

Implementation of Green Freight Transport approach in Egypt: A case study of Port Said ports

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Abstract: Sustainable transport and sustainable freight transport sector are among the world's most important contemporary challenges. Additionally, it is a top priority for Egypt's sustainable growth. East and West Port Said ports on the Suez Canal are considered a gateway of utmost importance for linking Egypt with the rest of the world's ports. The research aims to investigate implementing the green logistic transport approach in these ports to keep pace with the green logistic development in most of the world's ports, close the gap between Egyptian ports and global sustainable ports, develop sustainable and integrated logistics transport plan to link the two Ports: Part I of the research addresses the concept of green logistic transport reviews its components and its social, environmental, and economic benefits, and monitors Egypt's current situation in the sustainable transport and freight development field. Part II focuses on studying the global and local experiences that have addressed the application of the green logistic transport approach and establishes the lessons learned that will be applied to the case study. Part III focuses on applying the approach to the ports and creating an integrated plan. The implementation of the Green Logistic Transport Approach is based on several successive operations: (1) Container Access and Handling, (2) Operation Maritime Movement, (3) The process of movement on the railway, and (4) Distribution Centers Operation. The research finally suggests overcoming implementation challenges Egypt faced, as well as lessons learned to improve the adoption of the strategy in all Egyptian ports going forward.

Keywords: Green Freight Transport; Port Said ports; Egypt, Environmental Sustainability, Sustainable Transport.

1 Introduction

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Ports are the backbone of international trade and the key driver of globalization. They are an entity that contributes to shaping social and environmental performance around transport systems worldwide. and the most critical components of ports and associated cargo movements are green logistics, also referred to as environmental logistics services, which is a sustainable action and policy taken by the logistics industry to minimize the environmental impact on transportation, storage, and other logistics activities. This policy aims to create a sustainable value balance between economic and environmental efficiency.

Heavy vehicles, such as those used to transport goods, have a noticeable impact on climate and air quality, and vehicle activity is expected to grow significantly in the coming decades, especially in emerging economies. Green shipping programs can accelerate the adoption of advanced technologies and strategies that save fuel, reduce business costs, and lead to significant reductions in carbon dioxide, black carbon, particulate matter, and other air pollutant emissions across the entire transport sector.

1.1 Research Problem

Although there are solid economic key elements in the city of Port Said and its Eastern and Western ports that qualify it for a global role in merchandise volume, it faces some challenges and pressures that threaten this distinction, such as air pollution, non-diversity in cargo traffic, Absence of green logistics system, and the non-use of new and renewable energy [2], [36], [34].

1.2 Research Goal

Investigating implementing a green logistic transport approach in Port Said's Eastern and Western ports and concluding implementation challenges in the Egypt case, and listing some recommendations that encourage adopting the approach in other Egyptian ports.

2. Martial and Methods

The methodology of the research is based on three main parts: The first part examines the concept of green logistic transport, including its most crucial elements, as well as its social, environmental, and economic benefits, and assesses Egypt's existing situation concerning the sustainable development of the transportation and freight sectors. The second part emphasizes studying the most significant local and international experiences that have dealt with the implementation of the green transportation approach and concluding the main lessons learned to apply the approach to the two ports, as well as drawing outlines that are generally discussed within the main variables of the field of research, such as (1) Compiling all processes attained into an integrated green logistic plan for the Eastern and western ports of Port Said. (2) Identifying and addressing the significant logistical and environmental challenges in the two ports. And (3) Come to conclusions and make suggestions for effectively applying the approach in Egyptian ports in the future. The third part emphasizes the application of a relevant approach to be implemented in the ports of East and West Port Said and the formation of a comprehensive plan that includes the key operations and processes, such as (a) the Container Access and Handling process. (b) Operation Maritime Movement process. (c) The process of movement on the railway process. (d) Distribution Centers Operation process.

2.1 General Framework of Green Freight Transport

Green freight transport refers to the use of environmentally friendly practices and technologies in the transportation of goods. It involves reducing the environmental impact of freight transport through alternative fuels, improved efficiency, and collaboration among shippers. The goal of green freight transport is to reduce greenhouse gas emissions, improve air quality, reduce noise pollution, and improve public health, safety, and quality of life, as in Fig1. Green freight transport offers several environmental, economic, and social benefits. These benefits can help businesses to remain competitive in an increasingly environmentally conscious market while also improving public health, safety, and quality of life [1], [2], [3], [4], [5].

There are four main shipping methods for transporting goods from one place to another: Air freight, Freight by train, Shipping, and Road freight. These methods vary depending on the different modes used to convey passengers or goods and the different time taken by each method [5], [1].

Green logistics, also referred to as environmental logistics, is a sustainable action and policy taken by the logistics industry to reduce the environmental impact on

transportation, storage, and other logistics activities. This policy aims to create a sustainable value balance between economic and environmental efficiency [2].



Fig 1 Main Objectives for Green Freight Transport

Source: Authors

Heavy vehicles, such as those used in transporting goods, have a noticeable impact on climate and air quality, and vehicle activity. This impact is expected to grow significantly in the coming decades, especially in emerging economies [3].

