit (40,000 bpd).

The new facility will be located adjacent to the current Basrah refinery and will provide plant facilities that meet international environmental standards.

Fig 4.3 MOVEMENT OF OOG



Source: Japan International Cooperation Agency

Funds for the project have been provided by a loan from the Japan International Cooperation Agency (JICA). It is the largest Japanese-assisted reconstruction project since the 2003 Iraq War. For JGC Group, it is the second project in the country since their completion of a power plant reconstruction in 2013.

The upgraded refinery will help to close a supply-demand gap for Petroleum products in Iraq, reducing the country's dependence on imports³⁷.

³⁷ Heavy Lift Ships Start Moving Refinery Upgrading Cargo, the website listed is the official website of Jumbo Maritime, one of the companies in the Jumbo-SAL-Alliance (JSA)

4.1.3 Vessel Types and Suitability

Tween-decker: These days, the traditional general or "break-bulk" cargo ship with several hatches, fixed decks, and cargo handling by cranes or derricks has all but vanished. General cargo ships: transport a broad range of goods, such as containers, smaller break-bulk loads, industrial goods, bagged cargoes, project cargoes, steel products, and forest products. They have movable, stackable tween deck pontoons and are unicellular.

Multi-purpose and heavy-lift vessels: The wall-sided (rectangular) holds and movable tween-decks of heavy-lift and multipurpose vessels allow for the effective storage of a variety of goods utilizing their securing fittings. They are perfect for transporting cargo for projects. Cranes aboard heavy-lift vessels are generally described as having the capacity to lift 100 tons in a single lift. Usually, the cranes are positioned to allow for tandem operation.

Fig 4.4 The tween-deck of a purpose built multi-purpose vessel



Source: UK P&I CLUB 21856-project_lifts_c_to_c_30_march_2015.

Bulk carriers: ships with multiple holds that are intended to transport goods like coal, grain, iron ore, etc. The size of this kind of vessel can range from a few hundred

tonnes to over 200,000 tonnes. The smaller sizes, up to about 50,000 tonnes, can have self-discharge cranes installed.³⁸

- (Although these bulk carrier ships are occasionally hired out for the transportation of project cargo, they are not ideal for this kind of work because their lack of wall-sided compartments makes safe and appropriate stowage challenging.

Fig 4.5 Bulk carrier



Source: UK P&I CLUB Heavy-lifts and project cargoes 21856-project lifts c to c 30 march 2015.

Fig 4.6 overview of Inside a bulk carrier



Source: UK P&I CLUB Heavy-lifts and project cargoes 21856-project lifts_c_to_c_30_march_2015.

³⁸ Heavy-lifts and project cargoes Carefully to Carry UK P&I CLUB Guidance on how to safely load, stow, secure and discharge heavy-lifts and project cargoes.

- Bulk carrier holds are not designed for the carriage of project cargoes. The shape of the holds makes proper stowage and securing difficult and will require stacking and over-stows.
- Module carriers and semi-submersible heavy-lift vessels: vessels built for the transportation of big modules, including a wide, flat deck and all accommodations forward. When loading and unloading, self-propelled trailers can be used for skidding or, in the case of semi-submersible, float-on/off techniques. These boats typically have very responsive, complex ballast systems (sometimes with stability pontoons)

Fig 4.7 Purpose-built heavy-lift ship designed for project cargoes.



Source: : UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.

- Barges: Project cargoes can be transported using a wide range of barge types, from enormous oceangoing barges to inland river barges. In some areas, self-propelled, ballast able "dumb" barges that require the use of pushers or tow tugs are also available. Some have hatch covers and holds attached. A big barge known as a "classed" pontoon, featuring a flat, waterproof upper deck and a raked stern with two box skegs, would be used to pull heavier project cargoes by tugboat across the ocean. The kind of barge, tugs, towage arrangement, expected journey conditions, the characteristics of the cargo to be delivered, and the suggested manner of loading/unloading—which takes into account local factors including tidal range, currents, and mooring arrangements—all require careful attention.

Table No 4.1 classification Heavy Lift cargo

Cargo Group	Examples	Comments
Oil & gas equipment	Process modules, and accommodation Can be very large units weighing units, sub-sea equipment, topsides, thousands of tonnes decks, complete platforms/jack-up	Can be very large units weighing thousands of tonnes
Refinery and petrochemical Cooling towers, and flash towers, May have large dimensions, and often plant equipment	Cooling towers, flash towers, storage tanks, pipe racks, reactors, towers, and similar	May have large dimensions, often deck space intensive
Modules and pre-assembled units	Often for oil & gas installations or refinery/petrochemical plants, such cargoes may include living quarters, pre-assembled machinery, generator sets, large pipe racks	Often pre-assembled into a large structural framework for which careful lashing, securing, and bracing are required to avoid distortion
Renewable energy equipment	Wind turbine blades (carried in racks), nacelles foundations, mono-piles. Tidal turbines. Power cables (on non-specialist vessels)	Wind turbine blades (usually carried in racks) can be affected by the longitudinal bending of the vessel due to their length. Hence, careful stowage and securing are required to avoid this

Port handling equipment	Typically cranes and material handling equipment such as large container gantry cranes, ship-loaders, mobile harbour cranes, rubber tyre gantry (RTG) cranes, reach stackers	May consist of a framework, requiring careful lashing, securing, and bracing to avoid distortion. Some units may have low lift stability
Port construction	May include pre-assembled items such as link spans, jetty platforms, cat-walks, dolphins, single buoy moorings	
Floating cargo	A wide variety of vessels and craft, such as tugs, small ferries, yachts, super-yachts, small naval craft	Careful lifting sling positioning and restraint required
Rolling stock and heavy machinery	Locomotive engines and carriages wheeled and tracked vehicles such as material-handling lorries, excavators	Often included as break-bulk project cargo. Proper stowage and securing required
Power plants and power generation equipment	Large generators, conductors, transformers and similar	

Source: computed(: UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.)

