A Study on the Performance of JSW Terminal Kamarajar Port Limited – Chennai.

Submitted for the partial fulfilment of the requirement for the degree of

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In

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Submitted By

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DECLARATION

I, **GIRIPRASANTH D (Registration No.: 2005305015)** student of School of Maritime Management, **INDIAN MARITIME UNIVERSITY-KOCHI** hereby declares that this project report titled **"An Efficient Improvement of Cargo Handling Capacity at JSW Terminal, Kamarajar Port Limited - Chennai "** submitted in partial fulfilment of the requirement for the degree of "**Master of Business Administration in International Transportation and Logistics Management"** is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any degree or associate ship of any University/Institution. The information submitted is true and original to the best of my knowledge.

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DATE :

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I perceive this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives and hope to continue cooperation with all of you in the future.

CONTENTS

GLOSSARY

BOT	Build operate Transfer
KPL	Kamarajar Port Limited
TEU	Twenty Equivalent Unit
TNEB	Tamil Nadu Electricity Board
NHAI	National Highway Authority of India
TANGEDCO	Tamil Nadu Generation and Distribution Corporation
DWT	Dead Weight
TPH	Tons Per Hour
MMTPA	Million Metric Ton Per Annum
QC	Quay Crane
RTGC	Rubber Tyred Gantry Crane
MTPA	Metric Ton Per Annum
KL	Kilo Liter
MPH	Moves Per Hour
TPH	Tons Per Hour
Hrs.	Hours

1.INTRODUCTION

1.1.INTRODUCTION

Port and terminal have to adapt fast to meet rising demand driven by the rapid expansion in world trade during the 21st century. Globalization has put port models under growing pressure in increasingly competitive cargo markets. Better productivity - through expansion or more efficient use of existing assets - is crucial for economic survival by examining all operational aspects of port functions, from financing, legal concerns and planning through to operations, marketing, competition, equipment and infrastructure.

Looking at ownership models and the trends in privatization, Port and Terminal Management analyses the management techniques that can improve services and maximize profit potential. The age-old issue of labor efficiency is weighed against the growing use of automation, while the effects of trade specialization and larger ships are also use to seek attention for improvement of terminal activity.

The demand for shipping services has increased due to the booming e-commerce industry, which has led to an increase in cargo volumes at ports, leading to an increase in port infrastructure needs. Ports and terminal operations are the business of moving products, especially loaded or unloaded cargo containers within a port. Terminal Operations are part of the supply chain process that begins with purchasing raw materials to

manufacture products for sale. Ports play an important role in transporting goods between countries via ships that use different modes of transportation such as road, rail, or air transport systems.

In the last four decades the container and cargo capacity as an essential part of a unit-load-concept has achieved undoubted importance in international sea freight transportation. With ever increasing cargo capacity, the number of seaport terminals and competition among them have become quite remarkable. Operations are nowadays unthinkable without effective and efficient use of information technology as well as appropriate optimization and operations research methods. It can act as a catalyst for economic growth, creating competitive advantage by providing greater customer satisfaction, positive image and reputation and providing better opportunity to export their products in global countries . In this Study we describe about the port and terminal infrastructure and present a survey of methods for their optimization.

1.2.STATEMENT OF PROBLEM

During the period of the industry's extensive growth, most investments were made in infrastructure and reloading equipment. However, when terminals reached freight volumes of about 200,000 to 300,000 TEUs per year, they generally encountered significant difficulties Related to the inability to manage customer documentation processes at the terminal. As a result, it took longer for the terminals to handle vessels, and there appeared

long lines of trailers stretching out for many kilometers, waiting their turn before the terminal gates. It was obvious that by simply investing in equipment only, it was impossible to really improve terminals' operational efficiency. Instead, they could focus on proper utilization of existing resources which can reduce the loss of time and money to resolve the inefficiency problem.

1.3.OBJECTIVE

The following are the objectives of the study, which throw light on the essence of the study.

- To undertake the performance evaluation of Port Terminal.
- To understand the role Equipment's and Infrastructure.
- To analyze the requirement of any addition Investment to improve Efficiency.
- To study the challenges and Solutions of the terminal can take over.

1.4.SCOPE OF STUDY

The study was aimed to overview and to know about the performance evaluation of port terminal operation. This Comprehensive overview covers mainly following areas;

- **Planning operations efficiently** - It is dedicated to a range of tasks, including container site management; loading and unloading operations, cargo positioning, editing terminal topology, and so on.

