



Evaluating the Sustainable Green Seaports (SGP) in Egypt: Case Study of Alexandria and Eldekhila Seaports ¹

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ABSTRACT

The aim of this research is to evaluate the main problems faced by Egyptian ports toward applying the SGP concept and to determine the needed requirements by the Egyptian ports to be a SGP. Data was gathered through preliminary interviews and online questionnaire conducted to 70 persons from Alexandria and ElDekhila Port Authority and community to identify the barriers faced toward SGP concept and the best practices to overcome the problems found. Finally, the results showed that both ports are close of being SGP but they are suffering from lack of resources, awareness and alternative of clean energy resources.

Keywords: Seaports Economic Impact, Sustainable Green Seaports, Egyptian Ports.

1- Introduction

A Sustainable Green Seaport (SGP) is a sustainable development port, which not only meets the environmental requirements, but also raises the indicators of the economy. The core question of SGP is to achieve a balance between environmental impact and economic interests. The

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equilibrium point is based on the correct judgment of environmental consumption and economic interests, and meets the requirement that the reversible environmental changes never happen. The main objective of the SGP is to create good ecological environment and high economic efficiency in the port, to ensure the overall Consistent and sustainable construction of the community economy- environmental intricate ecosystem in port, and to establish the leading position of port in modern transportation. (kolios and stylios, 2011).

2- Research Aim

The aim of this research is to investigate the status of the Egyptian ports towards being sustainable green port and to evaluate the main requirements needed from the Egyptian ports in general, Alexandria port, and El Dekheila port in specific. The research also aims at identifying the main difficulties faced Alexandria and ElDekhilla port in terms of implementing the green concept in a trial to propose solutions to overcome the problems found.

3- Research methodology

The research follows a deductive research methodology including both quantitative and qualitative approaches. The research gap has been identified throughout the literature and the importance of green seaports (GS) concept in order to review the general issues related to ports that will be discussed in detail throughout the research. Moreover, GS concept complexity & challenges have been determined in order to study how the green seaport concept have been implemented and to identify the factors affecting it before and after implementation. Furthermore, a set of interviews and semi-structured questionnaires have been conducted to investigate the complexity factors of implementing GS concept. Last, the research is proposing a framework of the best practice to be implemented in the Egyptian ports industry.

The research is mainly depending on primary and secondary data. Primary data was gathered through on line questionnaire and set of interviews targeting Alexandria and ElDekhilla port authority and community to determine the status of both ports and to identify the main barriers faced in a trial to propose solution to overcome these barriers.

Secondary data sources was collected through literature review including; journal articles, newspaper articles, internet sources, library books, E-books, thesis and PhD research. They will also be obtained

through the utilization of previous studies such as case studies and statistics relating to the subject in review.

4- Seaports Influence on State's National Income

Indeed, the availability of sophisticated technology and modern equipment, together with orthodox approaches of management, not only fosters competitiveness of seaports but also enables them to offer even more aggrandized reinforcement to national economy. The seaports helping securing the raw materials necessary to enhance the domestic industrial activity at the possibly lowest cost incurred, and optimizing the competitiveness of its domestically manufactured products that are often deep into a fierce showdown with their foreign-made parallels. Perhaps, the clear-cut conclusion to draw of what was mentioned is the high unlikelihood for a certain country to establish healthy and stable economy unless it possesses its own coastal outlets reinforced with such growth potentials that cultivates their competitiveness. (Sheu, 2013)

5- Improvements in Seaport Logistics

Reviewing the traditional design of a seaport, one would notice that it was relied totally on human workforce to serve the patronizing vessels. However, the use of new technology such as multi-purpose containers and gantry tower cranes grew more dependable in loading to and unloading from the client, seaports were compelled to switch their obsolete machinery over to more sophisticated and versatile one. Seaports were, also, obliged to alter, or rather modernize, their business ownership and finance structures, and to bring about some very new concepts such as Smart Port or Green Seaports. These mentioned improvements were implemented, for the sake of optimizing the services rendered by seaport to its patronizing vessels, upgrading the merchandize handling cycle within the seaport premises, introducing some innovative loading and unloading techniques, employing modern and environmentally-friendly handling equipment, and, better conserving the seaport's surrounding ecologies. (Mangan, 2008; ZHAO, 2013; Nikitakos, 2012)

5-1 The Concept of Smart Seaport

The concept of Smart Seaport (SS) has earned strategic importance in recent years. Indeed, approving (SS) concept would direct, if not oblige, a seaport administration towards either a partial or full reliance on renewable sources to energize various operations and activities within a

seaport. Employing sources of renewable energy is of assured safety and has almost zero impact on environment compared to employing other non-renewable fossil energy sources. In addition, adopting (SS) concept would require the seaport administration to exploit modern technology marvels and innovations with nearly all operations and activities within a seaport. Smart Seaports contributes in accomplishing seaport sustainable development. Sustainable seaport is aiming at attaining a general state of integration and cohesion among multimedia transportation networks and among world maritime transportation networks in particular. It also aims at eliminating technological barriers and their usually concurrent congestions, and delivering freighted cargoes to even the remotest markets safely at minimal time and cost (Beltrán, 2015).

