Analysis of the impact in the maritime traffics of the Nicaragua Canal

Final Project

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Abstract

This paper was conducted to determinate how the construction of a new interoceanic canal in Nicaragua is going to influence global maritime trades.

One of the primary causes for the increased traffic through the Panama Canal and the expansion of the US East coast ports has been the importing of Chinese manufactured products. The new canal will offer a shorter route between China and the US East coast and will compete with the current expanded Panama Canal.

To analyze how the shipping routes would change, three scenarios have been studied, each one focused on a different aspect: economics, environment, and politics. For each one, similar conclusions have been extracted: the canal's feasibility is in doubt, since it does not provide enough guarantees for its construction.

Comparisons with different routes were made, including both Panama and Suez canals and the Magellan strait, in order to evaluate the different distances and transit times so to measure the impact of the Nicaragua Canal.

The main objective of this project is to assess if the construction of the new canal is going to influence future shipping routes, and how.

Resumen

Este trabajo de fin de grado se ha llevado a cabo a para determinar cómo la construcción de un nuevo canal interoceánico en Nicaragua va a influenciar las rutas marítimas globales.

Una de las principales causas del crecimiento en tráfico del Canal de Panamá y de la expansión de los puertos de la costa Este de los Estados Unidos ha sido la importación de productos manufacturados provenientes de China. El nuevo canal ofrecerá una ruta más corta entre China y EEUU y competirá con el actual Canal de Panamá ampliado.

Para analizar cómo cambiarían los fletes, se han tenido en cuenta tres escenarios, cada uno centrado en un aspecto distinto: economía, medio ambiente y política. Para cada uno de los casos, se han extraído conclusiones similares: la viabilidad del canal está en duda, ya que no ofrece garantías suficientes para su construcción.

También se han hecho comparaciones con diferentes rutas, incluyendo rutas por los canales de Panamá y Suez y el estrecho de Magallanes, con el fin de evaluar las diferentes distancias y tiempos de tránsito para medir el impacto de la Nicaragua Canal en éstas.

El objetivo principal de este trabajo es evaluar si la construcción del nuevo canal va a influir en futuras rutas marítimas, y cómo.

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ERM: Environmental Resources Management

DWT: Deadweight Tonnage

Ha: Hectare

HKND: Hong Kong Nicaragua Canal Development

km: Kilometers

km^2: Square Kilometers

LOA: Length overall

m: Meters

m^2: Square Meters

nm: Nautical mile

TEU: Twenty-foot Equivalent Unit

ULBC: Ultra Large Bulk Carrier

ULCC: Ultra Large Crude Carrier

VLBC: Very Large Bulk Carrier

VLCC: Very Large Crude Carrier

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Introduction

The main purpose of this project is to study the impact of the Nicaragua Canal on different shipping routes. Despite competing with the Panama Canal, the new canal will change the market and bring new routes to the game –the shipping game–.

One of the primary drivers for increased traffic through the Panama Canal and the expansion of U.S. east coast ports has been Chinese manufacturing and export. As we will see later in the paper, the Nicaragua Canal, sometimes described as "The Great Interoceanic Canal of Nicaragua", is largely influenced by the Chinese government, and it will allow for even faster expansion of the Asian giant, making it a chokepoint for future shipping lines and global economy.

The increasing gigantism over the past few decades seen in the construction of new vessels is a key stone in the construction of the Nicaragua Canal. The expanded Panama Canal is already too small for the biggest ships in the world, thus it is not an option for the main shipping routes actors: giant containerships departing from China with destination Europe or West America.

However, the Nicaragua Canal will allow larger vessels to allow through it. In fact, the project is aimed for 25,000 TEU vessels with over 500m of length overall, numbers that have not been reached yet in current vessels and will not be reached any time soon

The project also intends to build two international ports, an airport and several tourism attractions, making it one of the largest civil engineering projects ever proposed, if not the largest one.

Considering this, the Nicaragua canal will be a game changer.

Chapter 1. A description of the Nicaragua Canal

The Nicaragua Canal project, also known as The Great Interoceanic Canal of Nicaragua, is a project that aims for the construction of a new canal in the area of Nicaragua (close to Panama), providing a new route for vessels that need to cross to the Atlantic Ocean from the Pacific Ocean or vice-versa. This project promotes competence to the Panama Canal, making it no longer the unique option if a vessel cannot make it through the Cape Horn route.

The project, like any other major infrastructure projects like the Panama or the Suez Canal, would be one of the largest civil works projects ever done.

The project is proposed by the Chinese company Hong Kong Nicaragua Canal Development (HKND from now on), which was founded in 2012 specifically with the purpose of developing the Nicaragua Canal. The company is part of the HK Nicaragua Canal Development Investment, which is a business owned by the Chinese billionaire Wang Jing. HKND has also teamed with other companies for the project. For instance, a major partner is *the China Railway Construction Corporation*, which is a Chinese state-owned company that is in charge of designing and building the canal. HKND also takes part from other Chinese state-owned companies, such as *Xugong Group Construction Machinery Co*, which will become the only supplier of construction machinery for the project.

Essentially, the project is owned by Chinese parties, with interests in the strategic location of the canal.

1.1 Construction

HKND proposed to complete the construction in 5 years, including an initial period of approximately 6 months, with canal operations beginning in 2020. The chinese group was awarded the concession to develop and operate the Nicaragua Canal in June 2013. Below, in figure 1 we can see that the project had to be started at the end of 2014, and ended by 2019. However, the construction has not even started by now (end of 2017) and it is not forecasted to start any time soon.

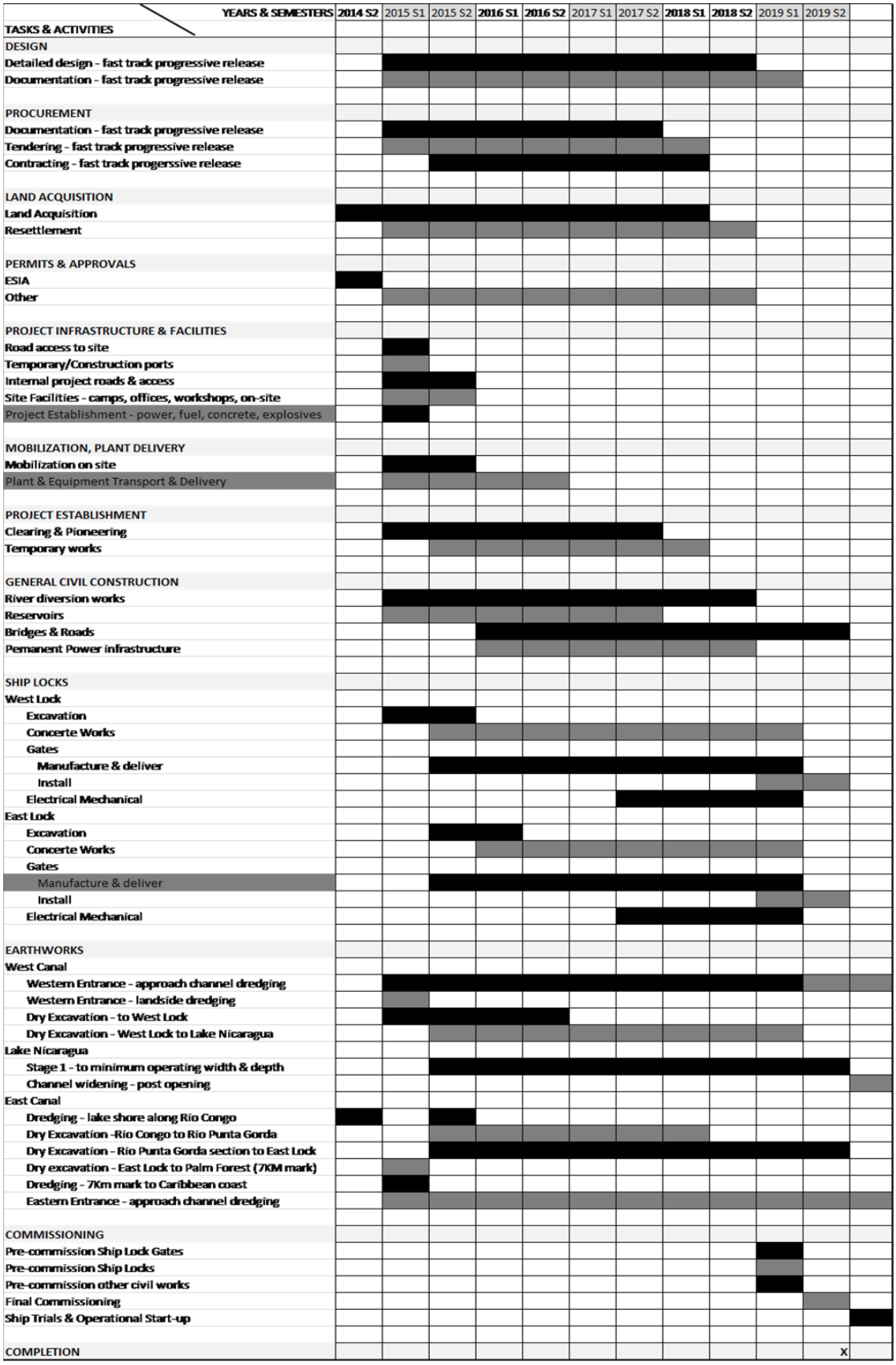

Figure 1: Schedule proposed by the project (HKND Group, p. 37)

HKND prepared an *Initial public offering* in 2014 to attract investors, but it has not been released yet (HKND Group, 2014). HKND also partnered with McKinsey & Company (a major consulting firm) for the creation of an economic feasibility study in 2014, but it has not been released yet to the public.

McKinsey & Co. claims that the agreement ended in 2014 (Zach, 2015); however, because HKND has not released yet the study, most of the international viewers of the canal (potential investors) are inclined to think that the study was not positive.

The ability to obtain funding from outside China via the completion of the McKinsey study was important to the canal project because the Nicaraguan government needed to show that everyone was in the project (internationally talking). In other words, it will be harder to Nicaragua from an international point of view if the project is completely executed by Chinese companies.

The general construction sequence proposed by the HKND project is such as follows (HKND Group, 2014):

- Pre-Construction Phase: Includes securing all necessary permits and approvals, finalizing the engineering design and construction drawings, land acquisition and initial resettlement, selecting contractors, purchasing construction machinery and equipment, materials
- Early Works Construction Phase (initially planned for September 2015): Includes provision of access to the construction sites, establishment of critical infrastructure (e.g., power, worker accommodations), and mobilization of the workforce.
- Construction Phase (September 2015 through March 2020) : This is the major part of the project. Excavation and lock construction, with the Brito Lock construction completed and West Canal filled with water by around January 2020, and the Camilo Lock construction completed and the East Canal filled with water by around March 2020.
- Commissioning Phase (April 2020 through June 2020) – final tests would begin as soon as the East Canal and West Canal segments were filled with water, and include testing of lock operations and training of lock and tug boat operators.

1.2 Canal specifications

The canal will extend 260 km from the Pacific Ocean, across Lake Nicaragua, to the Caribbean Sea. The Project would also require dredging of marine approaches to achieve required shipping depths of approximately 1.7 km in the Pacific Ocean and 14.4 km in the Caribbean Sea. Together, these create a total length of about 275 km (170 nautical miles).

Figure 2: Route of the Nicaragua Canal (Smithsonian Magazine)

Just like the Panama Canal, the Nicaragua Canal is divided into five segments for the description of its parts:

- Pacific Ocean and marine approach
- West Canal, including from the entrance until Lake Nicaragua, passing the Brito Locks and the Brito Port
- Lake Nicaragua
- East Canal, that goes from Lake Nicaragua to the Camilo Locks
- Caribbean Sea and marine approach, including the Aguila Port

As we can see, the Nicaragua Canal would be very similar to the Panama Canal, sharing its general outline having a central Lake and two areas of locks.

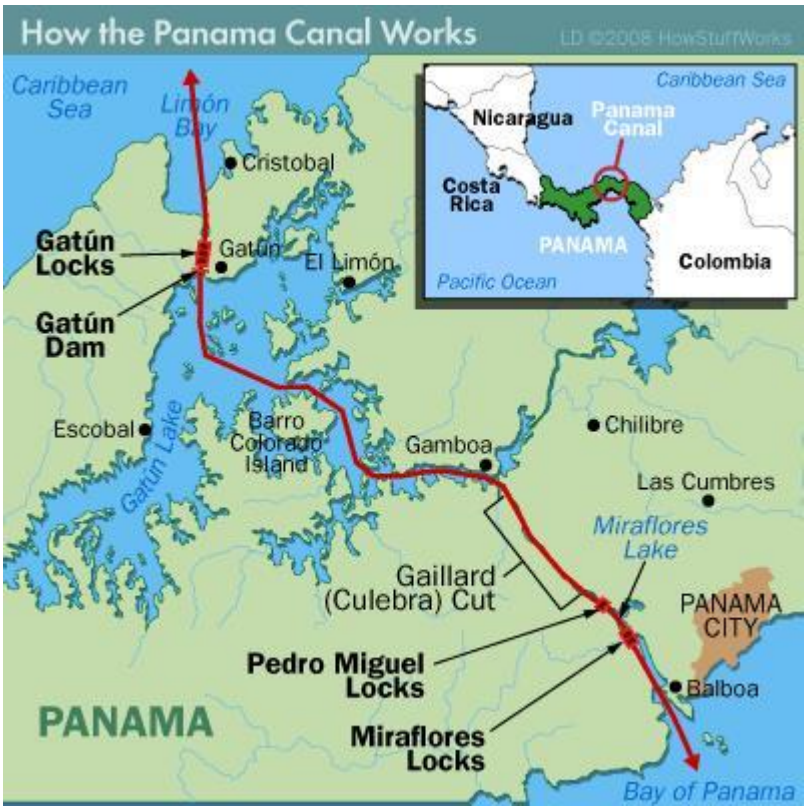

Figure 3: Outline of the Panama Canal (Almehairbi)

1.3 Target vessel

A critical component in the design of the channel is the selection of a target vessel. For competing with the Panama Canal, the Nicaragua Canal has to provide wide berth for the biggest vessels. The target vessel is the largest vessel that the waterway can accommodate safely, and it depends on some parameters: Length over-all, beam and maximum draft.

The Canal de Nicaragua is intended to provide transit for ships that will be too large for the expanded Panama Canal. As of September 2017, the largest container ship is the OOCL Hong Kong, with a capacity of 21.413 TEU. During the past 5 years, the maximum TEU capacity has increased from 16.000 to almost 21.500 TEU (from the first Triple E generation to the OOCL Hong Kong vessel generation). It is uncertain what will happen during the next 5 years. Because of this, the target vessel is estimated to have about a 25.000 TEU capacity. Just like the Panama Canal, the sole construction of the Nicaragua Canal would likely influence the construction of newer vessels.

The target vessel dimensions are as follows:

Boat Type	Dry Weight Tonnage (DWT) Ship Vessels Container Capacity (TEU)	Overall Length (m)	Type Width (m)	Fully loaded draft in seawater (m)
Container Ships	25,000 TEU	500	72	18
Very Large Crude Carriers (VLCC)	320,000 DWT	330	60	20
Ultra-large Bulk Carriers (ULBC)	400,000 DWT	365	65	23.5

Table 1: Target vessel dimensions of the Nicaragua Canal (HKND Group, 2014)

1.4 Transit

The canal is estimated to accommodate a daily average of 14 transits per day by year 2050, or approximately 5000 ships per year. The 2070 projections are provided in the following table (Table 2). The maximum theoretical capacity of the canal is 9,153 transits per year.

