"Efficacy of Automation and Sustainability in Port and Logistics Sectors"

Project Report submitted in partial fulfilment of the requirement for the award of degree of

MASTER OF BUSINESS ADMINISTRATION
In
INTERNATIONAL TRANSPORTATION AND LOGISTICS MANAGEMENT

By

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DECLARATION

I SHIVA SHANKAR U, Registration No. **2005305029**, student of **School Of Maritime Management, Indian Maritime University, Kochi Campus** pursuing **Master of Business Administration in International Transportation and Logistics Management**, hereby declare that this report titled **"EFFICACY OF AUTOMATION AND SUSTAINABILITY IN PORT AND LOGISTICS SECTOR** "has been prepared by me towards the partial fulfillment of the requirement for the award of degree of **"Master of Business Administration in International Transportation and Logistics Management"** under the guidance of my project guide **Dr.Sreeja K**. I also declare that this project report is my original work and has not been copied from any other report previously submitted for the award of any Degree, Fellowship, or other in the similar title.

Place: KOCHI **SHIVA SHANKAR U**

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Executive Summary

The use of mechanic, hydraulic, pneumatic, electric, electronic, and computerized elements or systems to control equipment and processes, thereby reducing the involvement of humans in such operations, is known as industrial automation. It allows for a reduction in human interference. In industrial activities, this allows for more precise management of the equipment and processes involved. This leads to the standardization of performance and service levels, as well as the elimination of inconsistencies. Automation reduces the operating costs and human errors due to uncertainty in reaction time. Automation takes place on a variety of scales, speeds, and locations. There are several stages of automation. Automation can be found at a wide range of port terminals, logistics industries depending on how it is defined and whether it focuses on infrastructure or information systems.

In recent decades, environmental concerns have grown and spread faster than forest fires, from country to region, region to the world, posing a significant threat to climate change and resulting in global warming. Many service operations rely on supply chain management, and it's vital that it operates efficiently while also being environmentally friendly. The sustainable supply chain concept tries to prevent environmental degradation and thereby regulate air, water, and waste pollution by adopting environmentally friendly practices for commercial operations.

The study is carried out to understand how Automation and Sustainable processes can increase the green operation in the work by reducing human interference. Conceptual ideas where given for the implementation of Automation and Sustainability.

Chapter 1: Introduction

1.1 Introduction

Port Sector and logistics sector plays an important role in moving physical resources across the globe. India has a coastline which is more than 7,517 km long, most cargo ships that sail between East Asia and America, Europe and Africa pass through Indian territorial waters. In Union Budget 2022-23, the total allocation for the Ministry of Shipping was Rs 1,709.50 crore (US$ 223.31 million). In July 2021, the Marine Aids to Navigation Bill 2021 was passed by the Parliament, incorporating global best practices, technological developments and India's international obligations in this field.

According to the Ministry of Shipping, around 95% of India's trading by volume and 70% by value is done through maritime transport. In November 2020, the Prime Minister, Mr. Narendra Modi renamed the Ministry of Shipping as the Ministry of Ports, Shipping and Waterways. India has 12 major and 205 notified minor and intermediate ports. Under the National Perspective Plan for Sagarmala, six new mega ports will be developed in the country. The Indian ports and shipping industry play a vital role in sustaining growth in the country's trade and commerce.

Supply Chain Management is the backbone for many service operations while it is also important to ensure its smooth functioning without causing any harm to the environment. Organizations have realized that, to manage the environmental burden that is caused by the industry it has to look beyond it's just operations and processes. Here we also need to consider the supply chain upstream and downstream by adopting corporate greening and environmental management-Green Supply Chain Management, Automations.

The green chain concept aim to mitigate environmental degradations and thereby control air, water and waste pollution by adopting green practices in business operations. Indeed, the basic ideology behind the green concept is to enhance environmental sustainability, but firms adopt green concept as "kill two enemies with one bullet" as, green supply chain and Automation can reduce the environmental pollution and production costs and it also 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 proenvironmental countries

1.2 Statement of the Problem

The study is carried out to know the impact of Automation and Sustainability management in the ports and logistics sector that enhances the existing supply chain by implementing green practices that help the organizations to eliminate environmental degradation and unwanted production and other operating costs, creating a competitive advantage simultaneously focusing greater customer satisfaction. Green ideas and Automations enable innovations and techniques to protect environmental sustainability.

1.3 Scope of the Study

The term Automation and Sustainability refer to the idea of integrating automation and sustainable environmental processes into the traditional supply chain. Rather than focusing on the elimination of the harmful impact of business and supply chain operations, Automation and Sustainability involves value addition or value creation through the operations of the whole chain. Unarguably reducing air pollution, water pollution and waste pollution is the main goal of Automation and Sustainability, while green operations also enhance firms' performance in terms of reuse and recycling of products, reduction in operating costs, greater efficiency of assets, positive image

building, and greater customer satisfaction. In this World, as environmental awareness is increasing, the Ports and Logistics industry is facing heavy pressure from different stakeholders including the government and customers to mitigate the harmful effect on the environment.

1.4 Significance of the Study

As International trade grew environmental matters are often neglected while carrying out the business, operational activities. Today, Logistics industry and Ports play a major important role for de carbonization. The sources of their competence and the range of their influence extend over the sea and also inland. The role of both the industry in the transport chain has the potential to influence the social and environmental performance of transport systems around the world. Many ports and logistics industry choose not to go beyond compliance with existing environmental regulations. Regulations in our city, region or country have in many cases used their potential to address both social and environmental externalities.

1.5 Objectives of the Study

1. To study the scope and implementation of Automation in the Logistics and Port sectors.

2. To study the scope and implementation of Sustainability in the Logistics and Port sectors.

3. To study the impact of Green Supply Chain Management and Green Logistics.

1.6 Research Methodology

This study uses secondary data to analyze and understand the impact of Automation and Sustainability in the port and logistics sector. The diverse data are collected and analyzed with the help of information from the research papers, reports, journals, websites, reference books written by industry experts and interview with the industrial players for the trends and suggestions.

1.7 Limitations of the Study

- This study is based on secondary data, which is descriptive in nature.
- There is zero amount of technology or automation implemented in India. Hence, comparing it internationally is bit difficult.
- The study is limited to theoretical explanation and these theories have to be implemented and further studied to make practically possible.
- Investment of time and money is needed to make the study useful to the public.

Chapter 2: Literature Review

2.1. The following paper and articles were studied to understand the various concepts and factors relevant to Port/Logistics industry Automation and Sustainability.

Marti Sole (2018) "Workplace Implications of Industry 4.0 at the Port of Barcelona": Nowadays, industry is in the beginning of the fourth revolution characterized by the upcoming of technological advances. Industry 4.0 will make it possible for companies to collect and analyze data beyond its equipment. This will make processes to become faster, more flexible, more efficient and to reduce costs. Moreover, the productivity will increase, moving forward economics and induce industrial growth. And this will eventually be followed by a modification process of the profiles of the workforce. Therefore, these nine technologies are already in use in this sector and at the same time transforming the whole supply chain by enhancing integration, automation, and optimization of flows. This will also lead to more efficient relationships between all actors of the supply chains and also in human machine interactions. Finally, by exploiting these nine technological advances the physical world connects with the digital one, enabling more precise data gathering and upgrading the overall quality of the industry along with a better monitoring and control of all its components. Due to the logistics nature of the field of research, as well as the relevance of four of the nine technological advances indicated by, there will be a definition of the four core characteristics of Industry 4.0 plus the Cyber security which is the main risk of these technologies. These four technologies are also consistent in logistics and are Internet of Things, cloud technology, automation and Big Data. In other words, the following paragraphs will present five out of the nine technologies that characterize Industry 4.0. These five

characteristics are relevant to logistics, to a port and represent the four core elements of Industry 4.0 plus cyber security which is the main present problem of these technologies

Fig 2.1 – Component of Industry4.0

Deloitte Port Services (2017) "Smart Ports": Being a part od both Larger transport and logistics (T&L) supply chains and in itself being a cluster of companies and businesses active in the T&L sector, ports are in a unique position to fully grasp the potential generated by these new high tech developments. Becoming a smart port means developing solutions to address the current and future challenges faced by seaports including spatial constraints, pressure on productivity, fiscal limitations, safety and security risks and sustainability. Today's technological and business model innovations can be a driving force behind the Smart Port. A fully developed smart port can use it gained insights (gathered information) for new business model generation. However not

all ports have the potential to integrate fully with their surroundings. Some ports might lack infrastructure or physical features with their surroundings or might simply not have the capacity required to perform the necessary investments. The determination of how much level of digitization should be implemented is to be done on a case to case basis.

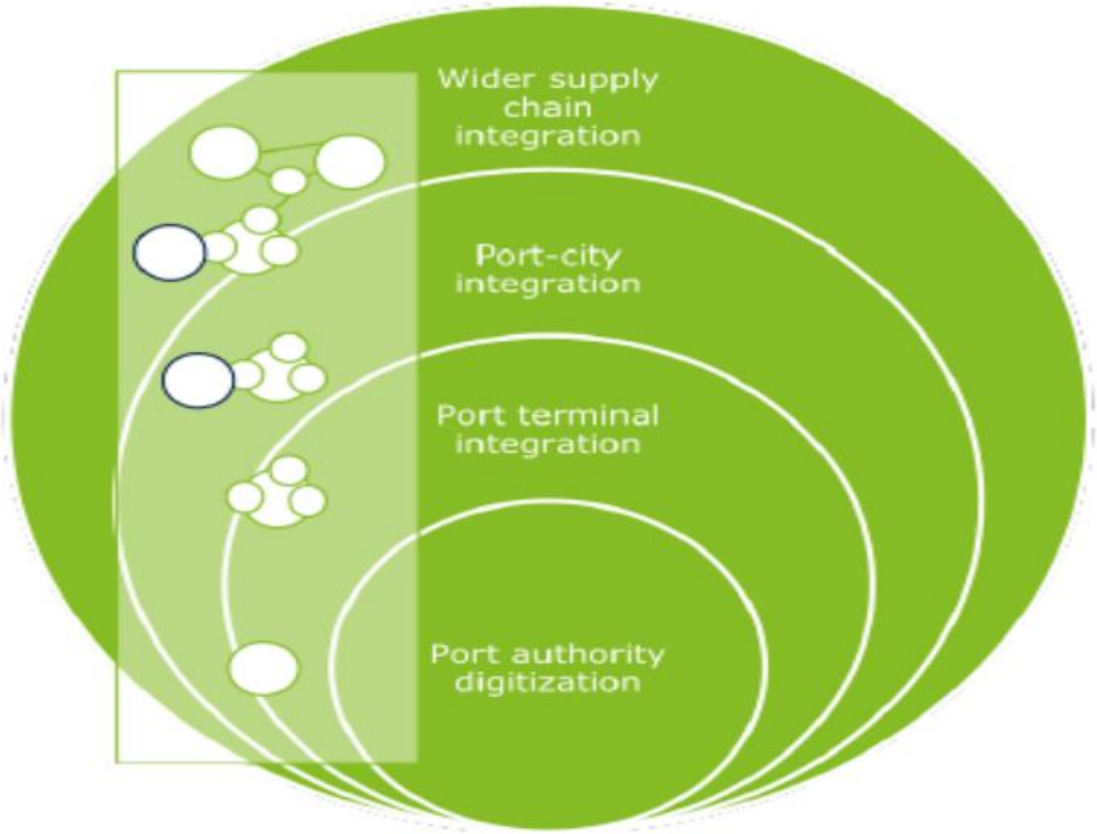
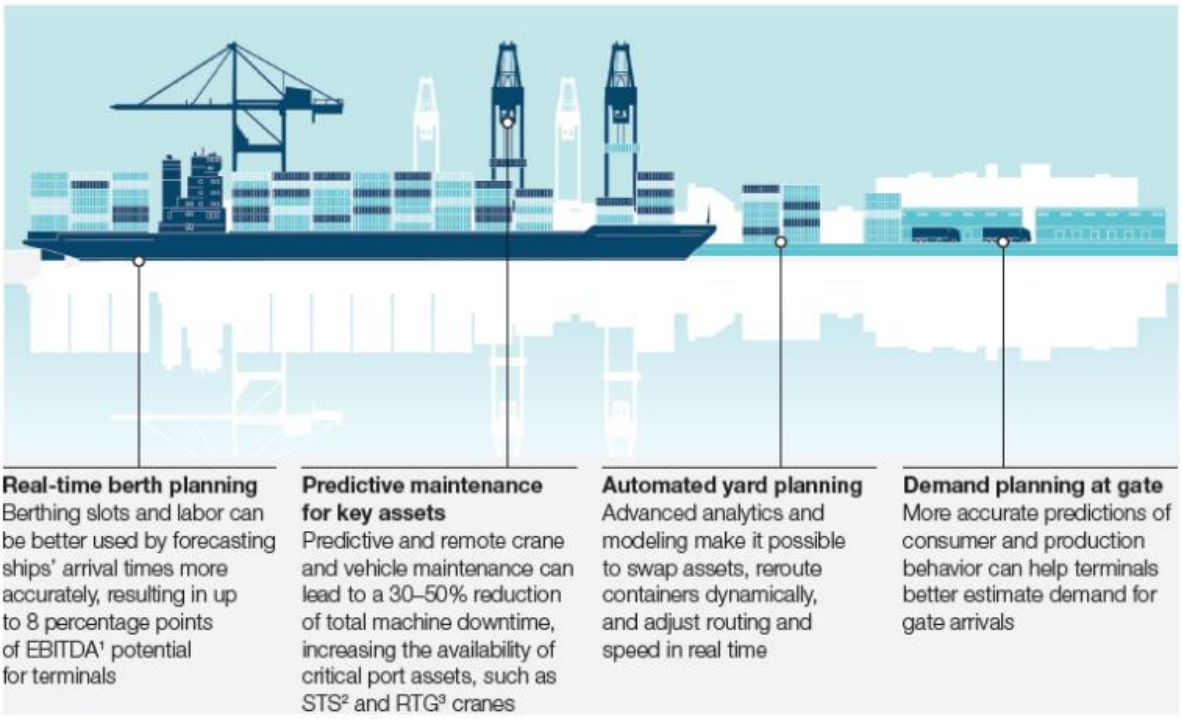