Furthermore, the investments in high-tech industry are seeking to secure worldwide and local environmentally friendly transportation systems; the future vision for most governments is to build the so-called Technology Platforms TP that would help setting future strategies for modern transportation. On the other hand, Green Corridors (GC) are becoming a prominent feature that serves as a clue to growingly spreading transportation corridors. (GC) is characterized by having the ability to offer optimum solutions that nourish Green Logistics within the seaport premises, to secure more superior and more environmentally friendly transportation, and to embrace integral logistic concepts and SS-supportive infrastructure. Green corridors will lead to smart corridors through which smart transportation services could be rendered. In summary, seaports are, seemingly, an underlying component within these corridors; in other terms, the major prerequisite for smart corridors is the availability of smart seaports (SS). The objective, hereupon, is improving and upgrading the validity of logistic services rendered within seaport premises, minimizing harm and damage to environment, and realizing seaport environmental sustainability (Beltrán, 2015).

5-1-2 Defining the Concept of Smart Seaport (SS)

Perhaps, the core of Smart Seaport (SS) concept lies in a trinity of aspects. Firstly, seaport and its environmental impacts could be adequately repaired; secondly, the degree of efficiency at which logistic operations within the seaport headquarters could be supported, and thirdly, the measures taken in the sake of reducing power consumption. This concept, hereby, helps transform conventional seaports into sustainable

smart seaports in global supply chains. The International Union of Communications defines (SS) As: “An innovative city that employs information and communication technology, along with other means, to improve quality of life, to optimize urban facilities, and to boost competitiveness in a manner that assures satisfying needs of both contemporary and upcoming generations in terms of all economic, social, or environmental regards.”

5-1-3 Smart Seaport’s Challenges

A number of challenges still hinder full application of SS concept; perhaps, due to the decisive role, it has in realizing sustainable development for both maritime activities and water corridors in a process so-called “Green Growth”. The Smart Seaport challenges can be summarized as follow:

- **Enhancing Competitiveness for Maritime Transport Industry:** Comprising multiple interests, which serve a wide variety of industries such as vessel construction and equipment maintenance. Maritime transport industry includes vessel owners, importers and exporters, or maritime freight agents, should be able not only to rival in an internationally competitive culture but also to retain such ability.
- Minimizing the costs of multimedia transportation by reducing the time to transport freights from one mode of transport to another.
- **Efficiency of Energy Consumption:** The core challenge in this context is the increasingly instable and fluctuating prices of energy and, namely, oil, which both serve as a propellant fuel for vessels and seaport cargo handling equipment.
- **Avoiding Damage in Maritime Transport:** Offering a modern mechanism of technology that can effectively monitor all activities occurring within the seaport premises. Smart seaports play indispensable role in imposing nearly full control against potential damages inflicted by maritime transportation activities and downsizing illegitimate acts of theft, piracy, human trafficking, or terrorism (Beltrán, 2015).

5-2 Sustainable Green Seaports (SGP)

Air-, water-, or soil-damaging pollutants and emissions from seaports are one major cause behind contaminated air persistently inhaled by humans. In other words, vessels moored to wharves and cargo-handling equipment can generate emissions and wastes that may cause a growingly endless list of health disorders such as lung cancer, cardiac and vascular disorders, or neonatal congenital anomalies. Indeed, annual estimates on life expectancy attribute nearly 60,000 deaths per year to contaminate air breathed by humans. Moreover, alongside the entire European continental coast, Eastern Asia, and Asian southern coast, air pollution alone results in uncontrollably numerous chronic, diseases such as cardiac and pulmonary disorders along with, namely, lung cancer. USEPA anticipates that within the two upcoming decades emissions of nitric oxides forced out into the atmosphere from traveling vessels would more than double their current amounts or, more quantitatively, would hit 2.1 million tons (Chang, 2012; Sheu, J., et al., 2013; Lirn, T., et al., 2012).

Indeed, container-based seaports still hold their rank as the type of seaports with the most significance facilitating of worldwide trade. Of all other available alternatives of transportation, maritime transport is, indeed, the most environmentally friendly. The resulting emissions and pollution from vessels and seaport satellite activities throw a draconian threat to the ecology of Mother Earth, a fact that invited yet further skepticism of this alternative's validity to sustainably match economic targets with environmental concerns. In other terms, the possibility of mutual interaction between economy and environment is ruled out. Consequently, looking more closely at maritime transport, one would find that not only seaports are perceived as its backbone but they also serve as an assembly point for all operations and activities that relate, more or less, to cargo loading and unloading. Thus, for the sake of reorienting the maritime transport activities towards the so-called green sustainability, seaport is determined to be the onset of this piece of research (Elzarka and ElGazzar, 2014).

Concerned mainly with maximizing economic benefits and minimizing potential environmental impact of seaports on their surrounding territories, the concept of Green Seaport (GS) is a rather recent trend in seaports industry. Ultimately, whenever environment conservation is held high, whenever environmentally friendly development is realized, whenever energy and economic resources are made abundant, thus,

Green Seaport is, then, believed to have successfully established the desired balance between economy and nature (Sheu, J., et al., 2013).

A Sustainable Green Seaports should not be considered solely in terms of the cost incurred; it should be considered in terms of generated benefits, sustainability, economic savings, and ultimate use of seaport available resources. Accordingly, the main goal of Green Seaports is lying into the environment-protection policies, the environmentally friendly development, the replacement of non-renewable energy sources with other renewable, the adoption of environment-oriented management within seaport headquarters, and, eventually, construction of seaports that support sustainable relationship between Mother Nature and economy. All these factors are of vital importance and should be allocated a greater much of attention (Kolios, 2011; Sheu, J. et al, 2013; Chang, 2012).