- **Increasing turnover** - It is a real-time management solution for cargo handling terminals, capable of increasing the performance of reloading equipment, optimizing technology operations, and providing the reliable and transparent data handling tools to ensure accurate planning and quick responsiveness to process changes.

- **Simplifies Inventory Management** - It makes it possible for to keep track of the inventory and manage it better than its physical presence.
- **Increases Opportunities for Scalability** - It makes easier for new companies in the shipping business to grow and expand to new regions.
- **Generates Data** - Shipping generates data, whether it's from customers or from processes within your shipping business itself. Maximizing the amount of data generation will help to take better business decisions.

1.5.SIGNIFANCE OF STUDY.

As terminals, it handles the amounts of freight in the port. For handling freight, port infrastructures jointly have to accommodate transshipment activities both on ships and inland and thus facilitate convergence between land transport and maritime systems. The sources of their competence and the range of their influence extend over the sea and also inland. This Study shows about the proper utilization of existing resources with proper planning will execute the increase in productivity as well as the performance.

1.6.RESEARCH METHODOLOGY.

Research methodology is the way in which the study has been done. The study is based on secondary data relating to Terminal Operation. The data was collected from various articles, magazines and Port website. This methodology is the systematic and theoretical analysis which the study has been done. The different aspects of research methodology the research fellow followed is described below:

1.6.1.SOURCE OF DATA

The information necessary for the study is collected by the researcher from secondary resources, such as annual reports, websites, journal, books etc. Secondary data analysis saves time that would otherwise be spent collecting data and, particularly in the case of quantitative data, provides larger and higher-quality databases that would be unfeasible for any individual researcher to collect on their own.

1.6.2.STATISTICAL TOOLS USED

For the Study, I adopted the tools like Simple Calculation used for easy and quick interpretation of data. The use of Calculation is used for comparing the existing and required capacity to find out the gap and estimating the future requirements. But it may change because industry and economic conditions change constantly.

1.7.LIMITATION

There are some limitations for this study that they are:

- Information gathered highly reliable on secondary data.
- The study is limited to theoretical explanation and these theories have to be implemented for further process will be difficult .
- For the Implementation of this study need some Financial Investment.

2.INDUSTRY PROFILE

2.1.TYPES OF PORTS

Considering a variety of factors such as location, depth, purpose, and ship sizes, ports are classified into various types.

There are five major types of ports, they are:

1. Inland port.

2. Fishing port.

3. Dry port.

4. Warm water port and

5. Seaport – Seaport is further classified into 4 types, they are:

- Cargo Port.
- Bulk cargo port.
- Cruise home port.
- Smart port.

2.1.1.INLAND PORT

Inland ports are built on small water bodies such as rivers or lakes. They can be used either for handling cargo or as passengers ferry or as both.

These inland ports may or may not connected to the main sea. The connection may be by rivers and canals.

INLAND PORT IN INDIA.

- Varanasi Multi-Modal Terminal, Varanasi, Uttar Pradesh
- Farakka Port, Farakka, West Bengal
- Dhubri Port - Dhubri, Assam
- Kolkata Port, West Bengal
- Haldia Inland Port, Haldia, West Bengal
- Sahebganj Multi-Model Port, Sahebganj, Jharkhand.

2.1.2.FISHING PORTS

Fishing port are mainly related to the fishing related activities. A fishing port can be an inland port or seaport.

2.1.3.DRY PORTS

Dry port is a yard used to place containers or conventional bulk cargo, usually connected to a seaport by rail or road. Dry ports are also known as inland terminals that can be interconnected with a seaport through the rail or road transport mode. Dry ports act as a center for multimodal transport system. Dry ports often useful for reducing the traffic in seaport. Mostly the dry ports are located within the range of 25 km from the main seaport. The cargos like containers which are to be loaded in vessel will be stored

here. All the customs related activities are also completed in these dry ports. Then while nearing the date, the respective container/cargo will be transported to the seaport through rail or roadways.

2.1.4.WARM-WATER PORTS

A warm-water port is one where the water does not freeze in wintertime. Because they are available year-round, warm-water ports can be of great geopolitical or economic interest. A warm water port allows you to carry on trade and commerce throughout the winter.

2.1.5.SEA PORTS

These are the most common types of ports and are used for commercial shipping activities all over the world. The ports are built in an area that can accommodate both small and large vessels. They are set along the coastline so that they can easily handle cargo transactions.