Fig 2.2 – Smart Port Integration

Fox Chu, Sven Gailus, Lisa Liu, and Liumin Ni (2018) "The Future of Automated Ports": Port 4.0 will enlarge their role by orchestrating physical and information flows inside and outside terminals to enhance the port ecosystem's broader, system wide efficiency. Forward-looking ports will push toward this next horizon, beyond automation, in the coming Port 4.0 period. Every player terminal operators, trucking companies, railroads, shippers, logistics companies, and freight forwarders will be connected to

optimize not just the port itself but also its entire ecosystem. The ultimatum of Port 4.0 will be automation, which if implemented and configured appropriately can transform ports into highly reliable and flexible logistics hubs that direct predictable physical flows and use extensive data and advanced analytics. Ports, now often seen as constraints in transportation networks, could then actively resolve problems in other parts of the value chain. This journey from Port 1.0 to Port 3.0 has been evolutionary, but Port 4.0 requires a leap into the future and bold changes in the operating model. We estimate that for a six- to eight-million TEU port that handles both imports and exports, the value at stake from Port 4.0 might be more than $1.5 billion a year for the port community, including terminal operators, shipping companies, intermodal operators, freight forwarders, shippers, and consignees. Terminal operators might capture less than 20 percent of the value pool directly, and other parties in the ecosystem would claim the rest. The sector wide gain in efficiency is obvious. But the ports ‘traditional investment model, which requires terminal operators to front-load investments, doesn‘t align with the distribution of value in Port 4.0. It will be essential to involve the relevant stakeholders and to develop, together with them, a new business and governance model for collaboration—a model that ties investments to the redistribution of value. Only then will Port 4.0 unlock its full potential. The value at stake from Port 4.0 is large but not proportionally distributed across ports and their ecosystems. Realizing that value will require innovative business models and new collaboration frameworks. They won‘t come easily. Yet this is surely a future worth striving for.



Source-Vijay Agrawal (2010). Highly productive, dense and container terminal automation trends

Fig 2.3 – Port 4.0

Sustainable development and ecological modernization: A radical homocentric perspective (1998): This research investigates whether commonly mentioned versions of strong sustainable growth are based on economic or anthropocentric approaches. Both eco-socialism and social ecology are examples of anthropocentric (or 'homocentric') strong sustainability: they are inherently humanistic but also incorporate environmental stewardship and are socially just. This development model's foundations are examined. Its value is argued from the standpoint of a socialist criticism of the alternative anthropocentrically-grounded interpretation of "sustainability" that is currently popular, termed "ecological modernization." Ecological modernity is said to be only marginally sustainable. Indeed, current Marxist interpretations of capitalism's intrinsic contradictions suggest that this development model is not long-term viable. Globalization, whether ostensibly 'ecological' or not, is sure to have an impact.

A study on port design automation concept (2008) whose authors is Loo Hay Lee Ek Peng Chew; Hai Xing Cheng; Yong Bin Han In this paper, an automation concept is proposed to facilitate the simulation version constructing for port layout problem. Currently, this process, which incorporates drawing the terminal format and programming the simulation common sense primarily based totally at the drawn format, is exceptionally guide, very tedious and time consuming. This makes the optimization of the port layout very tough as it includes an excessive amount of guide process. Hence, we construct an ALG (computerized format generation) software to generate the simulation version automatically primarily based totally at the enter parameters supplied through users. Besides, we combine this software with simulation optimization algorithms that can generate new designs, compare the designs effectively and ultimately pick out the promising designs.

Chapter 3: Automation in Port Sectors

3.1 Definition of Port

A port is a maritime facility comprising one or more loading areas, where ships load and discharge cargo and passengers. Although usually situated on a sea coast or estuary, ports can also be found far inland, such as Hamburg, Manchester and Duluth; these access the sea via rivers or canals. Ports are extremely important to the global economy; 70% of global merchandise trade by value passes through a port.

Ports can have a wide environmental impact on local ecologies and waterways, most importantly water quality, which can be caused by dredging, spills and other pollution. Ports are heavily affected by changing environmental factors caused by climate change as most port infrastructure is extremely vulnerable to sea level rise and coastal flooding. Internationally, global ports are beginning to identify ways to improve coastal management practices and integrate climate change adaptation practices into their construction.

3.2 Automation in General

Automation is a term for technology applications where human input is minimized. This includes business process automation (BPA), IT automation, personal applications such as home automation and more. Basic automation takes simple, rudimentary tasks and automates them. This level of automation is about digitizing work by using tools to streamline and centralize routine tasks, such as using a shared messaging system instead of having information in disconnected silos. Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. Automation has also found space in the banking sector, Logistics sector, Port sector, etc.

3.3 Port Automation

Port automation can be defined as the use of integrated technology to develop intelligent solutions for efficient control of traffic and trade flows on the port thereby increasing port capacity and port efficiency. Smart ports or automated ports generally deploy cloud based software to assist in creating the operational flows that help the port function smoothly. Currently, most of the ports across the world have technology integrated to some extent, if not for complete management. However, there has been a gradual increase in the number of smart ports, thanks to global government initiatives and the exponential growth of maritime trade.

The port of Hamburg, Germany is one such smart port that uses cloud-based solutions for managing energy resources, traffic control, infrastructure facilities, and port property for efficient port operation. Closer home, the port of Kandla, Gujarat is set to be India's first smart port city, as announced by the Indian Government. These efforts are in line with India's vision to create a country of smart ports, cities, and smart hospitals and increase maritime trade through the new and old ports built and modernized under the Sagarmala project.

The degree of automation differs from port to port, depending on the capacity of the port, its location, the amount of cargo it handles, and its economic value. With the growth of mega-ports, the scope of port automation has increased to an unprecedented level.

3.4 Features of Ports

1. The port has both sea and land access which enable them to transport the cargoes and passengers efficiently and to implement effective operations.

2. The ports are fully equipped with various kinds of cargo handling equipment and

facilities like cranes, forklifts, RMQC to the modern automated gantry crane, straddle carrier for its operations along with the skilled workforce as per the requirements.

3. Docks or berths are provided by the ports for undertaking the safe berthing and mooring of the vessels with all required supports and equipment.

4. The port provides cargo storage facilities for the safe storage of different kinds of cargoes; including the warehouses, transit shed tanks for the storage of liquid cargo within the areas.

5. The port provides various kinds of connectivity including road, rail, air, and inland waterways for accessing the port and engaging in business with them. These connectivity facilities are provided with the support of the government, as ports are considered as an important link in trade and also a contributor to the development of the country.

3.5 Types of Ports

Ports can be classified on the basis of their operational activity and geographical features

1. Operational Port Types

Ports can be conveniently defined by their operational activities. The most important operational port types are the following

a) Container Port

The ports that are mainly engaged in handling goods transported in containers. There are four main types of container ports:

i) Direct call port

A direct call port comprises a number of dedicated container terminal used for handling containers at very high throughput levels. Containers will be moved to and from the direct call port by rail, road or barges.

ii) Hub port

A hub port is a container port which acts as a focus for container movement through the use of mainline container ships and feeder ships. A hub port allows for container distribution by sea within a significant geographical area.

iii) Transshipment port

A transshipment port is an interchange point enabling containers to be transferred between different mainline container ships.

iv) Feeder port Feeder

Port is a small or medium sized port through which containers are fed to one or more hub port in the immediate geographical area.

b) Multi-purpose Ports

These ports deals with different kinds of cargo, volumes, ships dimensions, cargo handling equipment and others along its life span. Multipurpose port is found, where the trade volume are small and ports cannot afford to build expensive container terminal.

c) Bulk Ports

The movement of dry and liquid bulk commodities in seaborne international trade is significant. The specialist bulk ports and terminals have been developed to act as the places for interchange between the sea and land mode of transport. The bulk ports are divided into dry bulk commodity ports handling cargo namely coal, grains, phosphate and bauxite and liquid bulk commodity ports handling the export and import of crude oil and oil products.

d) Ferry Ports

Ferry ports are associated with the movement of passengers and freight carried on trucks and trailers and are integral to road network. Normally they operate between two nations on the shortest sea route. A ferry port terminal provides facilities to load and discharge the ferry in a safe and efficient manner. To do this, the port invests in terminal building, ramp system, port roadways and parking area.

e) Cruise Ship Ports

The development of the cruise ship business has brought with it a need for facilities for ships and passengers in ports. To service the cruise ships, cruise port may develop as port of call or turnaround ports. Turnaround ports provide terminal facilities for passenger arrival and departure, crew change, storing and bunkering. A cruise terminal will consist of a ship berth of appropriate size and passenger facilities including the terminal building, coach and taxi drop-off points and short/ long-term car parking.

3.6 Socio Economic Benefits of a Port

Ports are basically a means of integration into the global economic system. Some of the important socio-economic benefits of ports are

1) Fuels economic development

They are important links of hinterlands to points overseas. They facilitate the movement of goods to and from the hinterland. They increase international trade (both exports and import). Increase in exports lead to industrialization in the hinterland as well as around ports. Increase in imports leads to an increase in consumer choice and provision of goods at a competitive rate.

2) Development of cities

Most of the world's major cities are port cities. Ports spur the economic activities around them like banking, finance, insurance, logistics etc. This lead to development of cities around the ports.

3) Increase in Employment

Ports increase employment both directly and indirectly. Direct employment refers to employment in port related activities. Indirect employment increases due to increased industrialization.

4) Relatively Environment friendly

When compared to other transportation systems, railway transportation requires twice as much energy consumption, while road transportation requires ten times as much as sea conveyance. The world has become increasingly environmentally conscious and, with its lower energy consumption, marine transportation is obviously more environmentally friendly than other means of transportation.

5) Increase world Economic Integration

Globalization has been partially successful due to cheap transportation facilitated by ports.

6) Development of Infrastructure

Increase the economic activity between hinterland and port lead to development of infrastructure including railways, roads & inland waterways. Such infrastructure makes our exports more competitive and as a spillover effect provide world class infrastructure to citizens.

7) Promotes Tourism

The ports deriving economic profits from serving the ships develop not only the infrastructure of their own, but they additionally stimulate development of tourist infrastructure along with the coast.

3.7 The Scope of Automation

The evolution of port automation is seen across different avenues. These include material unloading and cargo handling equipment, digitization of ship records, inventory management, building the necessary infrastructure, assisting ship docking and maintenance, and more.

Generally, there are three principal areas of port automation – the gates, the Ship-to-Shore cranes, and the stacks.

3.8 Automation at Port Gates

Port gates are a key checkpoint for identifying and recording every entity entering or leaving the port. For ships, it also includes additional security checks, verification, customs, immigration, and quarantine. These are crucial tasks, necessary to protect the integrity of the port and require implementation of stringent security measures.

As the volume of container traffic through the port increases, these processes consume a lot of extra time, on account of manual limitations. Automating basic processes, such as entry/exit logs, verification, and docking payments can be done with the help of relevant technology. This makes the entire process flow much smoother and well-organized.

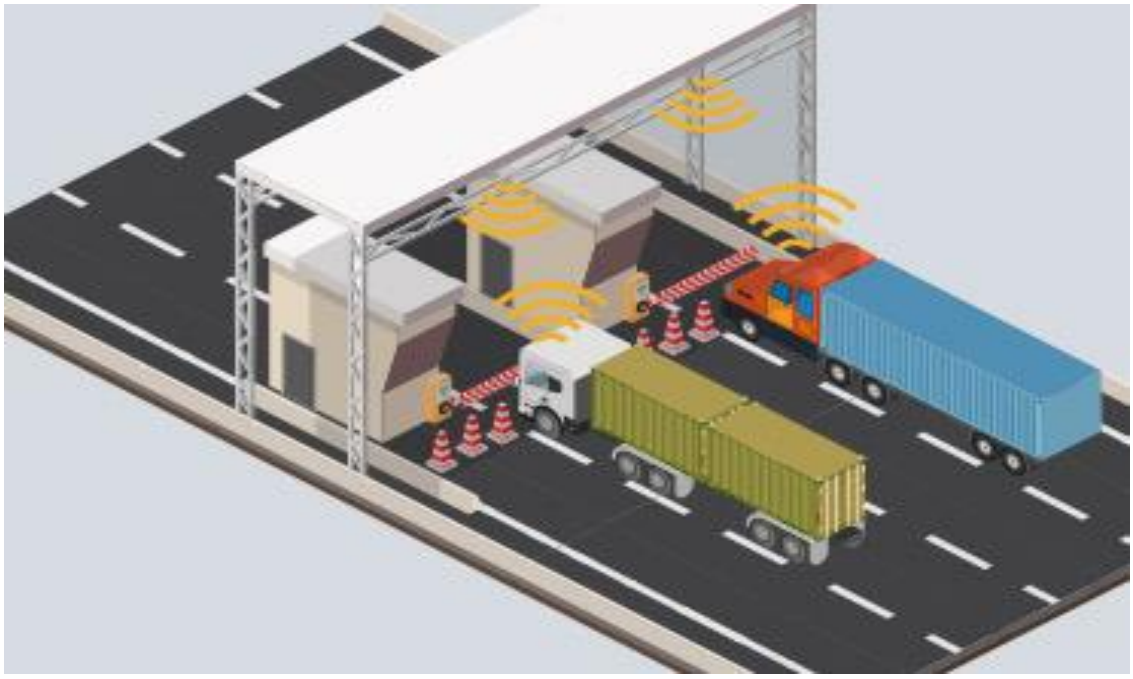


Fig 3.1 Automated Port Gate

3.9 Automated Ship-to-Shore cranes

Logistics management with IOT comes into action during the ship to shore delivery of cargo transported by ships. Use of both, manned and unmanned cranes for unloading is currently prevalent. Across the globe, there are only 30 terminals that can be considered fully automated, when it comes to container transportation.