Year	Container Vessel	Crude Oil Carrier	Product Carrier	Liquefied Natural Gas Carrier	Iron Ore Ship	Coal Hulk	Grain Carrier	Other	Total Number
2020	1,811	99	181	11	88	56	301	1,029	3,576
2030	1,752	392	186	11	123	80	348	1,246	4,138
2040	1,747	458	240	11	201	107	427	1,579	4,771
2050	1,403	495	282	12	279	151	531	1,944	5,097
2060	1,304	504	310	13	378	228	655	2,393	5,785
2070	1,236	496	324	13	513	295	775	2,945	6,598

Table 2: 2070 Projections of vessel transit in the Nicaragua Canal (HKND Group, 2014)

A Navigation Control Centre would be established in the Brito canal approach. Just as in the Suez Canal, the ships would transit the canal in a convoy, with up to four ships in each convoy, with the possibility of extending the amount of ships depending on the transit.

The theoretical ships' cruise speed would be 12 knots in Lake Nicaragua, and 8 knots in the rest of the canal.

The entrance to the locks is helped by tugboats, as in the new locks of the expanded Panama Canal. This provides a better control of the boat if the weather conditions are tough, unlike with the traditional locomotives from the *old* Panama Canal.

The transit time would be approximately 30 hours, compared to the 8 to 10 hours of transit of the Panama Canal. However, it is not an important difference if we

consider the time vessels stay anchored waiting for their scheduled entrance in the Panama Canal.

The detailed management of the convoy system has not been published yet by the HKND, but it is possible that convoys could pass each other in the passing lanes in Lago Nicaragua or one convoy could anchor in Lago de Atlanta while the other convoy passes.

Figure 4: Lago de Atlanta (La Voz del Sandinismo)

1.5 Canal Navigation Aids and Lighting

With the goal of vessels to securely travel the channel, HKND would give navigation aids as per international rules. These navigation aids would incorporate different reference points (e.g., acoustic, remote), warning signals (e.g., cables, pipelines intersections), channel markers, buoys, and the accompanying lit navigation aids:

- Lighthouses: one 30 meter high lighthouse lantern would be on both the Pacific and Caribbean coastline, each with a lighting range of 22 nautical miles. In Lago de Nicaragua, one 20 meter high lighthouse would be on both the west and east shores, each with lighting range larger than 22 nautical miles.
- Large sailing buoys to mark each side of the Pacific and Caribbean channel entrance, each buoy would be approximately 2 nautical miles from the shoreline and would be equipped with lights having visibility greater than 10 nautical miles.
- Light buoys to mark the channel entrance on both sides of Lago de Nicaragua, each buoy would be approximately 2 nautical miles from the

shoreline and would be equipped with lights having visibility greater than 10 nautical miles.

- Navigation Control Center: one at the Pacific canal entrance to control all ships in and out of the canal covering from the ocean approaches.
- Lock Control Centers: one at the Brito and one at the Camilo Lock to control the lock and direct ships.

The Project has been intended to not use any of the Lago de Nicaragua water. The area of the locks would catch a significant part of the Punta Gorda watershed that would some way or another get to the Caribbean Sea, and the provision of additional water would be given through the dam of Agua Zarca.

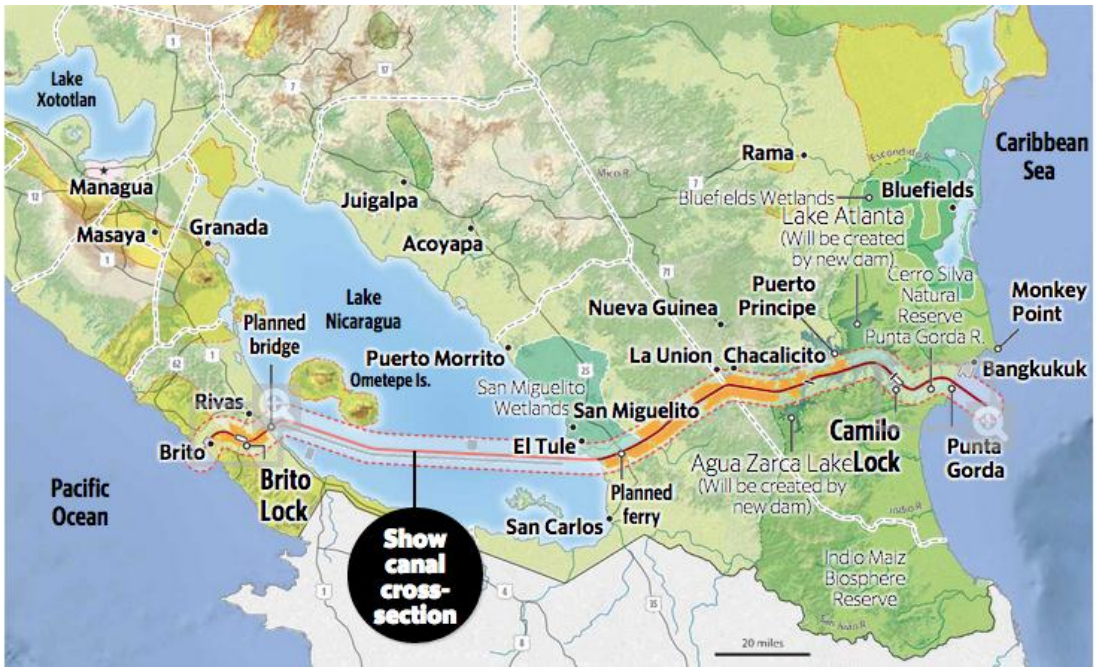

Figure 5: Nicaragua Canal overview, showing the location of the Agua Zarca Dam, next to Camilo Locks (Robert Dorell, GraphFix Lab)

Likewise, the locks have a framework for saving water that comprises of nine water sparing bowls, or lakes, to reuse water at both the Brito and Camilo locks, just as in the expanded Panama Canal Locks

The three proposed water saving basins would decrease the general water request by 60 percent. The water basins would have the same length as the lock, however, they would add an extra 240 m to the general lock width (counting with 3 basins of 80 meter wide each).

1.6 Development of new ports

The Canal construction would require the import of roughly 21M tons of materials and supplies, the most part of which are supposed to be transported by ship to the Corinto and Bluefields ports. HKND proposes to utilize these current ports to exchange these materials and supplies to shallow draft barges that would be used to transport these materials to two proposed Project ports, one on the Pacific called the Brito Port (approximately of a 4 km^2 size) and one on the Caribbean called the Aguila Port (14 km^2 area).

The ports would provide logistical support during the construction of the canal and would serve as international ports once the canal is constructed. These ports would support growth of the Nicaraguan economy by providing improved transport connections for agricultural and other Nicaraguan producers with major Atlantic market destinations. They would also serve as trans-shipment ports for normal cargo or containerized cargo.

1.6.1 Brito Port

The Brito Port (Figure 6) is designed to have a design capacity of 1.68 million TEU/year (in the HKND Project) and would include the following facilities:

1) North quay structure, approximately 1,100 meters long, capable of supporting a 200,000 (DWT) bulk carrier or 25,000 TEU container ship;
2) West quay berthing facilities, approximately 1,200 meters long, accommodating:
    - Three 70,000 DWT container berths
    - One 30,000 DWT oil/fuel jetty
    - 13 workboat berths

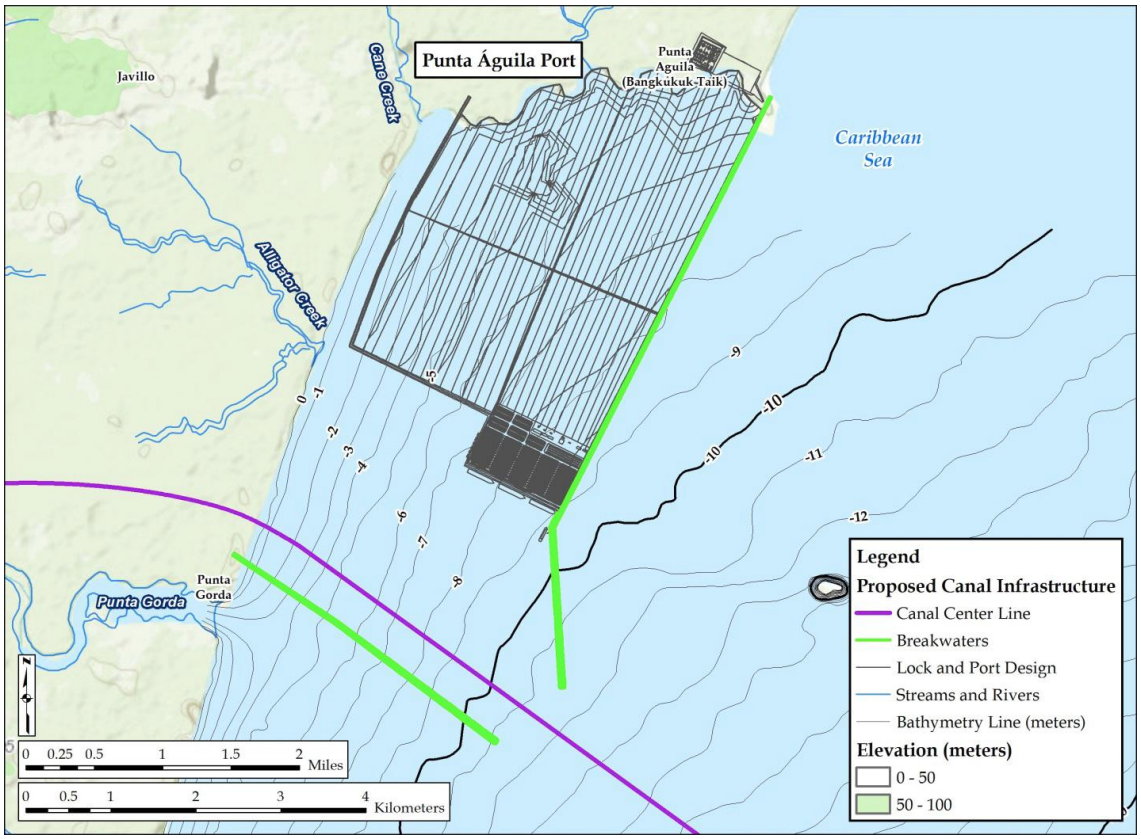

Figure 6: Brito Port as proposed in the Nicaragua Canal Project (HKND Group, 2014)

1.6.2 Aguila Port

The Aguila Port (Figure 7) would have a design capacity of 2.5 million TEU per year and would include the following facilities:

1) Quay structure design capable of supporting a 200,000 DWT container ship;
2) Berthing facilities, approximately 1,300 meters long, accommodating:
    - Three 150,000 DWT container berths
    - One 30,000 DWT oil/fuel jetty

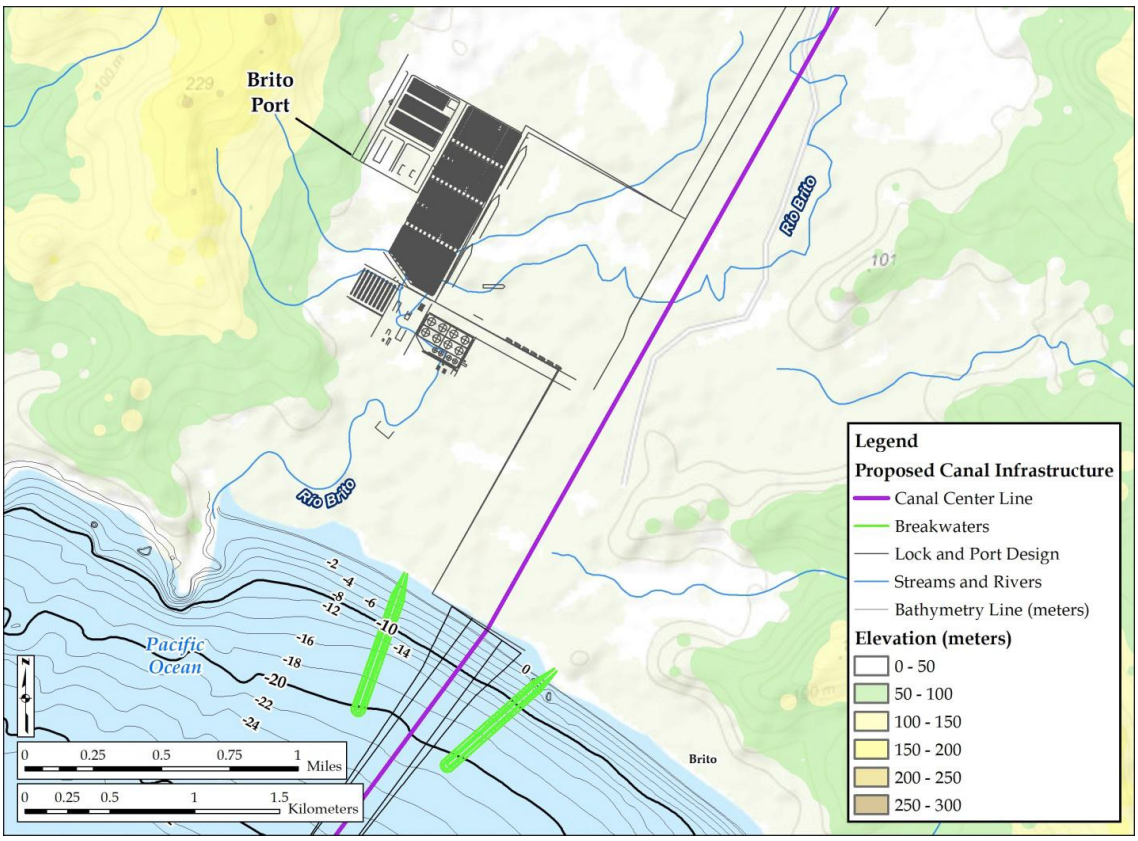

Figure 7: Aguila Port as proposed in the Nicaragua Canal Project (HKND Group, 2014)

To compare them, for example, with the port of Barcelona, we can see that these ports would actually be quite big, being that the Port of Barcelona had approximately a 2.2M TEU traffic in 2016 (Port Authority of Barcelona, 2017). However, it is a matter of discussion whether they would be economically feasible, given that the berths would mainly be constructed aimed at container vessels, and no major oil or solid bulk terminals are projected to be constructed.

However this would, without a doubt, impact the Far east container export routes to the East coast of North America, where a great part of Chinese products are imported. In addition, even if the canal does not succeed economically, these ports would be one of the largest in the area, although they would not surpass the Panama Canal Ports; the Balboa port, with a 2.8M TEU transit in 2016) and the ports in the Northern part of the canal (Colon, Cristobal and Manzanillo), with a total of 3.2M TEU transit in 2016.

Chapter 2. Impact of the Nicaragua Canal

2.1 Environmental Impact

It is not a matter of discussion whether the construction of the canal will affect the large forest and wetlands areas surrounding the area of Lake Nicaragua. However, it can be discussed whether the impact will be beneficial for the environment, or disastrous.

There is no part from the canal project that will be left unaffected after its construction. The environmental impact of the canal affects all kinds of life, in all kinds of environments. From trees to birds to fish, the extent of the footprint from this project reaches everywhere.