- **CARGO PORTS**

  Cargo ports are quite different from cruise ports, because each handle very different cargo, which has to be loaded and unloaded by a variety of mechanical methods.

- **BULK CARGO PORTS**

The difference between cargo ports and bulk cargo port is that, the bulk cargo ports will handle one particular type of cargo as well as variety of cargos such as grains, liquids, coals, fuelwoods, steels, chemicals, etc.

- **CRUISE HOME PORTS**

The cruise home ports are the port where passengers are boarded into the ships. It is used to transport people from one place to another. The transport may be taken place from one place to another within the nation or internationally. Six of India's major ports are being developed as world-class cruise terminals.

- These ports are Mumbai, Goa, Kochi, New Mangalore, Tuticorin and Chennai. In four of them, terminals for cruise liners are ready, but they require additional infrastructure for passengers to have a smooth entry into the city.

- **SMART PORTS**

As the technology is developing day by day, the port should also be able to handle the new technology like internet of things to store the data. The automation of the ports will help in efficient handling of cargo's.

2.2.PORT HISTORY.

- The New Ennore Port was declared as a Major Port under India Ports Act 1908.
- This is the **first Corporatized Port** in India.
- Ennore Port Limited has already been incorporated under the Indian Companies Act 1956 to manage the affair of the new port.
- Ennore Port Limited has been concurrently name changed as Kamarajar Port Limited.
- As a Corporatized Port, Kamarajar Port will be operating on a Landlord concept.
- The Port will provide only the basic infrastructure like Dredging the basin, provision of Navigational / firefighting facilities, supply of water and electricity etc.
- The development of berth and terminal will be on BOT basis by the prospective entrepreneurs.
- The Ennore Port Limited will let out the terminal to the private agencies.
- The company will, however, maintain the Marine services and common user facilities.
- The company has adopted the landlord concept for port development and management. As a Landlord Port KPL mobilizes and invests in the creation of waterside facilities

2.3.PORT STRATEGY

The various strategies adopted by KPL seek to address the following aspects so that KPL remains strong to face emerging changes with confidence, they are:

1. Development Strategy.
2. Commercial Strategy.
3. Financial Strategy.

2.3.1.DEVELOPMENT STRATEGY

- Develop cargo handling terminals through private sector participation with a view to bring in various required resources at the shortest time i.e., by public private partnership mode.
- Finance the required capital dredging and essential road and rail connectivity works.
- Develop in-house manpower to achieve optimum and effective core strength.
- Outsource specialized expertise as and when required.
- Monitor and co-ordinate the activities among the BOT operators, KPL and interfacing Departments/Agencies to maintain the time frame.
- Continuous market studies and updates for future development and operations.

- Co-ordinate with State and Central Government departments to improve access roads and rail connectivity.
- Act as an enthusiastic business facilitator.

2.3.2.COMMERCIAL STRATEGY

To ensure proper mix of cargo so as to have even dependence on all sectors of economy.

- Maximize utilization and revenue earnings of the existing dedicated coal berths of TNEB, BOT operator's terminals such as Marine liquid, Common User coal Terminal & Iron Ore Terminal and a own Car export terminal cum General cargo berth.
- Optimal utilization of land and waterfront.
- Form joint ventures/Strategic partnership with stakeholders to increase port throughput and connectivity.
- To explore new Ports for Joint Venture / Strategic partnership.

2.3.3.FINANCIAL STRATEGY

- Mobilize private sector funding for developing cargo terminals.
- Mobilize funds for development / expansion from market borrowings through loans and bonds.

- Invest in Joint Venture Companies / activities developed by State / Central/Railway / NHAI for augmenting the road and rail connectivity to and from the Port.

2.4.BERTH OVERVIEW.

The Kamarajar port was constructed to the handle coal for the power supply of Chennai since the Chennai port which is located in the main part of city and the coal operations might disrupt the urban activities and cause harm to the people and environment the government decided to go with construction of a port in the outer area.

So, the initial purpose of the port was to handled coal import for the TANGEDCO and the port started diversifying its activities, other terminals and berths were constructed andnow handles liquid, automobiles and other bulk cargoes.

The Kamarajar port has totally comprised of 8 berths out of which only 1 berth is under the control of KPL. The other 7 berths are leased for a period of 30 years to private under the Public Private Partnership. Let's take a look into the details of each berth briefly.