Green freight programs can accelerate the adoption of advanced technologies and strategies that save fuel, reduce business costs, and lead to significant reductions in carbon dioxide, black carbon, particulate, and other air pollutant emissions across the entire transport sector [1], [2].

Green logistic transport can contribute to sustainable development goals (SDGs) such as zero hunger, good health, clean water, and affordable energy. It reduces transportation and logistics costs, supports trade and market access, and contributes to economic growth and productivity. Green shipping infrastructure supports industry innovation and infrastructure development and promotes dry ports and ports for effective media exchange [2].

Urban logistics efficiency reduces travel wear and tear on infrastructure and contributes to sustainable cities and communities. Investments in cleaner cars or fuels reduce emissions per kilometer cities travel. Climate action is crucial in planning and constructing comprehensive green shipping infrastructure. Green packaging opportunities reduce the environmental impact of storage and waste and support the safe transport of dangerous goods.

Underwater life is protected through environmentally friendly practices in shipping operations, ports, and shipyards. Partnership contracts and common platforms are needed to stimulate industry-wide change and integrate green shipping programs. The transfer of technology and knowledge to developing economies in Asia is a critical element in the low-carbon transformation of goods transport.

2.2 Components of Green Freight Transport

Numerous elements of green freight transportation that have an impact on the environment:

- Alternative fuels like biomethane can significantly reduce emissions in freight transport, leading to increased demand for greener alternatives and willingness to pay more for them [6], [7].
- Green logistics procedures: adopting sustainable procedures across the logistics network, such as Utilizing energy-efficient cars and streamlining routes [7].
- Green transportation corridors encourage the use of inter-modality, which entails combining several modes of transportation (such as land, air, and sea) to maximize efficiency and reduce emissions [8], [9].
- Advanced ICT systems: By enhancing traffic management, boosting efficiency, and better integrating the logistical components of a corridor, integrated ICT systems play a significant role in green transport corridors [8], [9].
- Green freight transport focuses on lowering its impact on the environment and the climate while boosting efficiency and safety. This can be accomplished by creating solid logistics centers and long-lasting logistics hubs [9].
- Emissions consideration: A crucial aspect of environmentally friendly freight transportation is green vehicle routing problems. These issues seek to offer solutions while taking environmental concerns into account, such as lowering greenhouse gas emissions [10].

By integrating these elements, green freight transport can help reduce pollution, enhance sustainability, and encourage the adequate flow of products.

2.3 Benefits of Green Freight Transport

Green freight transport is the process of moving goods using methods that are more sustainable and efficient. It is fundamental for lowering greenhouse gas emissions and tackling climate change. It is a critical part of a zero-emissions transportation system. Green freight has several advantages, including advantages for the environment, the economy, and society.

Environmental benefits:

- Reduced greenhouse gas emissions: Liquefied Natural Gas (LNG) can significantly reduce greenhouse gas emissions in heavy-duty trucks, reducing PM2.5 and NOX emissions by up to 96.7% and 73.2%, respectively. [11].
- Improved air quality and reduced pollution: The PM2.5 and NOX emissions that contribute to air

pollution can be significantly reduced by using LNG in heavy-duty trucks [11]. Green freight programs, particularly in densely populated areas, can reduce air pollution by up to 50%. Vehicles with low or no emissions can also significantly enhance air quality [12], [13], [14], [15], [16], [17], [18], [19].

- In metropolitan environments, electric vehicles can minimize noise pollution [20], promote physical exercise for better health [12], [14], [18], and help the environment by lowering greenhouse gas emissions and averting climate change [15], [17], [18], [19].

Economic benefits:

Alternative fuels like LNG can significantly reduce operating costs [11], improving efficiency in freight transport logistics. Horizontal collaboration practices can optimize distribution, improving efficiency at strategic, tactical, and operational levels [21]. Green transport corridors can increase safety and efficiency and enhance competitiveness in an environmentally conscious market. Transportation management systems can detect efficient routes [1], improve visibility, and supervise emissions levels. These systems can also help businesses stay ahead of regulations by ensuring compliance with sustainability goals [22], [23]. Overall, adopting alternative fuels can lead to reduced operating costs, increased competitiveness, cost savings, and improved sustainability [19].

Social benefits:

Reducing air and noise pollution can enhance public health and quality of life in urban areas [20]. It also improves safety by reducing heavy trucks on roads and reducing congestion and accidents [24]. Overall, these measures contribute to a better quality of life for urban dwellers [20].

In conclusion, green freight transportation has a number of advantages, including social, economic, and environmental advantages. These advantages can enhance public health, safety, and quality of life while also assisting businesses in remaining competitive in a market that is becoming more environmentally sensitive. Overall, green freight transportation is an essential part of a sustainable transportation system and can have a positive impact on the environment and businesses in a number of ways. The green freight approach's environmental intervention components are as follows:

- 1) Vehicle Technology Alternative Fuel.
- 2) Vehicle maintenance.
- 3) Leadership.
- 4) Car Loading.
- 5) Vehicle orientation and scheduling.

- 6) Choose the right position for vehicles.
- 7) Logistics system design and supply chain structure.