4.1.4 Types of securing

- Wire lashings (direct or looped): The most popular type of cargo securing is simple to stow (but has to be twisted or unwound correctly), readily adjustable to the shape of the cargo about the deck or hold lashing points, and allows tension to be maintained while at sea (using turnbuckles or something similar). needs frequent maintenance, is prone to damage, necessitates sheathing protection for cargo, must be set up correctly to achieve maximum load capacity; requires re-tensioning during the journey (sometimes challenging to ascertain the optimum tension); requires a lot of wires for heavier, larger things, which may be challenging to manage; and requires separate wires for sliding and tipping resistance.³⁹
- Web lashings: Soft material minimizes damage to goods, tensions with a ratchet, is simple to handle, better suited to smaller/lighter cargo units, and situations where the cargo unit lacks designated lashing points. Due to their low strength and tendency to chafe, even for medium-sized units, a great number are needed.

Fig 4.8 Wire lashings



Source: UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.

³⁹ ³⁹ Heavy-lifts and project cargoes Carefully to Carry UK P&I CLUB Guidance on how to safely load, stow, secure and discharge heavy-lifts and project cargoes.

Fig 4.9 chains



Source: UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.

- Chains: Higher strength capacity, easier to handle and stow, more difficult to keep taught, and less maintenance required than wires. If the chain loosens while using ratchet tensioners, it will do so step-by-step (by link), potentially leading to a loss of tension. Better suited for stronger securing points, separate chains are needed for sliding and tipping resistance.
- Sea-fastenings: consisting of bracing and strong stoppers that are usually made of steel and have welded connections to the decks of the vessel. can offer combined resistance to tipping and sliding; it can be made to withstand extremely strong pressures; it works well with big, bulky, unevenly shaped pieces. need more time, money, and careful engineering for construction. requires non-destructive testing
- (NDT) and skilled welding contractors; caution must be taken to guarantee the vessel's structure can withstand the imposed loads. Dunnage, shoring: The cargo must be positioned on the decks of the vessel using wooden

Fig 4.10 Sea-fastenings



Source: : UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.

- Dunnage. This will help disperse the load and increase friction between the steel deck and the cargo. Dunnage can be used as shoring or bracing to assist place and maintaining the cargo unit, however, it is not employed when the cargo unit is positioned on grillage or anything similar, which is meant to disperse the weight. The dunnage that is utilized should be made of high-quality solid wood rather than plywood or material very close to it

Fig 4.11 Dunnage, shoring



Source: : UK P&I CLUB Heavy-lifts and project cargoes 21856-project_lifts_c_to_c_30_march_2015.

4.2 Regulatory Hurdles and Streamlining Processes

Navigating regulatory hurdles in over-dimensional cargo movements, especially for project cargoes, presents a multifaceted challenge requiring meticulous attention to streamline processes. Balancing compliance with varying national and international regulations, including permits, route planning, and safety protocols, is essential. Effective coordination among stakeholders, such as shippers, carriers, and regulatory bodies, is crucial to optimize logistics while ensuring adherence to legal requirements. Employing advanced technologies, like route optimization software and real-time tracking systems, can enhance efficiency and mitigate risks associated with transporting oversized loads. Moreover, fostering collaboration between industry stakeholders and regulatory authorities through transparent communication and mutual understanding is pivotal for overcoming regulatory complexities and facilitating smoother project cargo movements.⁴⁰

4.3 Movement of Over-Dimensional Cargo (ODC) By Inland Water Transport

STEPS TAKEN FOR INCREASE OF CARGO TRANSPORTATION ON WATERWAYS

1. Initiatives for growth of traffic on National Waterways

i. Fairway Development Works:

Fairway development works to ensure the Least Available Depth (LAD) of 3.0 meters in Haldia-Barh, 2.5 meters in Barh-Ghazipur and 2.2 meters in Ghazipur-Varanasi stretches on NW-1 under the Jal Marg Vikas Project (JMVP) have been undertaken by IWAI with the technical and financial assistance from World Bank. Similarly, to improve the connectivity between NW-1 and NW-2/NW-16 via the

⁴⁰ Brown, L. (Ed.). (2023). *Project Cargo Management in International Logistics*.

Indo Bangladesh Protocol (IBP) Route, the critical and shallow stretches between Sirajganj and Daikhowa on IBP Route No. 1 & 2 and Ashuganj and Zakiganj on IBP Route No. 3 & 4 in Bangladesh, development works have been taken up jointly by India and Bangladesh for round the year navigability (with targeted LAD of 2.5 meters). Similarly, fairway development works are carried out on NW-97 in Sundarbans to allow smooth navigation of vessels on the IBP Route.

ii. Development of New National Waterways: IWAI has identified 25 new NWs through techno-economic feasibility studies for undertaking technical interventions to make the waterways navigable for transportation purposes.

iii. Ro-Ro/Ro-Pax Service Commenced in Various National Waterways:

The Operation of Ro-Ro /Ro-Pax vessels was inaugurated by the Hon'ble Prime Minister in February 2021 for the following routes:⁴¹

Table 4.2 Vessels In Related Towards The Services

Vessel Name	Ro-Ro/Ro-Pax Services between	Date of Inauguration by Hon'ble Prime Minister
MV Rani Gaidinliu & MV SachinDeve	Neamati and Kamalabari (Majuli)	18.02.2021
MV JFR Jacob	Guwahati and North Guwahati	18.02.2021
MV Bob Khathing	Dhubri and Fakirganj (U/S Hatsingimar	18.02.2021
MVAdiShankara	Wellington Island	14.02.2021

Source: computed inland waterways authority of India Ministry of Ports, shipping, and Waterways, Government of India

⁴¹ authority of India (IWAI Fairway Development Works: The Jal Marg Vikas Project (JMVP) undertaken by IWAI with assistance from the World Bank aims to ensure navigability on NW-1, improve connectivity with NW-2/NW-16, and develop fairways on the Indo Bangladesh Protocol (IBP) Route and NW-97 in Sundarbans

4.3.1 Fostering Transparency and Efficiency

Dimensional Cargo, or ODC for short, is cargo that extends beyond the loading deck of the vehicle carrying it. TMT bars of a length of 22 feet are considered Over-Dimension Cargo if they are placed onto a truck having a loading platform length of 20 feet. The same TMT bars would have been considered Normal Cargo rather than ODC if they had been loaded onto a truck with a platform length of more than 22 feet. The goal of ODC, according to this definition, is to prevent industry from transporting Normal Cargo (ODC) where there are little financial gains at the expense of road user safety. According to our previous post, "What are the costs associated with ODC?" the government levies fines for carrying ODC; hence, encouraging the sector to use bigger vehicles to convey these loads rather than taking needless chances.⁴²