2.5.BERTH DETAILS

2.5.1.COAL BERTH - 1 & COAL BERTH -2

- The coal berth has been built basically to meet the needs of the TANGEDCO nearer to the port. The existing coal terminal at Kamarajar Port consists of two berths for accommodating each of 280m long two coal carriers of up to 77,000 DWT for the exclusive handling of coal required by Tamil Nadu Electricity Board for its thermal power plants at North Chennai, Ennore and Mettur.

- The berth dimensions are 280m long, 27m wide and 14.5m deep which can accommodate two coal carriers up to 77000 DWT.

- 2 shore-based gantry type Cranes for each berth which have an average grab capacity of 2000 TPH. Safe Unloading Load was 42 tons.

- Two conveyor belts capacity of 4000 TPH each which carry the thermal coal from the hopper to the TNEB stackyard, there is no stacking area for coal with the port so the coal is moved directly from the berth to the stacking yard from where a part of it is moved to Ennore and Mettur through rail.

2.5.2.CHETTINAD INTERNATIONAL COAL TERMINAL PVT LTD [OR] JSW TERMINAL

- Ennore Coal Terminal Private Limited [ECTPL] formerly known as Chettinad Coal Terminal is located in Ennore Port.
- ECTPL is state of the art fully mechanized terminal having a capacity of 8 MMTPA. The terminal has a berth which is 347 meters long can handle vessels up to 16.00 meters. The terminal can handle coal and coke cargo.
- Currently the CICTPL is owned and operated by JSW Infrastructure Limited as it acquisitions with Chettinad Groups Port business which includes both International Coal terminal and bulk terminal.

2.5.3.GENERAL CARGO BERTH [GCB].

- The General cargo berth which is situated in Kamarajar port is the second largest car exporting port in Asia next to Shanghai Port.
- Its general cargo berth is owned by the Kamarajar Port Ltd.
- This berth will be able to accommodate the world's largest car carrier of capacity of 8,000 cars.
- Further it has a parking area of 2,00,000 Sq.m with an expansive car parking yard for 13500 cars which is the largest facility in any Indian Port.

- Most of the famous automobile companies like Ford, Toyota, Daimler, Caterpillar, Nissan, are exporting their cars & heavy vehicles through KPL.
- Kamarajar Port entered into an agreement with M/s. Nissan Motor India Pvt Ltd., M/s Ford India Pvt Ltd., & M/s. Toyota Kirloskar Motor India Pvt Ltd., to export cars.
- In order to provide required terminal link facilities within the port, Port has constructed the berth as well as a car parking yard on its own with internal resources.

2.5.4.ADANI ENNORE CONTAINER TERMINAL (AECTPL).

- M/s. Adani Ennore Container Terminal Pvt Ltd (AECTPL) located inside Kamarajar Port, Ennore is operating container berth and handling containerized Import/Export cargoes.
- With a view to facilitate development of world class terminal facilities well suited to meet the present and future needs of the trades, Kamarajar Port has decided to develop the container terminal of Quay length of 730 m in straight line with 15m Draft.
- Length – 400m. Draft – 15m. Capacity - 16.80 MMTPA

- Four dockside gantry cranes(4QCs) for loading and discharging operation.
- 12 e-RTGs (Rubber-tyred gantry cranes) for stacking the container in storage yard.
- 36.50 Ha of backup yard segregated into different section for the smooth handling of general cargo containers, reefers, dangerous goods etc.
- Capable of handling both 20ft and 40ft containers.

2.5.5.CHETTINAD INTERNATIONAL BULK TERMINAL [CIBT]

- Ennore Bulk Terminal Private Limited formerly known as Chettinad International Bulk Terminal is located in Ennore Port.
- EBTPL is a state of the art fully mechanized terminal having a capacity of 2 MMTPA. The terminal has a berth which is 270 meters long and can handle vessels up to 14.50 meters draft. The terminal can handle Clean Cargo other than Coal, Iron Ore, POL and Automobile units.
- In order to cater to the EXIM traffic of Bulk and Project Cargos like Turbine & Generators, windmill etc., imports of Fertilizer/ wooden logs Port has initiated for development of Multi-Purpose Cargo Terminal for handling dry, bulk and project cargos other than Coal,

Iron Ore, POL and Automobile units, on DBFOT (Design, Build, Finance, Operate and Transfer) basis.