Automated cranes are used to deliver the containers from the ships to the port by means of unmanned horizontal transportation or unmanned yard cranes. These are later classified by the type of cargo and stacked accordingly in the inventory. These containers handling systems are stable, predictable, and highly efficient. As the cranes are controlled by a computer, the planning and execution process becomes extremely smooth, achieving the required outcomes in the least possible time.

Fig 3.2 Automated Ship to Shore Crane

3.10 Stacks and Inventory

Once the cargo has been offloaded on the port, it is time for the robots to step in. Cargo handlers and stacking cranes are used to stack the containers as per the category specified. The inventory is often managed by the date of departure inland. As the container is to be dispatched for further transportation, robots are once again used to bring them to the designated station and prep them for the road ahead.

Safety is one of the major concerns while designing the robotic equipment used to assist in cargo transportation. Smart design takes into account the level of human-machine interaction involved. In addition, the entire process is analyzed to optimize inventory flow and ensure that there is no friction between multiple processes.

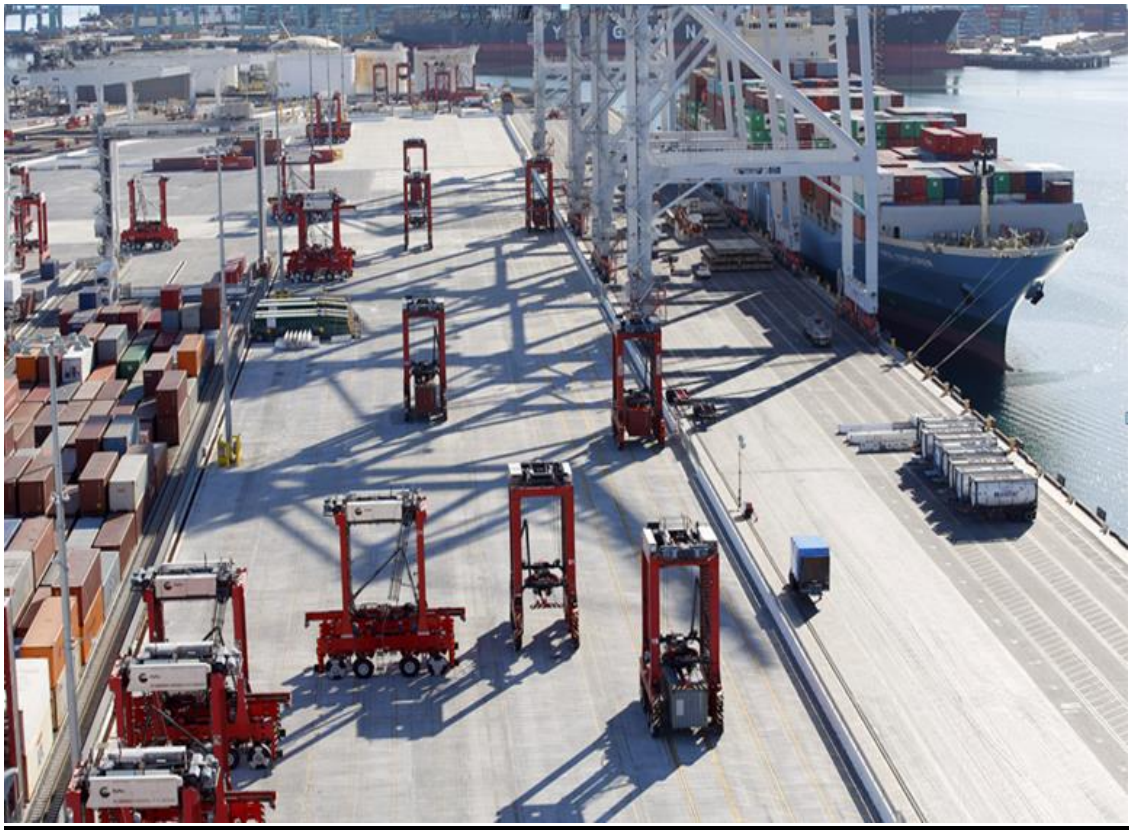


Fig 3.3 Automated Robot handling Container yard

3.11 Automated Straddle Carriers

Automated straddle carriers are suitable for the same types of terminals as manual straddle carriers. The main reasons to choose a straddle carrier setup compared to other terminal concepts include flexibility and simplicity. In a straddle carrier terminal, a single machine handles both stacking and horizontal transportation. Other horizontal transportation concepts, such as those built around automated guided vehicles (AGVs), will always need another machine to stack the containers and load landside transport vehicles

When considering the choice of automation solution and terminal concept, it is important to remember that the question is not an either/or choice. Hybrid terminal layouts utilizing multiple horizontal transportation and/or crane technologies are also possible. For example, if there is a need to increase the TEU capacity of an automated straddle carrier terminal in the future, one or more ASC blocks can be added to increase the stacking density.

Fig3.4 Automated Straddle Carriers

3.12 Smart Ports

Following the concept of Smart Cities, which assumes universal access to city information, efficient communication, and environmental stewardship, it's now time to consider Smart Ports. While the Smart City concept has been around for a while, Smart Port is a notion with no clear definition. As a result, this is one of the current port and shipping development viewpoints where no one has the last say. Smart Ports are about more than just managing technological processes; they're also about digitalization, boosting the efficiency of port operations, integrating ports with cities, and obtaining

energy from alternate sources. Smart Port - the new management model is a collection of cutting-edge technology and organizational instruments. It requires a lot of daring and ingenuity on the part of the ports to make the Smart Port concept a part of their strategies.

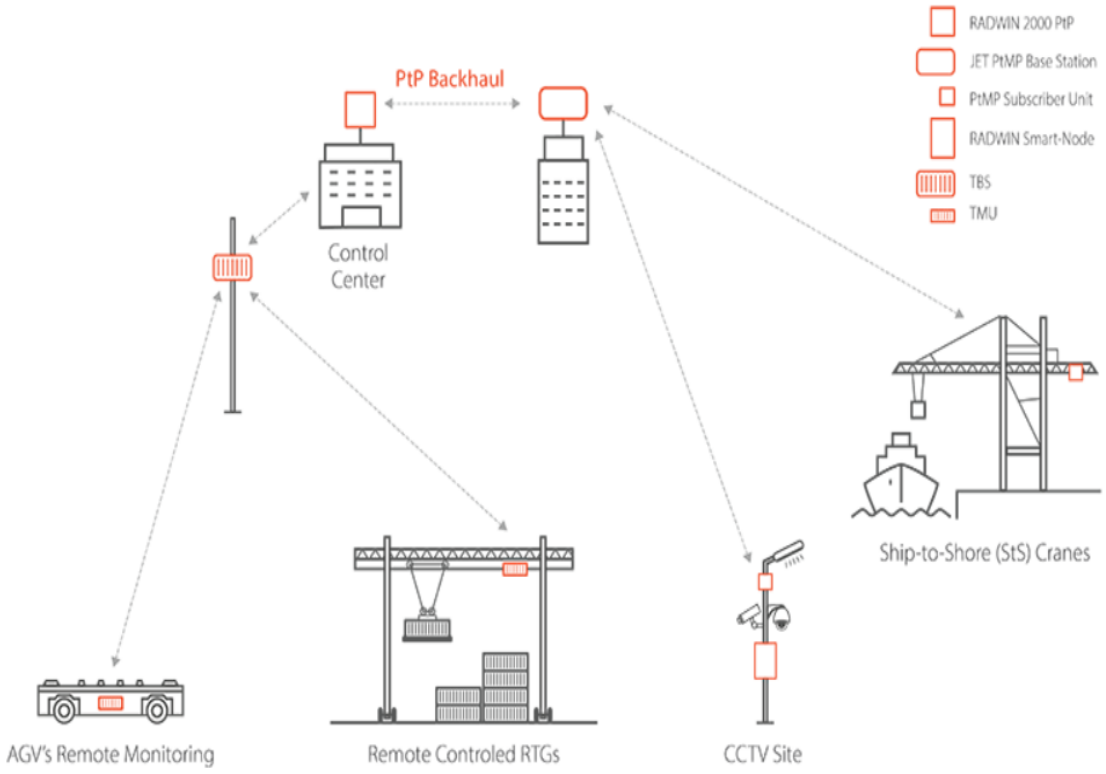


Fig 3.5 Smart Ports

And without creative solutions, modern ports would not be able to endure the fierce competition. Firstly the essential question is what the port desires to achieve by becoming intelligent. Implementing various forms of inventive solutions that are not the outcome of a long term strategy could be disastrous. Because the port is such a large area, all activities must take place at both the terminal and the port level. Stakeholders and port authorities should benefit from implementations based on the Smart Port concept.

While the market is flooded with technologies, many of which have general applications, ports have a wide range of activities that necessitate custom-made solutions. Other options necessitate general ports as well as ports that specialize in servicing specific cargoes, such as ports that handle crude oil and oil products. As a result, it is critical that terminals and port authorities work together to develop the necessary technologies.

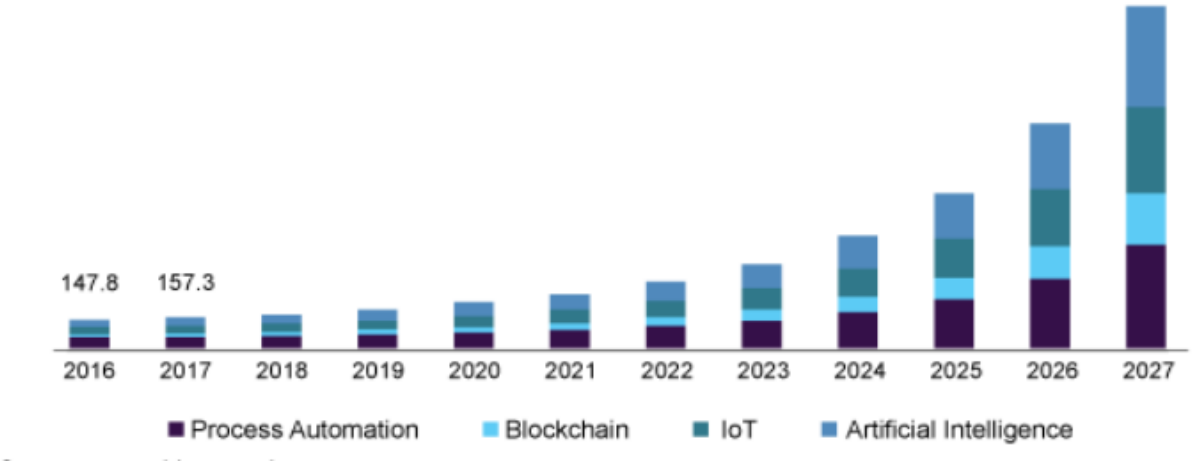


Fig 3.6 Graph on Automation

The above graph shows the US smart port market size. The growing needs to curb operational expenses, gather real-time information, and make data-driven decisions at Port facilities are collectively driving the adoption of smart technologies among port authorities. Several technologies including Artificial Intelligence (AI), Internet of Things (IoT), block chain, and process automation are used for transforming a traditional port into a smart port.

3.13 YSH4 Shanghai

Yangshan Phase 4 is the largest fully automated terminal in the world. It is supposed to help Shanghai become the international centre for shipping. In 2001, the Shanghai International Port Group (SIPG) started filling in the Great and Lesser Yangshan islands to build four new terminals a bit south of the city. Yangshan Phase 4 (YSH4), the newest terminal, opened in December 2017 and is the largest and most advanced automated terminal in the world. It already handled more than 2 million TEU in its first year in operation, and SIPG aims to boost this figure to 3.2 million TEU during the current year.