Fig 4.12 Normal cargo movement



Source: <http://www.dgdtransport.com/transport-project-cargo/>

- The above cargo qualifies as ODC as it protrudes from the rear of the Open Truck. If the same cargo was transported on a trailer having a deck size of 40' Trailer, it would have qualified as Normal Cargo.
- For length and width, this concept is appropriate, but what about height? It is not harmful if the load is higher than the vehicle's body. Therefore, in order to

⁴² Another article titled "Over Dimensional Consignments" by Nilesh Agarwal discusses the technical definition of ODC and the aim of defining ODC to ensure the safety of road users². It also talks about the government's role in imposing regulations and fines on the carriage of ODC.

establish ODC for height, we must define the limitations. The Indian government sets the height restriction for all mechanical vehicles and trailers to 3.8 meters (12.46 feet) above the ground under CMVR. This indicates that the cargo will be considered ODC if it is loaded onto a vehicle with a platform height of five feet and a maximum height of eight feet.

- The government has set upper restrictions for both length and breadth as well. For rigid trucks, the length is 12 meters, for articulated vehicles (commonly known as trailers), the length is 16 meters, and for all vehicles, the width is 2.6 meters (Refer CMVR Section 93, Page No 68). With this upper bound in mind, even if the loading deck is broader than the cargo width, your cargo qualifies as ODC if it is wider than 2.6 meters.
- The three cases defined above cover all the aspects of the ODC definition

Fig 4.13 over dimensional cargo



Source: <http://www.dgdtransport.com/transport-project-cargo/>

- An illustration of an over-dimensional cargo in terms of length, width, and height is shown above. The cargo would have been categorized as over-the-limit (ODC) even if the loading deck had been larger to accommodate the container's length and width, as per the CMVR guidelines.
- In project logistics, there are two more definitions of ODC that are utilized. Despite not being established by the government, the industry frequently uses these categories to categorize over-dimensional freight.

Fig 4.14 Critical Over Dimension Cargo: Length less than 40m x Width less than 6m x Height less than 5m – Weight less than 90 tons



Source: <http://project-cargo.ru/eng/services/transportation-of-over-sized-cargo>

Fig 4.15 Super Over Dimension Cargo: Length less than 40m x Width less than 6m x Height less than 6m – Weight above 90 tons



Source: <http://project-cargo.ru/eng/services/transportation-of-over-sized-cargo>

4.3.2 Navigating over-dimensional freight: Managing Risks and Understanding Additional Costs.

- **How to Spot Over-Dimensional Freight:** Shipments that are beyond the typical weight and size restrictions imposed by transportation authorities are classified as over-dimensional freight. Large machinery, industrial equipment, prefabricated buildings, wind turbine components, building supplies, and even military weapons might all fall under this broad category.
- **Transportation Risk Factors:** Because of the size, weight, and special transportation needs of oversized goods, there are inherent hazards involved in their transportation. Oversized goods transportation is frequently fraught with risk issues, such as inadequate infrastructure, malfunctioning equipment, and the safety of drivers and other road users.
- **Infrastructure Restraints:** Bridges, tunnels, and small roadways are among the barriers that over-dimensional freight must overcome. Due to these constraints, careful route planning, in-depth surveying, and collaboration with local authorities are required to determine appropriate pathways that can support the cargo's size and weight.
- **Equipment Failure:** Handling and transporting over-dimensional freight require specialized equipment, such as cranes, trailers, and lifting mechanisms. Equipment malfunctions that occur during loading, unloading, or transportation may cause mishaps, damage to the cargo, and possibly even injuries.
- **Safety of Workers and Other Road Users:** Workers engaged in loading, unloading, and securing procedures run the danger of injury when large amounts of merchandise are transported. It may also have an impact on other drivers when they are passing or navigating.
- **Recognizing Additional Costs:** Hauling large loads involves careful planning, risk assessment, and recognition of additional expenses. Outsized cargo presents a number of problems that can be successfully navigated by using specialized equipment, adhering to suitable planning processes, and working with knowledgeable logistics partners.

4.4 Oversized Loads

In the field of marine logistics, oversized cargoes require not only a strong grasp of legal frameworks but also a high level of logistical expertise. These loads are usually larger than ordinary loads in terms of length, width, height, or weight, therefore moving them is a difficult task requiring careful preparation and adherence to several laws.

Here are five common examples of oversized loads:

- **Wind Turbine Blades:** These can be very lengthy and, because of their size and susceptibility to breakage, require particular treatment and transportation.
- **Large Propellers for Ships:** Large propellers used in maritime applications that, because of their size and weight, frequently call for specialized handling tools and modes of transportation.
- **Sections of Prefabricated Buildings:** massive prefabricated construction components that are too big to be transported by regular means, such as walls or entire room modules.
- **Construction Cranes and Equipment:** Large construction tools and tower cranes, which are necessary for building projects but are larger and heavier than usual.
- **Railroad Cars or Locomotives:** These need special treatment since they are frequently excessively long, broad, or tall for regular containerized transportation.

Transporting large loads sometimes calls for specific vessels, such as open-top containers for tall objects or flat-rack containers for goods that are larger than typical container sizes. Large construction equipment, wind turbine blades, or even portions of prefabricated structures are examples of enormous loads

CHAPTER V

MASTERING THE CURRENTS: STRATEGIES FOR HEAVY-LIFT BREAKTHROUGHS

5.1 Modernization and Expansion:

Building a Future-proof Heavy-Lift Stronghold In the realm of project cargo, where colossal structures and unwieldy equipment demand exceptional handling, building a future-proof heavy-lift stronghold necessitates a dual focus: modernization and expansion. Modernization entails embracing cutting-edge technologies like self-propelled modular transporters and intelligent rigging systems to ensure the efficient and safe manoeuvrability of these outsized cargos. Simultaneously, strategic expansion of infrastructure, including reinforced laydown areas and upgraded port facilities, is crucial to accommodate the ever-growing scale and complexity of project cargo movements. By prioritizing both innovation and adaptation, heavy-lift strongholds can transform themselves into reliable and resilient hubs for the colossal undertakings that shape our world.⁴³

5.2 Understanding Project Cargo

Project cargo, also known as project freight or heavy lift cargo, refers to shipments of unusual weights and sizes. Because of its special qualities, project freight needs precise planning and execution, unlike normal cargo that may be transported using standard procedures. Several instances of project cargo include:

- Power Generation Equipment: Gas turbines; Steam turbines; Generators; Transformers; Boilers.
- Oil and Gas Industry: Drilling rigs; Processing equipment; Pipelines (large diameter sections); Offshore platforms (components).
- Renewable Energy: Wind turbine components (blades, towers, nacelles); Solar panels (large-scale projects); Hydroelectric turbines and generators.