Starting from the pacific towards the Caribbean, the port infrastructure along Nicaragua's West coast would threaten tree swamps and sea turtle nesting beaches. Then, the canal, dredged to a draft of about 30 meters, would pass through a large hilly area during 16 miles to Lake Nicaragua, the largest lake in Central America. The damage to Lake Nicaragua could be enormous. One third of the canal's total length would traverse the lake, which has an average bottom of 15 meters, and it would have to be dredged to nearly twice that depth in order to allow for the biggest vessels to pass.

Figure 8: Swamps in Lake Nicaragua (Hiveminer.com)

The dredging activities in the lake and over the rest of the canal's proposed route would generate an almost uncalculated amount of mud and dredging. Fine sand would cloud the lake's water column, threatening indigenous fish and other species and invasive species could make their way into the lake along the canal from the Pacific and the Caribbean.

From Lake Nicaragua, the canal will head east, through wetlands, nature reserves, and forests, many of them inaccessible by road. The canal and related infrastructure could be several kilometres wide, and roads and construction camps would open up large areas of wilderness.

On the Caribbean side, the traffic generated by vessels could threaten sensitive marine ecosystems, including the second-largest coral reef system in the Caribbean. (Kraul, 2015)

And the canal would cut in two the so-called Mesoamerican Biological Corridor, a network of reserves and other lands that stretches from Mexico to Panama and is used by animal species such as jaguars to traverse Central America. (ERM, 2014)

Another point of discussion is how much dredging will be necessary to keep the canal's channel across Lake Nicaragua with enough draft. If soft sediment such as fine sand, silt or clay keeps moving back into the channel, then frequent dredging could really wreak the food chain and the ability of species to survive.

The route the canal is proposed to go through the home of at least 22 species that are vulnerable of extinction, according to the red list of the International Union for Conservation of Nature (IUCN) including tapirs, jaguars, turtles and other species in this area (ERM, 2014).

On early 2014, HKND, the company responsible for the construction of the canal, hired Environmental Resources Management (from now on, ERM), a british consultancy, for the creation of an environmental study. One year after, HKND made public *the Environmental and Social Impact Assessment (ESIA)*, but has not given any pronouncement on any solutions to avoid environmental negative impact. While HKND is now funding additional investigations into the canal's feasibility, the company has not indicated if it plans to look further at the canal's impacts on biodiversity.

As a result, environmental groups have grown increasingly worried over the lack of wildlife research in the planning process. It is claimed that there are still many

missing pieces of information for creating an effective plan to reduce environmental impacts.

There is also the possibility that Lake Nicaragua will serve as the reservoir for the canal's lock system, requiring dams to be constructed in an area of frequent seismic activity, which would increase the risk of local water shortages and flooding. The lake would probably suffer from salt infiltration in the lock zones, as in the locks of the Panama Canal (ERM, 2014). This would transform a freshwater ecosystem with natural free flow into an artificial water reservoir combined with salt water.

Other negative impacts that can be analysed and extracted from the ESIA are:

- Changes in chemical composition and disruptions to dissolved oxygen levels in the water from pollutants and construction could harm numerous populations of freshwater and marine species.
- Boat wakes and dredging could weaken the shoreline of rivers leading inland from the new ports on both coasts
- The wetlands of San Miguelito and Bluefields, will suffer from dredging, sedimentation, invasive species, emissions and other types of pollution, such as water contamination.
- Animal populations on land will be enclosed to territories confined by the canal's infrastructure and ongoing projects, disrupting migration behaviours, connectivity and ecological activities.
- Nicaragua currently has 9 sites designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 406,852 hectares and also has 3 UNESCO Biosphere reserves. There is a high risk of contaminating the area.

Nicaragua is a crucial biodiversity hotspot, and thousands of hectares of the forests and wetlands would be destroyed for the canal construction, destroying the habitats and food sources of already endangered species such as the Baird’s tapir (Tapirus bairdii), the spider monkey (Ateles geoffroyi), the harpy eagle (Harpia harpyja) and the jaguar (Panthera onca), a creature of mystical importance to Central American cultures (Meyer, Huete-Perez, 2014):

Figure 9: On the top left corner, the Baird's Tapir. On the top right corner, the Spider Monkey. On the bottom left corner, the Harpy Eagle. On the bottom right corner, the Jaguar (AmazingLife.bio)

Invasive species from container bilge water are another concern. The environmental impact of ballast water has already been known for some decades. Ballast water contains a variety of biological materials, such as plants, viruses, bacteria or even small animals. This water is used to laden the ship in port or coastal waters once it has discharged, for stability reasons, and the water is discharged once the ship loads again in the next port of call. The problem of doing this is that it brings exotic species into new habitats, and may cause an invasion and problems to the autochthonous species. In the 1980s, something similar happened: the arrival of non-native fish had catastrophic results and there was an important decline in Lake Nicaragua's cichlid fish population due to the introduction of African tilapia.

Figure 10: On the left, a cichlid fish (Pixabay.com). On the right, an African tilapia (Chambers, 2014)

Although there are claims that the construction of the canal will lead to an environmental disaster, it may not. While some conservationists argue that wildlife studies and mitigation for the canal, such as the ESIA, have been inadequate, others say that deforestation across the region has become so severe over the past few years that the canal project may actually benefit biodiversity, with its profits used to fund wildlife protection and reforestation.

Even though the canal's potential for damaging the environment is great, some believe that it could provide an opportunity to slow the environmental degradation that Nicaragua has already had for some decades (World Bank, 2010).

The environmental impact of the Nicaragua Canal should be also seen in the context of environmental protection. It is an unfortunate fact that both Nicaragua and Panama, as many developing countries, need forest protection and management. However, since the construction of the Panama Canal, the country has not had a better forest protection (Chi Wong, 2013)

It is uncertain whether the Nicaragua Canal will bring environmental protection plans, or disastrous consequences for the native species of the area.

2.2 Social Impact

Another major impact of the construction of the canal is the expropriation of land. In 2014, the government of Nicaragua approved the expropriation of approximately 2,900 km^2 of land for the canal, of which approximately 1,188 km^2 will be temporary, lasting through its construction, and 1,721 km^2 will be permanent (HKND Group, 2014). The resulting displacement of human population is one of the project's most significant impacts and cannot be ignored.

On June 2013, without any public consultation or debate, the Nicaraguan government approved Law 840, granting the interoceanic canal concession to HKND for 50 years and an optional further 50. The agreement and the law that backs it up conferred astonishing powers to the Chinese company, including the right to expropriate any land it deemed necessary for the project.

This includes two types of displacement: physical displacement, which is specifically the relocation of or loss of shelter, and economic displacement, which refers to the loss of properties which results in a loss of income or other means of living. In September 2014, HKND performed a census of the population living in the affected areas. This census determined that approximately 30,000 people (7,210 families) will need to be physically or economically displaced. Later, in December 2014, HKND reached the agreement with the Government of Nicaragua regarding the expropriation limits.

Law 840 states that owners of land that is permanently expropriated for the canal would only be compensated at the lower market value of the property as of 14 June 2013. There are no provisions within Law 840 that require compensation for those without legal title or who otherwise occupy land on an informal or illegal basis. In addition, Law 840 limits admissible complains to those that relate to the amount of compensation, thus prohibiting complains with the objective to contest the decision, timing, or any other aspects of the expropriation.

Figure 11: Farmers protesting against law 840 (Miranda, 2016)

As of September 2017, a detailed proposal of the expropriation and resettlement specifics has not been published yet. There has been little to no engagement between the Government of Nicaragua, which has responsibility for land acquisition and resettlement, and householders that would be moved by the Project.

There also exist concerns about the legal authority granted under Law 840, the lack of publicly published resettlement plans and lack of consultation. This has helped to create uncertainty and distrust between potentially affected people. There also have been public protests in communities along the proposed canal route, which are primarily focused on the issue of physical displacement.

2.3 Economic impact

In order to study the impact of the Nicaragua Canal, it is important to establish three basic parameters that will influence or encourage international decisions based on current global matters.

The first power is, of course, economics. The trade patterns that the Nicaragua Canal will economically impact will surround the North-eastern China – North-eastern America areas majorly, although an impact in the Suez Canal may be seen too. The Nicaragua Canal will have one basic function: to allow larger vessels to transit between the Atlantic Ocean and the Pacific Ocean. The shortened distance and the ability to provide a wider berth than the Panama Canal reduces travel time and fuel cost, proving its economic value.

The second force proposed on the analysis of the canal is the environment. Environmental issues are nowadays a major concern of a great part of the population. For this reason, all types of companies are looking to provide sustainable operations and products. Countries are also involved in this, since they are the entities that have to put limits on emissions and pollution. International trade is generated by demand and supply between two countries. Product demand is magnified when the product manufacture costs are reduced, and product supply is increased too.

As a result of this, international trade results in a polluting operation: it involves transportation. International trade and emission of greenhouse gases are closely related in several aspects: energy consumption mix and manufacturing efficiency of exporting countries, transportation distance and mode, and system for putting emission responsibility. Transportation also emits carbon-dioxide emissions. And, of course, it allows for the use of local resources worldwide.

The third parameter that will influence decisions on a global basis, and that is related to the other two and to everything in general, is politics.

Politics plays a major part in global activities. Everything is surrounded by politics. Due to this, the construction of a new canal may create a new situation for maritime trades, since the canal will be critical for global economy, as is the Panama Canal today. Country closures from the Nicaragua Canal, or political contests over the area could largely negatively impact the maritime routes and global economy. Both canals are of uttermost importance for global economy, and they are bottlenecks when it

comes to route planning. If the canal aperture is limited by politic influence, it may create a critical situation of global economics.

Between the environment vs. economic costs, politics will play different roles, affecting global trade patterns in different ways. For this reason, politics have to be considered when planning for scenarios.

2.3.1 Three scenarios

For the purpose of analysing the impact of the canal, three scenarios are proposed. Each scenario takes more or less importance of each parameter, focusing on environment and economics. Politics will take the role of deciding how the global trade patterns occur, thus influencing in the role of the Nicaragua Canal.

For each scenario, the Nicaragua Canal will impact in a way, and the competition with the Panama Canal may be different.

2.3.2 1st Scenario: Environmental focus

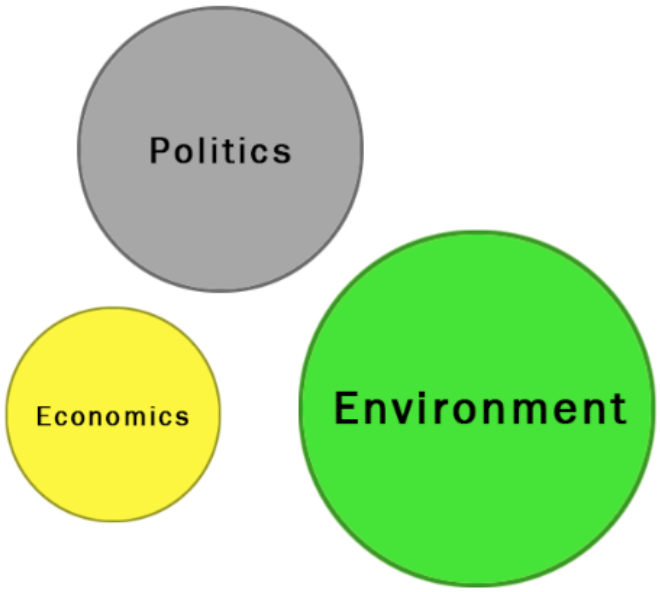

Figure 12: 1st scenario diagram

In the first scenario, countries will focus on boosting the national economic development and fighting against environment deterioration. The consideration of political safety will rise.

Globalisation will enable countries to specialize, enlarging their advantages and maximizing their national economic development by stimulating international trade. Developing countries will tend to manufacture at a large scale to enjoy benefits generated from economies of scale.

On the environmental part, the awareness of low carbon emissions will increase, and a carbon tax would be imposed in order to share the emission responsibilities embedded in import products.

Developed countries will share responsibilities of carbon emissions by exporting low carbon technologies to developing countries, improving efficiency and emissions of machinery. For example, developed countries could advance on the field of biofuel technologies, affecting globally on the overall emissions of all countries.

Impact on maritime traffic

Because the low cost will no longer be the only consideration by importing countries, the emissions of exporting countries will be reduced. On the other hand, developing countries will maintain the advantages by minimizing carbon emissions of manufacturing and transportation of products.

Focusing on lowering carbon emissions, the distance between trading companies and transportation nodes are now crucial factors. Countries will have to import products from closer countries, and they will be forced to use the most carbon friendly transport mode, which is shipping (Siegle, 2014).

Because of this, maritime shipping will become even more dominant in international trades, taking over aerial transportation, since shipping companies will have to use larger vessels and economies of scale with the objective of reducing even more their carbon emissions, reducing the environmental footprint of the whole transporting process to a minimum. The hub and spoke port system will be used more than now in order to maximize the efficiency of the transport operation.

The different roles of the Nicaragua Canal

In order to survive, shipper will adapt to international changes and satisfy the demands of the situation. The Nicaragua Canal would be forced to play one or more of these roles:

As a sustainable corridor

In order to avoid sailing through the Cape Horn route, the Nicaragua Canal, along with the Panama Canal, will be forced to impose green policies or to launch an environment protection program, avoiding all the pollution caused by going the long route. The price will be in a secondary plane, and the activities of the canal will be focused on causing as little as carbon footprint as possible. Some of these policies could include obligating vessels to use clean fuel or diesel when transiting the canal, or sailing at slow speeds in the areas near the canal.

As a large vessel corridor

The construction of the canal will influence the construction of new vessels. Because of the bigger locks and transiting capabilities of the canal, shipping companies will construct larger vessels, since it will be even more profitable using economies of scale. This also brings environmental benefits; because having bigger vessels means that the same volume of cargo can be transported with fewer vessels. Overall, the carbon footprint of the transportation of a container is reduced.

Also, because of the construction of the canal, Far East – North American trades will be less polluting, because the canal will offer a shorter distance, as we have seen previously.

Combining shorter distances offered by the canal, with larger vessels, the pollution of vessels is reduced to a minimum part of what it is today. The Nicaragua Canal will specialize in giving service to large vessels, and thus, *giving service* to the environment.

As a specialised vessel corridor

Another role that the Nicaragua Canal could assume is the specialization route. Specializing in something improves the efficiency of the operation, and this implies saving in cost, time and energy.

Because of this, the Canal will focus on specializing in different types of products, or only one of them. If the canal specializes in one type of cargo, such as containerized cargo (and thus, mostly serving container ships), this will speed up the overall operation of the ports and channels in the area. The speeding up would not only come from specialized equipment, but also because of focusing on only one type of cargo and vessel, which would reduce errors. This would enable the canal to offer an unobstructed flow, with little to zero anchoring time for transiting vessels.

The canal could specialize in three major vessels: containerships, tankers and bulk carriers.

Specializing in container ships would mean that the East Asia to North America trades would be affected, so it is the option which would result more rentable. It would also affect the containerization of even more products, and cargo which is not containerized, would be, in order to get to the other side.

Specializing in tanker ships would mean mostly the opposite. The trades from South America to East Asia would increase, and moving chemicals to producing companies in Asia would intensify. It could also affect the fuel trades between South America and Asia, affecting the fuel prices globally.

Specializing in Bulk Carriers would make less sense, but still impact the maritime trades.