- The terminal deploys harbour mobile cranes (2 Nos.) for the discharge of cargoes from/ to the vessels at the rate of 400-800 tonnes per hour, depending on the cargo.

2.5.6.MARINE LIQUID TERMINAL [MLT]

- Marine Liquid Terminal -1 is one of the major terminals in KPL with a capacity of 3 MMTPA, began its commercial operation in 2009 on BOT basis.
- Ennore Tank Terminal Pvt Ltd is the BOT operator of MLT-1 formed by IMC (89%shares) and L&T (11% shares). ETTPL is subsidiary of IMC LTD, which is the largest bulk cargo company in India. BPCL, HPCL, Shell are the major service users of ETTPL.
- Multiple pipelines for the transfer of cargo between vessel and shore tank, large pipeline for faster loading and discharging operations
- India's first independent bulk terminal project developed under BOT basis.
- Simultaneous berthing of two vessel can be done.
- Special facilities such as inert gas blanketing, heating, refrigeration, coated tanks, stainless steel tanks shall be provided on specific request.

TANK FARM.

- The tank farm is located in 33 acres of land within the port security. There are 64 storage tanks of various size.
- These can store class A/B/C petroleum products, vegetable oil, petrochemicals, biofuels, acids and other safe class liquids. Each tank varies in size, ranging from 860 KL to 12,300 KL suitable for all kinds of liquid products.
- All enclosure has their own truck loading bay with loading gantries. There are stainless steel tanks and internally coated tanks for handling specialized products. The storage terminal is equipped for both import and export operations.

Tank terminal has a total storage capacity of 2,52,990 KL.

2.5.7.LIQUEFIED NATURAL GAS (LNG) TERMINAL.

- IOC through its joint venture company Indian Oil Pvt Ltd signed a concession agreement with KPL for the construction of LNG import terminal on captive basis. The commercial operations began in 2019.
- Built at a cost of INR 5151 crores with a capacity of 5 MTPA for import, storage and regasification of LNG.
- Dimensions – 300m long and 14.5 m depth and 520000 sqm backup

yard.

- First LNG terminal on East Coast of South India.

The terminal will meet the fuel requirements of Chennai Petroleum Corp, Tamil Nadu petroproducts, Manali petrochemicals and Madras fertilizers

2.6.FINGER JETTY

It is the jetty that is being used for berthing of mooring launchers, pilot launch and tugs in KPL. These boats are generally called as crafts. These are hired by KPL on the basis of concession agreement and offer pilotage services to their respective terminals.

KPL has the following crafts in its finger jetty.

- Mooring Boat – JALSASHREE-1 and JALSASHREE-2 are the two mooring launches used in KPL for mooring operations of vessel.
- Pilot Launch – ABS DANIKA & ABS DHRUVA is the pilot launch, which used to carry pilot to the vessel that entering KPL.
- Tugs - Tugs are used to assist the vessel, while entering and leaving the port, LIBERTY, OCEAN THUNDER, OCEAN STAR and OCEAN SUCCESS are the tugs.

3.DATA INTERPRETATION

3.1.PROPOSED ANALYSIS.

In general, every production process is sized according to the capacity of its constraining resources, which is usually equipment that requires greater investment. A port operation should operate in the same way, in which the constraints dictating the operational capacity are the cargo handling equipment (Gantry crane, Mobile Harbor Crane, etc.).

The primary function of the back office is to provide the necessary conditions to maximize the utilization of the resources, and thereby increase the Moves Per Hour of the operation. Besides being the main operational efficiency indicator, Moves Per Hour also serves as a commercial tool to attract shippers, and freight forwarders, who seek to minimize the time of the ship standing at the port and avoid additional demurrage costs.

Major dry bulk commodities include iron ore, coal, and grains. They are not homogeneous as there are several grades of coal used for making steel (coking coal) and energy generation (steam coal).

Each represents a different market, implying a segmentation of the bulk trades. Further, there is an important directionality to bulk trade, implying that export bulk terminals are designed rather differently from import bulk terminals.

Import terminals for coal and iron ore use unloaders equipped with large grabs to discharge the commodities. There are several types of quay cranes and grabs available. The choice of the crane type depends on the operational needs of the terminal operator in terms of ship sizes to be served and minimum cargo handling productivity in tons per hour.