5-3 Sustainable Green Seaport Concept Factors

In order for the Sustainable green seaport concept to be ideally realized or fully applied, GS-oriented seaports should be allowing for a set of factors that further ease its full application. In this context, for the sake of balancing socio-economic dimensions against environmental ones, a thorough consideration of these factors is advised supposedly because they are easily applicable in nearly every seaport irrespective of economic status of its native country. The factors are listed as follow, Table 1:

Table 1: All factors of green sustainable seaport

-Sediment of port entrance and coast erosion.
-Aesthetic interference with local community.
-Cargo spilling from chemical carriers and tankers.
-Air pollution from bulkers' cargo handling.
-Oil spillage during disconnection of cargo pipeline.
-Interference with recreation and fishing boats.
-Effect of marine fauna during vessel sailing, operation, and anchoring.
-Pipeline network and its impact on the real estate value of the local community.
-Decreasing number of marine fauna near the seaport due to the seaport infrastructure.
-Interference during construction or renovation of the port facility.
-Marine biology protection.
-Waste dumping in water.
-Oil spill.
-Impact of ballast water on plankton.
-Noise and vibration from cargo handling.

(Lirn, et al., 2012; Sheu, J. et al., 2013)

All these factors are to be discussed in detail with the application on both Alexandria and ElDekhila ports.

6 - Orientations of Egypt Seaports towards Sustainable Green Seaports (SGS) Concept

Not only does the five-year, from 2012 through 2016, socio-economic development plan in Egypt aim at cultivating competitiveness of Egyptian economy but it also encourages an annual 12% increase in Egyptian-made exports of consumptive products, electric appliances, household hardware and furniture. Increased private-sector engagement in development and upgrade of Egyptian economy, namely in the service-based sectors whose role in realizing major goals of national economy turns inevitable, and is strictly emphasized. Through either total or partial liberalization of trading influx, Egyptian Government seems to be in relentless pursuit of maximizing the bulk of its domestic-made exports. The desired maximization will greatly support a yet more desired increase in the efficiency of Egyptian domestic seaports that reflects a growing demand on their services rendered. Hence, since demand on maritime transport, activity is usually derived from demand on seaborne freights and cargoes and since seaport is the underlying backbone of maritime transport industry and multimedia chain of transport (Sislian, 2016).

Egypt has, exactly 82 seaports divided ascendingly, based on their scale, into 9 major seaports; Alexandria, Dekhela, Safaga, East Port Said, Damietta, Adabiyya, Suez, Ain El-Sukhna, 6 generally commercial seaports; Arish, Tur, Hurghada, Sharm Elshiekh, Nuweiba which comprises a petroleum dock port, and other 76 specialty seaports. Holding the lion's share, roughly 60%, of Egypt's foreign trade and being of such magnificent influence on advancing Egypt's economy, Alexandria seaport will be the main concern of this study paper.

In terms of Container Handling Rate (CHR) on the entire Middle Eastern scale, Alexandria seaport ranks as the 9th top, while Port Said seaport is placed 5 ranks earlier, as shown by the following table 2.

Table 2: Middle East Top Ports, 2010-2014 (1000 TEU)

Ran k	Port	2010	2011	2012	2013	2014	Growth Rate (2014/20 10)	Countr y
1	Dubai	11.60 0	13.00 0	13.270	13.64 1	15.249	131%	UAE
2	Jeddah	3.830	4.040	4.738	4.561	4.263	111%	Saudi Arabia
3	Port Said	3.475	4.269	3.631	4.100	3.959	114%	Egypt (Misir)
4	Khor Fakkan /Sharjah	3.022	3.229	3.996	3.800	3.800	126%	UAE
6	Salalah	3.485	3.200	3.620	3.340	3.034	87%	Oman
7	Shahid Rajaei	2.593	2.839	2.317	1.763	1.842	71%	Iran
8	Damma m	1.333	1.596	1.622	1.660	1.748	131%	Saudi Arabia
9	Alexand ria	808	1.490	1.463	1.508	1.678	208%	Egypt (Misir)
10	Ashdod				1.182	1.250		Israel
11	Beirut				1.117	1.210		Lebano n
12	Haifa	1.264	1.235	1.372	1.357	1.196	95%	Israel
S. Total		31.40 9	34.89 8	36.029	38.02 9	39.229	125%	
Share among World Total		6%	6%	6%	6%	6%		
World Total		540.8 16	587.4 84	624.48 0	651.2 01	684.42 9	127%	
1) 2010-2012, "Containerization International Yearbook" (2004-2012) data. 2013- 2014, "The Top 101 ports 2014 of Containerization International" data.								
2) World Total UNCTAD data "Review of Maritime Transport" data.								

Indeed, Egyptian seaports are stressed with a handful of impediments that keep them off satisfactory, let alone perfect, realization of efficiency and sustainable development. Along with inferior maintenance services, the seaports still, have the use of decrepit machinery and technically obsolete loading trucks. The time range spent to take and implement decisions is outrageously and tediously prolonged by ill-structured administrative bodies that, alarmingly, exhibit cluttered red-tape bureaucracy and uselessly multi-level hierarchy dominated by underlings and bribery-addicting braggarts. Furthermore, almost never have Egyptian seaports allowed for environmental or societal indicators,

nor have they sought to balance such indicators against economic ones. This incorrigible remissness has had Egyptian seaports deviate from ideal realization of GS concept since they obviously abstained from adopting the modern GS conceptual framework. Obstacles (threats) along and bridges (opportunities) through full realization of GS concept will be studied in this paper. The domestic economic circumstances, together with the resources and assets exploitable by Egyptian seaports, will also be a point of concern in this paper (Sislian, 2016).