2.4 Benefits of developing the green freight process

There are several critical factors in generalizing access to and exchange of green shipping practices such as: information, experience, success stories, good case studies and best practices. Shipping In addition, the slow adoption of energy efficiency techniques and practices in the transport sector is a case of market failure caused by high initial costs, low awareness and lack of a dedicated support policy. Some key aspects of the advantages of green freight transport developing process include:

- Assess the current state
- Set goals and targets
- Identify and prioritize green practices
- Collaborate with stakeholders
- Invest in infrastructure and technology
- Monitor and evaluate performance
- Share best practices and lessons learned

The green shipping methodology should incorporate funding mechanisms to overcome challenges and promote fuel reduction techniques, emissions, and logistics solutions as in Fig2. Pilot projects and case studies are needed to understand investment potential, impact, strengths, and constraints in implementing new technologies and innovative measures. [25], [26], [27].

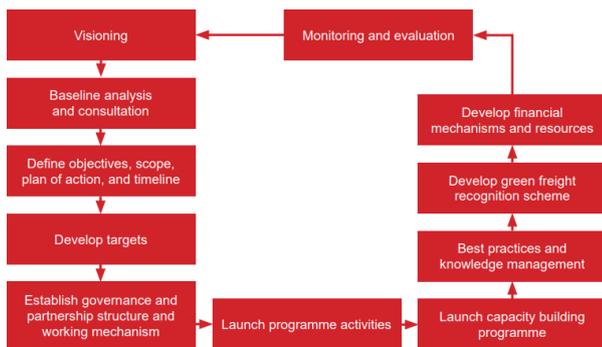


Fig 2 Green Freight Transport Developing Process

Source: Authors

2.5 Operational Phases of applying green freight approach “Inlet operations within the port.”

The application of the approach depends on the following phases, as in Fig3, that occur inside the ports and include all the operations by which the green freight approach modes from inside the ports to the end customer’s delivery. The research will focus on four main

operations, which are mainly carried out inside the port.

- 1) Operational Phase (1): Container Access and Handling
- 2) Operational Phase (2): Operation Maritime Movement
- 3) Operational Phase (3): The process of movement on the railway
- 4) Operational Phase (4): Distribution Centers Operation

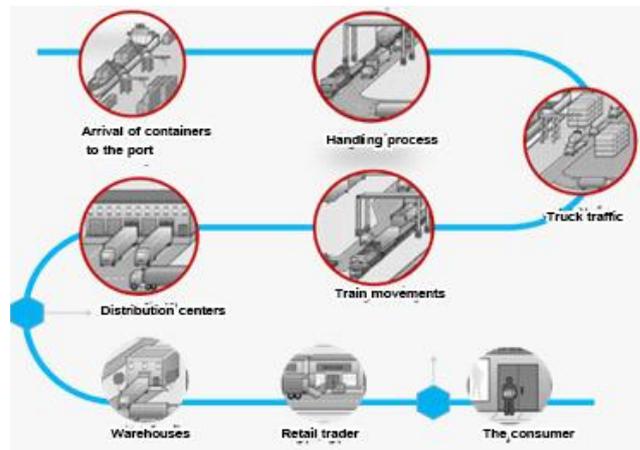


Fig 3 Inlet Operations within the Port

Source: Authors

2.6 Current Status in Egypt in Perspective of Green Freight Transport

Egypt has ambitious goals to develop and sustain its transportation industry. To help its transition to green mobility, the government has received substantial funding from foreign development partners [28]. With more than 19% of the total, the transportation industry is Egypt's second-largest source of greenhouse gas emissions [29]. Trains have a lower carbon footprint than automobiles for moving containers and other types of freight [29]. Consequently, Egypt's government is concentrating on the following [30]:

- 1) Established of sustainability goals for the logistic sector to be met by 2030 [31], including the development of sustainable freight transport systems [32].
- 2) Expanding the use of eco-friendly mass transit in major cities to reduce dependency on private vehicles and carbon emissions drastically:
 - Constructing metro and tram projects in Cairo and Alexandria, the two largest cities in Egypt [33].
 - Establishing the most significant electric bus pilot project in Africa, now in Cairo. Over thirty years, the project is anticipated to reduce greenhouse gas emissions by 965,000 tons [29].

- Seeking to build a railroad bypass in Egypt's congested Alexandria-the-6th-of-October-Great Cairo Area railway corridor, allowing for enhanced freight capacity and reducing congestion in regions with a high demand for passenger trains [29].
- 3) Establishing the groundwork for ecofriendly and transportation through numerous projects involving roads, rail, rivers, and ports [34].
- 4) Implementing a sustainable transportation strategy based on green infrastructure, eco-friendly technologies, and freight and passenger transportation [34].
- 5) Egypt has started a number of energy sector reforms, progressively cutting back on electricity subsidies and enacting feed-in tariffs to encourage the use of renewable energy sources [35]. International organizations have also provided climate financing to Egypt to aid in its mitigation efforts [36].

Last but not least, Egypt has acknowledged the need for legal reformation to promote green finance and has implemented a number of measures aimed at luring investments into the green field and facilitating the transition of businesses to green finance [37], [32], [38].