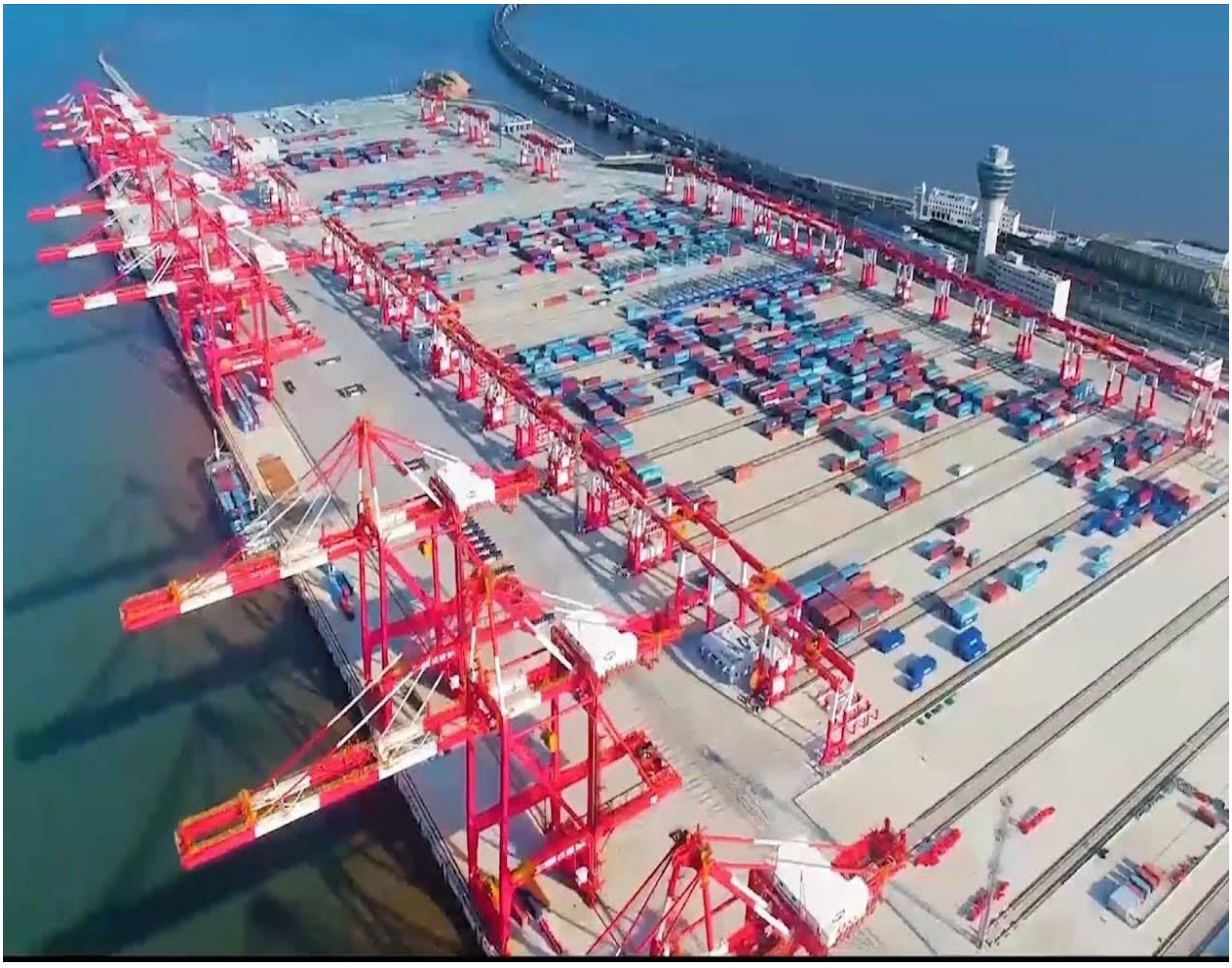


Fig 3.7 YSH4 Terminal

Sixteen container-handling gantry cranes, 88 automatic stacking cranes, 4 electronic portal cranes and 80 AGVs – these are the key figures for YSH Phase 4. As spectacular as that might sound, the reality seems almost sad, as the terminal is virtually deserted of people. Truck drivers and a few isolated workers can be seen at the berthed ships. Even the reception of containers is completely automated: Truck drivers hold a chip card up to a scanner at the terminal entrance. The scanner then reads the data on the card and tells the driver the collection point to which the desired container will be brought by an AGV. To keep everything running smoothly, there are 60,000 transmitters embedded in the ground.

The main work is performed in the tower, which houses about 16 crane operators. With a joystick in each hand, they sit in front of six large screens. On them, the containers can be viewed from the perspective of the crane, i.e. from above and from the side. Only a few stevedores are working under the cranes. Their primary jobs it to ensure that the twist locks i.e., the interlocks that connect containers to one another are securely fastened. In other words, only the very last step is done manually here. However, it is highly likely that this task will also be automated in the future.

Xi Jinping, president of the People's Republic of China, visited the terminal at the beginning of the year to form his own opinion. He was impressed, and the number of machines is now supposed to be doubled by 2021. Doing so will boost the terminal's annual capacity to 7 million TEU.

Below are some of the fully automated and semi-automated ports in the world.

Port	Terminal	Operational level of automation [a]
Brisbane, Australia	Container terminals, Fisherman Island Container Terminal	Semi
	Fisherman Island berths 8–10	Fully
Melbourne, Australia	Victoria International Container Terminal	Fully
Sydney, Australia	Sydney International Container Terminals	Semi
	Brotherson Dock North	Fully
Antwerp, Belgium	Gateway	Semi
Qingdao, China	New Qianwan	Fully
Shanghai, China	Yangshan, phase 4	Fully (trial vessels handled end-2017)
Tianjin, China	Dong Jiang	Not confirmed; in development
Xiamen, China	Ocean Gate Container Terminal [b]	Fully (phase 1 operational; phases 2 and 3 in development)
Hamburg, Germany	Altenwerder Container Terminal	Fully
	Burchardkai	Semi
Vizhinjam, India	Adani	Not confirmed; in development
Surabaya, Indonesia	Lamong Bay and Petikemas	Semi
Dublin, Ireland	Ferryport Terminals	Semi; planned
Vado Ligure, Italy	APM Terminals	Semi; due to be operational 2018
Nagoya, Japan	Tobishima Pier South Side Container Terminal	Fully
Tokyo, Japan	Oi Terminal 5	Semi
Lázaro Cárdenas, Mexico	Terminal 2	Semi
Tuxpan, Mexico	Port Terminal	Semi
Tanger Med, Morocco	Tanger Med 2	Not confirmed; due to open 2019
Rotterdam, Netherlands	"Delta Dedicated East and West Terminals, Euromax, World Gateway and APM Terminals"	Fully
Auckland, New Zealand	Fergusson Container Terminal	Semi; due to be completed 2019
Colón, Panama	Manzanillo International Terminal	Semi
Singapore	Pasir Panjang Terminals 1, 2, 3 and 4	Semi
	Tuas	Not confirmed; planned
Busan, Republic of Korea	"Pusan Newport International and container terminal, Newport Company, Hanjin Newport Company and Hyundai Pusan Newport"	Semi
Incheon, Republic of Korea	Hanjin Incheon Container Terminal	Semi
Algeciras, Spain	Total Terminal Internacional	Semi
Barcelona, Spain	Europe South	Semi
Dubai, United Arab Emirates	Jebel Ali Terminals 3 and 4	Semi (terminal 3 operational; terminal 4 due to be operational 2018)
Abu Dhabi, United Arab Emirates	Khalifa Container Terminal	Semi
Liverpool, United Kingdom	Liverpool 2 Container Terminal	Semi
London, United Kingdom	Dubai Ports London Gateway Container Terminal and Thamesport	Semi
Long Beach, United States	Container Terminal	Fully (Middle Harbour Redevelopment Project in development)
Los Angeles, United States	TraPac	Fully
New York, United States	Global Container Terminals	Semi
Norfolk, United States	Virginia International Gateway	Semi
	International Terminals	Semi; in development
Kaohsiung, Taiwan Province of China	Terminals 4 and 5 and Kao Ming Container Terminal	Semi
Taipei, Taiwan Province of China	Container Terminal	Semi

Source: Drewry Maritime Research, 2018b.

Fig 3.8 Automated port list, 2017

3.14 Reducing the Port Turnaround time by using Automation

With the help of Automation we can reduce the Port turnaround time. Countries with more port calls usually have shorter turnaround times as well. Ports with shorter turnaround times are more attractive to shippers and the carriers; therefore, the number of port calls will tend to be higher compared with competing ports that have longer turnaround times. The causality goes both ways if the turnaround time is shorter, a port with the same number of berths can accommodate more port calls. At the same time, countries that trade more and have more port calls will also generate more income to invest in efficient port operations.

From the below graph we can understand that Shipping companies are choosing the ports which has less turnaround time than the higher turnaround time. UNCTAD analysis shows that there is a negative correlation between the size of the largest ship that calls at a country's port and the median time ships spend in port, while there is a slight positive correlation for most market segments between the average size of vessels and the time spent in port. In other words, being able to accommodate very large container ships is an indicator that a port is fast and efficient, while ports that receive large ships will on average also take slightly longer to load and unload the higher cargo volumes.

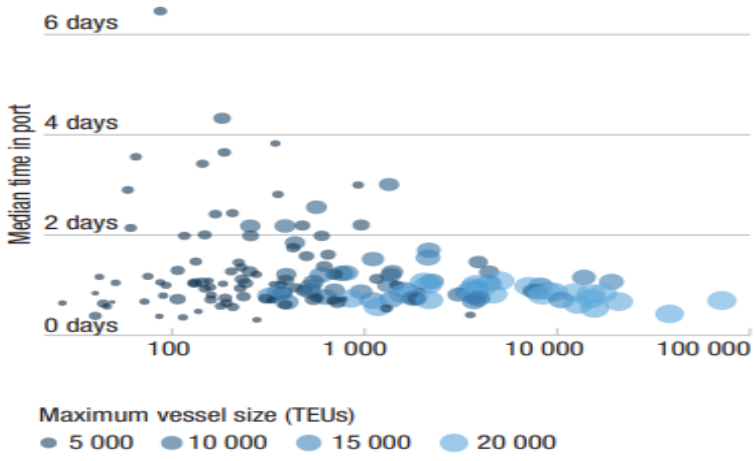


Fig 3.9 Graph on vessel turnaround time from UNCTAD

3.15 Foreland and hinterland automation

Foreland and hinterland automation refers to operations that aren't directly related to terminal automation but can help it achieve its goals upstream (foreland) or downstream (hinterland) in the transportation chain. Although fully automated ships are unlikely in the near future, several parts of ship operations (propulsion and power monitoring, ballast) have been automated, resulting in a significant reduction in crew size. Rail transit suffers from the same problem (control systems, signalling, and crossings). Automated trains are a distinct reality because they run on their own tracks and are now widespread in public transportation systems. Automated trucks transporting containers between terminals and their hinterland are a distinct prospect, especially along certain high-volume pathways. In recent years, warehouses with automated storage and retrieval technologies have been created, improving distribution efficiency, especially for e-commerce.

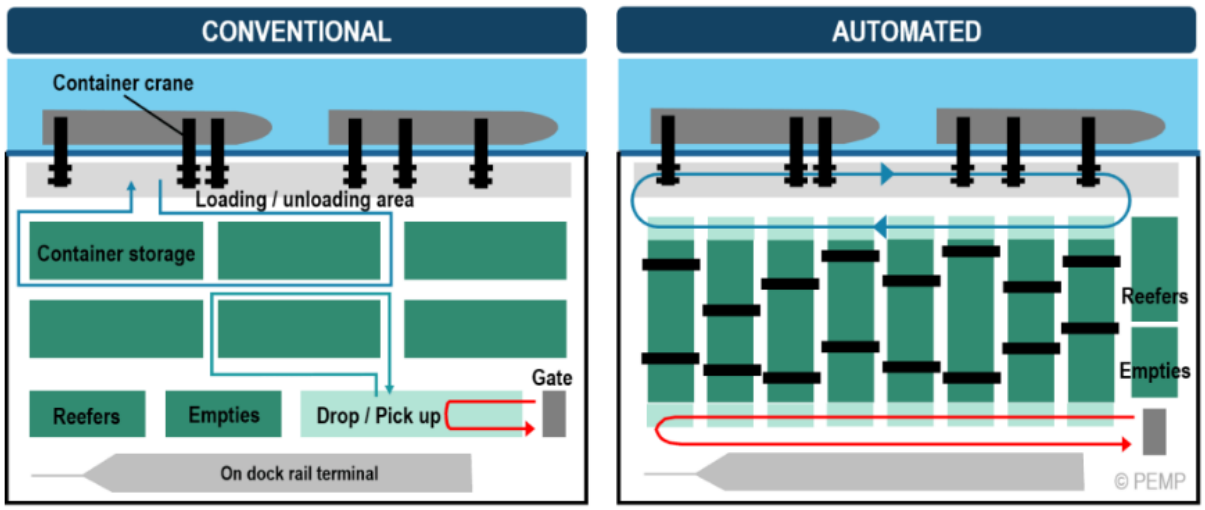


Fig 3.10 Conventional and Automated Container Terminal Configurations

Chapter 4: Automation in Logistics Sector

4.1 Definition of Logistics

Logistics is the art and science of management, engineering and technical activities concerned with requirements, design and supplying, maintaining resources to support objectives, plans and operation.

Logistics can be defined as “having the right item in the right place, at the right time, in the right quantity, at the right price and in the right condition, for the right customer”.

Fig 4.1 – Process involved in Logistics

In business, logistics is the management of the flow of things between their point of origin and their final destination in order to meet the needs of companies and customers. It is a subset of supply chain management. The logistics of physical things – things we can touch – generally involves the integration of material handling, information flow, production, packaging, transportation, inventory, warehousing and security.

4.2 Concept of Logistics

Logistics is a challenging and important activity because it serves as an integrating function. It links suppliers with customers and it integrates functional entities across a company. With the ever-growing competition in today's market place it becomes necessary for a firm to use its resources to focus on strategic opportunities.

It includes several internal factors like management style, culture, human resources, facilities and several external factors like technology, globalization and competition. This is where the concept of logistics plays a major role, i.e. it helps to leverage certain advantages the firm has in the marketplace.

