

## IS Dredging Entrance Channel for Ship Movement a Solution for Dares Salaam Port Efficiency?

BY

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### Abstract

This paper utilizes data from a study conducted at Dar es Salaam port to assess the impact of dredging channel at the port of Dar es Salaam for ship movement a case study of Dares Salaam Port in Tanzania. Specifically, the study was interested to examine the effects of dredging the entrance channel at the port of Dar es Salaam, to identify the challenges facing the process of dredging of port entrance channel at Dar es Salaam port and to evaluate outcomes of dredging the port entrance channel at Dar es Salaam port for ship movement. The study used environmental and economic theories as well as Balanced scorecard theories to show that dredging of the entrance channel has positive impact in national economy. Both qualitative and quantitative approached and descriptive research design were used to get the real data of the study about the impact of dredging channel at Dares Salaam port. Purposive and simple random sampling techniques were used in this study to select a sample size of 66 respondents from a group of 80 of the target population. Also, questionnaires, interview, documentary review, focus group discussion and observation were employed in the data collection. The paper ends with giving conclusions and recommendations which should be taken by the Tanzanian' government in order to make Dares Salaam port to be the hub of East Africa.

**Key words:** Port Entrance Channel, Ship movement, Dredging of port entrance channel and Port efficiency.

## 1.0 Introduction

According to Tanzania Ports Authority (TPA) Handbook Report, (2019). Tanzania is situated just south of the equator; it became a sovereign state in 1964. The port of Dar es Salaam is the principal port of Tanzania and handles more than 90% of the country's cargo traffic. It saws an average of 9% annual growth of cargo traffic from the year 2003 onwards.

It is parastatal organization acting under the Ministry of Works, Transport and Communications. It was established on 2005 (Tanzania Port Authority, 2018). It operates a system of ports serving the hinterland of Tanzania and the neighboring land-linked countries of Malawi, Zimbabwe, Zambia, Democratic Republic of Congo, Burundi, Rwanda, and Uganda. The TPA presently owns three major seaports for example Dar es Salaam, Tanga, and

Mtwara Ports and three small seaports of Kilwa, Lindi, and Mafia and all lake ports (James, 2016). Dar es Salaam port is the main port of Tanzania; it has 11 dry berths, two tanker berths, a multi-product single point mooring (SPM), and lighter quay and handles a vast array of cargo including containerized dry bulk and liquid bulk cargo.

According to Michael, (2018). Improvements of port entrance channel it allows more ship of any size deployed at the port where more cargo will be loaded and discharged that will need more skilled and unskilled port labors in order to fasten loading and discharging of cargo. This creates employment opportunities to the people hence increases the family economy in the society (Tahar, 2017). Improvement of entrance channel, improvement of the

entrance channel will increase port performance as well as more large ships of different size will be deployed at the port due to quality, deepest, and enough channel width to accommodate large containerized ship to enter the port.

Now a days, there is a global trends of increasing vessels sizes to reduces transportation cost and vessels construction cost (per unit cost). (Hilton, 2015). The study of dredging of port entrance channel will gives port authority to implement the project of expanding the entrance channel as the results will lead to the deployment of larger vessels and changes in services. Complete project of expanding the entrance channel will also lead to increase of port performance, improving port facilities, deployment of larger vessel, improving port operations and efficiency (McGrew, 2021).

## 2. 0 Definitions of the Key Concepts

Port is a maritime facility comprising one or more wharves or loading areas, where ships load and discharge cargo and passengers. Although usually situated on a sea coast or estuary, ports can also be found far inland, such as Hamburg, Manchester, and Duluth; these access the sea via rivers or canals (Joan, 2017)

**2.1 Port Entrance Channel** is the port channels that allow ship to enter the port, this channel may varies depending on the nature of the port. There is port channel that allow any type of ship of any size to enter the port and other are selective due to narrowness and depth of the entrance. Examples there is port channel that allow large containerized ship of length 290M and others are restricted (Cleos, 2018).