Competition with the Panama Canal

Instead of being competitors, both canals would be complementary routes. The new expanded canal allows the transit of 366m long, 49m wide and 15m drafting vessels, the equivalent of a 12.000 TEU containership. This means that the already biggest vessels in the world cannot transit through the canal, and it is very likely to see that the Panama Canal will not have the opportunity to be "A large vessel corridor". The Panama Canal would now have its limits on the New Panamax ships, while the Nicaragua Canal would take bigger vessels (in addition to a normal transit).

However, because the Panama Canal and its two ports have already specialized in handling containerships, it will be hard for the Nicaragua Canal to become the logistics hub of Central America. The Nicaragua Canal will, then, fulfil the market gap by attracting shippers with its low emission and green services. In order to survive and be rentable, the Nicaragua Canal will have to prove that it is an environmental friendly way of passing from one ocean to the other, while also proving to be a reliable option for those who want a faster service.

2.3.3 2nd Scenario: Equal focus between Economics and Environment

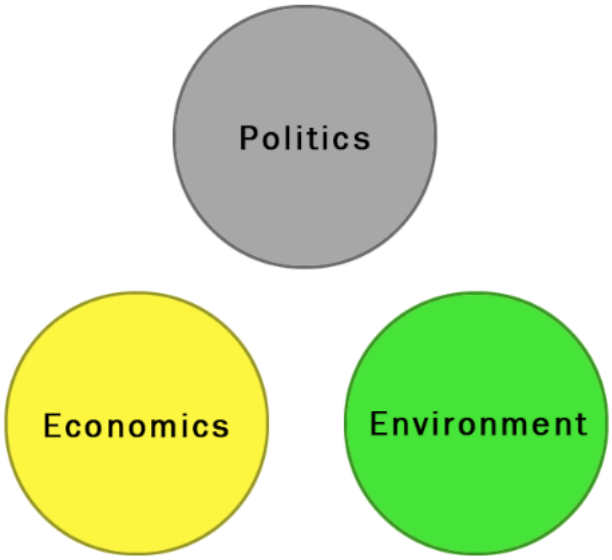

Figure 13: 2nd scenario diagram

In this second scenario, the environmental issues will be the main focus of the canal activities, and countries will impose conservative environmental policies.

Global warming concerns will rise, and there will be two groups with different opinions: the ones concerned with the environment and the ones concerned with economics. The *pro-green* group would impose taxes on imported products, and higher taxes on the ones with the most footprint on the planet, thus reducing the amount of imported products by making it more expensive to import. The responsibility of taking care of the environment falls on the importing country. In the other case, the *anti-green* group would make responsible the exporting countries for the pollution footprint, and would do nothing on the imported products.

Because of this, international trades would only happen between countries with the same belief on the environmental problem. Again, two blocks would be formed: the *pro-green* block and the *anti-green* block. The European Union, South America and Japan, would be the leaders of the pro-green group, while China, the United States and Russia would be the leaders of the anti-green block.

The first ones would impose national regulations and support the importing taxes on the most polluting products, while the second ones would have a more liberalist point of view, focusing on the economic development of their own countries.

Impact on maritime traffics

Countries from the pro-green block would develop products on closer destinations, with *eco* tags on their names, and would focus on the footprint rather than the cost of the product. Pro-green countries would attract investments from the EU, and would export to countries in the block only what is strictly necessary. Other products that can be manufactured or produced in the block's countries would be produced there, thus affecting maritime trades negatively. However, between close countries, shipping would be the major transport system, since it is the one most eco-friendly, and measures would be taken so it happens this way.

The importance of biofuel would then rise, and producing countries would develop faster. South America would benefit from it, as well as the maritime trades with origin or destination South American countries.

On the other hand, the anti-green block countries would focus purely on the economic aspect. They will minimize costs by using economies of scale, which at the same time also minimizes pollution and footprint on the planet. However, products would be manufactured and imported from producing countries, as long as the price remains cheap, without taking any care of the environment.

The different roles of the Nicaragua Canal

Division of environmental protection will create a political argument, and the splitting of political trade blocks will induce into traffic separation.

The separation of traffic between blocks will imply that the Nicaragua Canal will have to focus on providing both an economic and an eco-friendly passage. Because it will be hard to reach such an efficient system that benefits both the economy and environment need of the blocks, the Nicaragua Canal would have to be economically supported by the countries, instead of shippers (Chi Wong, 2014)

Because the economic costs would be less important. or in a second plane, the canal would have to prove its capabilities as a green corridor. To attract pro-green block countries to the canal, it would have to implement green policies or to launch environmental protection programs. The Canal will develop a strategy based on enabling countries to transport cargo by minimizing pollution from transportation.

Competition with the Panama Canal

The political argument will alter the roles of the canals. Energy and scarce materials will be mostly dependent on maritime transport, and canals and straits are considered as bottlenecks or strategic routes. Because China is very interested in the growth of the Nicaragua Canal, it will invest in maintaining a good relationship with all other countries, from both blocks.

China would need to appear to be part of both blocks, since it has interests in keeping the Nicaragua Canal rentable by rising an economic benefit, which cannot be raised if it is not seen as an eco-friendly route. The Nicaragua Canal will act as a green corridor, while the Panama Canal will stay as it is, and both will be complementary routes even though the type of traffic would be similar between them.

2.3.4 3rd Scenario: Economical focus

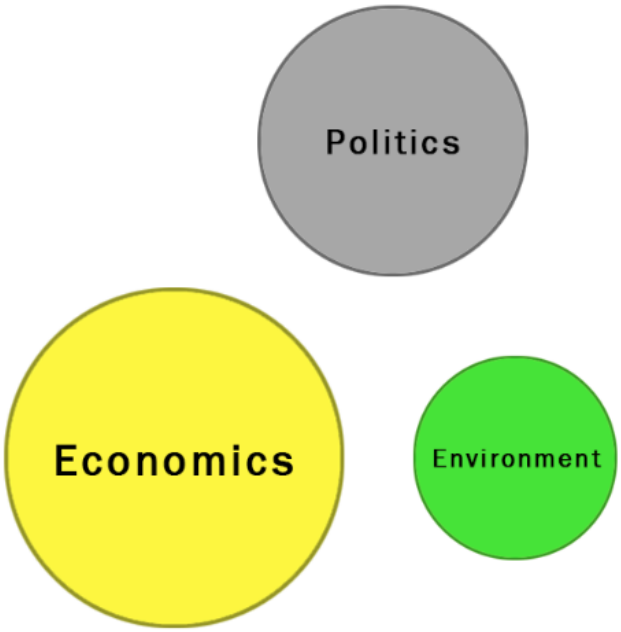

Figure 14: 3rd scenario diagram

In this third scenario, countries and companies will focus on the economic matters, leaving on a second plane the environmental costs of production and transport. Conservatives policies will be imposed and rapid development will be more important than green development.

Countries will focus on national economic development. The fast rise of China will accentuate, affecting all other countries. Other producing countries, such as China, Russia or the United States will have a wide berth to continue with their open policies, affecting all other countries. They will extend their political influence and start to invest in other countries, inducing into a global economy growth that will negatively affect the

Impact on maritime traffics

Countries will be separated (even more than nowadays) between manufacturers and buyers. Producing countries will specialize in manufacturing to maximize economic benefits.

To minimize the cost even more, larger vessels will be construced, which will positively affect the environment as an advantage. In an economical inclined world, larger vessels will provide the most economical route option and will be able to get even more market share by proving to be a green option, even though it is not as important as the cost.

Shipping companies will maximize the capacity of vessels and take the most cost efficient routes, without taking in care the environmental costs. The hub and spoke port system will of uttermost importance to minimize costs.

The role of the Nicaragua Canal

As shipping companies will construct larger vessels to enjoy the economic benefits that economies of scale provide, the canal will need to have enough water draft to accommodate post-panamax and very large vessels. Combined with the shorter distance offered by the Canal, the transport costs will be lowered, even having in mind the transit costs.

The Nicaragua Canal will specialise in servicing very large vessels. As we have seen before, specializing improves the efficiency of the operation, and this implies saving in cost, time and energy. Instead of focusing on different types of products, now the canal will focus on large vessels, although containerships will be the most important traffic of the canal.

Competition with the Panama Canal

Specialized hub ports of containers or tankers will be developed in both North America and China to facilitate trade and maximize operation efficiency. The Nicaragua Canal will offer the possibility to accommodate the largest vessels in the world, and by focusing on the economic costs, the hub and spoke system will succeed.

Even though the Panama Canal had a recent expansion, it cannot accommodate ships that carry more than 12,000 TEU. Because of this, the Panama Canal will stay with its normal traffic, or probably even reducing it. The Nicaragua Canal will rise as the only option for large vessels to cross from ocean to ocean. In addition, Panamax and Post-Panamax vessel owners may find the Nicaragua Canal safer to cross, since it allows for wider ships and the danger of accidents or collision inside the docks is reduced.

The Panama Canal would now be complementary to the Nicaragua Canal for smaller vessels.

Chapter 3. Competition with the Panama Canal and alternative routes

Nowadays, the Panama Canal is a strategic route for global trade: 5% of all traffic passes through the canal (8% for the Suez Canal), representing 200 million tons of goods a year, on board more than 15,000 vessels (American Journal of Transportation, 2017). In its old configuration, before the expansion, the canal could allow the transit of what is refered as PANAMAX vessels: they had a 294m LOA and a 32m beam.

After the expanded locks construction finished, the new size that the Panama Canal can hold is still not in accordance with the largest existing vessels. The locks can now hold vessels up to 366m long with a beam of 49m and a draft of 15.2 meters. Vessels constructed according to the new size are usually refered as New Panamax vessels.

However, there is a considered number of container vessels that are bigger than this. Examples of it can be both of the first generations of the Maersk Triple E ships, being 400 meters long and 59 meters wide, with a draft of 16 meters, or the OOCL Hong Kong, which is the largest container vessel in the world in terms of TEU Capacity, carrying 21.413 TEU. Of course, these new vessels are not intended for the Panama Canal route, or even the North-eastern China – American trades. However, the construction of a Nicaragua Canal that allows these newer vessels to cross to the Eastern coast of the American continent may allow these ships to berth in new ports.

Currently, vessels that do not want to cross or cannot cross the Panama Canal have to either discharge their load on the West Coast of the United States (and continuing the trip using the U.S. railroad system), or pass through the Cape Horn route, the southernmost point of the American continent, although this is usually bypassed using the Strait of Magellan (*Magallanes*), which is considered shorter and safer.

For the moment, the best option for vessels larger than New-Panamax vessels that need to cross from the West Coast to the East coast, is doing so using the Cape Horn route.

3.1 Guayaquil - Barcelona

A container vessel leaving from the Guayaquil Port that needs to reach the port of Barcelona needs to travel a distance of 10.192 nautical miles, using the Cape Horn route. However, if we consider the possibility of crossing the Panama Canal, the distance is now reduced to 5676 nautical miles, almost half of the initial distance.

If we supposed that the vessel is cruising at 20 knots (the cruising speed refers to a reasonable speed in terms of economical and time terms), we would be talking about 21 and 12 days journeys, respectively, also including the transit time of the Panama Canal. This is such an important difference that it is crucial when shipping companies plan their routes and schedules, and it supposes an enormous impact on modern shipping lines routes.

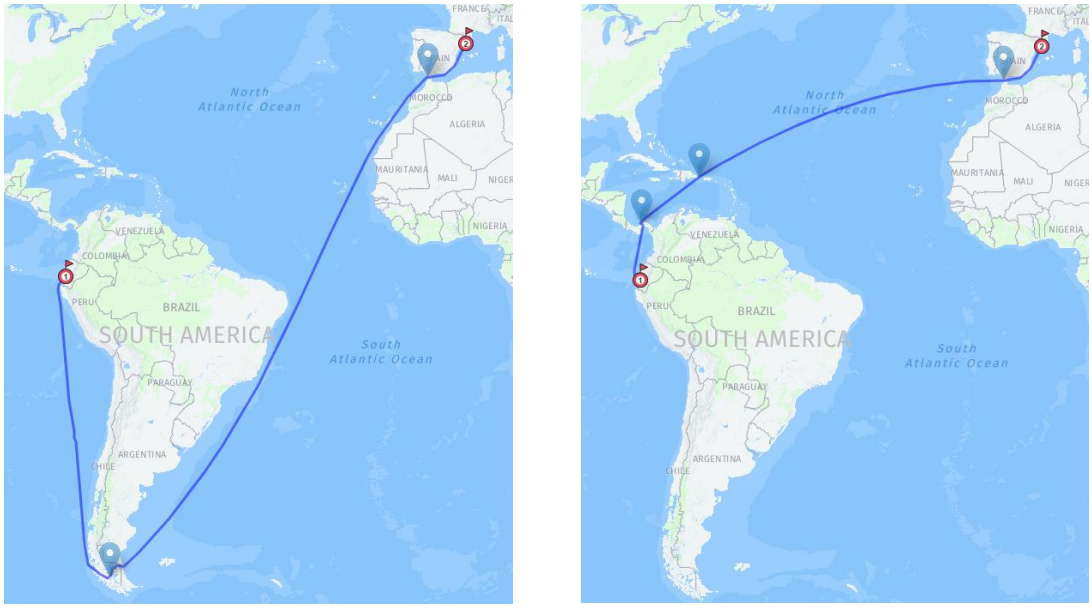

Figure 15: Guayaquil - Barcelona routing options, on the left via the Magellan Strait, on the right via the Panama Canal

But as we have seen, the Panama Canal is not an option for these types of newer vessels. However, if we take the Panama Canal out of the equation, and we draw this line passing through the imaginary Nicaragua Canal, the distance is now of 5961 nautical miles, which would take 14 days to cross, including the transit time of the canal, which HKND calculated to be of about 30 hours (HKND Group, 2014)

Route	Distance (nautical miles)	Canal Transit time (h)	Total Time (h)	Total Time (days)	Fraction of time
Via Cape Horn	10192	-	509.6	21.23	-
Via Panama Canal	5676	8	291.8	12.16	57%
Via Nicaragua Canal	5961	30	328.05	13.67	64%

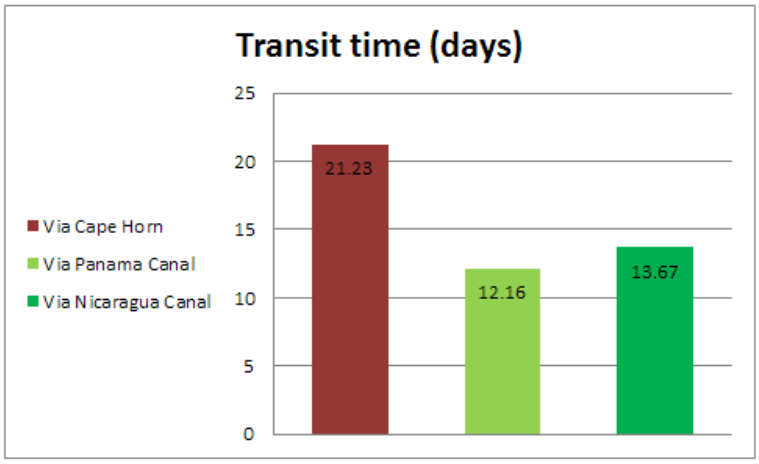

Table 3: Distance and time comparison between the different options for the Guayaquil – Barcelona route at a 20kt speed

Because current route calculators do not take in mind the Nicaragua Canal, the distance is the sum of three diferent routes: From Guayaquil to Brito (975 miles), the length of the proposed canal (170 miles) and from the Bluefields port to the port of Barcelona (4986 miles). However, the 170 miles from the canal are not counted on the time calculations since it is already counted on the transit time of the canal.