Related Egyptian organizations & agencies

Egypt's various organizations and agencies are working to tackle environmental issues in freight transport. The Egyptian Environmental Affairs Agency (EEAA), the Ministry of Water Resources & Irrigation, the Ministry of Housing, Utilities & Urban Communities, the National Water Research Center, and the Holding Company for Water and Wastewater are all involved in addressing water and environmental issues [39], [40]. The EEAA has implemented policies and regulations to promote sustainable transport and improve energy efficiency [36], [41]. The World Bank has approved a \$400 million green plan for logistics and transportation in Egypt, aiming to reduce greenhouse gas emissions by 965,000 tons over a 30-year period [41].

3 Results and discussion

3.1 Global and Local Experiences

3.1.1 Methodology for selecting global and local experiences

The integration of green freight transport concepts and policies to deal with ports is covered in a number of global

and local experiences of green freight transport that are reviewed. In the study, these experiences were compared in a number of ways, including:

- Scope of application and stakeholders;
- Objectives;
- Principles of development and upgrading; and
- Criteria and indicators measured during the experiences.

To comprehend the relevance of the green freight transport approach intended to be implemented as part of a more comprehensive perspective of points for dealing with sustainable transportation in ports, a comprehensive comparison was made to the experimental investigation, analysis, and assembly of methodological frameworks that may be extracted from experiences.

The study investigated various experiences to achieve diversity to cover the subject matter and all regulations pertaining to the various facets of green freight transport, including the various aspects, standards, and dimensions that may be connected to related port inputs.

3.1.2 Criteria for selecting experiences

Global and local experiments include three sets of experiments: the first covers initiatives that have been taken to promote green freight transport on the environment in developing countries; the second includes examples of successful green freight transport initiatives in Europe, and the third concludes projects already implemented and assessed after a period of operation. The criteria for selecting experiences include the following:

- The experience must be based on measuring indicators, physical and environmental standards, and infrastructure indicators relating to green freight transport indicators.
- The experiment objective must be comprehensive to the principles of urban planning.
- Choosing at least one experience covering one of the four main processes on which the research focuses, as shown in **Table 1**.

3.1.3 Initiatives to promote green freight transport in developing countries

There have been numerous research initiatives to lessen the negative environmental effects of urban freight transport in developing nations. A study emphasizes the need for a comprehensive planning strategy for urban freight movement and associated urban infrastructure [42], [43]. However, the majority of cities in developing countries lack a uniform distribution of urban space, complex land use patterns, mixed traffic conditions,

widespread use of non-motorized vehicles, and a lack of traffic discipline, which makes managing urban freight transport more challenging [44].

As a result, it is essential to come up with novel solutions to enhance the effectiveness of urban freight transport in these cities because doing otherwise could impede both the economic development of these cities and the overall momentum of the country's GDP growth that has been built over decades [45]. Here are a few instances of prosperous green freight transport programs in developing nations:

- **India's Green Corridors:** This nation's Green Corridors are a system of highways that are solely for the transportation of freight [46].
- **Electric trucks from China:** The world's largest market for electric trucks is China. The Chinese government has recently offered sizable financial incentives to encourage the use of electric trucks. As a result, China has seen a sharp rise in the number of electric trucks [47].
- **Kenya is a leader in smart logistics technologies,** enhancing freight transport efficiency and reducing emissions [48].

These are just a few examples of several successful green freight transport initiatives in developing countries, promoting sustainable practices, improved air quality, and reduced emissions in the transportation sector.

3.1.4 Successful Green Freight Transport Initiatives in Europe

Using biomethane as a Green Logistics Practice (GLP) in Sweden is one of the successful green freight transport initiatives in Europe [7]. Customers increasingly demand green freight transport, even if it means paying slightly more, and internal corporate initiatives drove this initiative. Creating a database for the best examples of environmentally friendly transportation methods is another initiative by the certification body Green Freight Europe (GFE) [49]. The database motivates shippers and logistics service providers to develop sustainable initiatives. Green Karma has also been suggested as a tool for tracking and proactively managing environmental sustainability initiatives in freight transportation businesses [50]. The method, which is based on Quality Function Deployment, has the ability to accelerate the greening of businesses' strategy and operations [51].

3.1.5 Examples of Successful Green Freight Transport Projects

The following is a review of some selected experiences already implemented and assessed after a period of

operation discussed in the study, as shown in **Table 1**: Each experience also covers one of the main operations of the approach inside the port as follows:

- **Operational phase (1) "Container Access and Handling":** Oakland Port experience: The port suffers from economic inefficiency and has played an influential role in California's economy [51].
- **Operational phase (2) Operation Maritime Movement:** Thailand Railway Experience: Problems in Thailand's port were concentrated in (1) environmental pollution resulting from increased CO2 emissions to trucks and (2) heavy congestion as a result of reliance on trucks to transport goods. [52], [53].
- **Operational phase (3) The process of movement on the railway:** Virginia Port Experience: The main problems at the port were (1) the lack of a plan to manage a large number of containers and (2) the overlapping of the city urban area with the port [54].
- **Operational phase (4) Distribution Centres Operation:** Jebel Ali Free Zone Experience in UAE: The main problem was the lack of planning requirements for the area by type of goods [55].