**2.2 Ship movement** is movement of ship from one point to another this involves inadequate of port facilities and infrastructure including poor berth quality, narrowness of the entrance channel, one-time discharge and loading of cargoes, inefficiency of cargo handling equipment and availability of skilled and unskilled labor it indicates poor port performance resulting in shipping delay (Bendalla, 2020).

**2.3 Dredging of port entrance channel**, involves expansion or increase in width of the entrance channel as well as increase in height (depth) of the channel in order to allow large containerized ship of any length to enter the port (Bryan, 2019). Improved channel results in an increase of port performance, increase of large ship deploying to the port as well as it reduces the berth waiting time.

### 2.4 Port efficiency

Port efficiency is one of the three components of port performance. The Other two being effectiveness and resilience. Efficiency commonly refers to the operational performance of ports and the maximization of the produced output with given resources or the production of a given output with limited possible resources (James, 2018).

### 2.5 Three Major Types of Port Efficiency

#### 2.5.1 Consider the boundary conditions

A port planner needs to take into an account many boundary conditions such as space for the pier operator for cargo handling transport facilities, as well as space needed by the vessels for bypassing and turning, and so on. Think about environmental aspects for example by aiming for a calm harbor basin. Think about breakwaters.

#### 2.5.2 Apply extreme value analyses and numerical modelling

Predictions for wind conditions and all kinds of waves and currents in a port can be made by using long-term measurements and numerical modelling which affect berthing conditions like long-period waves (swell, long fetch lengths, passing vessels)

#### 2.5.3 Conduct dynamic mooring analyses

The data above should be used in dynamic mooring analyses which provides vessels motions line and fender forces. With such a tool, meteorological and hydrodynamic data in a test matrix can be combined freely. The Port of Dar es Salaam has been the subject of several studies due to its strategic location in East Africa. In their examination of the port's gate operations (UNCTAD 2020) observed that inefficiencies in gate operations led to significant delays and increased costs for shippers and carriers. Their findings emphasize the need for improvements in gate management practices.

## 3.0 Theories Applied in the Study

### 3.1 The Balanced Scorecard

Balance scorecard is theory of port infrastructure measurements. Kaplan (2015) develops the theory which is useful in studying or explaining the phenomenon whose central focuses is efficiency shipping including quality port navigational infrastructure that creates efficiency shipping and efficiency cargo handling process on enhancing port performance. This theory also explained on the importance of improving port entrance channel in order to increase port performance by allowing more ship of different sizes to deploy on the port (Esmer, 2018).

The importance of port entrance channel to shipping delay and port performance is well recognized. Screening performance outputs and taking appropriate action based on whether or not expected results manifest is also crucial. (Hayuth and Pollat 2017). The analysis of how port entrance channel affect ship movement and port performance will undoubtedly benefit from regular performance reviews. As a result, the balance scorecard theory can assist in predicting future performance related to shipping delay and port performance due to expansion of port entrance channel. (Hayuth, and Pollat, 2017).

### 3.2 Economic Theory

An economic theory of a port is another theoretical justification for shipping delay resulted from the improvement of port entrance channel and the port facility issue (Wayne, 2007). The relationship between a port's maximum throughputs and a given level of its productive resources is reflected by the quality port infrastructure including quality port entrance channel. This theory can be used to describe how well-improved port infrastructure enhances performance and shipping delay of the by looking at the operational that a port utilizes, such as quality port entrance

channel, berth capacity, and cargo handling equipment (Hayuth, 2020).

**3.3 Environmental theory**

Environmental and economic theory is the theory of environment measurements. James (2018), describes the theory of environment and economic by looking forward on how port entrance environment may affect economic performance of the port as well as shipping process. It describes the importance of expansion of port entrance channel, that it allows deployment of large vessels in ports, increases port performance, and reduces berth waiting as well as reduces ship turnaround time (James, 2018). This theory emphasizes on the importance of dredging of the entrance channel on how will affect on international shipping mechanisms in the world (Drainer, 2017).

McGrew, (2021) also explained economic importance of the port entrance channel that it should have international standard in order to allow many ships with different size to enter the port for loading and discharging of cargo. (Bacchioni and Ramus, 2018) More containerized ship failed to enter in many ports due to nature of the entrance channel.