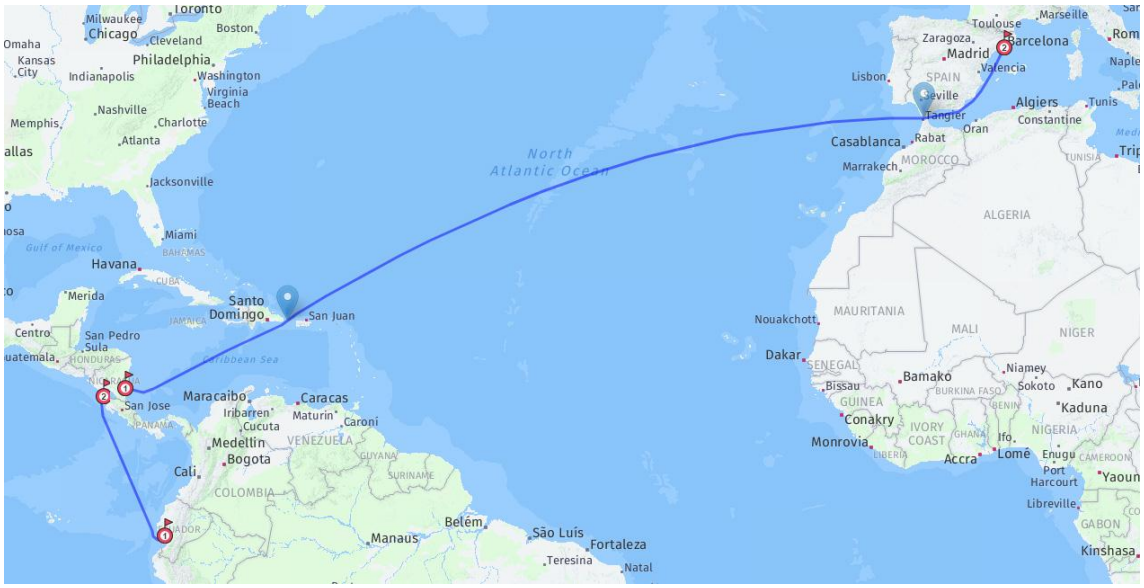

Figure 16: Guayaquil - Barcelona through the Nicaragua Canal

On Table 3 we can see an overview of the different routes leaving from the Port of Guayaquil with destination Port of Barcelona.

3.2 Ningbo - Norfolk

Another interesting comparison can be made taking the ports of Ningbo and Norfolk, for example. There are two main options: using the Central American canals and using the Suez Canal.

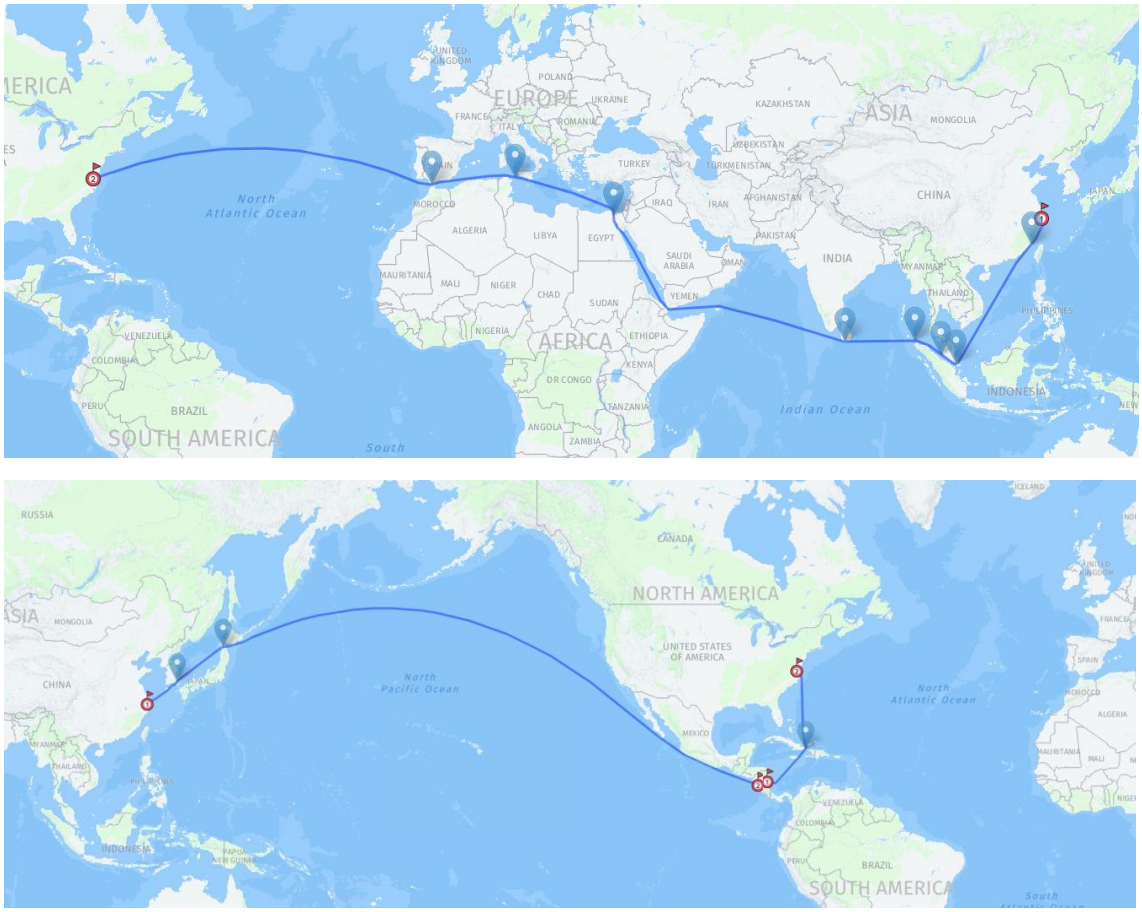

Figure 17: Comparison between the Atlantic and the Pacific options for the Ningbo – Norfolk route

However, big container vessels (Post New-Panamax) that need to do this route cannot pass through the Panama Canal, and are obliged to take the Suez Route, which takes 4 days longer to navigate, as we can see in Table 4. In other words, if the Nicaragua Canal was constructed, these vessels would have the possibility to navigate until the Norfolk Port directly from the Ningbo Port (or other Chinese ports in the area), saving 4 days of total transit time.

Route	Distance (nautical miles)	Canal Transit time (h)	Total Time (h)	Total Time (days)	Fraction of time
Via Cape Horn	16471	-	823.55	34.31	-
Via Suez Canal	12371	12	630.55	26.27	76.6%
Via Panama Canal	10412	8	528.60	22.03	64.2%
Via Nicaragua Canal	9937	30	526.85	21.95	64.0%

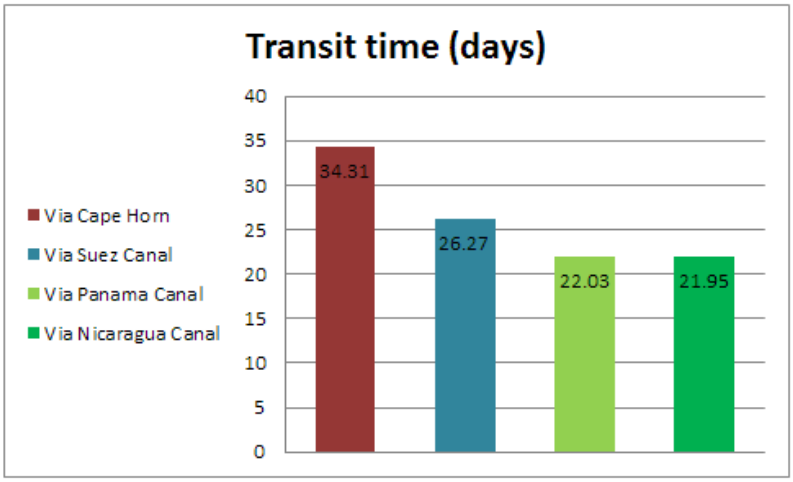

Table 4: Distance and time comparison between the different options for the Ningbo – Norfolk route at a 20kt speed

As we can see, there is not much of a difference between the Panama Canal and the Nicaragua Canal routes. In fact, the difference is about the maximum size they can allow, not about time saving.

However, if the only option of navigating this route is going through the Pacific Ocean, there would only be two alternatives: going through the Cape Horn or crossing the Nicaragua Canal. For the first option, not only it takes 12 more days to navigate, and thus costing more to the shipping agency, in terms of economic exploitation of the vessel, but also it will use more fuel, inducing in a greater cost for the trip (and more pollution).

To see it in perspective, let's imagine that the trip lasted 10 more times, that is, 340 days. Then the Nicaragua Canal route would last 220 days.

That means that vessels doing the Cape Horn route constantly over a year would have been spent 130 days more sailing, which is a significant difference for choosing one option over the other.

3.3 Algeciras – Vancouver

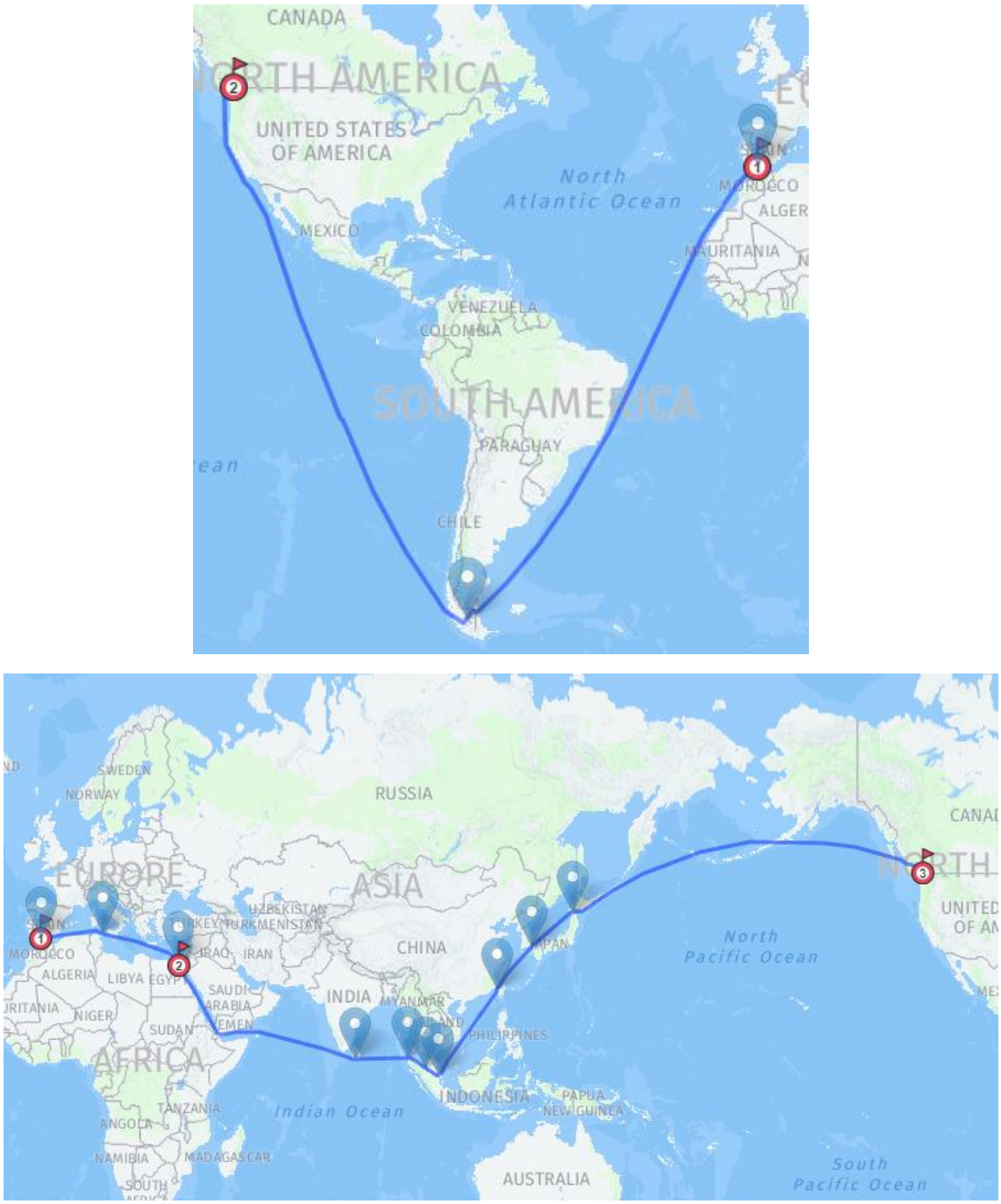

Figure 18: Figure 16: Comparison between the Atlantic and the Pacific options for the Algeciras – Vancouver route

For this one, the conclusions are quite obvious. The amount of time saved travelling the Nicaragua Canal is substantial, and would definitely impact similar shipping routes.

The difference with the Panama Canal, as always, is non-existent. However, compared to routes going around the globe through Cape Horn or the Suez Canal, the Nicaragua

Canal would provide a 10 day shorter route, which would mean a reduction of 35.5% of the time (Table 5)

Route	Distance (nautical miles)	Canal Transit time (h)	Total time (h)	Total time (days)	Fraction of time
Via Cape Horn	13398	-	669.9	27.91	-
Via Suez Canal	13981	12	711.05	29.63	106.1%
Via Panama Canal	8464	8	431.2	17.97	64.4%
Via Nicaragua Canal	8041	30	432.05	18.00	64.5%

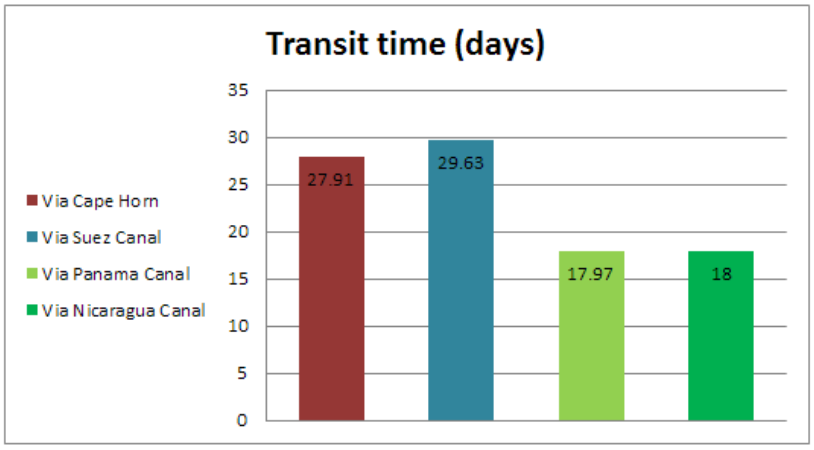

Table 5: Distance and time comparison between the different options for the Algeciras – Vancouver route at a 20kt speed

Shipping routes on the European – U.S. West coast would be affected. The existence of the new canal would provide big tanker ships and bulk carriers, coming from Africa, the ability to provide the West coast of the U.S. However, there is not much of a container ship market share between these two points, since none of them belongs to a major manufacturer country.