6-1 Egyptian Seaports Capacity

Egypt possesses roughly 15 commercial seaports divided into 9 major commercial seaports and 6 aforementioned peripheral seaports. The following is a table indicating a list of the Egyptian seaports together with elaborate details on every individual seaport in terms of total (land/sea) area, total loading capacity of both general and containerized cargoes, number of working wharfs and quays, and whole sum of warehouses, storages yards assigned for either general, containerized, or hazardous cargoes.

Table 3: Specification of Egyptian commercial seaports

Port	Area		Max. Capacity		Containers Berths			Total no of Berths (Including Containers Berths)			Total Areas of Warehouses and Yards (m ²)
	Total (Km ²)	Land (Km ²)	Cargo (Million Tons)	Containers (Million TEUs)	No.	length (m)	Draught (m)	No.	length (m)	Draught (m)	
Alexandria	8.40	1.60	36.80	0.5	6	914.4	12.8	59	7624.7	12.8	544785.3
El Dekheila	6.20	3.50	22.10	0.5	6	1520	12.0	20	4586.0	20.0	16399380
Damietta	11.80	8.50	19.75	1.2	4	1050	14.5	19	5100.0	14.5	1115380
Port Said	3.00	1.30	12.78	0.8	3	350	13.2	32	4452.0	13.2	243253
El Arish	0.23	0.05	1.20	0	0	0	0	2	364.0	8.0	34000
East Port Said	72.10	70.60	12.00	2.7	4	2400	15.0	4	2400.0	15	1800000
Suez	162.40	2.30	6.60	0	0	0	0	14	2070.0	8.22	18615
Petroleum Dock		1.16	4.14	0	0	0	0	7	828.0	9.0	0
Adabiya		0.85	7.93	0	0	0	0	9	1840.0	12.0	37000
Sokhna Port	87.80	22.30	8.50	0.4	1	750	17	7	2350.0	17.0	11140
Hurghada	9.90	0.04	0	0	0	0	0	1	330.0	10.0	0
Safaga	57.00	0.6	6.37	0	0	0	0	6	1327.4	14.0	200159
El Tour	1.65	0.43	0.38	0	0	0	0	1	75.0	5.0	385600
Nuweiba	9.90	0.40	1.90	0	0	0	0	3	385.0	8.0	168500

Source: (Maritime Transport Sector, 2016)

6-2 A case study (Alexandria and El-Dekheila ports)

6-2-1 The geographic location of Alexandria port

Alexandria is located in the western part of the River Nile between the Mediterranean Sea and Maryoot Lake, and it is considered as the second important city in Egypt since it has the main port that two third of the world trade passes through. Alexandria has two ports; one of them is located in the east and it is known as the eastern port whereas the second is in the west known as the western one. The two are segregated through a T form peninsula. The eastern port is shallow and it is not used in navigation as it has a view of the maritime scout club and the small touristic ships. Also, a marina is being established nowadays to link the western port regarding the crucial and actual sides. That is why it is called Alexandria port (Port Authority website, 2017).

6-2-2 The Port's size

Alexandria port's water surface is almost 6.8km while the land surface is about 1.6km. Also, a space of around 204000m is added to the port's customs duties to make the overall size of the port almost 8.4km+ 204000m, and the borders of this size is identified according to the following:

- **The north border:** Alexandria's port wall (the current customs duties wall).
- **The south border:** the policlinic + the store of trade wood company + the refrigerating building the is related to Egypt company for import and export + fish resources building + gas station + refrigerating building, these borders include all the intersecting streets which are Set El-Malek, Set Masr- El-Ameer and Bergwan streets
- **The east border:** Estani Street.... The west border: El-Anmaty Street.
- Alexandria's port is geographically divided into 6 main areas that deal with loading and discharging of all the ships that come to the port as well as the storage spaces that are linked to each berth (Port Authority website, 2017).

6-2-3 The number and usages of the berths

Alexandria port has many berths that deal with the loading and discharging cargo operations for all the ships visiting the port. These berths are divided according to the kind of cargo handled through them, which specify the kind of equipment used in each berth. Infact, Alexandria port has 28 berths for loading and discharging general cargo, 1 berth for livestock, 4 berths for Alexandria containers station, 1 berth for H.P.H. 1 berth for loading and discharging ships that have Molasses, 3 berths for military ships, 5 berths for passengers and tourism, 4 berths for handling coal, 3 berths for supplies and grains, 5 berths for handling petroleum products and food oil (petroleum basin), 4 berths for roll on roll off ships, and 2 berths for scraps. This will make a total of 61 berths owned by the Authority of Alexandria port.

6-2-4 The total number of equipment owned by the port

Since Alexandria port is one of most important and oldest Egyptian trading ports as it receives most of the Egyptian international trades, it owns a lot of equipment and machines that help it to receive all kinds of ships and offer all the services such as tug services, guiding on the port's berths and all the services related to cargo handling on the berths.

The port has 20 tugs that were manufactured between 1976 and 2012 in Egypt, Japan and Singapore; 6 of them are broken down while the others are working. Also, the port has 6 motor boats that were constructed between 1988 and 2005 as an Egyptian production only (the Arab contractors' shipyard); 2 of the motor boats are not working only. In addition, it has 3 maritime sterilization units that were constructed in 1979 in Japan; one of them is under training while the other 2 are working. The port has also 14 pilot motor boats that were built in Egypt, Japan, and England between 1979 and 2012 that are all working in good conditions except only one. Furthermore, there are 11 service motor boats in the port that were built between 1979 and 1995 that are divided into 3 not working, 1 under training and the rest are in good conditions. There are 4 floating cranes that range between 1960 and 1980, and they have 2 not working and 2 working as illustrated in table 4 (Central maritime and technical department, 2017).