**4.0 The Description of the Study Area**

The study was conducted at Dar es Salaam port in Tanzania. According to Tanzania Ports Authority (TPA) Handbook Report, (2019). Tanzania is situated just south of the equator; it became a sovereign state in 1964. The port of Dar es salaam is the principal port of Tanzania and handles more than 90% of the country’s cargo traffic. It saws an average of 9% annual growth of cargo traffic from the year 2003 onwards.

It is parastatal organization acting under the Ministry of Works, Transport and Communications. It was established on 2005 (Tanzania Port Authority, 2018). It operates a system of ports serving the hinterland of Tanzania and the neighboring land-linked countries of Malawi, Zimbabwe, Zambia, Democratic Republic of Congo, Burundi, Rwanda, and Uganda. The TPA presently owns three major seaports such as Dar es Salaam, Tanga, and Mtwara Ports, and three small seaports of Kilwa, Lindi, and Mafia, and all lake ports (James, 2016). Dar es Salaam port is the main port of Tanzania; it has 11 dry berths, two tanker berths, a multi-product single point mooring (SPM), and lighter quay and handles a vast array of cargo including containerized dry bulk and liquid bulk cargo (TASAC, 2018).

**5.0 Methodology**

Primary data were collected using both qualitative and quantitative methods, where secondary data obtained from literature search and review of relevant official documents. The literature review further highlighted the key concepts used in the study and three major types of port efficiency. The sample of the study comprised of 66 respondents by using purposive sampling and simple random sampling techniques. used descriptive research design because this technique describes in details the impact of dredging entrance Channel for Ship Movement at Dares Salaam Port and to see whether or not taken dredging channel adopted by Dares Salaam Port Authority may be a solution for increasing port efficiency.

Two phases of data collection and analysis were conducted. In the first phase, qualitative data was collected based on fa the impact of dredging entrance Channel for Ship Movement at Dares Salaam port. The second phase of data collection was focused on quantifying some variables on important issues discussed during focus group discussion, observation, and key informant interviews.

**Fig. 1: Shows Dar es Salaam port entrance channel**



Source: TPA Handbook Report, (2023)

**6.0 Findings of the Study**

The findings of the study were presented under the following sub-sections:

**6.1 Respondents Characteristics**

The study categorized respondents based on their gender, age group, and educational level, and job categories in order to avoid gender biasness as well as assessment of respondents’ maturity depending on their age group and level of thinking depending on their education level. Job categories allows researcher to select the targeted specific group of professionals relevant to the study. This ensured that the sample represented the population of interest accurately and allowed for more accurate findings and conclusions. Categorizations of the characteristics of respondents minimize possibility of errors or data redundancy and enhance data integrity during data collection. See table 6.1 below.

**Table 6.1: Respondents based on Gender**

Gender	Frequency (f)	Percentages (%)
Male	53	80.3
Female	13	19.7
<b>Total</b>	<b>66</b>	<b>100</b>

Source: Field data (2023)

The table 6.1 shows that (80.3%) of respondents were male which was equal to 53 out of 66 respondents and (19.7%) of respondents were female which was equal to 13 out of 66 respondents. This was due to the mere fact that men were more employed than women in any organization. Therefore, the findings showed that the majority of respondents were male compared to female. All of the respondents had interested on elaborations of the effect of dredging entrance channel at the port of Dar es Salaam for shipping delay. The fact that the study involved few female

respondents was justified by the reason that few women were employed in marine sector. This was justified by the statistics found in the Global Seafarers workforce reports that women represent only 1.2% of the global seafarers' report. The maritime industry, like many other historically male-dominated, is more than women in sectors in Tanzania and it was operated traditionally rooted in the form of patriarchal system. This means that power, authority, and decision-making have historically been concentrated in the hands of men, while women have been underrepresented or excluded from key roles and opportunities within the industry. These findings were concurred by Huang and Kuo (2016) who commented that the maritime industry has long been characterized by a significant gender imbalance, with the majority of seafarers, ship officers, and maritime executives being male. Women have historically faced barriers to entry and career advancement in this field.