Perhaps, the impact of the canal may not be that big, given that the Panama Canal provides the same option for tankers and bulk carriers, ships that still have not reached the sizes of container ships or cruise ships in an usual way

3.4 Tanjung Pelepas – Boston

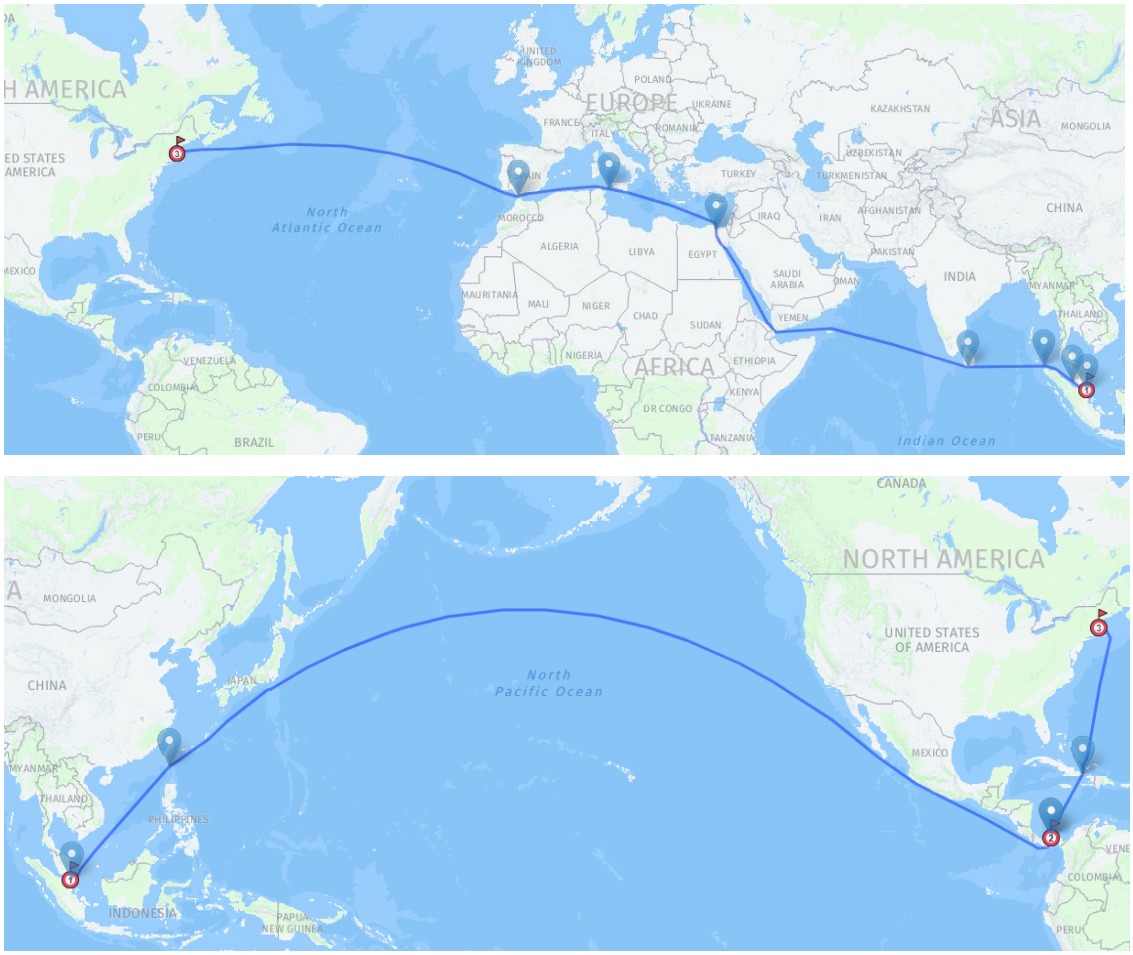

Figure 19: Comparison between the Atlantic and the Pacific options for the Tanjung Pelepas – Boston route

Route	Distance (nautical miles)	Canal Transit time (h)	Total time (h)	Total time (days)	Fraction of time
Via Suez Canal	9961	12	510.05	21.25	-
Via Panama Canal	12746	8	645.3	26.89	126.5%
Via Nicaragua Canal	12271	30	643.55	26.81	126.2%

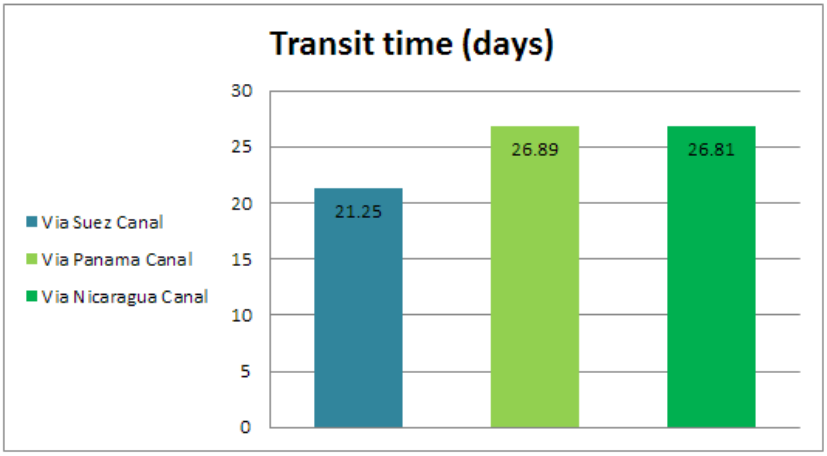

Table 6: Distance and time comparison between the different options for Tanjung Pelepas – Boston route

Given that the Suez Canal provides a faster route for trades between South-eastern Asia and the Eastern Coast of the U.S., the Nicaragua Canal will not be likely to impact these routes, unless the vessel needs to reach U.S. Western ports first.

Additionally, going through the Nicaragua Canal not only takes 5 more days to navigate, but also it does not pass on any other significant ports, unlike the Suez Canal route, that passes through many countries with a significant number of big ports.

The impact on the South-eastern Asia routes would not be existent at all.

3.5 Santos – Long Beach

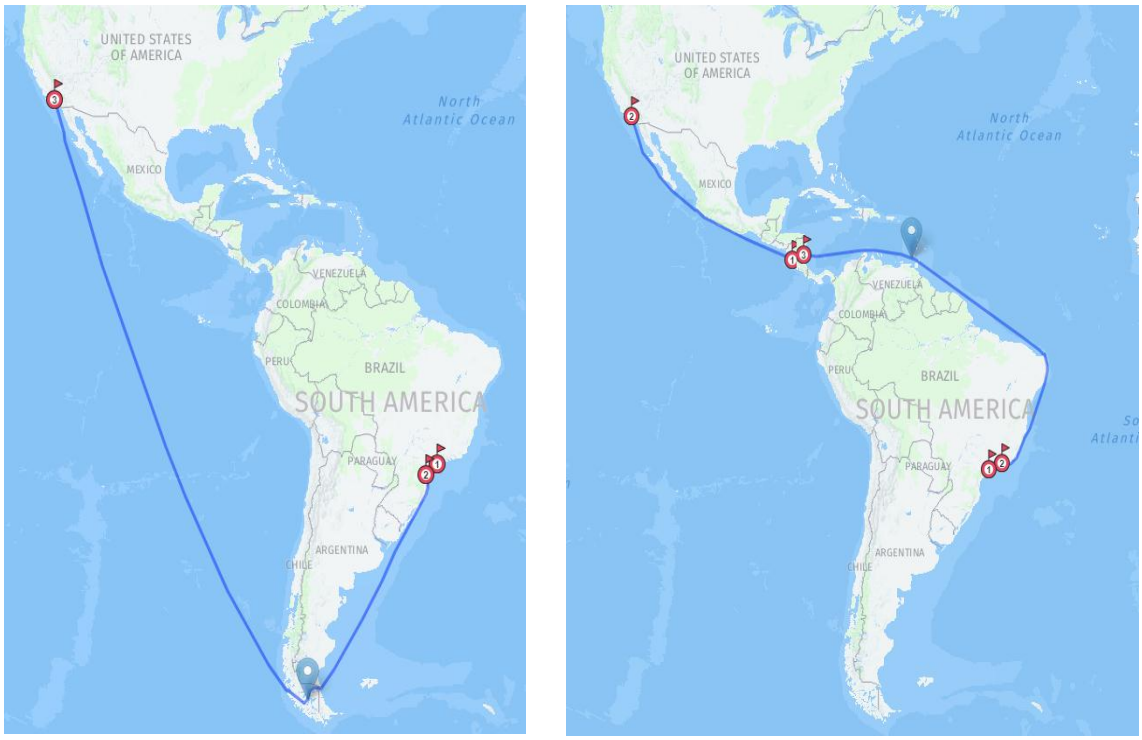

Figure 20: Comparison between the Atlantic and the Pacific options for the Santos – Long Beach route

Despite of the line of the Nicaragua Canal route on the map looking quite shorter, the difference between sailing these two routes is not that big. In fact, going through the Nicaragua Canal route is shorter, but it only provides a 21 hour saving, not enough for making any of the canals viable to cross (Table 7). If we add anchoring and waiting times to the equation, the difference is probably smaller, or even in favour of the Cape Horn route.

Route	Distance (nautical miles)	Canal Transit time (h)	Total time (h)	Total time (days)	Fraction of time
Via Cape Horn	7864	-	393.2	16.38	-
Via Panama Canal	7538	8	384.9	16.04	97.9%
Via Nicaragua Canal	6844	30	372.2	15.51	94.7%

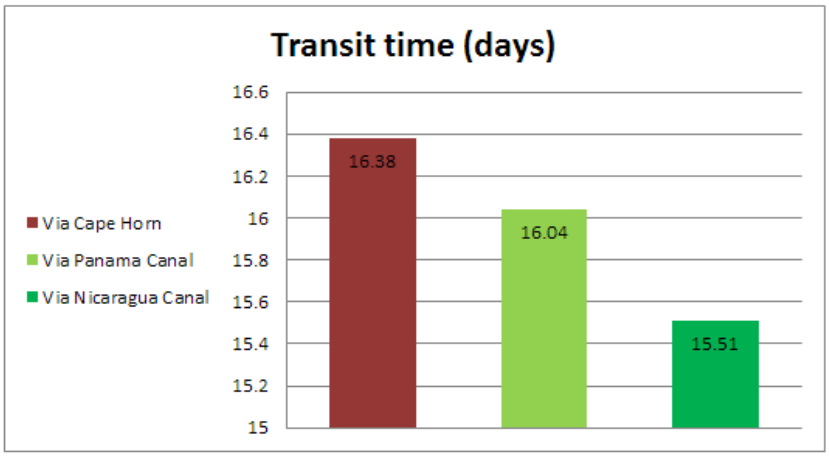

Table 7: Distance and time comparison between the different options for the Santos – Long Beach route

Definitely, the impact on these routes would be insignificant. One thing can be stated; the south of Brazil is a break-even point for the Nicaragua Canal route to be viable to cross.

Despite of that, it could impact routes in the north of Brazil or in Central American countries on the Atlantic Ocean, sharing similarities with the Ningbo – Norfolk route.

The impact of the Canal could be seen on liquid and solid bulk products coming from Central America with destination China or similar manufacturing countries. However, there is not much of a container trade in these countries to make the Canal feasible to cross.

3.7 Routing conclusions

Some conclusions can be extracted from these tables. First of all, it is obvious that sailing this route through Cape Horn is not a good idea in most of the occasions. Instead, a vessel could pass through the Suez Canal and make it through the Atlantic Ocean, finishing its route in fewer days. The busier the boat is, the more money it generates (and spending almost a tenth part of the year on a one way trip is an important hole in the ship's accounts).

In figure 20, we can see the difference of time saved between the studied routes. We can see the routes that the Nicaragua Canal will mostly impact, those being mostly on a horizontal plane, with no big latitude differences. For example, vessels departing from North-eastern China ports will save a lot of time when going to Eastern U.S. ports. This is probably the route that the Nicaragua Canal will impact the most, since it is one of the routes with most activity nowadays. Other routes, such as the Europe – West America ones, will also be impacted, but will be less important since the trades are not that big.

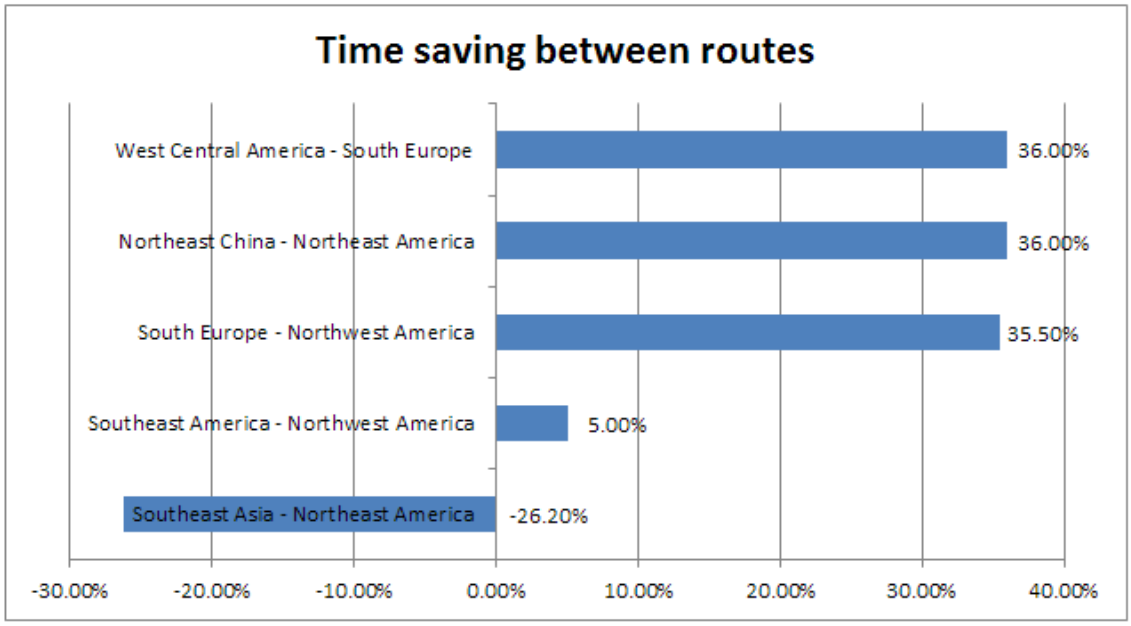

Figure 21: Comparison between the fraction of time saved between the studied routes

That being said, the possibility of cutting through Central America is a huge time saver, and thus, a money saver, which is basically what shipping companies aim for. We can see that the Panama Canal route and the Nicaragua Canal route take almost exactly the same time to navigate on all routes, with small differences. This is crucial for the newer

vessel generations that are coming in the next decades, since the construction of the canal will allow for profitable routes to North American ports in the East coast. Nowadays, the biggest ships in the world only go from China to Europe (to ports like Antwerp, Rotterdam, Hamburg, Gioia Tauro), and from China to the Western Coast of the U.S..