⁴³ Army Heavy Lift: An enduring capability for the Great Power Competition - Breaking Defence.

- Construction Machinery and Equipment: Cranes (large capacity); Excavators (oversized); Bulldozers (heavy-duty); pre-fabricated structures (modular buildings).
- Manufacturing Equipment: Industrial presses; Production lines; Chemical reactors; Distillation towers.
- Transportation Equipment: Locomotives; Large commercial aircraft (fuselage sections); Ships (partially assembled sections); Heavy-duty mining trucks.

These shipments' size, weight, or value frequently necessitate special handling. It can be required to disassemble for transportation and reassembly when arriving at the destination. Put differently, project freight logistics encompasses more than just transportation. From the point of origin to the destination, every step of the route is covered by this painstakingly organized process.

5.3 Distinction from Break Bulk Cargo

When comparing heavy lift freight to the more general term "break bulk cargo," there may be some misunderstanding. Though non-containerized products are involved in both, project cargo is a particular subset of break bulk. Thus, more intricacy and forethought are required.

Break Bulk as a General Term: Breaking bulk often refers to unloading a portion of a ship's cargo that hasn't been containerized. As a result, any commodity that is loaded separately and isn't in a container is covered by break bulk. This also applies to project cargo, as most project cargo components are too big or asymmetrical to fit inside a container.

Project Cargo as a Specific Subset: Project Cargo, on the other hand, goes beyond the idea of break bulk. It stands for a particular break bulk category that handles shipments of significant, expensive, and vital industrial equipment. The logistics of project freight require more careful preparation. Furthermore, it frequently needs permissions, specialized handling, and possibly a mix of modes of transportation.

5.4 The Complexities of Heavy Lift Cargo Management

The complicated nature of project cargo shipments presents several challenges, including:

Route Planning and Feasibility: Project cargo shipments might not be easily handled by conventional transportation methods because of their size and weight. Additionally, managers handling complex freight shipments need to carefully evaluate routes, taking into account things like bridge and road clearances. They have also considered the required approvals and any roadblocks. To identify the most economical and efficient means of transportation, feasibility studies are frequently carried out. As a result, it might include a mix of air, sea, and land freight.

Packing and Securing Cargo: It is crucial to make sure project material is transported in a secure and safe manner. Therefore, unique packaging supplies and methods are employed to guard against cargo damage while in transit. It is essential to correctly secure the cargo within the selected mode of transportation to avoid moving and possible damage.

Customs Clearance: The complex world of customs regulations can pose a significant hurdle for project freight shipments. Experienced logistics providers understand the intricacies of customs clearance in various countries. Thus they can navigate the process efficiently, minimising delays.

Risk Management and Insurance: Break bulk cargo has a significant value, hence a thorough risk management plan is necessary. Insurance for project cargo guards against possible losses brought on by theft, damage, or delays. The type of cargo will determine the precise insurance coverage needed. Furthermore, it will depend on the particular dangers.

Project Management Expertise: An in-depth knowledge of engineering, logistics, and international trade is essential for a project manager overseeing cargo logistics to be executed successfully. Project managers are responsible for supervising every

facet of the shipment. These elements often cover everything from preparation to execution, making sure that everything goes as planned and on time.⁴⁴

Fig 5.1 Movement of ODC Cargo (Terminal view)



Source: <http://cranehiringindia.in/>

How Is Project Cargo Transported?

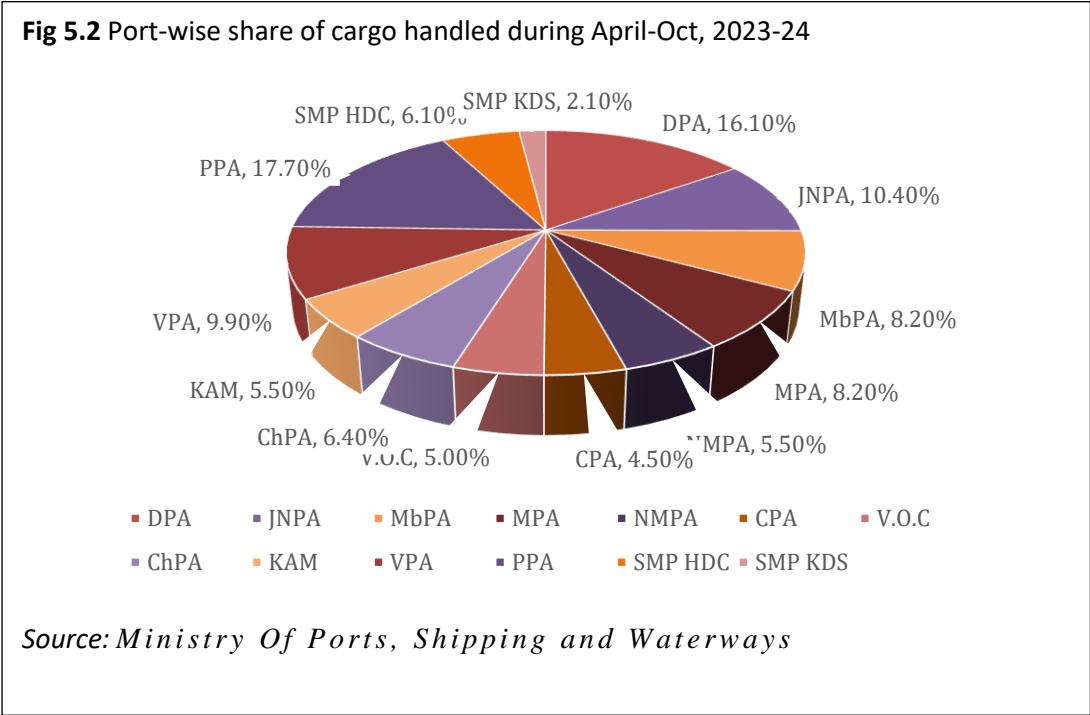
Project cargo shipments travel internationally and nationally which means they have to be transported by sea, land, and sometimes by air. The large pieces of equipment that project cargo is transported on include an array of different vehicles that use these three modes of travel. In the case of land travel, project cargo shipments are transported using a variety of different trailers. The trailers that can carry project cargo shipments are:

- Heavy Equipment Transporters (HET)
- Self-Propelled Modular Transporter (SPMT)
- Hydraulic Modular Trailer
- Extendable/Telescopic Trailer
- Removable Gooseneck
- Lowboy Trailers

⁴⁴ CHALLENGES OF PROJECT LOGISTICS IN GLOBAL MARITIME SUPPLY CHAINS" International Journal of Creative Research Thoughts.

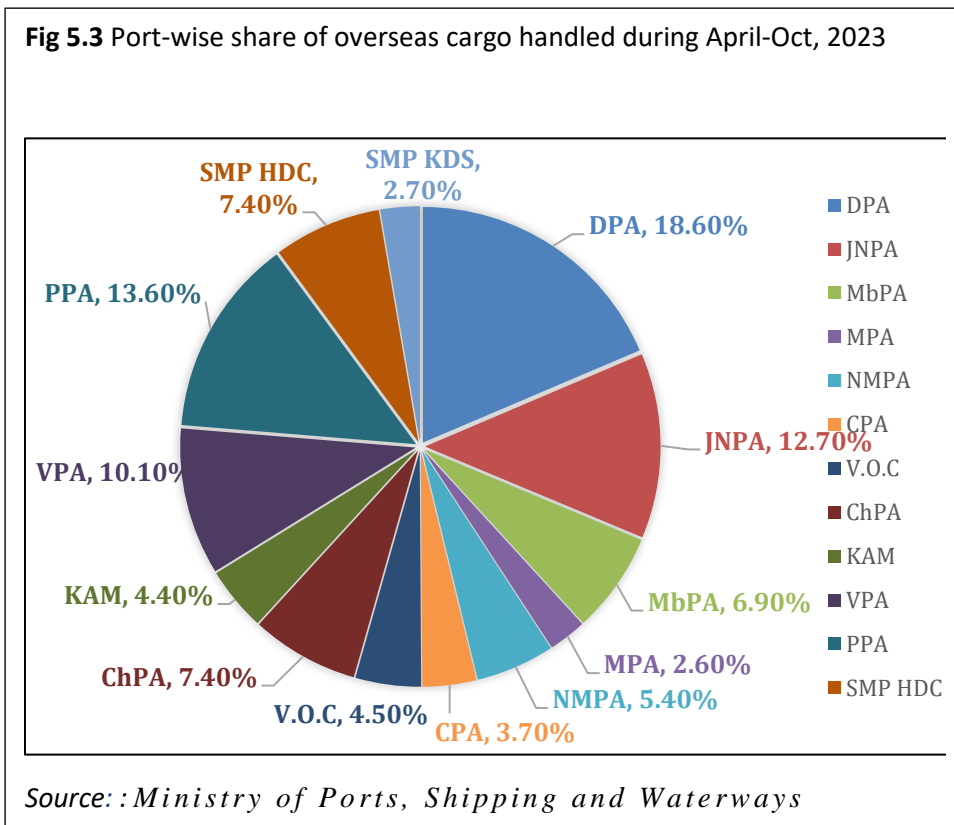
5.5 CARGO TRAFFIC HANDLED AT MAJOR PORTS DURING AND UP TO JANUARY, 2024

Total Cargo traffic at India’s Major Ports Maritime transport activity is driven by developments in the world economy, viz, growth in world output and trade. Thus, the volume of seaborne cargo traffic handled by ports is mainly shaped by the levels and changes in both global and domestic activity. Cargo traffic at India’s 12 major ports during April-January, 2023-24, increased by 4.8% to 677.22 million tonnes from 646.22 million tonnes of cargo handled during April-January, 2022-23. The Overseas cargo handled at Major Ports increased by 5.2% from 497.41 million tonnes during April- January 2022-23 to 523.34 Million tonnes handled during April- January 2023- 24. The Coastal Cargo handled at Major ports also increased by 3.4% from 148.81 million tonnes during April- January 2022-23 to 153.87 million tonnes handled during April- January 2023-24.



INTERPRETATION

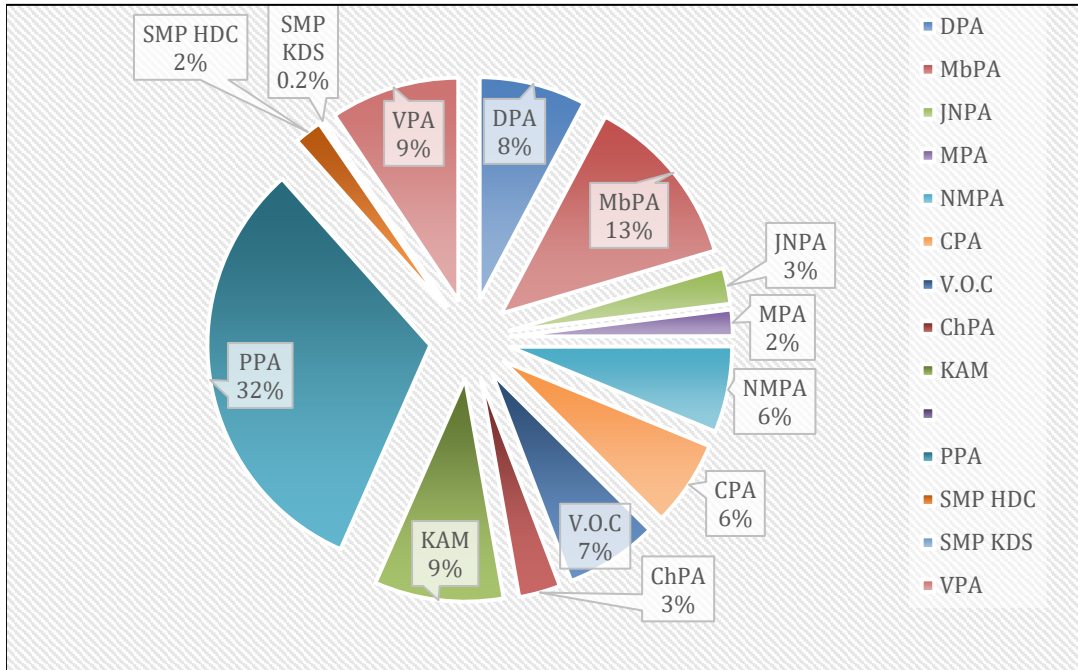
- Amongst the 13 major ports, Paradip Port handled the maximum cargo traffic of 14.33 million tonnes with a share of 19.8% in the total cargo handled at Major Ports followed by Deendayal Port (14.6%), Vizag Port (10.1%), JNPA (9.3%), Mumbai Port (7.2%), Chennai Port (6.4%), SMP Haldia Dock Complex (6.3%), NMPA (6.1%), Kamarajar Port (5.2%), VOC Port (5.0%), Cochin Port (4.6%), Mormugao Port (3.4%) and SMP Kolkata Dock System (1.9%).