Table 1 Experience-based principles achieve green freight transport:

Operational phases	1	2	3	4	Principles weights
Principles	Thailand	Oakland USA	Virginia USA	Jebel Ali UAE	
Development and maintenance of port docks					2/4
Increase water depth					2/4
Provision of premises for commercial trucks	✓	✓	✓	✓	4/4
Integration of land uses and transport			✓	✓	2/4
Non-polluting energy efficiency	✓	✓	✓	✓	4/4
Attention to green spaces					2/4
Attention to the railway system and upgrading its efficiency	✓			✓	2/4
Use eco-friendly transport and cranes mechanisms					3/4
Redesign intersection solutions to reduce					2/4

accidents					
The facilities of the vessels					1/4
mitigate climate change	✓	✓	✓	✓	4/4
reduce carbon emissions					2/4
Separate ways of transporting goods	✓		✓	✓	3/4
relative weights	8/13	8/13	11/13	6/13	

3.2 Implementation of the Green Freight Transport in Egypt: Port Said Ports case study

3.2.1 Identifying the Location

The ports of East and West Port Said are a commercial and strategic gateway to Egypt, as they link vitally with a wide range of global ports around the world. Linkages of ports: Port Said port reaches many continents as in Fig4: (1) To the Arabian Gulf, (2) US East Coast, (3) East and South Africa, (4) Mediterranean Basin Countries, (5) Northwest Europe and (6) South East Asia. Furthermore, the main features of the two ports enhance this crucial importance as shown in Table 2 and Fig 5 in which there are so many possibilities can be used to apply green logistics and green ports approaches.

Table 2 Identifying main features in West & East Port Said Ports:

	West Port Said	East Port Said
Total number of berths	up to 32	up to 4
The diver	reaches 16 m	reaches 19 m
Total imports	reach 0.25 million tons per year	reach 1.70 million tons per year
Total exports	reach 0.16 million tons per year	up to 1.64 million tons per year
Possibilities	Commercial port consisting of multiple facilities such as: - Container - General goods - Roro. (Specialized Motor Station) - Multipurpose - Vessel and petroleum service.	The region's first value-added logistics center and commercial port consisting of multiple facilities such as: - Container - General goods - Roro. (Specialized Motor Station) - Multipurpose station - Reception Port



Fig 4 Linkage between Port Said Ports and World ports
Source: Authors

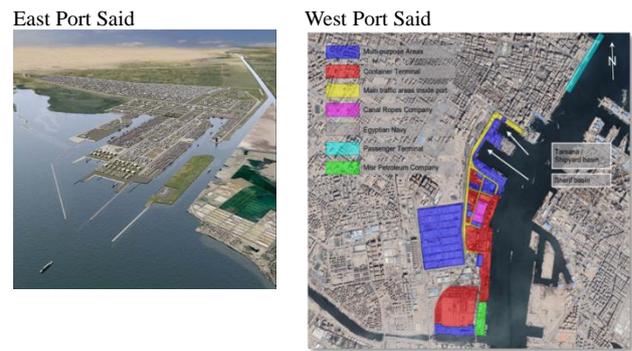


Fig 5 Map of Port East and West Port Said
Source: Authors based on GOPP maps

3.2.2 Reframe the problem

In order to apply green logistics approach in these two ports; first some main logistical and environmental issues have to be identified and addressed as the following:

- Absence of logistical system components as in Fig6.
- Inadequate shipping quality: Cargo on main roads is up to 72% compared to the railway, which is up to 28% as in Fig7. The port technology is weak, including:
 - Short lengths of docks that limits receiving big ships.
 - Limitation of the reception of some vessels due to the depth of water on the docks.
 - Absence of the application of electronic management of ship traffic and container handling.
 - Lack of a green logistic transport system.

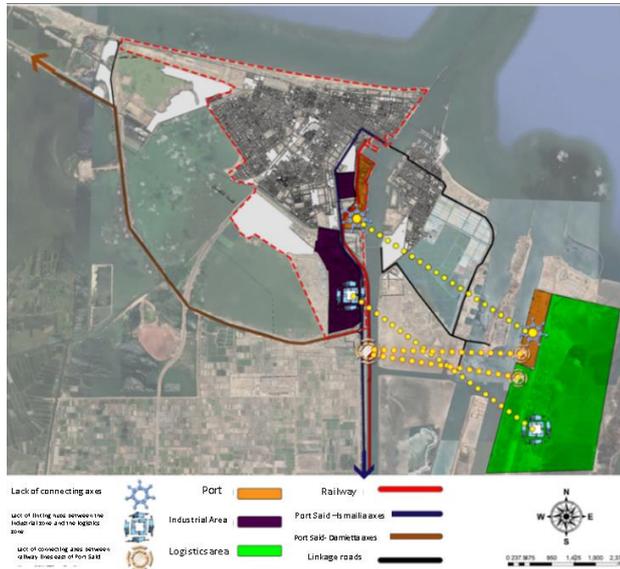


Fig 6 Absence of logistical system components
Source: Authors based on GOPP maps.