Conveyor systems transport the discharged commodities along the quay and onto the yard. As import terminals usually handle multiple types and grades of major bulks, stockpiles of bulk material are spread across the yard. The terminal surfaces of import terminals are quite large to avoid cross-contamination between stockpiles and comply with necessary certification requirements.

Stacker reclaimers are used to transport the bulk products from the yard to the loading stations for seagoing vessels, inland barges, and railcars.

Dust control is a key concern at dry bulk terminals. Whenever a transfer of coal or iron ore occurs, there is a potential to break the lumps, resulting in dust, which can be spread by crosswinds. Once the coal or iron ore is stockpiled, dust can still be a problem. Even if it arrives wet, wind across the stockpile can evaporate the moisture and dust will be lifted. Any vehicles driving over crushed lumps will also raise dust. Several measures are taken to reduce dust emission, such as:

- Dust covers on grabs and conveyors.

- Fogging systems that release small droplets of water into the air, forcing dust to precipitate.
- Sprinkler systems spray water on stockpiles to keep them damped down. This includes an adapted drainage system and on occasion a water recycling station.
- Optimized stockpile design such as avoiding edges that can dry quicker than a rounded surface.
- Add a protective layer over the stockpile such as a skin formed by a water additive.
- In case of loading operations in the vessel holds, loading chutes with heavy-duty dust skirts can be used in order to prevent dust cloud formation arising from the product falling onto the peak of the product pile in the hold.

3.2.HEALTH & SAFETY RISK ANALYSIS.

1.Berthing and Moving Ships

- Risk of Serious injury or death due for example to being hit by a line or falling.
- Property damage.

Possible causes:

- Collision between berthing ship and loader and/or unloader on terminal.
- Breaking mooring lines risk to personnel on ship and terminal from snap back effect.
- Passing ships causing ship to move.

2.Biological Agents

- Risk of Infection.
- Adverse health effects.
- Asphyxiation.

Possible causes:

- Presence of insects, rodents, pigeons and other vermin.
- Exposure to dust containing bacteria or fungi.
- Bacteriological action on certain cargoes.

3.Chemical Agents

- Risk of Health hazards e.g. by ingestion or inhalation.
- Asphyxiation / death.

Possible causes:

- Exposure to toxic, fumigated or corrosive cargoes:

- Failure to notify that cargo has been fumigated due to lack of communication and consultation.
- Inherent property of the cargo e.g. corrosive cargoes.
- Cargoes liable to cause oxygen depletion e.g. forest products, metals, vegetable or fruit products.
- Decomposition or bacteriological action on cargo giving rise to toxic products e.g. coal, bark, fishmeal and other types of wet fish.
- Ammonium nitrate fertilisers can explode or decompose to release toxic gases.
- Some coal products produce carbon monoxide or methane.
- Cleaning holds for grain after discharging a dirty cargo e.g. use of degreasing chemicals.
- Fumes from mechanised plants and vehicles.

4.Environmental Conditions

- This includes tidal movements, wind conditions, heat, cold, ice, wind etc.
- Risk of Increased risk of accident or incidents occurring.
- Serious injury.
- Property damage.

Possible causes:

- Gangway becoming unsafe.

- Collision between (un)loader and ship's structure or gear.
- Failure of (un)loader braking system in high winds, leading to collision with the ship.
- Runaway of (un)loader and/or cranes in high winds.
- Vessels roll affecting cargo stability.
- Passing ships affecting stability.

5.Handling Equipment

- Includes equipment such as grabs, chutes, conveyors, throwers, suction devices, augers etc.
- Risk of Impact, entrapment or entanglement resulting in serious injury or death.

Possible causes:

- Where mobile machinery is operated on top of cargo there is a risk of the machine overturning, sliding, falling or becoming damaged.
- Dangerous parts of conveyor systems not securely guarded.

6.Falling / Unsecured Objects

- Risk of Serious injury or death.

Possible causes:

- Unsafe system of work when swinging loads.