Since the port is concerned with the environmental aspects, it has to own what helps it in this task as it owns some units that are responsible for protecting the environment like 8 motor boats that were built in Holland, Egypt and Japan between 1980 and 2015, but they have 3 not wring units

while the other 5 are working. (Environmental protection administration, 2017)

6-3 El-Dekheila Port

El-Dekheila Port is the natural extension of Alexandria port as it was constructed as per the national decree number 494 of 1986 from the executive projects unit, its geographic position takes the gulf form that has a great depth on the seaside that reduces from the costs needed for sterilizing the port. Also, the port's north side is shallow and has some small islands that help in reducing the costs of building water barriers.

El-Dekhila Port has many advantages; one of which is that it is located in a sand-like area, which reduces the cost of landfill and the buildings that the port intends to establish in the future. The port's land area is sufficient for the future development stages and it allows establishing a logistics area in the future. Another major advantage of this port which makes it attractive for trading is that it can easily connected to the national roads (Alexandria- Cairo desert road) as well as having a rail road. Moreover, the port is close to El-Dekhelia Steel Company, the free zone and the electric power station in the west part of Alexandria, which reduces the costs of transporting the needed materials inside the port.

The water size of the port is 74kmm the land size is 3.5km, and the total size of the port is almost 6.24 km as shown in table 4 The port carries out all the loading and discharging work 24hours.

Table 4: El-Dekhila Port details

Illustration	Details
Water area	2.74km
Land area	3.5km
Number of berths	14 berths
Berth's length	7200
Draft	10m: 20m
Rear area	3500000 m getting the administrative buildings and the outside area
Number of stations	6 stations

Source: (Port Authority website, 2017)

6-4 The port's current state from the GS perspective

In order to specify the current state of Alexandria and El-Dekhila Ports and know the extent of having the factors contributing to achieve the concept of a GS, a lot of personal interviews are conducted with

representatives from Alexandria port Authority who are (Alexandria port Authority spokesperson and some employees from the electronic, power and maintenance and environment protection departments). Also, set of semi-structured interview is conducted with a working company in the port Authority which is Alexandria container handling company with each of the following (the company's president, safety and occupational health manager, power and maintenance department manager, equipment maintenance department manager, sewage department manager, research and information department manager, and the company's consultant of power and maintenance issues). some questions are conducted to identify the extent of implementing the concept of a GS in the port along with specifying the GS factors that do not exist in the port and that exist in both ports and specifying the port's fulfillment to achieve the balance between the economic, social and environmental sides.

The interviews questions are divided into parts to collect all the data that specify the extent of implementing the GS concept in the port, and the following data are extracted from them to know the current state of each of the two ports.

6-4-1 The environment friendly projects that are made and financed or operated via foreign investments

A personal interview was conducted with the Alexandria port Authority spokesperson to know the extent of having new foreign environment friendly investments, and it showed the following; Alexandria port Authority has made a contract of designing, establishing, managing, operating, maintaining and submitting a station that receives and handles the unclean bulk in El-Dekhila Port using B.O.T system between the general port Authority and Sesco Trans Company for loading and discharging cargo with a total amount of 3 milliard Egyptian pounds. In addition, the share of the company is with a percentage of 20%, this project takes 24 months, and the company will benefit from it up to 30 years. The length of the berth that the project is made on is 320m with 20 m depth and a total of 155000 m. the total area of storing, stowage and managerial buildings is more than 100m in which this contract facilitates receiving coal and the pollutant cargo in the port. In fact, this station is considered a gain to El-Dekhila Port efficiency and it helps in achieving the goal of a standard environmental use of handling operations.

The spokesperson clarifies that the port Authority will sign a contract with China Harbor Company of a multi-purpose station on berth 55 in Alexandria port on an area of 500000m with a berth length of 1800m and 17m depth with a total cost of \$700000000. This station is considered an addition to the port as the existence of these kinds of berths will help the port to receive different kinds and sizes of ships.

6-4-2 The urgent measure to get rid of the dangerous goods in Alexandria port

The spokesperson clarifies that Alexandria port Authority is about to finish establishing electronic system that include taking some urgent measures to get rid of dangerous containers and cargo that might cause disputes among the working bodies in the port as the total number of dangerous cargo containers is 3120 containers that are handled on berths inside the port. It also includes taking some urgent measure to get rid of waste containers (reefers and food containers) that remain inside the handling stations more than 15 days. The port Authority has made a store in El-Nobaryaa city of a size of 3200m to store the waste containers with a cost of \$1000 per container; 20 in advance, and \$2000 per container with 40 in advance with a possibility of paying in Egyptian pounds.

6-4-3 Factors contributing in achieving the GS concept

The researcher displays some constituents of the GS concept that were discussed in the personal interviews that were conducted with the participants from the port Authority (the Authority spokesperson, some employees in the electronic, power, maintenance, and environment protection departments), and they resulted in the extent of their availability in the port Authority as in the following:

6-4-3-1 The solar power station

The port has some solar power stations to generate electric power that can be used for lighting the yards, stations, and buildings inside the port. However, the port Authority supply Alexandria Electricity Company with this electric power that results from the solar power stations which is then responsible to supply the port with all the electric power needed.

6-4-3-2 The port's berths state

The port Authority owns some designed berths that are ready to supply the anchored ships with electric power instead of using the ship's generators to get it. Nevertheless, the port Authority makes this service optional and does not oblige the ships to stop their generators and depend on the electric power stations that exist on the berths. Moreover, the berths are ready to supply the ships with all the other catering services whether supplying them with fuel, oil or water along with some marine supplies like supplying the ships with spare parts, paints, various kinds of food, cleaning tools, safety equipment and all what the navigational agent or the captain needs except water, fuel and oil.