INTERPRETATION

Amongst the Major Ports, Deendayal Port handled the maximum Overseas Cargo of 97.32 million tonnes with a share of 18.6 % followed by Paradip Port (13.6%), JNPA (12.7%), Vizag Port (10.1%), SMP Haldia Dock (7.4%), Chennai Port (7.4%), Mumbai Port (6.9%), NMPA (5.4%), VOC Port (4.5%), Kamarajar Port (4.4%), Cochin Port (3.7%), SMP Kolkata Dock (2.7%) and Mormugao Port (2.6%) during April- January 2023-24.

Fig 5.4 Port-wise share of Coastal cargo handled during April-Oct, 2023-24



Source: Ministry Of Ports, Shipping and Waterways

INTERPRETATION

- Amongst the Major Ports, Paradip Port handled the maximum Coastal Cargo of 48.66 million tonnes with a share of 31.6% followed by Mumbai Port (12.6%), Kamarajar Port (9.3%), Vizag Port (9.3%), Deendayal Port (7.7%), Cochin Port (6.9%), VOC Port (6.7%), NMPA (6.2%), Chennai Port (3.0%), JNPA (2.6%), SMP Haldia Dock (2.0%), Mormugao Port (1.9%) and SMP Kolkata (0.2%) during April- January, 2023-24

TABLE-5.1: PORT-WISE MONTHLY CARGO TRAFFIC HANDLED

(In '000 Tonnes)											
S. No.	Name of Ports		January,2023(P)		January,2024(P)		April-January, 2022-23 (P)		April-January, 2023-24 (P)		% Change {(Col.10/Col.8 -1) *100}
			Cargo handled	% share	Cargo handled	% share	Cargo handled	% share	Cargo handled	% share	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	SMP Kolkata	Overseas	6030	11.3	5655	10.2	48934	9.8	52628	10.1	7.6
		Coastal	422	2.5	301	1.7	4809	3.2	3363	2.2	-30.1
		Total	6452	9.2	5956	8.2	53742	8.3	55991	8.3	4.2
	KDS	Overseas	1724	3.2	1358	2.5	13243	2.7	14005	2.7	5.8
		Coastal	28	0.2	14	0.1	337	0.2	354	0.2	5.0
		Total	1751	2.5	1371	1.9	13580	2.1	14359	2.1	5.7
	HDC	Overseas	4306	8.0	4298	7.8	35691	7.2	38623	7.4	8.2
		Coastal	394	2.4	287	1.7	4471	3.0	3009	2.0	-32.7
		Total	4701	6.7	4585	6.3	40162	6.2	41632	6.1	3.7
2	Paradip	Overseas	7613	14.2	8763	15.9	62336	12.5	71187	13.6	14.2
		Coastal	4858	29.3	5564	32.3	46946	31.5	48663	31.6	3.7
		Total	12470	17.8	14328	19.8	109282	16.9	119851	17.7	9.7
3	Visakhapatnam	Overseas	4987	9.3	5658	10.2	46177	9.3	53078	10.1	14.9
		Coastal	1518	9.2	1644	9.5	15456	10.4	14250	9.3	-7.8
		Total	6505	9.3	7302	10.1	61632	9.5	67328	9.9	9.2
4	Kamarajar	Overseas	1849	3.5	1922	3.5	21632	4.3	22958	4.4	6.1
		Coastal	1891	11.4	1851	10.7	14707	9.9	14260	9.3	-3.0
		Total	3740	5.3	3773	5.2	36339	5.6	37218	5.5	2.4
5	Chennai	Overseas	4245	7.9	4044	7.3	36102	7.3	38501	7.4	6.6
		Coastal	517	3.1	628	3.6	4958	3.3	4554	3.0	-8.1
		Total	4762	6.8	4672	6.4	41060	6.4	43055	6.4	4.9
6	V.O.C.	Overseas	2232	4.2	2513	4.6	21123	4.2	23556	4.5	11.5
		Coastal	1450	8.7	1086	6.3	10273	6.9	10346	6.7	0.7
		Total	3681	5.3	3599	5.0	31395	4.9	33902	5.0	8.0
7	Cochin	Overseas	1811	3.4	2182	4.0	18984	3.8	19603	3.7	3.3
		Coastal	923	5.6	1144	6.6	9025	6.1	10623	6.9	17.7
		Total	2734	3.9	3326	4.6	28010	4.3	30226	4.5	7.9
8	New Mangalore	Overseas	2751	5.1	3241	5.9	26087	5.2	28107	5.4	7.7
		Coastal	1035	6.2	1212	7.0	7626	5.1	9472	6.2	24.2
		Total	3786	5.4	4453	6.1	33712	5.2	37579	5.5	11.5
9	Mormugao	Overseas	1421	2.7	2113	3.8	12666	2.5	13855	2.6	9.4
		Coastal	150	0.9	385	2.2	1090	0.7	2981	1.9	173.4
		Total	1571	2.2	2498	3.4	13756	2.1	16836	2.5	22.4
10	Mumbai	Overseas	3659	6.8	3314	6.0	33890	6.8	35896	6.9	5.9
		Coastal	1924	11.6	1903	11.0	18924	12.7	19464	12.6	2.9
		Total	5584	8.0	5217	7.2	52814	8.2	55360	8.2	4.8
11	JNPA	Overseas	7035	13.1	6303	11.4	64837	13.0	66650	12.7	2.8
		Coastal	541	3.3	418	2.4	3943	2.6	3981	2.6	1.0
		Total	7576	10.8	6721	9.3	68780	10.6	70632	10.4	2.7
12	Deendayal	Overseas	9910	18.5	9511	17.2	104648	21.0	97323	18.6	-7.0
		Coastal	1349	8.1	1099	6.4	11052	7.4	11914	7.7	7.8
		Total	11259	16.1	10611	14.6	115700	17.9	109237	16.1	-5.6
Total	Overseas	53542	76.4	55220	76.2	497414	77.0	523343	77.3	5.2	
	Coastal	16577	23.6	17236	23.8	148809	23.0	153872	22.7	3.4	
	Total	70119	100.0	72456	100.0	646223	100.0	677215	100.0	4.8	