**6.2 Age of Respondents**

During data collection, data were collected and analyzed depending on their respondent's age, respondent were asked to provide their age. The study focused also on assessment of the maturity of the respondents by examining age group. Data related to age of the respondents are represented in table 6.2. below.

**Table 6.2: Respondents Age Group**

Age Group	Frequency (f)	Percent (%)
18 - 30 Years	28	42.4
30 – 40 Years	18	27.3
40 – 50 Years	14	21.2
50 Above	6	9.1
<b>Total</b>	<b>66</b>	<b>100</b>

Source: Field Data (2023)

Findings from Table 6.2 indicates that on the basis of age characteristics (42.4%) equals to 28 respondents out of 66 respondents were aged between 18 and 30 years, (27.3%) equal to 18 respondents out of 66 respondents were aged between 30- and 40-year-old and (21.2%) equals to 14 respondents out of 66 of respondents were aged between 40 and 50 years old whereas (9.1%) which equals to 6 respondents where aged 50 and above. The study showed that most of the respondents were aged between 18 and 30 showing that many respondents were port workers and agents. Based on the findings shown above, there was an implication that most of respondents were still young because marine activities need young and energetic people with mental and physical ability to perform the work properly. The maritime industry, like many others, had an aging workforce. Many seafarers and maritime professionals were approaching retirement age, which has implications for workforce planning and succession management. There was a need to attract and train younger talent to replace retiring workers.

**6.3 Respondents Education Level**

In this study, data were collected and analyzed depending on respondent's knowledge levels. Most respondents have degree,

diploma, certificate and few of them have masters. By considering education level, researcher was able to collect information depending on different level of understandings and knowledge since respondents may have different views and understandings. The data related to level of education of respondents were recorded and presented in table 6.3 below.

**Table 6.3: Respondent Educational Level**

Education Level	Frequency (f)	Percent (%)
Master Degree	8	12.1
Bachelor Degree	42	63.6
Diploma	9	13.6
Certificate	7	10.6
<b>Total</b>	<b>66</b>	<b>100</b>

Source: Field Data (2023)

Findings from table 6.3 shows that (12.1%) equals to 8 respondents out of 66 respondents had Master's Degree, (63.6%) equals to 42 respondents out of 66 respondents had bachelor degree, (13.6%) equal to 9 respondents out of 66 respondents have diploma, and (10.6%) equal to 7 respondents out of 66 respondents had certificates. Based on the findings narrated above, there was an implication that most of respondents were bachelor degree holders and above. This was due to the fact that they consisted of key informant' who know more about the topic of this study. Also, the findings revealed that the study involved respondents of all kind of knowledge and understanding in order to extract strong data or information depending on their views and opinions on the effect of dredging entrance channel at the port of Dar es Salaam for shipping delay. The education level was very important aspect required in the marine industry varied significantly depending on the specific roles and career paths within the sector. The marine industry encompasses a wide range of jobs, from entry-level positions to highly specialized roles, and the educational requirements can differ accordingly (Bichou and Gray, 2004).

**6.4 Job Categories**

In this study, data were collected and analyzed depending on respondent's knowledge levels. Most respondents have degree, diploma, certificate and few of them have masters. By considering education level, researcher was able to collect information depending on different level of understandings and knowledge since respondents may have different views and understandings. The data related to level of education of respondents were recorded and presented in table 6.4 below.

**Table 6.4: Job Category**

Job category	Frequency (f)	Percent (%)
Port Workers	16	28.1
TPA Officers	12	21.1

Pilots	2	3.4
Ship Engineers	3	5.3
Port Operation Officers	24	42.1
<b>Total</b>	<b>66</b>	<b>100</b>

Source: Field Data (2023)

Findings from table 6.4 above on jobs of respondents indicates (28.1%) of all respondents asked reported to be port workers, (21.1%) of them were TPA workers, (3.4%) of all respondents asked pilots, (35.3%) of them were ship engineers and the remained (42.1%) of them were ports operation officers. Based on these findings there was an implication that most of respondents were ports operation officers. Who were the key informants on matters related to dredging their involvement in this study enriched the findings that port operation officer were knowledgeable, experience in the study.