6-4-3-3 The protection measures of receiving petroleum ships

Alexandria port has a specific area to handle petroleum products which is called petroleum basin that conducts all the handlings of the petroleum products like loading, unloading, storing, rehabilitating and washing the petroleum tanks of ships to load liquid cargo in the same tanks instead of making the ship return empty. In fact, the petroleum basin helps the port to avoid pollution or spilling from petroleum ships into the water area of the port.

6-4-3-4 Procedures of Getting rid of Waste

The port authority does not own a special unit or company to get rid of salvage, so it depends on giving a license to a private sector company to get rid of the wastes and salvage resulting from the working units inside the port and the ships. Therefore, this company recycles part of the recyclable waste, and gets rid of the other repetitive waste with specific ways away from the port. Since the job of these companies are dangerous and have a great effect on the surrounding environment of the port, all the licenses and operations are done directly by the acceptance of the port Authority president.

6-4-3-5 Protection measures of the environmental elements

Alexandria port Authority owns 4 marine units to protect the marine environment from the different pollutants that can affect the water. The port always seeks to protect the maritime environment and preserve the different environmental supplies from the surrounding pollutants. Also, the port uses new technological devices for the environmental measurements that work on investigating and specifying the percentages of environmental pollution whether in air or water as well as fighting them. In addition, the port accepts a certain level of pollutants

only that result from equipment, machines that are owned by the port Authority, loading and unloading equipment that are owned by different companies and the equipment and machines owned by cargo handling stations. Also, a record is kept for the pollution accident, its reason and treating it by imposing taxes and financial penalties on who exceeded the limit made by the port Authority. The port sets conditions and environmental descriptions on the equipment and machines that are bought or rented by the stations and shipping companies to be used in cargo handling whether on berths or inside the spaces. The port obliges the loading and unloading companies and cargo handling stations to report a statement including all the equipment and machines that they own along with their technical descriptions, the year and place of manufacturing, the extent of their efficiency and their suitability for their purpose.

6-4-3-6 Ships' maintenance and repairing

The port owns a dry basin that was established in 1839, and it is used in all the periodic and urgent maintenance of the ships that deal with the port instead of making them on the berths. According to the characteristics of this dry basin, it is possible to enter ships that are about 1200 tonnes with a maximum length of 60m, a maximum width of 10m and underwater of 7m. The efficiency of the basin increases by installing new pumps, nowadays the special entrance of the basin is being repaired to enlarge its width by the Egyptian company of repairing and building ships.

Also, there are some repairing and maintenance works that are done outside the dry basin: all the Simple repairing and maintenance work that are made to the ship body, surfaces, machines and helping machines, composing and repairing electronic devices that do not require the ship to enter the dry basin but it is always done in the port's underwater or on specialized berths assigned by the port Authority.

6-4-3-7 Sewage treatment station

Since Alexandria port has strategic importance and it is a very important economic port for our beloved Egypt along with its persistence to preserve the surrounding environmental elements, it is keen on getting rid of the sewage water safely whether it is the outcome of all the working units inside the port or the existing ships. The port has a special station to treat the sewage water, which helps it to reuse this water again

in the agricultural works to increase the green areas in the port. Also, it owns a special sewage network isolated from the other sewage networks of the nearby residential areas to avoid any malfunctioning in the residential areas network that might cause environmental or economic harm to the port society by stopping all the inside work and activities. The port also allows the anchored ships on the berths to get rid of their sewage water by dealing with its special network to avoid the discharging of the sewage water of the ships in the port's water, as it is keen on protecting the environmental life of the water from any pollution.

6-4-3-8 Using liquefied natural gas

Alexandria port is one of the most important marine trading ports inside the Egyptian region, as it owns 60% of the international trade to the Arab Republic of Egypt. Therefore, the port and its working units should have the equipment and machines that will help them to carry out all the handling operations of this percentage of the international trade to Egypt. Although it owns a large number of equipment of loading, unloading, and handling machines inside the place along with the tug and piloting equipment and different cranes. It totally depends on the fossil fuel (solar) to operate all the equipment and machines that result in a high percentage of co2 emission that pollutes the environment. Therefore, the port does not use the liquefied natural gas at all in operating equipment and machines, which has a positive impact on the environment since it releases a low percentage of emissions, and which is less harmful on the environment, and has environmental characteristics as well illustrated in the previous studies. In fact, the port does not pay attention to the usage of the liquefied natural gas to fulfill all the loading, unloading, and handling operations or even to generate electric power from it. Both ports (Alexandria and El-Dekheila) do not use the liquefied natural gas.

7- Discussion

According to the Primary data collected through the questionnaire and semi-structured interviews, it was found that the foreign investments needed for funding new environmental-friendly projects within Alexandria and El Dekheila ports are available. It was also found that it is very vital to attract many environmental-friendly foreign projects to achieve compatibility between the economic and environmental requirements through an unclean bulk station that will be built at El Dekheila port for

receiving environmentally polluting goods. In addition, a contract has been signed for establishing a multipurpose station for receiving all kinds of cargo. The port and its working units ensure to get new machines and equipment that complies with its economic requirements and achieves its environmental aims. The port already owns machines and equipment whose manufacturing date varies between 1960 and 2015. As well, the port's working units always seek to get new and environmental-friendly stevedoring equipment.