Source: - Port Data Management Portal, Ministry of Ports, Shipping & Waterway

INTERPRETATION

- Cargo handled at India's major ports during January 2024 is 72.46 million tonnes showing an increase of 3.3% as compared to the corresponding period of the previous year. The overseas cargo handled at Major Ports increased by 3.1% from 53.54 million tonnes in January 2023 to 55.22 million tonnes in January 2024. The coastal cargo handled at Major Ports during January 2024 increased by 4.0% from 16.58 million tonnes in January 2023 to 17.24 million tonnes during January 2024.
- During January, 2024; Mormugao Port recorded the highest growth of traffic handled i.e. 59.0% followed by Cochin Port (21.6%), NMPA (17.6%), Paradip Port (14.9%), Vizag Port (12.3%), Kamarajar Port (0.9%). Major Ports that recorded negative growth are SMP Kolkata Dock System (21.7%), JNPA (11.3%), Mumbai Port (6.6%), Deendayal Port (5.8%), SMP Haldia Dock Complex (2.5%), VOC Port (2.2%) and Chennai Port (1.9%).
- During April- January 2023-24, Mormugao Port recorded the highest growth of 22.4% in traffic handled at Major Ports followed by NMPA (11.5%), Paradip Port (9.7%), Vizag Port (9.2%), VOC Port (8.0%), Cochin Port (7.9%), SMP Kolkata (5.7%), Chennai Port (4.9%), Mumbai Port (4.8%), SMP Haldia Dock (3.7%), JNPA (2.7%) and Kamarajar Port (2.4%). Major Port that recorded negative traffic growth is Deendayal Port (5.6%) during April-January, 2023-24 and April-January, 2022-23 (Table 5.1).

Table 5.2 Commodity-Wise Growth Of Cargo Traffic										
Commodities	(In '000' Tonnes)									
	January,2023(P)		January,2024(P)		April-Jan 2022-23 (P)		April-Jan,2023-24(P)		% Change {{(Col.8/Col.6-1)* 100}}	
	Cargo handled	% share	Cargo handled	% share	Cargo handled	% share	Cargo handled	% share		
POL Crude	13932	19.9	14897	20.6	133240	20.6	139344	20.6	4.6	
POL Products	4632	6.6	5049	7.0	47251	7.3	50708	7.5	7.3	
LPG or LNG	1377	2.0	1589	2.2	13324	2.1	13617	2.0	2.2	
Edible Oil	1178	1.7	848	1.2	10167	1.6	9831	1.5	-3.3	
FRM-Liquid	592	0.8	451	0.6	5592	0.9	5246	0.8	-6.2	
Iron Ore Pellets/ Fine	5520	7.9	6753	9.3	35421	5.5	49369	7.3	39.4	
Other Ores	723	1.0	531	0.7	6314	1.0	6983	1.0	10.6	
Thermal Coal	8212	11.7	9596	13.2	88838	13.7	92120	13.6	3.7	
Coking Coal	4027	5.7	2974	4.1	33332	5.2	30304	4.5	-9.1	
Other Coal	3669	5.2	4157	5.7	34591	5.4	37870	5.6	9.5	
Fertilizer	769	1.1	391	0.5	6813	1.1	6935	1.0	1.8	
FRM-Dry	724	1.0	850	1.2	6976	1.1	7711	1.1	10.5	
Food Grains excluding Pulses	490	0.7	90	0.1	5732	0.9	1034	0.2	-82.0	
Pulses	130	0.2	77	0.1	541	0.1	661	0.1	22.2	
Sugar	609	0.9	465	0.6	2806	0.4	2453	0.4	-12.6	
Cement	313	0.4	282	0.4	2861	0.4	2364	0.3	-17.4	
Iron and Steel	1090	1.6	1263	1.7	7535	1.2	9142	1.3	21.3	
Project Cargo	91	0.1	75	0.1	695	0.1	693	0.1	-0.3	
Container	Tonnes	15289	21.8	14624	20.2	141037	21.8	150335	22.2	6.6
	TEUs (in 000 nos.)	1008	-	995	-	9454	-	10171	-	7.6
Others	6752	9.6	7494	10.3	63157	9.8	60495	8.9	-4.2	
Total	70119	100.0	72456	100.0	646223	100.0	677215	100.0	4.8	

Source: - Port Data Management Portal (PDMP), Ministry of Ports, Shipping & Waterways

INTERPRETATION

By analysis, this on Table At a broad commodity level, Iron Ore pellets/fine recorded the highest growth in traffic during April- January 2023-24 at 39.4% followed by Pulses (22.22%), Iron & Steel (21.3%), Other Ores (10.6%), FRM-Dry (10.5%), Other Coal (9.5%), POL-Products (7.3%), Container (6.6%), POL-Crude (4.6%), Thermal Coal (3.7%), LPG/LNG (2.2%). Fertilizer (1.8%). Foodgrain excluding Pulses recorded the highest negative growth of 82.0% followed by Cement 17.4%, Sugar 12.6%, Coking Coal 9.1%, FRM-Liquid (6.2%),

Other Commodities 4.2%, Edible Oil 3.3% and Project cargo 0.3% over April-January, 202.