Two fundamentally different forms of logistics:

- Optimizes a steady flow of materials through a network of transport links and storage areas

- Other coordinates an effective sequence of resources in order to carry out a project.

4.3 Supply Chain Automation

Supply chain automation is the use of digital technologies to improve efficiencies, connect applications and streamline processes within supply chain operations. Automation is bringing about the most significant revolution in the logistics industry. Robots and artificial intelligence are taking over tasks that formerly required human workforce. Companies can save money while satisfying consumer demand by automating key components of logistics. It is the process of using various control systems to run or operate various organizations with minimum human assistance. With the advancement of technology, every business sector is switching to automation to ease their business workflow. Starting from the minor business to major industries, automation is reducing manual errors and helping to succeed in their respective field. One of the great impacts that automation had, is on the sector of logistics.

The modern supply chain is all about speed. Supply chain managers are looking to jump on the latest trends to get a leg-up in the race for elite optimization. Supply chain automation is the leveraging of digital technologies to lower operational costs. The technologies that automation applies to can vary, but most commonly include artificial intelligence (AI) and machine learning (ML).These systems are vital to optimizing our supply chain, and implementing further automation will ease the workload of our team and supply chain solutions.

4.4 Artificial Intelligence

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. AI is transforming warehousing processes, such as collecting and analyzing information and inventory processes, enabling companies to increase efficiency and boost revenues. In warehousing, AI is used to make demand predictions, modify orders, and re-route products in transit. We can adjust our orders according to these predictions and have the in-demand goods delivered to local warehouses as needed. In case there are multiple warehouses in the chain, AI can connect them to find the best option for transporting the inventory. When we predict the demand for certain products and plan the logistics well in advance, we can improve our service, cut transportation costs, and save a lot of money. Computer vision technology used in warehousing allows recognizing and organizing items. In the future, this type of technology will help perform quality control and eliminate the need for human supervision.

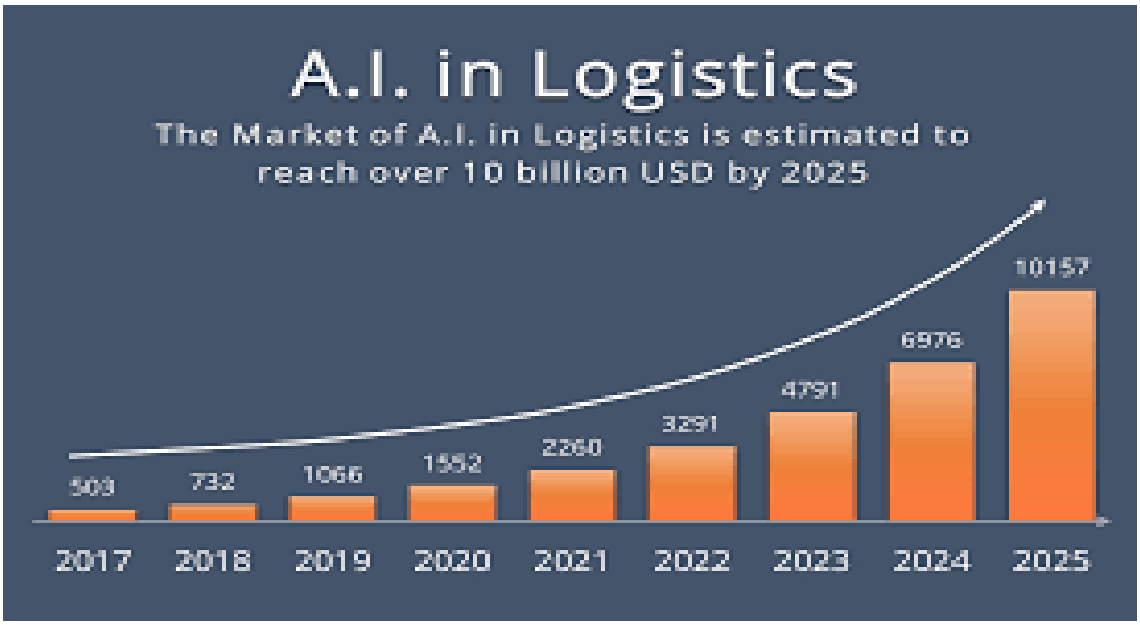


Fig 4.2 Graph on increase in value of AI in Logistics sector

4.5 Machine Learning

Machine learning (ML) is the study of computer algorithms that can improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence. Machine learning algorithms build a model based on sample data, known as training data, in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as in medicine, email filtering, speech recognition, and computer vision, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks.

A subset of machine learning is closely related to computational statistics, which focuses on making predictions using computers; but not all machine learning is statistical learning. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a related field of

study, focusing on exploratory data analysis through unsupervised learning. Some implementations of machine learning use data and neural networks in a way that mimics the working of a biological brain. In its application across business problems, machine learning is also referred to as predictive analytics.

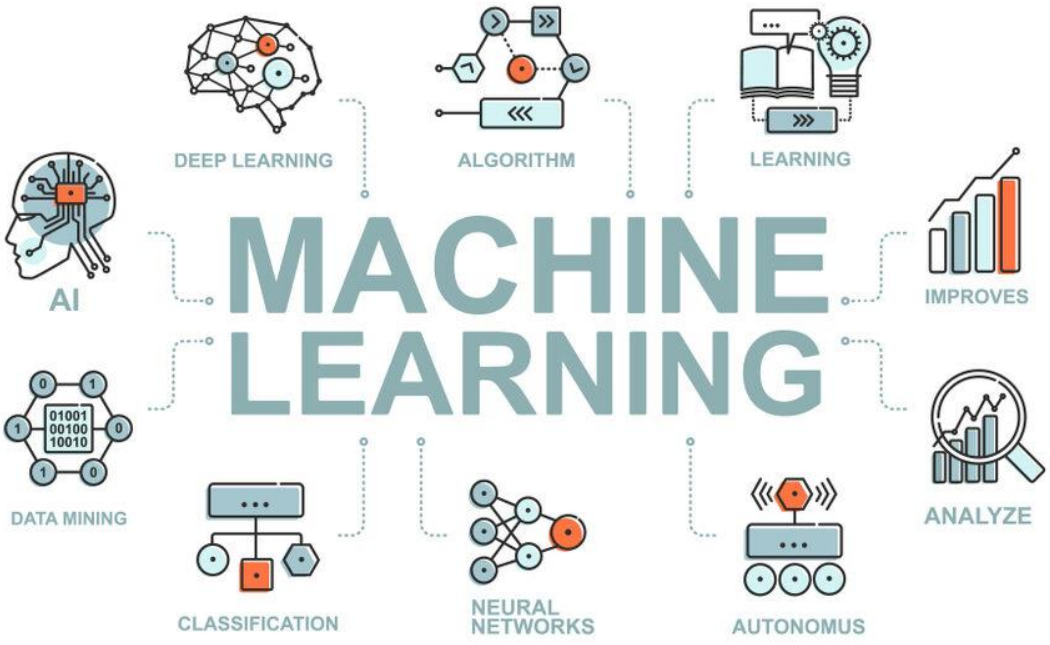


Fig 4.3 Machine Learning

4.6 Internet Of Things

Logistics management requires monitoring multiple activities at once supply chain, warehousing, transportation, and so on. There are dozens of factors that can influence the process itself and cause delays. To streamline processes and increase customer satisfaction, industry leaders and decision-makers embrace innovation and evaluate the cost-benefits of using Internet of Things for logistics process optimization. Companies

use IOT to improve logistics processes both in warehouses and beyond. The Global IOT in logistics market is expected to surpass $100 billion by 2030 and strengthen the role of Internet of Things and big data technologies for location management, inventory, and fleet management.

4.7 Benefits of IOT

Logistics and transportation operations have always been associated with risks connected to the lack of control over weather conditions, high odds of scams, and a wide range of assets to manage. With the Internet of Things, logistics can finally become a fully controlled domain, where all the factors that could negatively impact the delivery process can be either neutralized or avoided. The benefits of using the Internet of Things in transportation and logistics are

- Reliable vehicle tracking
- Reduced shipping costs
- Improved supply chain planning
- People safety and employee monitoring
- Product safety and improved transportation conditions

4.8 IOT application in Industry

Global logistics and transportation companies actively adopt IOT and use connected technology and big data to make their operations more effective, cost-efficient, and sustainable. Here are a few impressive examples of IOT in logistics from industry leaders: DHL, Nippon Express, DB Schenker, and Maersk.

4.8.1 DHL

DHL uses IOT and wearable to create a safer work environment for on-site employees. DHL's regional distribution center in Singapore integrated a monitoring system with connected beacons and wearable to track employees rest levels, better align breaks and working schedules and prevent fatigue. Using location data, the system maps employees on site and sends proximity alerts to prevent collisions and accidents.

4.8.2 Nippon Express

Nippon Express teamed up with Accenture and Intel to develop an effective system for tracking shipment through the entire supply chain. The goal was to enable better security, product safety and traceability for shipping pharmaceutical products and make sure no counterfeit medications would infiltrate the supply chain.

4.8.3 DB Schenker

DB Schenker set a goal to connect an entire supply chain and equip every touch point in the logistics infrastructure with sensors. Connected vehicles, spaces and goods will gather data throughout the supply chain process and provide customers with much-needed transparency, improve delivery routes and shipping conditions.

4.8.4 Maersk

Maersk was one of the first industry leaders to realize the power of technology in logistics and the need to drive transparency into an increasingly complex and fragmented supply chain. Logistics giant in collaboration with technology companies has developed a variety of applications for container booking, IOT based shipping management, and tracking.

4.9 Warehouse Automation

Warehouse automation is the process of automating the movement of inventory into, within, and out of warehouses to customers with minimal human assistance. As part of an automation project, a business can eliminate labor-intensive duties that involve repetitive physical work and manual data entry and analysis.

For example, a warehouse worker may load an autonomous mobile robot with heavy packages. The robot moves the inventory from one end of the warehouse to the shipping zone and software records the movement of that inventory, keeping all records current. These robots improve the efficiency, speed, reliability and accuracy of this task. But warehouse automation does not require physical or robotic automation, and in many cases simply refers to the use of software to replace manual tasks. However, this scenario illustrates how robots and humans work together to accomplish repetitive tasks while minimizing fatigue and injury.

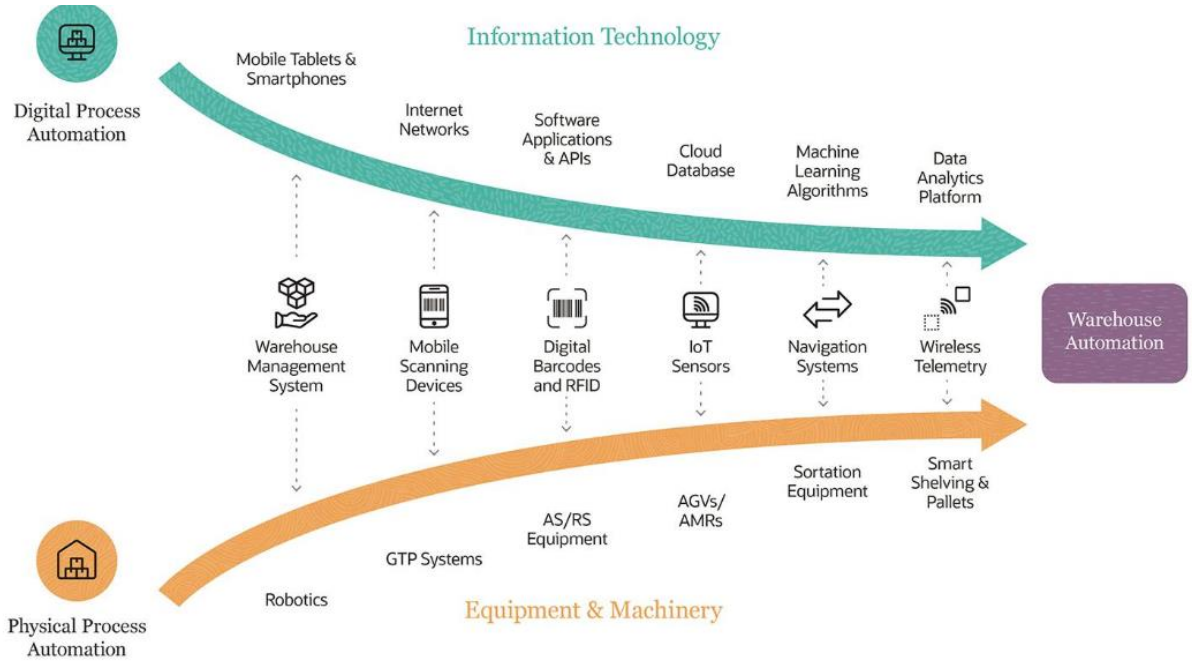


Fig 4.4 Warehouse Automation

The major benefits of Warehouse Automation are

- Reduce human error
- Minimize labor
- Enhance material handling coordination
- Improve workplace safety
- Boost inventory control
- Improve customer service

The bellow vendors sell warehouse management systems, either as comprehensive modules or standalone products

- SAP
- Oracle NetSuite
- IBM
- Microsoft Dynamics

4.10 Indian Customs Automation

Indian Customs Electronic Gateway (ICEGATE) is the national portal of Indian Customs of Central Board of Indirect Taxes and Customs (CBIC) that provides e-filing services to the Trade, Cargo Carriers and other Trading Partners electronically. At present, about 43542 users are registered with ICEGATE who are serving about more than 12.5 lacs importer/exporter. Through this facility Indian Customs offers a host of services, including electronic filing of the Bill of Entry (import goods declaration), Shipping Bills (export goods declaration), e-Payment of Customs Duty, a free of cost web-based Common Signer utility for signing all the Customs Documents, facility to file online supporting documents through e Sanchit, end to end electronic IGST Refund and etc.