The port owns the capability of dealing with various types of hazardous cargoes through its berths, yards and equipment that are allocated for dealing with this kind of cargoes; that is through a petroleum basin area for trading petroleum goods, and there are berths, that are equipped with equipment and stowing yards, allocated for receiving hazardous cargoes. The port does not own the potentials for achieving electricity self-sufficiency, as the port does not own any power stations that its working units may need for operating in the port community, but the port relies entirely on Alexandria electric company for obtaining electricity.

The port has berths that are prepared for providing ships with power electricity, which is known as Onshore Power Supply (OPS) in addition, it provides all the services that the ship might need. It also offers the service of providing ships with power electricity and fuel while berthing. However, this is actually contradicted with what was stated by the occupational safety and health director of Alexandria Container and Cargo Handling Company.

Regarding the availability of factors contributing to the waste management at the port, to some degree, the port monitors the waste and garbage disposal process produced from its working units, where the port gets rid of its wastes through private waste collecting companies, and using new environmental measuring machines that help in detecting pollution. As well, the port owns an electronic system for disposing hazardous containers. The port always monitors the pollutants produced from the ships through imposing financial penalties, and imposes strict restrictions on ships concerning their pollutants. As well, the port owns sufficient potentials for disposing all wastes in a safe way, whether these wastes are produced from its working units or ships, and recycles some of the wastes for the aim of disposing, reusing them, or conserving the available resources through its contracting cleaning companies for collecting wastes and recycling some of them.

Regarding the availability of water pollution management at Alexandria and El Dekheila ports, the port owns many efficient management potentials/capabilities for preserving the waters, where the port owns four marine units for protecting the port's marine environment. As well, the port owns sewage treatment plants to ensure that there is a safe disposal of sewage water. The port also owns its own private sewage system that is separated from the sewage system of the surrounding residential area. But the port allows the ships to dispose their ballast water inside its own waters, which was one of the justifications discussed in the personal interview, and does not have the ability to prohibit the ships from carrying out the maintenance works in its depth. Because of the port owns a dry basin for performing/carrying out the maintenance works, however, the basin's specifications does not allow all ships to perform their own maintenance works. Thus, some ships may seek performing their maintenance works in the port's depth.

Regarding the efficient management of the port authority toward the air pollution and protecting the air from any kind of pollutants, all the handling equipment and machines used in the port are operated with fossil fuels and there is no chance for employing electrical energy except with huge electric-operated gantry cranes. Unfortunately, the port does not know any ways of using liquefied natural gas in the operation of machines and equipment. Meanwhile, the port is committed to perform all the periodic maintenance works for the aim of reducing their harmful emissions. It also forces its working units to carry out their own periodic maintenance works of the equipment they own. The port imposes strict restrictions and penalties on ships regarding their production of environmentally harmful wastes and emissions. The port also forces its working units to abide by these restrictions and penalties, and applying financial restrictions and penalties on the ships causing any pollution to its surrounding environment. To certain extent, the port aims at finding other alternatives for unclean energy, where there are some initiatives towards finding alternatives for unclean energy such as establishing a solar energy plant inside the port.

Regarding the availability of noise pollution management at the port, the port ensures that there are always new equipment that produces lower noises than their counterparts' do, where the port always seeks to use new equipment that produces lower noises than their counterparts do. To a certain degree, the port performs its entire maintenance work in isolated and well-closed areas as much as possible; as well, the small

ships’ maintenance works are mostly carried out inside dry basins to which they are allowed to enter. While large ships carry out their maintenance work inside the port’s draft and the port seeks to conserve its environment so that it does not become a source of disturbance to the nearby residential areas. Where the port authority imposes strict restrictions and penalties regarding the loud noises produced from ships. Thus, the research discusses the main factors of SGP concept and the barriers faced by the maritime transport industry in Egypt. The literature showed that SGP concept implementation has become very critical to seaports to adopt SGP concept as it affects the economic performance of ports and environmental protection against pollution.

The following is a proposed framework describing the main problems and obstacles found in terms of implementing SGP in Alexandria and El-Dekheila seaports and a proposed solutions on how these problems could be overcome.

Table 5: Framework for Implementing SGP on Alexandria and El-Dekheila seaports

Problem	Ways to be overcome
Port authority does not have the ability to prevent the ships to dispose their ballast water in the berths during the loading and discharge operations	<ul style="list-style-type: none"> - Impose strict restrictions and penalties on ships to stop them from discharging the ballast water in the port. - Encourage the ships to conform to these rules as well to implement the general policy of the port Authority to preserve the environmental factors of it.
The ships do not use the existing electric power platforms on the berths.	<ul style="list-style-type: none"> - Force the ships to use the existing electric power platforms on the berths. - Impose strict penalties on those ships that use their own generators to get electric power to reduce the emissions released when ships are anchored on the port’s berths.
Disability to prevent the ships from carrying out their maintenance works in the loading and discharge berths.	<ul style="list-style-type: none"> - The port must increase the efficiency of the dry basin to allow the ships to carry out all the maintenance operations inside it.
Lack of using the liquefied natural gas in the machines and equipment operations.	<ul style="list-style-type: none"> - The port should initiate to use this liquefied natural gas in all the ships’ activities or operations or cargo handling.
Maintaining use the old and diesel-operated equipment instead of electric ones.	<ul style="list-style-type: none"> - The port should scrap its equipment and machines according to the environmental criteria not the economic criteria.

	- Follow the environmental restrictions with the rented or bought equipment and machines.
Lack of using the environmentally friendly or clean energy such as; solar and wind energy.	- The port authority and the working companies should replace and old equipment with other new ones that use clean and environmentally friendly energy.