### 7.0 The Effects of dredging the entrance channel at the port of Dar es Salaam

The paper under this subsection shows that dredging the entrance at the port of Dar es Salaam had a positive impact to the port itself and to the increased nation economy. The quality of the entrance channel at the port of Dar es Salaam had and employment a direct impact on trade with neighboring countries. A navigable entrance channel facilitates the entrance of ships of any size, improving accessibility, efficiency, and cost-effectiveness of cargo operations. These factors contributed to increased trade volumes and enhanced competitiveness for the port, leading to economic development and growth for the entire region. See Table 7.1 below.

**Table 7.1: Quality of the entrance channel leads to improvement of trade with neighboring countries due to receive calls of big ships of any size for cargo discharge at the port of Dar es Salaam.**

	Frequency (f)	Percentage (%)
Agree	33	50
Strong Agree	33	50
Neutral	0	0
Disagree	0	0
Strong Disagree	0	0
<b>Total</b>	<b>66</b>	<b>100</b>

Source: field data (2023)

Finding from table 7.1 indicates that most respondents (50%) agreed that Quality of the entrance channel led to improvement of trade with neighboring countries due to entrance of many ships of any size for cargo discharge at the port of Dar es Salaam, (50%) strongly agree that quality of the entrance channel led to

improvement of trade with neighboring countries, (0%) were neutral whereas (0%) disagreed and (0%) strongly disagreed. As 50% which were equal to 33 respondents out of 66 of the overall respondents agreed that the quality of the entrance channel at the port of Dar es Salaam played a significant role in improving trade with neighboring countries. Respondents agreed that a well-maintained and navigable entrance channel allowed for the smooth and safe passage of ships, regardless of their size, into the port for cargo discharge. This, in turn, had several positive impacts on trade and economic development where (50%) of the overall respondents strongly agreed that quality entrance channel increases accessibility, means when the entrance channel is of good quality, it can accommodate ships of any size, including larger vessels.

This enhanced the port's accessibility and enables it to handle a greater variety of cargo. As a result, trade with neighboring countries could flourish, as ships of varying sizes can easily access the port, facilitating increased import and export activities, also respondents agreed that quality of entrance channel enhances efficient Cargo Operations since a well-maintained entrance channel reduces waiting times for ships, as they can navigate into the port more efficiently. These findings aligned with the study conducted by Bichou and Gray (2004) on the increasing port efficiency, the efficiency performance of the port it depends on quality infrastructure including quality entrance channel, quality cargo handlers as well as quality berth occupancy. Improvement of infrastructure leads to efficiency port performance as well as increases port financially.

### 7.2 Employment generation was one of the positive impacts towards quality entrance channel of the Dar es Salaam port

Based on the findings generated to the study, the views critically that there is a close relationship between the dredging entrance channel for ship movement at Dares Salaam port and employment generation. See Table 7.2 below.

**Table 7.2: Employment generation was one of the fruits of quality entrance channel of the Dar es Salaam port**

	Frequency (f)	Percentage (%)
Agree	18	27.3
Strong Agree	40	60.6
Neutral	4	6.1
Disagree	3	4.5
Strong Disagree	1	1.5
<b>Total</b>	<b>66</b>	<b>100</b>

Source: field data (2023)

Findings from Table 7.2 shows that most respondents (60.6%) strong agreed that the presence of a quality entrance channel at the Dar es Salaam port can contributed to employment generation in several ways including direct employment since a well-maintained and navigable entrance channel attracts more vessels and increases the port's capacity to handle larger volumes of cargo. This

heightened activity required additional human resources to manage various port operations such as vessel docking, navigation, cargo handling, equipment operation, and logistics. As a result, the port of Dar es Salaam can create direct employment opportunities for a wide range of individuals, including ship pilots, dockworkers, crane operators, stevedores, and administrative staff, (27.3%) agreed that efficient operational of entrance channel facilitates indirect employment due to increased trade and business activity. Respondents agreed that as import and export volumes grow, industries and businesses connected to port activities experience a surge in demand for their products and services. This, in turn, creates opportunities for job creation in sectors such as transportation, warehousing, freight forwarding, customs clearing, and brokerage services, (6.1%) are neutral whereas (4.5%) disagreed and (1.5%) strongly disagreed that quality entrance channel at the Dar es Salaam port generates employment opportunities. These findings aligned with the study conducted by Tahar (2017) that asserts that employment generation, improvements of port entrance channel it allowed more ship of any size deployed at the port where more cargo will be loaded and discharged that would need more skilled and unskilled port labours in order to fasten loading and discharging of cargo. This created employment opportunities to the people hence increases the family economy in the society.