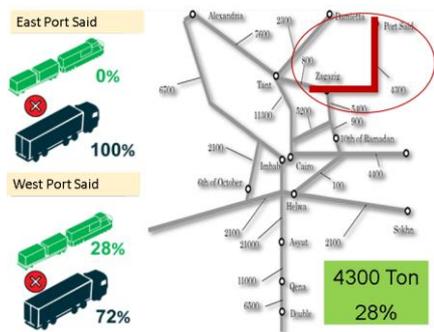


Fig 7 Cargo status on railway network
Source: Authors

3.2.3 Goal Setting

- Developing cargo transport infrastructure to reduce congestion.
- Upgrading the railway system integration between the ports of East and West Port Said into an integrated green logistic transport system that includes road, port, and railway transport.

3.2.4 Approach Process Implementation and operational phases.

The implementation of the Green Logistic Transport Approach is based on the Eastern and Western ports of Port Said from several successive operations, as in Fig8:

- Phase (1): Container Access and Handling

- Phase (2): Operation Maritime Movement
- Phase (3): The process of movement on the railway
- Phase (4): Distribution Centers Operation.

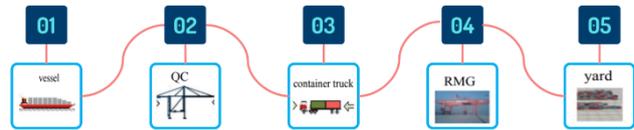


Fig 8 Operational phases
Source: Authors

Operational Phase (1) Container Access and Handling.

The main objective is to access the scheme and shipping traffic of the container arrival process. Operation Details First Container Access and Handling as in Fig9 & Fig 10:

- The main processes of the port's outline to understand the functional relationships between different uses.

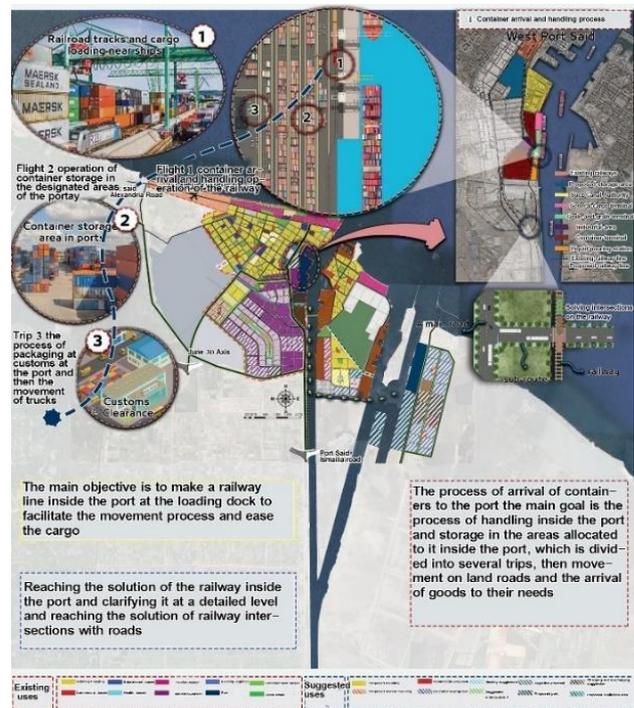


Fig 9 Container Access and Handling.
Source: Authors

- Details of operations within the port as a whole and detailed areas.
- The form of handling, storage areas and customs clearance operations within the port.
- Solving road junctions with railways.

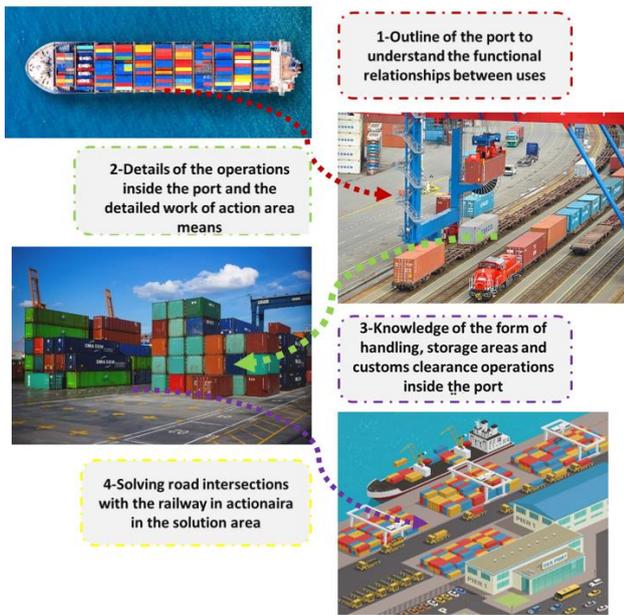


Fig 10 Container Access and Handling Details.

Source: Authors

Operational Phase (2): Operation Maritime Movement:

The main objective is to facilitate the shipping process by linking East and West Port Said Port. Maritime Traffic Operation Details as in Fig11 & Fig 12:



Fig 11 Operation Maritime Movement.

Source: Authors

- Identifying of seaport shipping solutions and disturbing the Strait's uptake of operations.
- Illustrating a detailed Action area within the port to follow handling and maritime traffic operations.

- Determining the quality of vessels performing operations, loading quantity and loading time.