The Indian Customs EDI System (ICES) is now operational at 245 major customs locations handling nearly 98% of India's International trade in terms of import and export consignments. ICES has two aspects

- Internal Automation of the Custom House for a comprehensive, paperless, fully automated customs clearance system that makes the functioning of Customs clearance transparent and efficient.
- Online, real-time electronic interface with the trade, transport, Banks and regulatory agencies concerned with customs clearance of import and export cargo through ICEGATE.
- ICES is designed to exchange/transact customs clearance related information electronically using Electronic Data Interchange (EDI). A large number of documents that trade, transport and regulatory agencies (collectively called Trading Partners) are required to submit/ receive in the process of live customs clearance are now being processed online.

4.11 MV Yara Birkland

MV Yara Birkeland is an autonomous 120 TEU container ship. At the time of project initiation, the Yara Birkeland project was designed to create the first fully autonomous logistics concept in the world. In 2019, the Yara Birkeland was a finalist in the competition for the annual Nor-Shipping Next Generation Ship award. Yara Birkeland will be 80 metres (260 ft) long, with a beam of 14.8 metres (49 ft) and a depth of 12 metres (39 ft). It will have a draught of 6 metres (20 ft). It will be propelled by electric motors driving two azimuth pods and two tunnel thrusters. Batteries rated at 6.7 MWh will power the electric motors, giving it an energy optimal speed of 6 knots (11 km/h) and a maximum speed of 10 knots (19 km/h). It will have a capacity of 120 TEU. Yara Birkeland is named after its owners Yara International and its founder, Norwegian scientist Kristian Birkeland.

Fig 4.5 Fully Automated Ship

Chapter 5: Sustainability in Port sector

5.1 Generation of Ports

Ports are strategic nodes that facilitate the flow of goods in the international arena, as a part of an extensive logistics network over which trade and exchange of information is established between points and / or distant geographical areas. Within port management the fields of strategic planning, marketing, logistics development and business management have broken through, following the same trend as other productive areas. Thus, ports evolution has changed its management forms, which are turned to be structured into four levels (1st, 2nd, 3rd and 4th generation).

5.1.1 1st Generation Ports

1st generation ports were conceived to transport goods between land and sea and vice versa, through a local or regional hinterland (area near the port that serves as a route for goods sales and distribution), unrelated to the socioeconomic environment of the territory where it was located.

5.1.2 2nd Generation Ports

The 2nd generation ports begin to be seen as a transportation hub and a center of industrial and commercial activity. Services are limited to ships and goods but in its vicinity processing industries are installed. These are called industrial ports.

5.1.3 3rd Generation Ports

The 3rd generation ports incorporate logistics functions related to the distribution of goods in services, data processing and use of telecommunications systems, and help to generate added value.

5.1.4 4th Generation Ports

The 4th generation ports make a step further and are characterized by telematic networks (communication networks based on new technologies) that connect different port areas and allow the collaboration with other ports, with the objective to internationalize and diversify their activity. These are called network ports. These ports are integrated into the international transport logistics chains, door to door services with other logistics operators working in several geographically nearby ports. The 4th generation ports are logistics platforms with security and communications systems at the highest technological level. Also called network ports, are able to integrate into a multi-modal transportation network. They have business and management units, and a growth and expansion strategy in common with other ports that are similar.

5.1.5 5th Generation Ports

Because of the rapid advancement of technology, port categorization has changed, and ports of the fifth and sixth generations are now more commonly used. Handling services are provided by Ports 5 GP at the most affluent level in the globe. Shanghai, Singapore, Hamburg, and Rotterdam are examples of such ports. Ports of the fifth generation are primarily concerned with improving the efficiency and quality of their services in order to meet the demands of port stakeholders. This type of port's position as a logistic hub also includes the capacity to handle megaships without any restrictions. The adoption of innovative technologies and IT solutions is another characteristic of 5th generation ports. The port should become an important intermodal center as well as a comprehensive logistics hub in order to meet 5th generation requirements. The infrastructure and superstructure of the port should be handled as a single, integrated system employing contemporary information technology.

5.1.6 6th Generation Ports

Neither of the world's ports currently fits the sixth generation port standards. The 6th generation ports should be recognized by the servicing of container boats with a capacity of 50 000 TEU and a maximum draught of more than 20 meters, taking into account the requirements that describe the ports of the first, second, third, fourth, and fifth generations. The 6th generation ports will also confront the problem of increasing the surface area of storage yards, which can be accomplished by establishing modern storage systems, automating terminals, and developing and implementing technological and organizational improvements. The 6GP ports' mission will be to engage in communication with port stakeholders, respond to their requirements, with and forecasting loading capabilities.

5.2 Sources of Pollution from Ports

The below are some of the pollution created by port sector.

5.2.1 Air Pollution

In port environment there are a lot of activity connected with ships activities, generating air pollution, and in particular

- Loading and Unloading of petroleum products produce volatile organic compound emissions;
- Dry docks (evaporative volatile organic compound emissions)
- Passenger car traffic (combustion products and evaporative volatile organic compound emissions)
- Heavy vehicle traffic (combustion products emission)

- Railway traffic (combustion products emission)
- Demolition or main modification of ships (asbestos, heavy metals, hydrocarbons, ozone depleting substances and others)

5.2.2 Water Pollution

In port and in its neighborhood there are different sources of water pollution

- Operations on terminals and fuel deposits (accidental discharge of oil in the sea, loss from deposit tankers and pipeline)
- Dry docks operations (accidental discharge of oil and other chemicals in the sea)
- Ships demolition (accidental discharge of oil and other chemicals in the sea)
- Storm water runoff from port parking lots (organic compounds, fine particulate, heavy metals, etc.)
- Water stagnation and eutrophication and anoxia risks due to weak water turnover

5.2.3 Noise Pollution

Sources of noise can be individuated in port areas in the following three main areas

- Passenger car and heavy vehicle (trucks) road traffic (the most important one)
- Goods movement (from machinery such as quay-crane, pumps, etc.)
- Rail traffic noise: rail movement in port and in surrounding areas are prevalent to low speed and of consequence the noise level is not so high, however in highly trafficked areas the problem can be relevant

5.2.4 Soil Pollution

In port and in its neighborhood there are different sources of soil pollution

- Operations on terminals and fuel deposits (accidental discharge of oil in the soil, loss from deposit tankers and pipeline)
- Spill from the bulk handling device (oil, rubber etc.) and dust spread during the handling (transports between quay and storage area)
- Oil and other spillage from the vehicles dissolve the surface and may cause a homogeneous tarmac to dissolve; heat and high loads cause settlements of the surface
- Spill of chemicals from demolition of ships.

5.2.5 Waste Production

The following main sources of wastes can be recognized in port and in its neighborhood

- Oil terminals and fuel deposits (oily and toxic sludge)
- Dry docks operations (oily and toxic sludge)
- Ships demolition (particularly in India, Bangladesh, Pakistan and in the future probably, China, Vietnam and Philippines) connected with the nearly complete absence of facilities for handling waste residues from the demolition process (including heavy metals, PCB, HFC's, asbestos as well as hydrocarbons)
- Retrofits and Maintenance of older vessels, also in developed countries.

5.2.6 Dredging Issues

The construction of man-made structures and alteration of natural waters can lead to direct and indirect issues on the water body and ecosystem. Deterioration in ground water quality can occur during both the construction and operation phases. During the construction phase, pollution may result from soil run off to sanitary waste from labor force. Dredging and reclamation result in the formation of residue of suspended sediments around dredgers, reclamation outfalls and dumping grounds. Dredging and dredge spoil disposal activities for port development and maintenance can expose short- and long-term impacts on aquatic systems, namely degradation of marine resources such as coral reefs and fisheries etc.

5.3 Sustainable Shipping Ports

Sustainable ports are the way of the future. They operate with environmental impacts in mind, and take steps to mitigate these wherever possible. Sustainable ports focus on the social, economic and environmental impacts, as well as business as usual. Ports are the central nodes connecting ships worldwide. As hubs for the industry, any changes made can have a positive ripple effect on the rest of the sector. This is why the focus has been placed on creating sustainable ports, and branching out from there. Regulations by the International Maritime Organization (IMO) and the European Green Deal (EGD) are a step in the right direction.

Some of the most recent policies put in place by the IMO include a focus on

- Cleaner air: Making drastic cuts in sulfur oxide emissions from vessels.
- Human health: Putting regulations in place to improve air quality by reducing the emissions of harmful gasses.

- High quality fuels: Implementing the use of fuels that have low emission rates and are not harmful to the environment.
- Industry guidance: Releasing industry guidelines that will be constantly monitored.

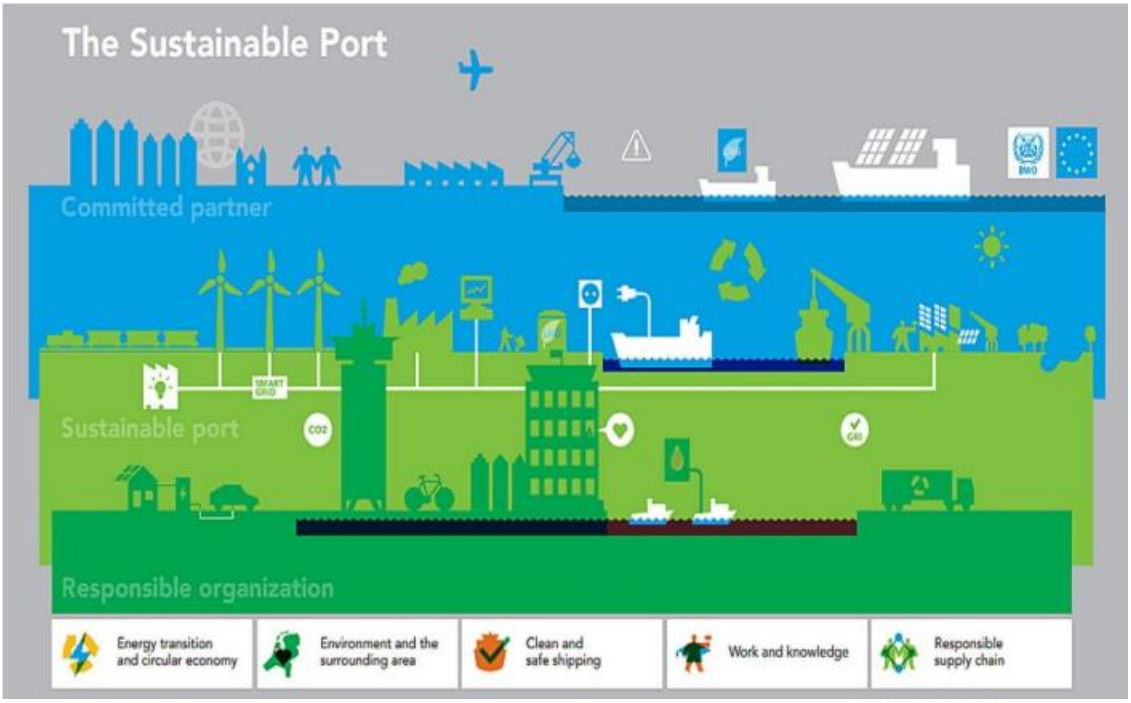


Fig 5.1 Sustainable Port

Let us see the sustainable measures which can be done by the Port Sector

5.4 Installation of Solar panel in the roof tops

Since port has a vast are there will be lot of warehouse or building. So installing the Solar panels on the top of the buildings will be helpful for generating the electricity by converting the Solar Energy into Electrical energy. This idea is also followed by one of the port. The installation of solar panels on the roofs of the warehouses at Verbrugge

Scaldia Terminals (VST) and Verbrugge Zeeland Terminals (VZT) is nearing completion. More than 140,000 panels are almost installed, with a total capacity of 50 million watts in 2021. This is enough to yield more than 16 million kWh of energy a year, generated by the Zeeland sun. This amount can supply power to approximately 5500 households. Moreover, it will result in a CO2 reduction of 10,200 tons a year.

Fig 5.2 Solar Panel on Roof Top

5.5 Electricity supply to vessel at Berth

Vessel usually has two types of engines. The first one is Main Engine and another one is Auxiliary Engine. Main Engine will be switched off when the vessel will be at the Berth. The Auxiliary Engine will be on for all the time. An emission from auxiliary engines

running while ships are at berth is a substantial source of pollution. By using shore-side electrical power, or cold-ironing, ships can reduce emissions and operational costs. Shore power or shore supply is the provision of shore side electrical power to a ship at berth while its main and auxiliary engines are shut down. The source for land-based power may be grid power from an electric utility company, but also possibly an external remote generator. These generators may be powered by diesel or renewable energy sources such as wind or solar. Shore power saves consumption of fuel that would otherwise be used to power vessels while in port, and eliminates the air pollution associated with consumption of that fuel. A port city may have anti-idling laws that require ships to use shore power. Use of shore power may facilitate maintenance of the ship's engines and generators, and reduces noise.