Majority of the respondents who were interviewed and observed directly and showed that:

The respondents agreed that dredging of quality entrance channel always reduces cost that means a navigable entrance channel enables larger vessels to access the port, which often results in economies of scale. Larger vessels have the potential to carry greater cargo volumes, leading to reduced transportation costs per unit of goods. This cost reduction could make the port of Dar es Salaam more attractive to neighboring countries, encouraging more trade and economic exchanges.

Also, the dredging entrance channel increased port accessibility and efficiency because it can accommodate ships of any size, including larger vessels. This enhances the port's accessibility and efficiency to enable to handle a greater variety of cargo. As a result, trade with neighboring countries can flourish, as ships of varying sizes can easily access the port, facilitating increased import and export activities.

Apart from that, it enhanced Competitiveness: Neighboring countries depend on efficient and reliable trade routes to access international markets. By maintaining a high-quality entrance channel, the port of Dar es Salaam can position itself as a competitive gateway for trade in the region. This reputation for operational excellence and accessibility could attract more shipping lines and traders, boosting the port's overall competitiveness.

### 8.0 Challenges Facing Dredging Entrance Channel to he Dares Salaam Port

Despite to the above success, the dredging entrance channel at the Dares Salaam port has faced with various challenges which

sometimes can break the development and efficiency to compete in the global competition to the newly emerged ports of African countries like Mombasa (Kenya), Beira (Mozambique), Jabot, Somalia, Cape town (South Africa) etc. These challenges can be summarized as follows. See Table 8.1 below.

**Table 8.1: The challenges facing the process of dredging of port entrance channel at Dar es Salaam port.**

	Frequency (f)	Percentage (%)
Shortage of enough funds is among of the challenges facing the process of dredging port entrance channel.	20	30.3
Limited Availability of Resources	25	37.8
Lack of skilled manpower for machinery operation draws back the implementation of the process of dredging the entrance channel at the port of Dar es Salaam.	10	15.2
Environmental and social effects is among of the consequences facing the program of dredging the entrance channel implementations	11	16.7

Findings from Table 8.1 shows that 20 respondent equals to 30.3% out of 66 overall respondents agreed that, shortage of enough funds was among of the challenges facing the process of dredging port entrance channel. Dredging, which involves removing sediments and maintaining proper depths in the channel, is crucial for ensuring safe and efficient navigation of vessels into the port. Here's an explanation of the challenges that arise due to a shortage of funds. 25 respondent's equals to 37.8% of 66 respondents agreed that limited availability of resources was among of the challenges since dredging operations require specialized equipment, machinery, and skilled personnel. Inadequate funds restrict the availability of these resources, hindering the ability to carry out dredging activities effectively. Insufficient funding can limit the procurement and maintenance of dredgers, survey vessels, sediment disposal equipment, and other essential tools, constraining the capacity to perform regular and timely. Poor government policy on implementing the project is among of the challenges facing dredging of the entrance channel. Government policies play a critical role in providing the necessary framework, guidelines, and support for effective project implementation. Here's an explanation of the challenges that can arise due to poor government policy.

Poor government policy may result in the absence of clear guidelines and regulations regarding dredging activities. This can create uncertainty and confusion among stakeholders involved in the project, including the port authority, dredging contractors, and environmental agencies. Without clear guidelines, decision-making processes, environmental impact assessment procedures, dredged material disposal protocols, and other key aspects of the project may be poorly defined or not addressed adequately.