Source: The researcher

8- Conclusion

- The current situation of Alexandria and El Dekheila ports have been identified through semi-structured interviews in order to determine the current problems and barriers facing each port in terms of applying a green port concept. In-depth interviews were conducted to gain an insight of the implementation of the concept of GS in order to solve Pollution problems and ensure safety, productivity, and efficiency of the whole activities of port.
- It was found that these companies face the same problems. Moreover, some companies and Port Authority were partly aware of the SGP concept benefits, while others were not. After the detailed explanation of the importance and benefits of GS concept due to its effectiveness in solving the discovered problems, saving Natural resources of the port, costs, improving Environmental safety, and solving pollution problems; a clear view of opportunities form applying the SGP concept have been clarified for all seaports from an environmental and economic benefits. Furthermore, due to the lack of awareness, cultural context, funding, education, and lack of innovative ideas and technologies, this research provides guidance to overcome the barriers of applying this concept on Egyptian seaports in general and Alexandria, El Dekheila port in specially.
- Moreover, a questionnaire was conducted with freight forwarders companies and companies of cargo handling, shipping companies, Shipping Agencies in order to verify the current problems on Alexandria and El Dekheila ports. It was found that the both ports do not own the potentials for achieving electricity self-sufficiency to some degree, nor to allow the ships to dispose their ballast water inside its own waters, and not have the ability to prohibit the ships from carrying out the maintenance works in its depth. Besides, they do not seek the ships to replace its diesel-operated equipment with electric ones, and they do not have the knowledge of using liquefied natural gas in the operation of machines and equipment. To certain extent, the port aims

at finding other alternatives for unclean energy and best practice to overcome these problems.

- Afterwards, the study has discussed the factors and Barriers of implementing GS concept on Alexandria and El Dekheila ports. Moreover, the results have showed that the implementation of GS concept requires a Public Private Relationship in order to overcome the stated barriers.

9- Recommendations

By reviewing the findings of this research, several recommendations, which may rectify some of the challenges and problems for applying the GS concept on Egyptian seaports in general and Alexandria and El Dekheila ports in particularly, are formulated and can be summarized as follows:

- The port Authority (the government) should direct many foreign investments towards establishing new environment friendly projects inside Alexandria and El- Dekheila ports to achieve the compatibility between the environmental and economic goals in the Egyptian trading maritime ports.
- The port Authority should put restrictions to force the ships on using the existing electric power platforms on the berths, and impose strict penalties on those ships that use their own generators to get electric power to reduce the emissions released when ships are anchored on the port's berths.
- The port has a lot of depreciated equipment and machines that are scrapped according to economic criteria of equipment performance, which has harmful effects on the environment. Therefore, the port should scrap its equipment and machines according to the environmental criteria of the equipment performance as well to preserve the surrounding air and atmosphere of the port.
- The port should increase the efficiency of the dry basin to allow all ships that visit the port to carry out all the maintenance operations inside the dry basin instead of making them on berths of port.
- All the port's equipment and machines (whether owned by the port Authority or working companies inside the port) work with fossil fuel which releases harmful gases on the environment. Thus, the port Authority and the working companies should replace these machines

and equipment with other new ones that depend on clean energy (electric power or liquefied natural gas).

- The port Authority should pass strict restrictions and penalties on ships to stop them from discharging the ballast water in the port's water to protect it from the pollutants that might affect it.
- The liquefied natural gas has a lot of environmental characteristics that makes it one of the most important and the best energy sources that is needed in all the maritime port activities. However, Alexandria and El-Dekheila ports do not consider the usage of this clean source of energy. Thus, the port Authority should initiate to use this liquefied natural gas in all the ships' activities or operations or cargo handling.
- The companies of cargo handling in the port should abide by the port Authority restrictions and penalties, and they should urge the ships to conform to these rules as well to implement the general policy of the port Authority to preserve the environmental factors of it. In addition, they should follow the environmental restrictions set by the port Authority on the equipment and machines that are owned or might be bought or rented.
- All the working companies inside the port should support the idea of preserving the environment, and they should keep the employees aware of following the procedures to reach this.

10 - Further Research

This research is conducted to investigate the requirements of applying a GS concept on the Egyptian seaports through selecting Alexandria and El Dekheila ports as a case study. First, the research output can be applied to several seaports. Further work would investigate the applicability of SGP concept on different Egyptian seaports such as Alexandria port. Moreover, the SGP concept consists of several technologies and factors that could harmonize the economic, environmental, and social objectives of seaports, further research could test the applicability of such advanced trends for operating the seaports showing their benefits in any of developed or developing country.

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ملخص البحث باللغة العربية

يعتبر الهدف الرئيسي من هذا البحث هو تقييم المشكلات الرئيسية التي تواجه الموانئ البحرية المصرية نحو تطبيق مفهوم الميناء الأخضر- المستدام SGP وتحديد المتطلبات المطلوبة من الموانئ المصرية لتكون ميناء صديق للبيئة. تم جمع البيانات من خلال المقابلات الشخصية والاستبيان عبر الإنترنت الذي تم إجراؤه على 70 شخصاً من هيئة ميناء الإسكندرية والدخيلة والمجتمع لتحديد العوائق التي تواجه مفهوم SGP وتحديد أفضل الممارسات للتغلب على المشكلات الموجودة. أخيراً، أظهرت النتائج أن كلاً من مينائي الإسكندرية والدخيلة قريبان من كونهما ميناء أخضر SGP لكنهما يعانيان من نقص الموارد والوعي وبدائل موارد الطاقة النظيفة.

الكلمات المفتاحية: أثر الموانئ الإقتصادي، الموانئ الخضراء المستدامة، الموانئ المصرية

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