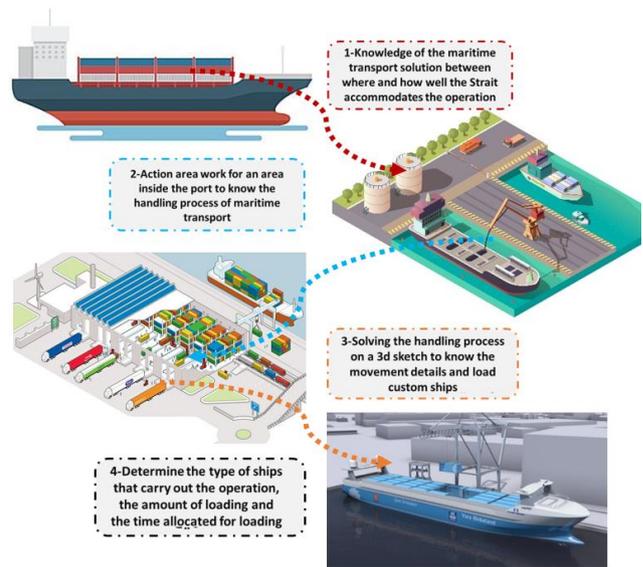


Fig 12 Operation Maritime Movement details.

Source: Authors

Operational Phase (3): The process of movement on the railway:

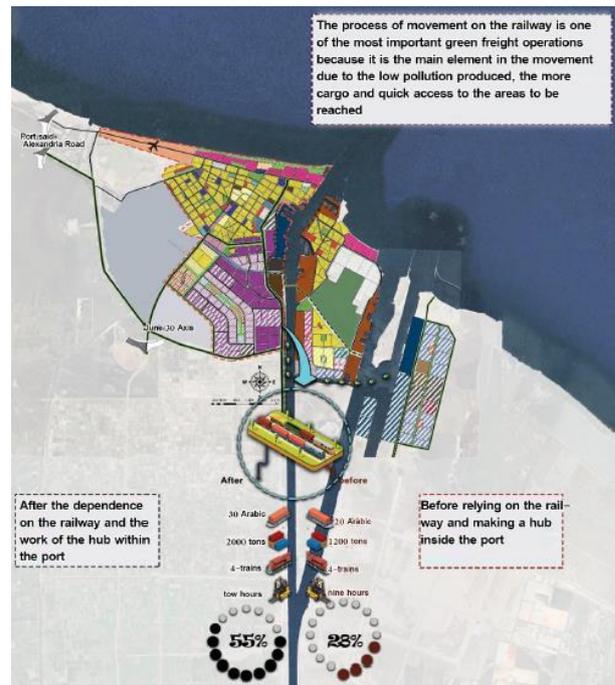


Fig 13 Operation Maritime Movement.

Source: Authors

The main objective is to increase the efficiency of work on the railway. Details of the process of movement on the railway as in Fig13 & Fig 14 as follows:

- Proposing a railway at West Port Said Port to facilitate cargo transport and achieve green freight approach.
- Increasing railway capacity and efficiency from 28% to 55% of total freight in the first phase of implementation.
- Implementing a rail traffic duct between East and West Canal to increase connectivity between ports.
- Reducing pollution and emissions along the proposed and existing railway line.



Fig 14 Operation Maritime Movement details.
Source: Authors

Operational Phase (4): Distribution Centers Operation:

The main objective is to design a storage area to fill the gap and consider the environmental dimensions. Details of distribution centers operations are as in Fig15 & Fig 16 as follows:

- Choice of charging and unloading area in industrial zone and Action Area work
- Implementing internal details of charging and unloading areas and functional relationships between operations
- Bridging part of the gap in East Port Said port through storage operations in the region
- Increasing access to the storage area to global environmentally friendly specifications and

strengthen its link to railways.



Fig 15 Distribution Centers Operation.
Source: Authors



Fig 16 Distribution Centers Operation details.
Source: Authors

3.2.5 Final Plan of the Green Logistic Transport for Port Said's Eastern and Western Ports

The planning concept

The idea of the plan as illustrated in Fig 17 is based on three pillars:

Pillar 1: Integration with land uses with the proposed plan and also proposed projects through:

- The first part is the extension of the Industrial Integration Zone and the link to the port's shipping process.
- The second part is the establishment of a logistic area to serve the port with localization elements of added value to enhance global competitiveness
- The third part is the extension of the eastern port to meet the requirements for loading and unloading operations to fill storage gaps.

Pillar 2: logistics axis through which:

- Linking the east and west of Suez Canal with a sea axis to facilitate the shipping process between the two regions to make integration between the ports by relying on a system of movement and types of ships dedicated to the operation considering the environmental aspect.
- Linking logistics shipping operations (ports - industry - logistics) to facilitate movement and shipping process and raise competitive advantage.