- Shifted cargo during sea passage.
- Falls of unstable cargo.
- Failure of lifting equipment or accessories e.g. during lifting and suspension of grabs.
- Material / lumps of cargo falling from the conveyor belt of the ship loader or from the discharging grab onto the deck of the ship or the quay. A number of bulk cargoes such as quartz, iron ore, pig iron and steel scrap contain sizeable lumps which could cause death or injury if they fall from a height and hit someone.
- Personnel on deck walking under the grab.
- Unsafe system and/or unsafe lifting accessories for lifting equipment from the terminal to the ship e.g. whilst lifting mobile plant from hold to hold, lifting loading chutes, spouts and arms or lifting welding and other equipment into the hold to carry out damage repairs.
- Cargoes falling from ship's structures, frames, beams, ledges and ladders.
- Personnel lowering or raising equipment in and out of holds with personnel still at work underneath.
- Personnel monitoring cargo operations standing too close to where the grab is working and at risk of being struck by grab or by a breaking grab rope.
- Unsuitable lifting accessories selected for cargo with sharp edges.

- Cargo movements as loads lifted into or out of adjacent hatches or as other vessels pass.
- Improperly secured hatch covers.

3.3.CHALLANGES.

Therefore, to increase the efficiency of a port operation it is necessary to understand what factors impact the MPH. In general, such factors can be divided into two types: internal and external. Internal factors are directly linked to the operation of the port and it is possible to identify improvement opportunities for direct action. External factors are indirect and do not allow a more effective action.

3.3.1.EXTERNAL FACTORS.

External factors are problems arising from natural causes or uncontrollable factors, in which the operation cannot act directly to prevent. This type of problem or risk should be mapped in order to find an opportunity to minimize its impacts. These factors can include:

- **Weather conditions** : Depending on the severity of climatic conditions – wind, lightning and rain – the activity should be interrupted for operational safety reasons.

- **Tide** : Ports that do not have a deep draught need to evaluate the tide tables to check whether the ship will have the conditions to dock at the berth during that period.

- **Hatches** : The MPH is related to the number of hatches on the vessel and also the distribution of containers along the vessel.

- **External cargo** : Often, even with the vessel's shipment nearly finished loading, the vessel needs to stand still for hours, or even for days, awaiting the arrival of external cargo.

3.3.2.INTERNAL FACTORS.

Internal factors are operational source issues, which need to be measured and monitored to obtain a reliable database that supports concrete improvement actions. These factors can include:

- **Obstruction of internal flows** : Obstructions increase the arrival time of the vehicle to the ported vessel and consequently expands the cycle time of the internal Structure, leaving the crane at idle.
- **Employee Shift Changeover** : The Moves Per Hour usually drops dramatically, reaching less than 50% of its capacity during the intervals between the current shift exit and the entry of the next shift.
- **Equipment failures** : Unexpected shutdown of the cargo handling crane due to the lack of preventive maintenance plan.
- **Container Cranes and Cranes Operators' Productivity** : The variation of ability between operators can generate an oscillation of up to 40% in the productivity of operations that use older equipment.

3.4.SOLUTION

To increase the efficiency of a port operation, since external factors generally cannot be addressed with direct action, efforts should be focused on improving internal factors. Some actions can be implemented to help increase efficiency according to the internal factor that is impacting the operation:

Clearing internal flows:

1. Excessive concentration of cargoes in a given area of the terminal

In this case, the planning area should distribute the cargoes to be loaded and unloaded from the ship in the rear area in a balanced manner in order to avoid a concentration of containers, vehicles, RTGs and reach stackers operating simultaneously in a single location.

2. Quantity of excess vehicles within the terminal

The planning area must control and maintain a balance between entry and exit of vehicles in the terminal to avoid obstruction of pathways and reduction of the operational capacity of the vehicle. Thus, it is necessary to know the capacity and have good control of the processes of gate in and gate out, prioritizing inputs, outputs and using reversible gates when possible.

3. Inefficient gate processes

Map the gate in and gate out process to identify opportunities for automation and increased efficiency of these activities. Check what information can be collected beforehand in order to minimize the vehicle's time in the gate.

4. Minimization of employee shift changeover time

The best way to minimize the impact of shift exchange on MPH is to measure employees at their equipment so operation does not stop. To enable this, a good practice is to install an electronic employee time attendance on the equipment itself.

5. Decrease in equipment downtime

It is essential to plan and perform preventive maintenance in order to reduce the occurrence of corrective maintenances. This planning must be carried out in an integrated manner between maintenance teams and operation teams, aligning the periods of downtime of each equipment with the needs of the operation.

Another important action is to monitor is the repair time of the equipment. It is often better to perform the immediate exchange of equipment (if you have spare equipment in stock), instead of attempting to repair it in place. A good example is the spreader, a piece of equipment that often needs maintenance (due to the high impact use), but in several situations, the time to change it is shorter than the time to repair it.