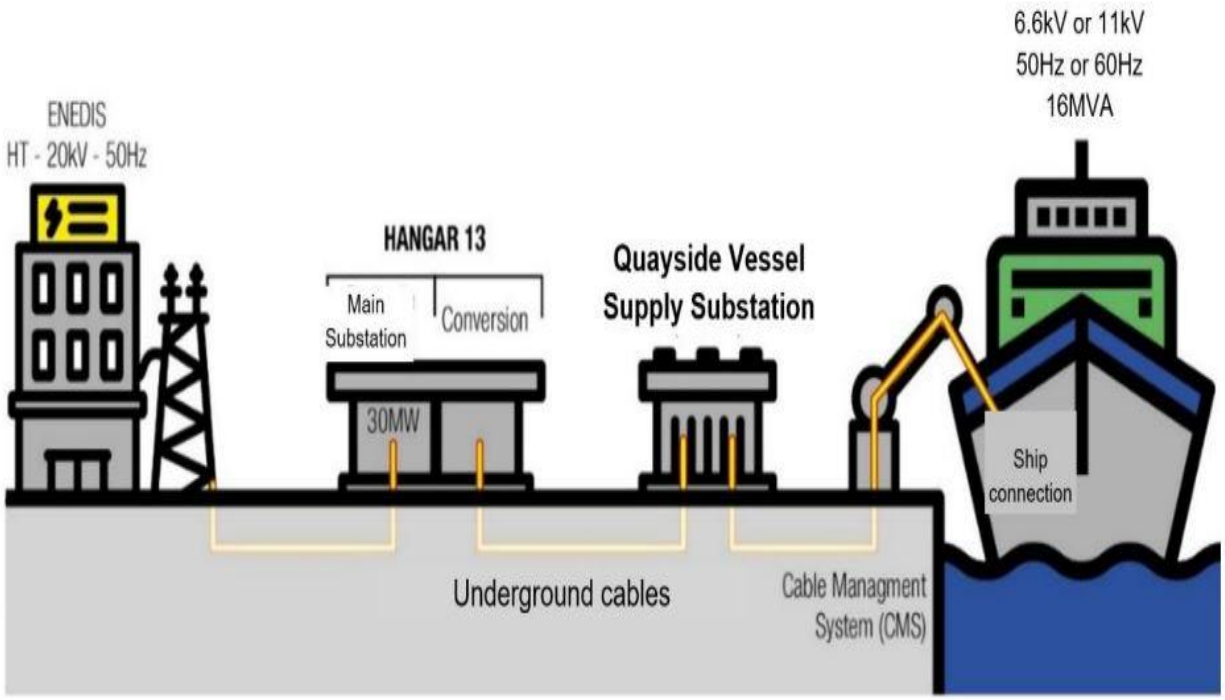


Fig 5.3 Shore to Ship Supply

5.6 Green Vehicle inside Port

Usage of Green vehicle or Electric vehicle inside the ports will help us to reduce the air pollution in that area. They produce less harmful impacts to the environment than comparable conventional internal combustion engine vehicles running on gasoline or diesel, or one that uses certain alternative fuels. Green vehicles can be powered by alternative fuels and advanced vehicle technologies and include hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicles, compressed-air vehicles, hydrogen and fuel-cell vehicles etc. Recently Shipping giant A.P. Moller Maersk have ordered 110 Volvo VNR Electric trucks to join their network and support customers sustainable supply chains.

Fig 5.4 Electric Truck

Partnering with Volvo Trucks North America assists Maersk's long-term goal in North America with Performance Team to move toward a fully electric trucking fleet to offer customers an environmentally-friendly alternative for short-haul trucking. This is an important part of Maersk's goal of enterprise-wide, carbon neutral operations by 2040 with significant steps to be taken by 2030.

5.7 Solar Powered Lamps

Instead of using the conventional street light or focus light in port, we can use the Solar Powered light to make it environmental friendly. Solar street lights are raised light sources which are powered by solar panels generally mounted on the lighting structure or integrated into the pole itself. The solar panels charge a rechargeable battery, which powers a fluorescent or LED lamp during the night. Most solar lights turn on and turn off automatically by sensing outdoor light using solar panel voltage. Solar streetlights are designed to work throughout the night. Many can stay lit for more than one night if the sun is not in the sky for an extended period of time. Older models included lamps that were not fluorescent or LED. Solar lights installed in windy regions are generally equipped with flat panels to better cope with the winds.

Fig 5.5 Solar Powered Lamp

Modern designs use wireless technology and fuzzy control theory for battery management. The street lights using this technology can operate as a network with each light having the capability of performing the turning on and off of the network.

5.8 Hybrid Cranes

This is another way to increase the sustainability in the port. Converting the old diesel powered cranes into Hybrid crane will reduce the carbon emission in the port. This will help for the de carbonization. The crane is operated with electrical power from the battery and diesel generator. In normal use the operations use only battery charged energy and at peak power (over 40LT) diesel and battery are operating parallel. The energy from braking is recharged to the battery. It is 60% higher fuel efficiency compared to conventional type cranes.

Fig 5.6 Hybrid Crane

The major benefits of this type of cranes are

- Maximize crane uptime
- Drastically reduce maintenance and running costs
- Significantly lower fuel consumption
- Increased eco-efficiency with fewer emissions and significantly lower noise levels
- Reduce time spent refueling and maintaining diesel engines

Chapter 6: Sustainability in Logistics Sector

6.1 Role of Logistics industry in World Trade

The modern era of international trade is one of increasingly complex interactions between people, firms, and organizations. Supply chains cross countries and regions. Trade has become a 24/7 business and good performance in trade requires connectivity along not only roads, rail, and sea, but in telecommunications, financial markets and information-processing. Having inefficient or inadequate systems of transportation, logistics, and trade-related 7 Infrastructure can severely impede a country's ability to compete on a global scale. Logistics play a crucial role in today's economy. Improved trade logistics infrastructure such as roads & highways, ports, railways, airports including dry ports, warehousing infrastructure and labs & testing facilities are necessary for sustainable and balanced economic development of all parts of the country.

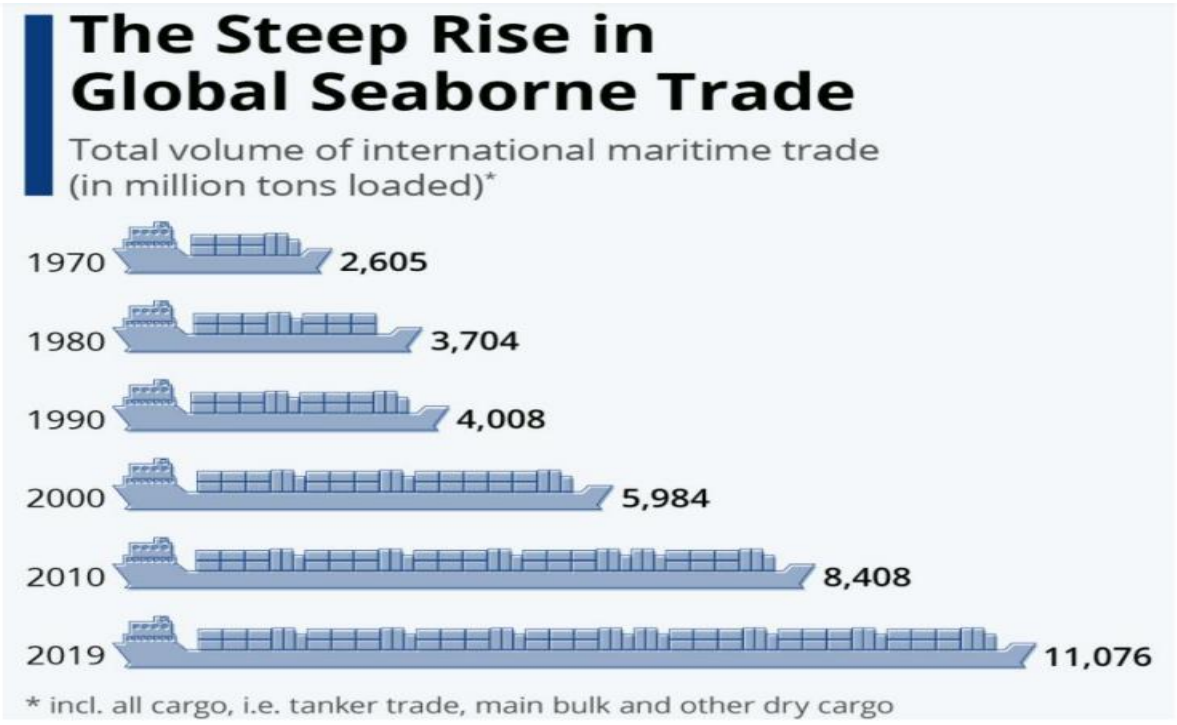


Fig 6.1 Graph on world trade based on UNCTAD data

The above data published by the United Nations Conference on Trade and Development (UNCTAD), globalization has caused a steep increase in maritime trade over the past few decades, with the total volume growing from 4,000 million tons loaded in 1990 to more than 11,000 million tons loaded in 2019. Container shipping in particular has boomed over the past three decades, with total shipping volume growing nearly eightfold since 1990. Logistics services provide sectorial connections within the local economy. It also connects the domestic economy to the international economy. The connectivity of various interdependent production sectors (agriculture, manufacturing, agri-food, tourism, amongst others) of the domestic economy strengthened through an efficient transport and logistics systems.

6.2 Sustainability in General

Sustainability refers to the ability to maintain or support a process continuously over time. In business and policy contexts, sustainability seeks to prevent the depletion of natural or physical resources, so that they will remain available for the long term Accordingly, sustainable policies emphasize the future effect of any given policy or business practice on humans, ecosystems, and the wider economy. The concept often corresponds to the belief that without major changes to the way the planet is run, it will suffer irreparable damage. In business contexts, sustainability refers to more than just environmentalism. Harvard Business School lists two ways to measure sustainable business practices: the effect a business has on the environment, and the effect a business has on society, with the goal of sustainable practice being to have a positive impact on at least one of those areas.

6.3 Sustainable Logistics:-

Sustainable logistics refers to the practices and processes aimed at improving the sustainability of supply-chain activities, ranging from the supply of raw materials to the

storage, manufacture and distribution of products. Transport is second only to the energy sector in terms of CO2 emissions and greenhouse gas production. That means it is responsible for one-fifth of the global CO2 emissions. Furthermore, the industry's contribution to CO2 emissions has increased by 1.9% annually since 2000, most of which can be attributed to the rise of globalization and increased demand for consumer goods. So as the consumer creates the necessity for more movement of goods.

The general belief among most companies with logistics operations is that shifting to sustainable solutions is an expensive venture. Many companies consider logistics processes as mere costs that do not generate any value for the company and its customers. These companies will tend to compress these costs as much as possible by selecting suppliers based on the lowest price, trying to limit the consumer's visibility on these elements. But in reality, that's not always the case. Organizations can still comply with the sustainability guidelines and advanced planning tools and maintain a high profit margin.

6.4 Green Logistics

Green logistics refers to the set of sustainable policies and measures aimed at reducing the environmental impact caused by the activities of this business area. This logistics concept affects the configuration of processes, structures and systems or equipment in the transport, distribution and storage of goods. The traditional approach to logistics often leaves environmental sustainability on the sidelines during decision-making. On the other hand, the aim of green logistics is to find a balance between ecology and economy. Green logistics has its origin in the mid-1980s and was a concept to characterize logistics systems and approaches that use advanced technology and equipment to minimize environmental damage during operations.

Fig 6.2 Green Logistics

Implementing green logistics results in a number of contradictory issues. Timing is a critical component of any logistics system. The increased demand for door-to-door services and just-in-time strategies ultimately leads to an increase in environmental impacts. These demands require the use of more air and truck transportation, which reduce energy efficiency and cause high pollution levels. Another contradictory issue involves reliability. The least polluting modes of transportation are generally the least reliable in terms of on-time delivery, lack of damage, and safety. Logistics systems are focusing on reducing inventories in order to reduce costs. However, this will require more in-transit inventories, thus further contributing to more pollution

6.5 Green Logistics Strategies

Businesses in all industries can benefit from implementing green logistics strategies. Some of the common sustainable logistics activities include adjusting product sourcing, improving efficiency in warehousing, and reducing emissions from transportation. Used

on their own or in conjunction with one another, these strategies can work for businesses in all industries.

6.6 Benefits of Green Logistics

Firms are attempting to overcome such challenges through the use of different strategies. A green logistics system must start at the source, and therefore must be considered during initial product development and raw material purchasing stages. For instance, companies can choose local suppliers in attempt to reduce transportation and environmental costs. Also, contracting with suppliers that procure their materials in a sustainable manner can lower a firm's environmental footprint. As product components are becoming recyclable, companies can start to use recycled materials in manufacturing and production. Sustainable logistics provides benefits to the economy, society, and environment.

6.7 Green Logistics Operation

The bellow flow chart shows the various components of green logistics.