10 respondent's equals to 15.2% of 66 overall respondent agreed that lack of skilled manpower for machinery operation draws back the implementation of the process of dredging the entrance channel at the port of Dar es Salaam. Dredging the entrance channel is a complex task that requires skilled workers who can effectively operate the machinery involved. Dredging involves the removal of sediment, silt, and other debris from the entrance channel to maintain its depths and ensure safe navigation for vessels. This process requires the use of specialized machinery such as dredgers, excavators, and pumps, which can efficiently remove the material. Skilled operators are required to handle these machines effectively and ensure the dredging process is carried out safely and efficiently.

11 respondents equals to 16.7% of 66 overall respondents agreed that environmental and social effects are among of the consequences facing the program of dredging the entrance channel implementations. Dredging the entrance channel of a water body, such as a harbor, river, or estuary, involves the removal of sediment, silt, and other materials from the bottom of the channel to create a deeper and wider passage for ships and vessels. While dredging can offer benefits like improved navigation and increased economic activity, it could also lead to a range of environmental and social consequences. There was a sense in which based on these finding there was an alignment with the study conducted by Bichou (2014), that asserts that the shortage of enough funds, any project needs a lot of funds to implement it, the same to the project of dredging of the entrance channel at the port needs a lot of funds and supports in order to implement the projects. It also aligns with the other study conducted by James (2019), that found that environmental and social effects, assessment of the environment are the key issues before implementing the project due to possibility of occurrence of soil erosion that will lead to accumulation of muds into the water resulting in reducing depth of the channel, the construction of the channel depends on the nature of the environment

### 9.0 Conclusion

Based on the discussion above, a number of conclusions can be drawn from this paper that:

To answer the title of this paper, it is true that dredging entrance channel at the Dares Salaam port is a solution to the Dar es salaam port efficiency for a number of ways. The introduction of dredging entrance channel at Dar es Salaam port is very crucial and plays an important role to the Tanzanian economy. This is due to the positive impacts which have come after the introduction of dredging system like:

- It fosters economic benefits in the Tanzanian economy. As trade increases, economic development is stimulated. Improved trade relations with neighboring countries can lead to increased employment opportunities and economic growth, benefiting both the port and the surrounding areas.
- Increasing of turnaround speed, reducing skip waiting times, improvement of navigation and safety and enhancing port infrastructure utilization are largely the products of dredging entrance channel system in Dar es Salaam port. This to a large extent puts Dar es Salaam port to the position of being an efficiency port to compete seriously in the global market as far as globalization is concerned. These positive impacts have been summarized in Table 9.1 below by showing port performance indicators.

**Table 9.1.: Shows the port performance indicators.**

Port Performance Indicators	Explanation
Services Provided	Service provided measures the quality of services provided to customers, ship owners, ship operators, importers, and exporter operators.
Ship Turnaround Time	This measures the time it takes for a vessel to arrive at the port, complete its operations (loading, unloading, refueling, etc.), and depart. A shorter turnaround time indicates better efficiency.
Container Handling	This includes metrics like the number of containers handled, loaded, and unloaded as well as the average time it takes to process a container.
Berth occupancy	This indicator assesses the utilization of berths at the port, showing how efficiently ships are being accommodated and how well the port is managing its space.

Source: Jean, (2020).

### 10.0 Recommendations

Based on the study findings, the following recommendations are made:

- Implementation of regular and optimal dredging practices for maintaining the depth and accessibility of the entrance channel. This will highlight the importance of adhering to a well-planned dredging schedule to

prevent excessive silting and maintain safe navigation for vessels;

- There must be a systematic monitoring and maintenance program to track the condition of the entrance channel. This program should include regular surveys to assess sediment buildup and potential obstructions. Timely dredging and maintenance activities can minimize shipping delays caused by reduced water depth.;
- The paper proposes capacity-building initiatives to enhance the skills of personnel involved in dredging operations. Well-trained staff can contribute to the successful execution of dredging activities, ensuring that they are conducted efficiently and with minimal interruption to port operations;
- The government must consider the importance of environmental effects when conducting dredging activities. Recommend the implementation of environmentally friendly dredging practices and adherence to environmental regulations to minimize negative effects on marine ecosystems; and
- The government must invest much on long-term planning and investment in port infrastructure, including dredging equipment and resources. Adequate funding and planning are essential for sustained dredging efforts and continuous improvements in port performance;

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