Having the Nicaragua Canal opens the possibility of doing this route in a continuous loop: vessels leaving from China, passing through Europe, then to Eastern U.S. ports and later to the Western ones, then finally heading back to China. And the numbers agree: after the expansion of the Panama Canal, most of the New-Panamax vessels that passed through it were Container vessels (Figure 17)

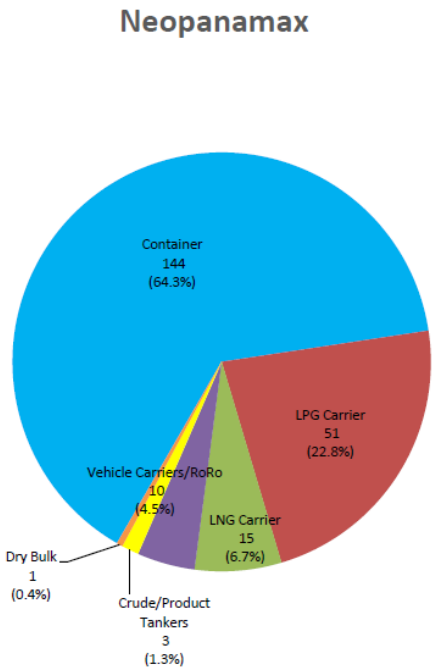

Figure 22: Panama Canal New-Panamax vessel market share after the expansión. Source: Panama Canal Authority

Despite of that, it is unlikely that there will be this massive impact, or at least for the first decades after the opening of the Nicaragua Canal, for a very simple reason: the Eastern coast ports are not prepared for ships this big. The busiest port in the eastern coast is the Port of New York & New Jersey (Port Authority of New York & New Jersey, 2017), and in June of 2017 they announced that they are rebuilding the Bayonne Bridge, which is on the waterway entering the port.

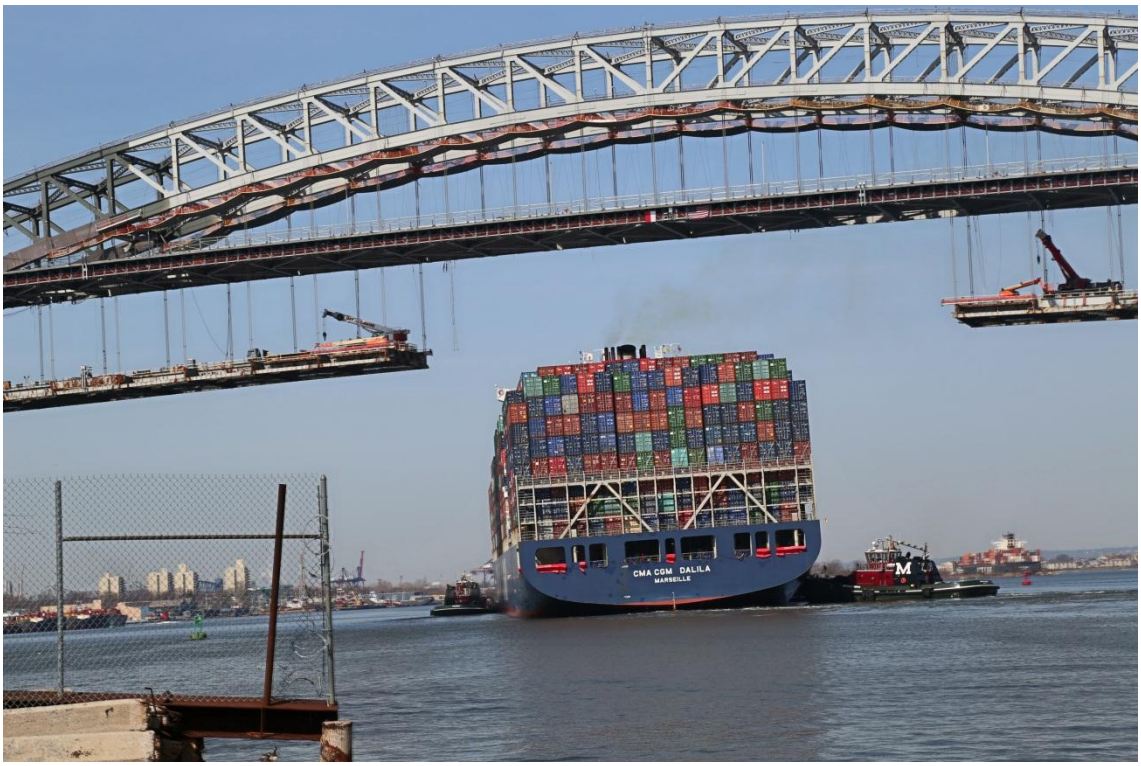

Figure 23: Bayonne bridge being rebuilt to allow for bigger vessels to pass (Salson media, 2017)

Currently, the port of New York & New Jersey can only provide berth to vessels with up to 9.800 TEU (Port Authority of NY & NJ, 2017). On the future, this limit will be lifted to 18.000 TEU, a number still smaller than the capacity of the world's biggest ships at the moment. The second U.S. port in the eastern coast ratings is the Savannah port (Georgia Ports Authority, 2017) and the biggest ships it can handle have around a 14.000 TEU capacity. So the question is: can the North American ports benefit from the construction of the Nicaragua Canal? It seems like not, but port development is at its fastest and by the time the Nicaragua Canal would be constructed, we would see big changes in the north American infrastructures.

And there is still another option for cargo to travel from the West coast to the East coast of North America: the U.S. railroad system. The major part of containers imported from China arrives in ports located in the West coast, such as the port of Los Angeles or the port of Long Beach, the two busiest ports in the U.S., which are actually next to each other. Both ports can accommodate vessels that carry up to 24.000 TEU, a capacity way larger than the one that the eastern ports can manage (Port of Long Beach, 2017).

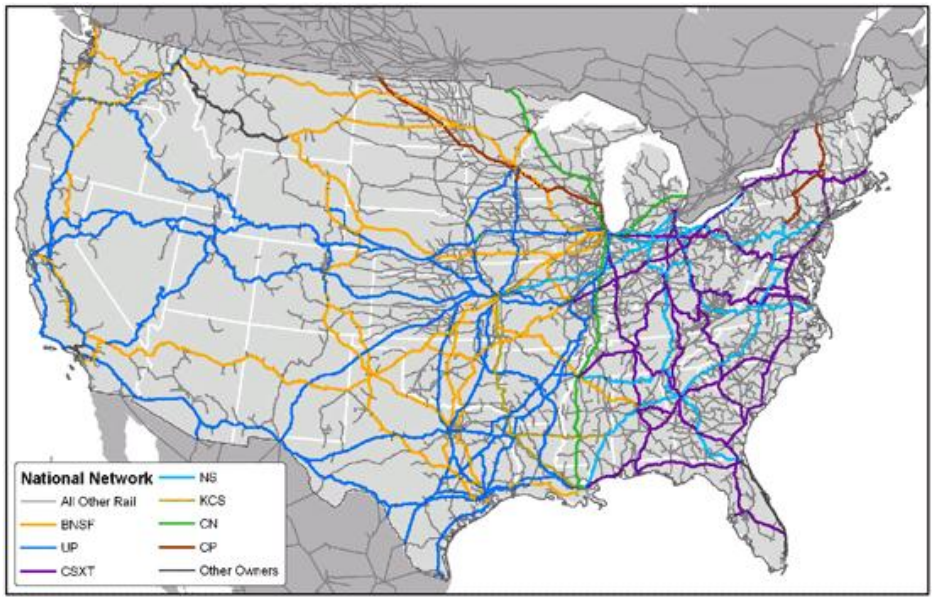

Figure 24: The United States rail network ("Looking At Rails Through A Warren Buffett Lens For 2015, 2014")

This cargo enters through the West Coast and travels to the East coast by the US railroad system. From coastal gateways long distance rail corridors, taking the form of a landbridge, they form part of a continental hinterland made solid by major industrial hubs such as the ones in Chicago and Kansas City (Notteboom, n.d.). The large scale inland railroad transport system of North America is unique in the world, not only because of its size, but also because of the direct link made between two different coasts.

3.7 Challenges

The lack of experience of the company arises a the basic problem from the point of view of any outside observer, although it is true that some of the companies listed on the list of consultants and designers of the project have a good record of construction programs, including the Panama canal, (Ruiz, 2015).

Therefore, the doubts are focused on the capacity to manage and coordinate a vast number of human and material resources.

Not only is the lack of company experience important to the construction of the canal, but also the lack of personnel with higher education but also skilled to handle heavy machinery. No numbers have been researched yet, but thousands of workers would have to be hired to move the vast amounts of terrain.

Another challenge in the construction of the canal is the instability of the ground. Nicaragua is on top of a delicate volcanic area, and the main concern about this goes to the volcano "Concepción", which is in the island of Omepete, within the Lake Nicaragua. In addition, earthquakes are also dangerous for the canal. The last important one happened in April of 2014 (Nicaragua: Earthquake - Apr 2014, 2014) and it reached several other countries in the area, such as Honduras, Costa Rica or Guatemala.

Any critical errors, during or after the construction of the canal will negatively impact its activities and the economy of the country. Challenges like this, make the Nicaragua Canal project a delicate business venture that needs to be well-defined and understood from the beginning, without having any hesitations on the construction. The canal, once finished, will be under international observation, for both economic and ecological fields. It will have to prove itself to be a reliable option and alternative to Panama, and a greener one.

Personal opinion

Personally I have some doubts about seeing the canal constructed somewhere near the future, it just does not make any economic sense. However, I think the associated projects that come with the canal are more likely to happen, before the construction of it. Improvement of current infrastructures is something that has to be done first in order to start the construction of the canal; there would be tourism projects coming along with the canal and it is being studied to build an airport in the area. Just putting good roads or a railroad to the Caribbean coast would be a great addition, economically speaking, to Nicaragua. And of course, both ports would assure a great economic future for the people of Nicaragua.

Since the Panama Canal is not that far away (about 600nm) and has been recently expanded to handle larger ships, the competition it can offer is close to none.

There will be only one good fact about the construction of the Nicaragua Canal: the biggest vessels in the world will be able to cross through Central America, just like smaller vessels do with the Panama Canal. This would offer new route possibilities, or a "round the globe" route departing from China and arriving in China.

But the question is: is it really necessary? Are the benefits too good to accept the consequences of the construction of the canal? It is true that many of the largest shipping companies are Asian –with the exception of the 2M alliance–, and that the Chinese government could influence those companies to use the Nicaragua Canal instead of Panama's, thus forcing a lowering of both canal tariffs, which would be beneficial for global traffics.

But the doubt is still there, and it is hard to decide whether to continue with the construction (or even start it) when there is that much money on the table. In the end, it is just about money, and no one wants to spend it without the security of a fine payback.

Conclusion

Independently of the outcome of the project of the construction of the Great Interoceanic Canal of Nicaragua, the truth is that at least the construction of infrastructure and any or both deep water ports will benefit the country. Factors such as the presence of private Chinese companies, involving public Chinese money, go in the political and strategic interest of the Asian giant, promoting the project to reach its objective.

The presence of other international actors, such as the U.S., Panama or European countries adds a notable interest to the topic. It is uncertain whether the construction of the canal will affect the Panamanian canal, but it will indeed benefit the North American trades and probably the European ones.

The increasingly gigantism over the past few decades in construction of new vessels will move along the construction of the canal, and major ports will have to develop in order to provide berth for these new ships. The transportation of goods from North-eastern Asia to the Eastern coast of North America will eventually get cheaper, as the Hub and Spoke port system is used with larger vessels capable of carrying up to 25,000 TEU.

However, this project would have made more sense as a first canal, replacing the current Panama Canal. But as a second one, it just does not make sense either economically or ecologically. Every transit will require far more tug and pilot time than the Panama Canal, since it takes almost three times the transit time to pass through, and the waterway will require far more maintenance dredging in order to keep the –almost- 28 meter draft on the line. This will reduce the net income from operations, as shipping lines will look at the entire cost of a transit, and not just the toll.

Meanwhile, very few ports can handle the New-Panamax ships, let alone the Maersk second generation of Triple E, or larger ones coming for a dedicated service between just a few ports. Even fewer have an economic attraction area to justify service by those vessels. That means that most transits of the Nicaragua Canal by ships that cannot transit the expanded locks in Panama would be VLCC's and VLBC, while containerized cargo falls in a second plane. Both tankers and bulk carriers carry the least

time-sensitive cargoes and because of this they are looking to pay the lowest possible tolls, rendering the canal and its two new container-focused ports nonsense.

Whatever is left after the construction of the canal will last for decades; probably centuries, so it is important to study to the detail whether the canal will be economically feasible or not. Until that, we will have to see how the construction evolves and what role it will take in the future.

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Annex A. Panama Canal Traffic Along Principal Trade Routes

Vessel Trade Route	Fiscal Year 2016		Fiscal Year 2015		Percent Increase or (Decrease)	
	PC/UMS Net Tons[2]	Long Tons Cargo	PC/UMS Net Tons[2]	Long Tons Cargo	PC/UMS Net Tons[2]	Long Tons of Cargo
East Coast U.S. - Asia	104,791	64,193	104,903	80,086	(0.1%)	(19.8%)
East Coast U.S. - W.C. South America	35,877	34,811	38,606	38,047	(7.1%)	(8.5%)
Europe - West Coast South America	21,768	12,334	24,556	12,969	(11.4%)	(4.9%)
South America Intercoastal	18,845	9,281	14,793	8,694	27.4%	6.8%
East Coast U.S. - W.C. Central America	15,954	12,338	20,842	14,953	(23.5%)	(17.5%)
U.S. Intercoastal including Alaska and Hawaii	13,804	4,776	12,874	5,949	7.2%	(19.7%)
Europe - West Coast U.S.	12,318	7,386	10,190	7,105	20.9%	4.0%
Asia - E.C. Central America	10,505	5,176	6,387	4,040	64.5%	28.1%
E.C. South America - Asia	8,659	3,408	5,600	3,095	54.6%	10.1%
E.C. South America - W.C. Central America	6,752	3,607	11,957	4,817	(43.5%)	(25.1%)
E.C. Central America - W.C. South America	6,496	2,900	10,177	4,227	(36.2%)	(31.4%)
E.C. South America - West Coast U.S.	6,169	2,588	2,512	1,732	145.6%	49.4%
East Coast U.S. - Oceania	5,617	2,083	5,698	2,111	(1.4%)	(1.3%)
Central America Intercoastal	4,623	2,098	5,910	2,917	(21.8%)	(28.1%)
W.C. Central America - Europe	2,757	3,002	2,973	2,296	(7.3%)	30.7%
West Indies - W.C. Central America	2,527	1,155	2,516	1,175	0.4%	(1.7%)
W.C. Canada - Europe	2,420	3,774	1,869	2,996	29.4%	26.0%
West Indies - W.C. South America	2,306	1,786	3,671	2,294	(37.2%)	(22.1%)
West Indies - Asia	2,223	1,442	2,612	1,269	(14.9%)	13.6%
East Coast U.S. - Pacific World	1,846	2,486	3,587	4,628	(48.5%)	(46.3%)
E.C. Central America - West Coast U.S.	1,738	566	2,756	818	(36.9%)	(30.8%)
Oceania - E.C. South America	1,663	346	957	187	73.8%	84.9%
Asia - Europe	1,560	552	2,203	627	(29.2%)	(12.0%)
West Indies - West Coast U.S.	1,171	1,167	1,038	957	12.9%	22.0%
Europe - Oceania	1,047	553	1,248	564	(16.1%)	(2.0%)
W.C. Central America - Africa	813	1,222	460	623	76.9%	96.2%
Around the World	770	813	5,876	2,694	(86.9%)	(69.8%)
E.C. South America - W.C. Canada	691	1,045	327	461	111.5%	126.8%
Oceania - E.C. Central America	680	312	1,124	285	(39.5%)	9.6%
East Coast U.S. - W.C. Canada	585	686	618	668	(5.3%)	2.7%
W.C. South America - Atlantic World	538	526	2,590	1,099	(79.2%)	(52.1%)
W.C. Canada - Africa	424	714	475	815	(10.8%)	(12.3%)
W.C. South America - East Coast Canada	282	381	603	855	(53.3%)	(55.5%)
All Others Routes	31,224	15,200	27,510	13,093	13.5%	16.1%
Grand Total	**329,445**	**204,705**	**340,016**	**229,147**	(3.1%)	(10.7%)