6. Encouraging healthy competition among operators

Constantly monitoring the performance of operators and publishing their productivity rankings are ways to promote healthy competition between them. The mere fact of knowing that they are being monitored and compared to each other contributes considerably to the increase in performance. Another alternative is to implement a bonus model or variable remuneration to reward operators with the best performance. Often a simple reward can bring a huge return to the operation.

Although not exhaustive, given the particularity of each operation, these actions act on points commonly found in the daily management of port operations and also serve as insights to support the identification of new opportunities for improvement.

3.5.INTERPRETATION

Features - JSW Coal Terminal.

- Capacity: 8 MMTPA.
- Developer: Ennore Coal Terminal Pvt Ltd (promoted by M/s JSW Infrastructure).
- Status: Commissioned in 2011.
- Length: 347 meters.
- Draft: 16 meters depth.

- Loading: 4 owned locomotives for placement rakes.
- Conveyor: 7.5km closed conveyor.
- Stacker Reclaimer: 2 nos. with stacking capacity of 3500 TPH and reclaiming capacity of 2000 TPH.
- Storage Space: 12nos. each stackyard – 280mtrs x 40mtrs.
- Grab Unloaders: 2 nos. with 1750 TPH capacity each.

CALCULATION.

- Average one vessel = 75,000 tons.
- Total per annum = 8 million metric tons per annum [80 Lakhs].
- Coal unloading operation (Grab 1 & 2) = 3500 tons per hour.
- Actual unloading = 3000 tons per hour (Approx.)
- Vessel average turnaround time = 52 hrs. (Approx.)
- Expected output = 10 MMTPA (Approx.)

Approximate calculation for unloading :

Unloading time

- 75,000 tons / 3,000 tons = 25 hrs + 7 hrs (Machine Rest time) = 32 hrs.
- 52 hrs - 32 hrs = 20 hrs – for maintenance and documentation process.
- 52 hrs x 12 vessel (approx.) = 624 hrs = 26 days (Maximum engaged).
- So Within a month the Terminal can handle :

  12 x 75000 = 900000 Tons.

- 1 Vessel = 75000 Tons (approx.)
- For Achieving 1 MMTPA = 10,000,000 / 75000 = 134 Vessel (Avg)
- For 1 vessel = 52 Hrs. Therefore,

  134 x 52 = 6968 Hrs = 291 Days (Approx.)
- So, 10 MMTPA is Achieved in 291 Days.

Efficiency Calculation.

- Working Days / No. of. Days in a year = 291 / 365 = 80% (Approx.)
- Terminal Working Efficiency is 80%.
- Actual output is 8 MMTPA and Estimated Output is 10 MMTPA.
- So, there will be an additional 25% Improvement from the Actual Output.

Remaining Days Calculations:

- 365 (days per year) – 291 (total working days) = 74 (free days).
- 75 Days in case of Leap Year.

In those Remaining Days they can do their Maintenance work like,

- Dredging work
- Maintenance and repair of bollards and fenders
- Conservation of road networks and pavements
- Terminal electrical system maintenance

- Maintenance of cranes and stowage equipment
- Repair of signage elements
- Repair of harbors and other structures such as dykes, piers, walkways and ramps.
- Maintenance of submerged structures.

4.CONCLUSION

Operational performance measurements focus on productivity and relate to the physical quantities of items, the levels of effort expended, the scale or scope of activities, and efficiency in transforming resources into some product or service. Indicators traditionally used to measure terminal operations efficiency or productivity include berth occupancy, revenue per ton of cargo, capital equipment expenditure per ton of cargo, turnaround time, and the number of gangs employed to facilitate cargo operations.

Such efficiency measurements span a performance continuum from maritime operations to terminal and hinterland operations. This performance is too important to be measured at the terminal level since the facilitation of cargo arriving, staying, and leaving the terminal through various bundled services is vital in integrated transportation chains. Efficiency performance is measured at the port level as well.

The efficiency of maritime access is a component of port performance, which includes average anchorage time , where ships are waiting for an available berthing slot. Long waiting times at anchorage can be the outcome of a lack of berthing slots able to accommodate specific ship classes (e.g., draft and cargo type) as well as terminal productivity issues.

Terminal operations Represent the most common performance indicator to assess port efficiency. For cargo terminal operations, this commonly

involves several key operations. Crane performance is a common bottleneck in terms of the average number of crane movements per hour.

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