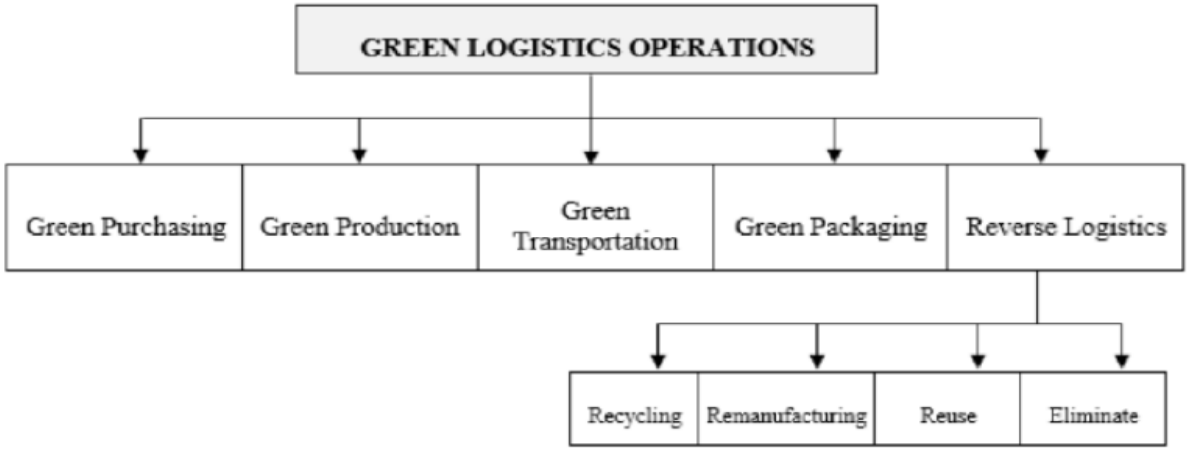


Fig 6.3 Green Logistics Operation

6.7.1 Green Purchasing

Green purchasing is the practice of purchasing goods and services with negative environmental effects in the least possible amounts. When faced with competing choices, it is the preference of materials that are fewer adverse effects on human health and environment. While the choices are compared, a multitude of factors are considered, factors such as the amounts and types of energy and resources used in production of those materials, the cleanliness of manufacturing processes, the means of distribution and whether the utilized resources are replenished. Green purchasing is a launch strategy with a proven success record, which involves purchasing products with recycled contents

6.7.2 Green Production

Green production is defined as the implementation of preventative environmental management strategies in a manner integrated in the production process, the elimination of the risks on human health and environmental values and the improvement of efficiency. The idea of producing goods and services with less waste has entered the business world with the name “green production”.

6.7.3 Green Transportation

Green transportation means transporting the goods by usage of the alternate fuels. Distribution is managing the movements of all the materials in the value chain from the beginning to the end. Business managers responsible from distribution observe the relationship between competitive advantages with the environmental factors. Distribution does have considerable effects on environment. So usage of alternate fuels such as electricity, Hydrogen will reduce the carbon effect on the environment.

6.7.4 Green Packaging

This type of packing is also known as Ecological Packing. Green Packaging is defined as the method of packaging, which value human and animal health, as well as the environment throughout the lifecycle, using reusable or recycled materials made up of natural plant material. The characteristics of packaging affect performance and efficiency all through the supply chain. For green packaging, attention must be paid to sizes, shapes of the packages and the use of environmentally-friendly materials. The way packaging is done using recycled materials affect the economic performance of a business in a positive manner.

6.7.5 Reverse Logistics

Reverse Logistics is an emerging concept but it will be one of the main pillars for sustainability in the logistic sector. The concept of reverse logistics is to keep operating costs low; it is an equally important component in a company's sustainability practices. Because the goal of reverse logistics is to maximize value from assets, it makes recycling Products and materials are a focal point. As a result, reverse logistics ensures a company produces less waste. Some of the Reverse logistics activities are repair, refurbishment, repackaging, recycling, and material harvesting which can reduce a company's environmental, social and economic impact. At the same time, it can increase a company's profitability and asset utilization.

Fig 6.4 Reverse Logistics

6.8 Foldable Containers

During this Covid 19 outbreak, the repositioning of empty containers was a major issue. The repositioning of empty containers will cost more and the environmental effect while doing this is very high. So this foldable container will become a revolutionary when the shipping company started uses it. This will help to reduce the space thereby storing more containers in single storage space. We can fold a container in two types one is horizontal folding and another one is vertical folding. Approximately we can store five containers in a single container storage area.

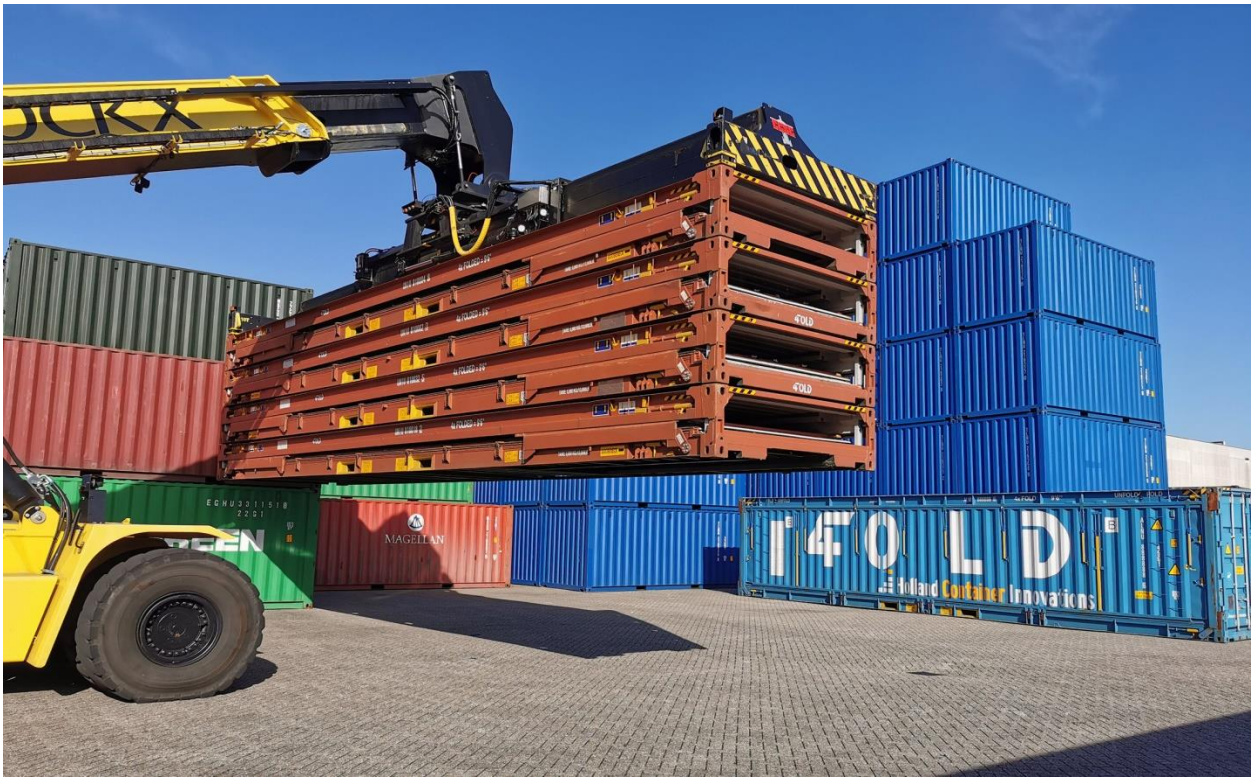


Fig 6.5 Vertical Foldable Container

Fig 6.6 Horizontal Foldable Container

Not only for shipping, these types of containers are help full for road transport also. Instead of transporting a single container by truck, we can transport four to five containers at the same time. Therefore the cost of transporting empty containers will be less and at the same time we can also improve sustainability.

6.9 Low Sulphur Fuels in Shipping Industry

This is a new type of fuel used by the Shipping industry. If the vessel is not using LSFO fuel they need to install scrubbers that will filter the sulphur from the exhaust. Sulphur is a naturally occurring element, present in all fossil fuels. It's essential to life, but its presence in the atmosphere as sulphur oxides (SOx) can, at high concentrations; cause much serious health and environmental problems. Until now, the shipping industry has been one of the greatest emitters of SOx – in 2007, for example, ships emitted 15 million tonnes of SOx, approximately 5-8% of global emissions. But this is set to change quickly.

Chapter 7: Findings, Analysis and Conclusion

7.1 Findings

Both Automation and Sustainability are interlinked with each other. The world today is witnessing an unparalleled growth of digital technologies, particularly in the field of Machine Learning, communications, Industrial Automation, and Artificial Intelligence. These buzzwords are collectively called “Automation” technologies. Implementation of these technologies has already begun in many transport chain areas and will keep impacting all transport modes in the future. COVID-19 has caused lots of problems for the international shipping and logistics industry. Of course, the global lockdown slowed the spread of COVID-19, but it influenced the demand for logistics technology. According to a Global Survey, 73% of users of logistics services noticed that the pandemic affected the supply chain operators. Lockdowns of cities caused massive disruptions for shippers. Delays at pickup or delivery points were created by limited labor supply at distribution centers. Therefore, to streamline all the processes, lots of companies turned to logistics automation. Automation means the use of special software or control systems to enable the running of the supply chain. The main goal of automation is to reduce human intervention.

Digitalization can assist ports to enhance the efficiency of processes and operations, ensuring that they become more environmentally sustainable, economically efficient, and capable of handling increased port traffic. Advances in automation and new innovative technologies, including Artificial Intelligence (AI), big data, Internet of Things (IoT), and block chain, offer great opportunities for ports. In this context, the ‘Smart Port’ concept has emerged. Smart Ports use technology solutions to increase efficiency and improve

security. Digitalization also serves trade facilitation, removing administrative burdens and simplifying data exchange between parties in the supply chain.

Sustainability mainly focuses on environmental-related activities. With the help of Automation, we can increase the sustainability of the industry. The World Ports Sustainability Program (WPSP) was launched in 2018 to contribute to the sustainable development of world ports in line with the United Nations Sustainability Agenda and its 17 Sustainable Development Goals. The International Association of Ports and Harbors is leading the Program in partnership with some of the world's major port industry-related organizations. WPSP's mission is to demonstrate the global leadership of ports in contributing to the Sustainable Development Goals of the United Nations. The program aims to empower port community actors worldwide to engage with business, governmental and societal stakeholders in creating sustainable added value for the local communities and wider regions in which their ports are embedded.

On 1 January 2016, the 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development were adopted by world leaders in September 2015 at a historic UN Summit and officially came into force. The 17 Goals are all interconnected, universally apply to all, and are the blueprint to achieve a better and more sustainable future. The Port and Logistics sector is an integral part of reaching the plan goals, specifically in areas of local solar, energy-efficient buildings, carbon and climate leadership, green jobs, preparedness and resiliency, air quality, and environmental justice.

7.2 Analysis

The main strength of Automation and Sustainability in port & Logistics sector is

Automation:-

- Improved work environment
- Increase production capacity

- No labour shortage
- High Efficiency
- Lower operating cost
- Fewer accidents
- Reliability and consistent output
- Increased in production, accuracy and safety
- Reduced the operation time

Sustainability:-

- Minimize negative environmental impacts
- Conserve energy and natural resources
- Will be safe for employees, communities and operators
- Tax Incentives
- Boost Workforce Morale and Innovations
- Attract New Customers and Increase opportunities
- Reduce energy related cost
- Increase the quality of life

The common weakness for Sustainability and Automation are

- Heavy capital cost
- Dependency on Technology
- Increase in Unemployment
- Incompatible with Customization
- Going green and automation need more human effort

7.3 Recommendations

1. The favorable Green attitude and Automation of supply chain players working in ports and logistics, as well as their commitment to further greening their operations, should be openly recognized and supported.

2. The port and logistics industry is already interacting and exchanging ideas on green supply chain goals and accomplishments. Port ecosystems must step up their efforts in this area since this component is projected to become even more critical in the coming years.

3. Greening supply chain management necessitates a mental shift as well as a shared commitment and devotion from all stakeholders involved. More than ever, market actors will need to communicate with other chain partners (including final customers) about how they can assist businesses in achieving green corporate and societal goals.

4. In terms of the energy transition, it is critical for port & logistics ecosystems to investigate and contribute to the development of a diverse range of activities that assist a shift to more renewable energy, rather than focusing on just one renewable energy source.

5. To reach the CO2 reduction targets, CCU and CCS will be required. The emergence of cross-border and inter port & Logistics cooperation in this area is a positive step toward taking it to the next level of execution.

6. In the framework of the transition to a circular economy, port ecosystems and logistics operations are expected to evolve further into significant areas for

recycling operations and material re-use. Through an adequate legal framework, knowledge development, and infra- and superstructure, the Ports & Logistics industry should be able to fully embrace this role.

7.4 Conclusion

As there is an increasing need to integrate environmentally friendly decisions into SCM procedures, GSCM have attracted increased attention within the industry. This Green supply chain management can be done with the help of Automation and Sustainable procedure. Tighter regulatory requirements, as well as community-wide expectations for a cleaner, more sustainable environment, are pushing Supply chain management practices to the next level. Actors in global supply chains are acutely aware of the need to transition to greener supply chains. Since the early 2000s, a gradual conceptual change has occurred from simply being environmentally conscious to incorporating green projects as a means of achieving excellent economic sense and increased profitability. In recent years, this conceptual change appears to have intensified.

The Ports and Logistics industry are hotbeds for projects aiming at greening supply chains even further. Green shipping, green port development and operations, green inland logistics, seaports, and the circular economy, and actions in the field of knowledge development and information sharing are some of the fields of action for private and public actors involved in environmental activities to pursue Green Supply Chain Management object.

Port communities and Logistics communities are also aware that the problems are still enormous, and that progress is not being done at the same rate in all areas. Against a backdrop of increasing volumes and investments, Port & Logistics ecosystems are being challenged to dramatically reduce their carbon footprints. These two industries are part of larger networks and chains thus requiring coordination and cooperation between the

actors involved in these networks and chains, thereby facilitated by technology, new governance, and business models and facilitation and regulation by governments. Therefore, as this network expands there is a definite need to become green and adopt green methods.

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