From	Asia	West Coast of South America	West Coast of Central America	West Coast of The United States	Around The World (Pacific)	East Coast of South America	East Coast of Central America	Oceania	Balboa, Republic of Panama	East Coast of The United States	Other	Total
East Coast of The United States	41,465,015	23,970,826	8,884,407	2,517,941	2,418,335	1,222,968	1,211,906	1,408,168	1,074,970	84,158	1,448,993	**85,707,687**
East Coast of South America	1,983,520	6,027,500	2,450,767	1,306,772	133,215	116,308	404,164	243,679	144,738	126,169	681,968	**13,618,800**
Europe	292,963	4,636,093	900,780	4,055,205	64,369	361,776	169,507	247,043	166,060	693,019	75,016	**11,661,831**
West Indies	1,000,227	1,341,482	817,560	1,036,438	234,639	159,183	68,661	-	21,271	177,882	70,764	**4,928,107**
East Coast of Central America	803,156	1,291,412	709,499	331,262	-	205,069	43,451	39,037	219,875	114,465	129,152	**3,886,378**
Around The World (Atlantic)	112,137	145,268	33,707	24,015	286,168	-	-	-	39,113	-	740,839	**1,381,247**
Cristobal, Republic of Panama	953,714	161,195	-	8,747	-	3,173	-	-	152	7,993	116	**1,135,090**
Africa	6,956	46,703	158,672	147,152	-	40,608	-	-	-	-	348,604	**748,695**
Other	433,913	256,929	39,703	293,429	-	48,710	52,791	-	104,011	112,705	201,207	**1,543,398**
Grand Total	**47,051,601**	**37,877,408**	**13,995,095**	**9,720,961**	**3,136,726**	**2,157,795**	**1,950,480**	**1,937,927**	**1,770,190**	**1,316,391**	**3,696,659**	**124,611,233**

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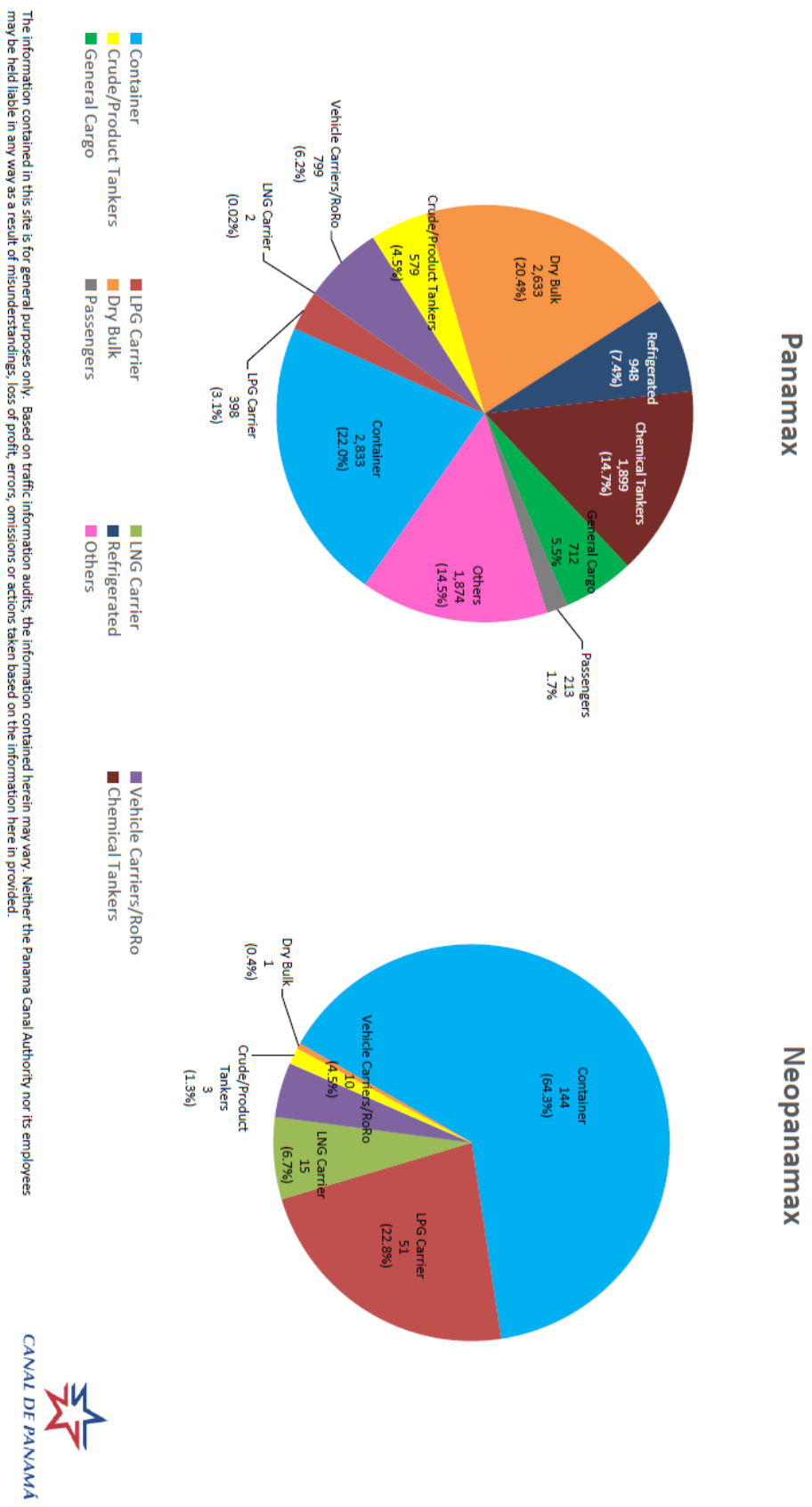
Annex B. Panama Canal Traffic Segments

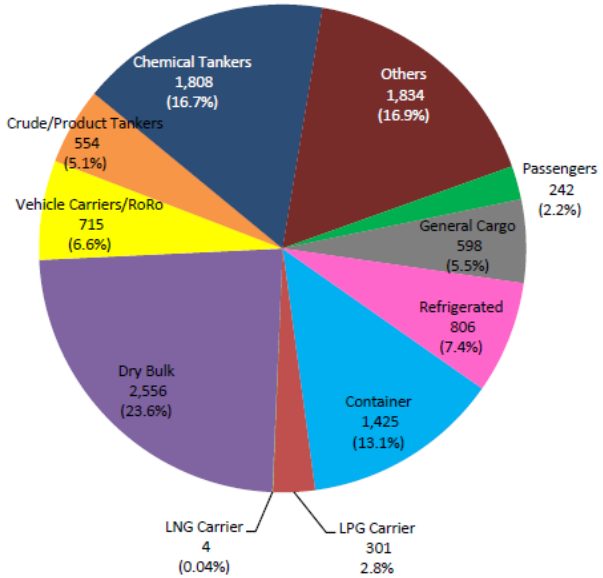
Panama Canal Laden and Ballast Traffic by Market Segment[1]
Fiscal Years 2016-2015

Market Segment		LADEN						BALLAST						GRAND TOTAL	
		Northbound		Southbound		Total		Northbound		Southbound		Total			
		2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015
Container	Number of Transits	1,555	1,533	1,396	1,510	2,951	3,043	16	16	10	10	26	26	2,977	3,069
	PC/UMS Net Tonnage[2] (thousands)	63,759	57,811	55,642	56,878	119,401	114,690	244	264	155	171	399	435	119,800	115,125
	Total Cargo Tonnage (thousands)	21,882	20,797	17,770	18,139	39,651	38,936		17	-	-		17	39,651	38,953
Dry Bulk	Number of Transits	1,137	1,356	1,265	1,628	2,402	2,984	221	259	11	21	232	280	2,634	3,264
	PC/UMS Net Tonnage[2] (thousands)	26,769	32,435	31,978	42,328	58,747	74,763	6,930	7,839	123	342	7,053	8,181	65,800	82,944
	Total Cargo Tonnage (thousands)	36,562	45,570	52,927	69,385	89,488	114,955	37	-	-	-	37	-	89,525	114,955
Vehicle Carriers/RoRo	Number of Transits	437	444	284	289	721	733	9	21	79	90	88	111	809	844
	PC/UMS Net Tonnage[2] (thousands)	25,444	25,713	16,580	16,723	42,024	42,436	457	1,005	4,278	4,766	4,734	5,771	46,759	48,207
	Total Cargo Tonnage (thousands)	3,116	3,110	1,706	1,854	4,822	4,964	2		-	15	2	15	4,824	4,979
Chemical Tankers	Number of Transits	364	366	954	828	1,318	1,194	554	465	27	20	581	485	1,899	1,679
	PC/UMS Net Tonnage[2] (thousands)	6,447	6,613	19,989	17,253	26,437	23,866	12,834	10,642	349	259	13,182	10,901	39,619	34,766
	Total Cargo Tonnage (thousands)	8,548	8,793	29,740	24,936	38,288	33,728	31	76	-		31	76	38,319	33,805
Crude Product Tankers	Number of Transits	80	126	292	316	372	442	199	198	10	14	209	212	581	654
	PC/UMS Net Tonnage[2] (thousands)	2,373	3,904	7,923	8,961	10,296	12,865	5,074	5,193	205	225	5,279	5,418	15,575	18,283
	Total Cargo Tonnage (thousands)	3,158	5,431	11,598	13,034	14,756	18,464	310	433	-	-	310	433	15,066	18,897
Liquified Petroleum Gas	Number of Transits	6	14	221	196	227	210	221	207	1	3	222	210	449	420
	PC/UMS Net Tonnage[2] (thousands)	164	174	5,755	4,913	5,919	5,086	5,621	5,049	2	30	5,623	5,079	11,542	10,165
	Total Cargo Tonnage (thousands)	45	116	6,122	5,014	6,166	5,130	68	34	-	-	68	34	6,234	5,164
Refrigerated	Number of Transits	476	487	325	347	801	834	5	6	142	123	147	129	948	963
	PC/UMS Net Tonnage[2] (thousands)	4,540	4,547	3,257	3,377	7,798	7,924	41	25	1,201	1,040	1,243	1,065	9,040	8,989
	Total Cargo Tonnage (thousands)	2,912	2,893	428	426	3,340	3,319	-	-	-	-	-	-	3,340	3,319
General Cargo	Number of Transits	373	392	297	340	670	732	27	54	13	18	40	72	710	804
	PC/UMS Net Tonnage[2] (thousands)	4,578	4,683	3,511	3,825	8,090	8,508	204	-	125	169	330	169	8,419	8,677
	Total Cargo Tonnage (thousands)	2,334	2,774	2,512	2,892	4,846	5,666	-	-	-		-		4,846	5,666
Passengers	Number of Transits	77	77	132	129	209	206	2	1	2	1	4	2	213	208
	PC/UMS Net Tonnage[2] (thousands)	2,149	2,380	6,020	5,892	8,170	8,273	10	81	4	20	15	101	8,185	8,374
	Total Cargo Tonnage (thousands)	-	1	-	-	-	1	-	-	-	-	-	-	-	1
Liquified Natural Gas	Number of Transits	2	-	7	-	9	-	8	2	-	-	8	2	17	2
	PC/UMS Net Tonnage[2] (thousands)	198	-	681	-	878	-	628	38	-	-	628	38	1,507	38
	Total Cargo Tonnage (thousands)	120	-	430	-	550	-	-	-	-	-	-	-	550	-
Other	Number of Transits	125	151	100	149	225	300	59	54	52	69	111	123	336	423
	PC/UMS Net Tonnage[2] (thousands)	1,457	1,967	1,209	1,623	2,666	3,590	310	223	223	257	533	480	3,199	4,070
	Total Cargo Tonnage (thousands)	970	1,839	1,377	1,564	2,348	3,403		1	-			1	2,348	3,404
Grand Total	**Number of Transits**	**4,632**	**4,946**	**5,273**	**5,732**	**9,905**	**10,678**	**1,321**	**1,283**	**347**	**369**	**1,668**	**1,652**	**11,573**	**12,330**
	PC/UMS Net Tonnage[2] (thousands)	**137,879**	**140,227**	**152,547**	**161,773**	**290,426**	**302,000**	**32,353**	**30,359**	**6,666**	**7,280**	**39,019**	**37,640**	**329,445**	**339,640**
	Total Cargo Tonnage (thousands)	**79,646**	**91,323**	**124,610**	**137,245**	**204,256**	**228,567**	**447**	**561**	**-**	**15**	**447**	**577**	**204,703**	**229,144**

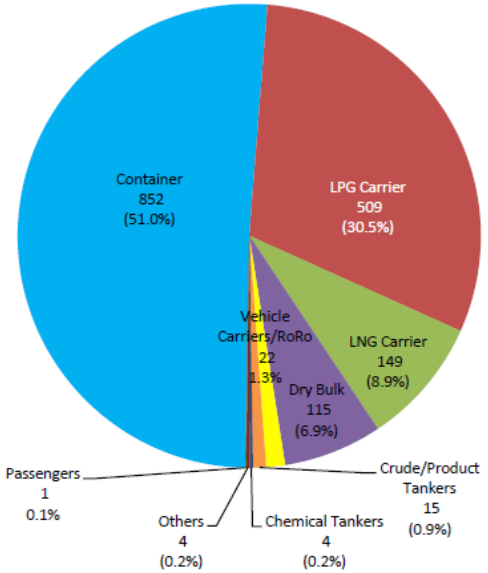

Traffic to Fiscal Year 2016
Panamax
Refrigerated 948 (7.4%)
Chemical Tankers 1,899 (14.7%)
General Cargo 712 5.5%
Passengers 213 1.7%
Others 1,874 (14.5%)
Container 2,833 (22.0%)
LPG Carrier 398 (3.1%)
LNG Carrier 2 (0.02%)
Vehicle Carriers/RoRo 799 (6.2%)
Crude/Product Tankers 579 (4.5%)
Dry Bulk 2,633 (20.4%)
Neopanamax
Container 144 (64.3%)
LPG Carrier 51 (22.8%)
LNG Carrier 15 (6.7%)
Vehicle Carriers/RoRo 10 (4.5%)
Crude/Product Tankers 3 (1.3%)
Dry Bulk 1 (0.4%)
Container
Crude/Product Tankers
General Cargo
LPG Carrier
Dry Bulk
Passengers
LNG Carrier
Refrigerated
Others
Vehicle Carriers/RoRo
Chemical Tankers
The information contained in this site is for general purposes only. Based on traffic information audits, the information contained herein may vary. Neither the Panama Canal Authority nor its employees may be held liable in any way as a result of misunderstandings, loss of profit, errors, omissions or actions taken based on the information here in provided.
CANAL DE PANAMÁ

Cumulative Monthly Panama Canal Traffic by Market Segment
From October 2016 to August 2017 of Fiscal Year 2017

Panamax



Neopanamax



Container | LPG Carrier | LNG Carrier | Dry Bulk
Vehicle Carriers/RoRo | Crude/Product Tankers | Chemical Tankers | Others
Passengers | General Cargo | Refrigerated

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