• Amongst all the commodities, Container handled the maximum cargo of 150.34 million tonnes with a share of 22.2% followed by POL-Crude (20.6%), Thermal coal (13.6%), Others commodities (8.9%), POL Products (7.5%), Iron ore/Pellets (7.3%), Other coal (5.6%), Coking coal (4.5%), LPG/LNG (2.0%), Edible oil (1.5%), Iron & Steel (1.3%), FRM Dry (1.1%), Other Ores (1.0%), Fertilizer (1.0%), FRM liquid (0.8%), Sugar (0.4%), Cement (0.3%) Food grains excluding Pulses (0.2%), Project Cargo (0.1%) and Pulses (0.1%) during April- January 2023-24.

• At a broad commodity level, Iron-ore/Pellets achieved the highest growth of 22.3% in January 2024 followed by FRM-Dry (17.4%), Thermal Coal (16.9%), Iron & Steel (15.9%), LPG or LNG (15.4%), Other Coal (13.3%), Other Commodities (11.0%), POL Products (9.0%), 2 POL-Crude (6.9%). Food Grains excluding Pulses recorded highest negative growth of 81.7% in January 2024 followed by Fertilizer (49.1%), Pulses (41.2%), Edible Oil (28.0%), Other Ores (26.6%), Coking Coal (26.1%), FRM-Liquid (23.8%), Sugar (23.7%) Project Cargo (18.2%), Cement (10.1%) and Containers (4.4%).

• At a broad commodity level, POL-Crude handled the maximum cargo traffic of 14.9 Million tonnes in January 2024 with a share of 20.6% followed by Containers (20.2%), Thermal Coal (13.2%), Other commodities (10.3%), Iron-ore/Pellets(9.3%), POLProducts(7.0%), Other coal (5.7%), Coking coal (4.1%), LPG/LNG (2.2%), Iron & Steel (1.7%), FRM-Dry (1.2%), Edible Oil (1.2%), Other ores (0.7%), Sugar (0.6%), FRMLiquid (0.6%), Fertilizer (0.5%), Cement (0.4%), Food grains excluding Pulses (0.12%), Pulses (0.11%) and Project Cargo (0.1%).

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY OF FINDINGS

These findings provide a comprehensive understanding of the current state of heavy-lift logistics in India, the challenges faced, and the strategies employed by leading firms. They also offer insights into potential improvements in planning, executing, and monitoring heavy-lift operations to increase safety, efficiency, and cost-effectiveness. These findings can serve as a basis for further research and policy recommendations in the field of heavy-lift logistics.

- **Strategic Location and Infrastructure:** Indian ports offer several advantages for global heavy-lift movements, including strategic location, extensive infrastructure, and cost-effective operations.
- **Port Upgradation:** The upgradation of port facilities with deeper channels, stronger cranes, and specialized equipment is enhancing India's capacity to handle heavy-lift cargo.
- **Dedicated Terminals and SEZs:** Dedicated terminals for oversized cargo and special economic zones with logistics benefits are attracting businesses involved in heavy-lift logistics.
- **Freight Corridors:** The development of dedicated freight corridors is improving the seamless movement of heavy-lift cargo from ports to inland destinations.
- **Planning Needs:** Heavy-lift cargo transportation requires meticulous planning due to the oversized and overweight nature of the cargo.
- **Regulatory Challenges:** Several challenges hinder heavy-lift cargo movement in India, including overhead power lines, clearances, and permit requirements from various authorities.
- **Regulatory Compliance:** Regulations play a crucial role in ensuring safe and secure transportation of heavy-lift cargo.
- **High-Speed Sealift Technologies:** High-Speed Sealift (HSS) technologies offer faster transportation methods for heavy-lift cargo.

- **Infrastructure Limitations:** Infrastructural limitations in Indian ports hinder ODC movement.
- **Risk Management:** Common challenges in heavy-lift cargo management include route planning, packing and securing cargo, navigating customs clearance, risk management, and project management expertise.

6.2 SUGGESTIONS

Suggestions for Handling Heavy-Lift Cargo: Seek assistance from the Industrial experts before jumping into solving problems -During all aspects of Heavy-Lift Cargo (HLC) movement planning and movement implementation- seek assistance from the professionals and experts.

- Project planning - Always provide adequate importance and time to project planning and review of the total project logistics requirements for the Heavy Lift Cargo (HLC) movement.
- Transportation analysis- determining the best transportation scenario for our type of Heavy Lift Cargo, Forecasting the practical needs, and improvising the professionalism and technical know-how incompatible with the circumstances.
- Project logistics plan - developing a logistics plan to meet the safest Heavy Lift Cargo delivery goals.
- Optimization - design and implement optimal logistics solutions specific to project Heavy Lift Cargo Transportation goals and costs. Execute the logistics plan, with consistent client updates and optimize for any changes to meet client demands and scheduling.

Active open dialog between engineering, project management, procurement, and logistics is a key factor for overall project success. The early involvement of logistics concerns can significantly affect the optimization of transportation and logistics costs. By implementing a comprehensive logistics plan the overall project efficiencies are greatly enhanced, and traditional logistics' impediments are minimized.

Foresight-driven, smart, sensory, adaptive, reproductive, and responsive types of heavy-lift cargo transportation planning would be ideal. The Heavy Lift Cargo (HLC) transportation planning has to be responsive to the growing

6.3 CONCLUSIONS

This project is a detailed investigation of heavy cargo handling, logistics planning, selection of transport routes optimizing the plan, and reducing risks. With a deep investigation, it is understood that we need to consider various factors while transporting Heavy lift cargo.

It is required to think of various parameters for the transportation of heavy lift cargo and we need to get permission from all the authorities involved for safe movement. And it is necessary to consider the health and safety aspects of people to avoid casualty.

This project will provide an idea of various difficulties in heavy-lift transportation and methods to follow to implement successful transportation of Heavy-lift cargo. Challenges do exist because every cargo is unique and handling may vary and these can be overcome by getting trained in heavy-lift handling. Attending seminars and understating various case studies of heavy lift shipments.

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