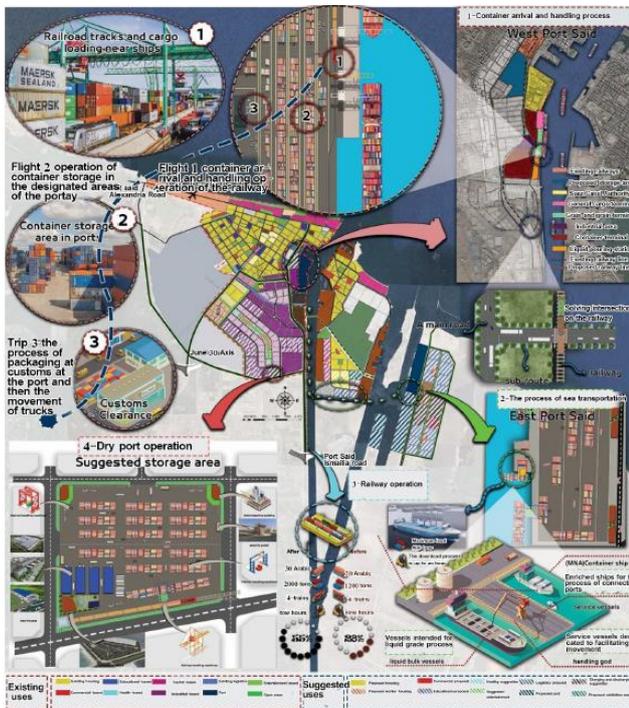


Fig 17 Final plan of the green logistic transport for East and West Port Said's ports

Source: Authors

Pillar 3: Solving the shipping corridor and the quality of ships and connecting to the bottom of the triangle: the railway line connects to the port's internal handling operations and increases the efficiency of shipping on them, which will lead to a remarkable rise in working on them and adopt them more by 45% instead of 28%.

Reflections of the planning concept

There are many benefits return on both ports as the following:

- 50% reduction in pollution.
- 85% integration of all shipping elements in the city.
- Raising global competitiveness by 4.8%.
- 40% increase in jobs.

4 Conclusions

Theoretically, a green freight transport approach may be implemented at Egypt's ports and logistics hubs. It offers a number of advantages that can help with the country's existing problems in these areas while also fostering the sector's sustainable growth. On the other hand, Egypt's green freight transportation has difficulties and restrictions that may make it impossible to put the strategy into practice.

The research investigated the implementation of green freight transport approach on East and West Port Said ports on the Suez Canal. The research gave a comprehensive framework for the implementation process elaborating the four main operations typically needed for greening and integrating the two ports. Thus, improving the port processes and addressing the environmental, social, and economic complications of not implementing such approach in Egypt's ports:

The following problems are some of the frequent barriers to implementing green freight transport in Egypt [56], [56], [57], [58]:

Lack of strategic planning: The implementation of green freight transport in Egypt faces challenges due to a lack of strategic planning, including long-term planning for infrastructure development and coordination among stakeholders involved in the planning process.

Lack of government regulations and support: Due to a lack of government support and regulations, including insufficient financial incentives for businesses to invest and laws requiring green technologies, the implementation of green freight transport in Egypt faces significant difficulties.

Financial constraints: Financial constraints are a major barrier to green freight transportation, which requires significant investments from both transporters and authorities. Public support programs aim to keep costs as low as possible for all parties involved.

Infrastructure limitations: Egypt's infrastructure may not be suitable for green freight transport due to a lack of electric vehicle charging stations, limited alternative fuel access, and inadequate road and rail networks for efficient and sustainable transportation.

Technological challenges: The integration of green technologies in the freight transport sector may face challenges like the reliability and availability of electric vehicles and the development of efficient and cost-effective alternative fuel sources.

Lack of awareness and knowledge: Limited awareness among stakeholders, including transport companies, government officials, and the public, about the benefits and feasibility of green freight transport can hinder the adoption and implementation of green initiatives.

Resistance to change: The implementation of green freight transport may be hampered by companies' reluctance to invest in new technologies and procedures because the freight transport sector frequently resists change due to potential disruptions to operations and business models.

Social Impact: The transition to green freight transport may lead to job losses in traditional sectors, necessitating social support and addressing these social impacts.

Environmental Impact: Egypt's freight transport sector faces significant environmental challenges due to air, greenhouse gas, and noise pollution, necessitating significant investments in infrastructure and technology.

Limited Resources: Egypt faces resource limitations, including land, water, and energy, which could hinder the adoption of green freight transport due to the need for additional resources.

5. Recommendations

The following recommendations should be taken into account in order to address the environmental, social, and economic difficulties facing green freight transport in Egypt:

Government Support and Regulations: The Egyptian government should implement policies and incentives to promote green freight transport, including financial incentives, tax breaks, and subsidies for companies investing in green technologies and infrastructure.

Investment in Infrastructure: Egypt should invest in green freight transport infrastructure, including electric vehicle charging stations, alternative fueling stations, and efficient road and rail networks, to overcome infrastructure limitations and promote green technology adoption.

Awareness and Education: Stakeholders, including transport companies, government officials, and the public, should be educated about the benefits and feasibility of green freight transport to combat a lack of awareness and promote green initiatives.

Public-Private Partnerships: The successful implementation of green freight transport requires collaboration between the government, private sector, and other stakeholders, facilitated by public-private partnerships that overcome financial constraints and drive

sector innovation.

Job Transition and Training Programs: The transition to green freight transport requires government and private sector support, including job transition programs and green logistics sector training opportunities, to mitigate its social impact.

International Cooperation: Egypt can leverage international cooperation and knowledge sharing in green freight transport to access funding, expertise, and best practices, thereby overcoming challenges and implementing sustainable solutions.

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