otp
Office of Transport and Traffic Policy and Planning

Feasibility Study, Conceptual Design, Environmental Impact Assessment and Business Development Model Analysis for Transport Infrastructure Development under Southern Economic Corridor Development for Transport Connectivity between the Gulf of Thailand and the Andaman Sea Project (Landbridge Project)

Executive Summary Report

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Chapter 1
Introduction

The Office of Transport and Traffic Policy and Planning (OTP) has undertaken Feasibility Study, Conceptual Design, Environmental Impact Assessment and Business Development Model Analysis for Transport Infrastructure Development under Southern Economic Corridor Development for Transport Connectivity between the Gulf of Thailand and the Andaman Sea Project (Landbridge Project), with the project period from 2 March 2021 to 1 September 2023.

In the Southeast Asian Region, the Strait of Malacca is the shortest route connecting the trade and transport between countries in the Indian Ocean and Pacific Ocean. Several important ports are located along this route, namely Port of Singapore, and Malaysian ports: Port of Tanjung Pelepas, Port Klang, and Pulau Pinang Port. The 2017 density of vessel traffic in the Strait of Malacca is about 85,000 vessels per year or 250 vessels per day on average, with an upward trend of 2.35 percent per year or about 100,000 vessels in the current year. The expansion of global trade contributes to an increasing trend of cargo vessels traversing.

An idea to develop the Landbridge project that will create a new shipping route connecting the Andaman Sea and the Gulf of Thailand in southern Thailand. Due to the current situation, it was found that the Strait of Malacca has a large number of cargo ships passing through and is almost at full capacity.

The advantage of the strategic geographical location of Thailand is that it is located at the center of Southeast Asia, and Thailand is located near the main sea route, so Landbridge can serve as a connection between the Pacific Ocean and the Andaman Sea within a short distance of about 100 kilometers. The project will benefit to world marine transportation, to reduce transportation time up to 4 days comparing to regular main sea route passing Malacca Strait.

Landbridge project will reduce the congestion of the Strait of Malacca and it also helps to reduce the cost and time of cargo transport passing to the Strait of Malacca. The shipping route after the development of the Landbridge Project will result in Thai ports being on the main sea route or the main shipping route, which will be the new line of the world for large ships that connect Asia-Europe and Australia-Europe. Loading and discharge goods will be picked up at Ranong port, which will reduce costs and the time of cargo transport passing through the Malacca Strait. It can also be linked to GMS and inland by road and train

The Landbridge Project is a project to provide maritime transport connectivity between the Gulf of Thailand and the Andaman Sea via Ranong and Chumphon provinces. Thailand has developed a deep-sea port in Ranong Province as a container port. According to the policy, that has been designated as a trading gateway on the Andaman side of Thailand by being able to transport goods connecting the shipping route between Ranong Port and the port in the South Asian Countries, or BIMSTEC. Which is an economic cooperation framework that Thailand joins with six other countries: Bangladesh, Bhutan, India, Myanmar, Nepal, and Sri Lanka. By transporting goods through Ranong Port, it will be able to reduce the time and cost of transporting goods because they do not have to pass through the Strait of Malacca (Singapore).

The Landbridge Project consists of two deep seaports in the Gulf of Thailand and the Andaman Sea. The automatic port management system will be installed and used in order to reduce time and increase efficiency in container transshipment. Develop a land link, which consists of a motorway, railway, and land for pipeline connecting two ports. Moreover, develop commercial area, residential and industrial park such as goods distribution centers, oil tank farms, industrial estate, hotels, and office buildings. The project will not only develop infrastructure but also place Thailand as a transportation hub to enhance economic growth in the region. Linking trade in the region to other countries Indian Ocean and Pacific Ocean Regional Links link ASEAN, BIMSTEC, Gulf, EU, China, and APEC together. The concept of the Landbridge Project is One Port two sides consisting of the Andaman Coast port and the Gulf of Thailand Coast that can accommodate cargo volumes of 40 MTEUs. Cargo transport from two ports will be of 94.50 kilometers, comprising intercity motorway, railway, pipeline transportation and service roads. The route alignment includes at grade and elevated sections as well as tunnels.

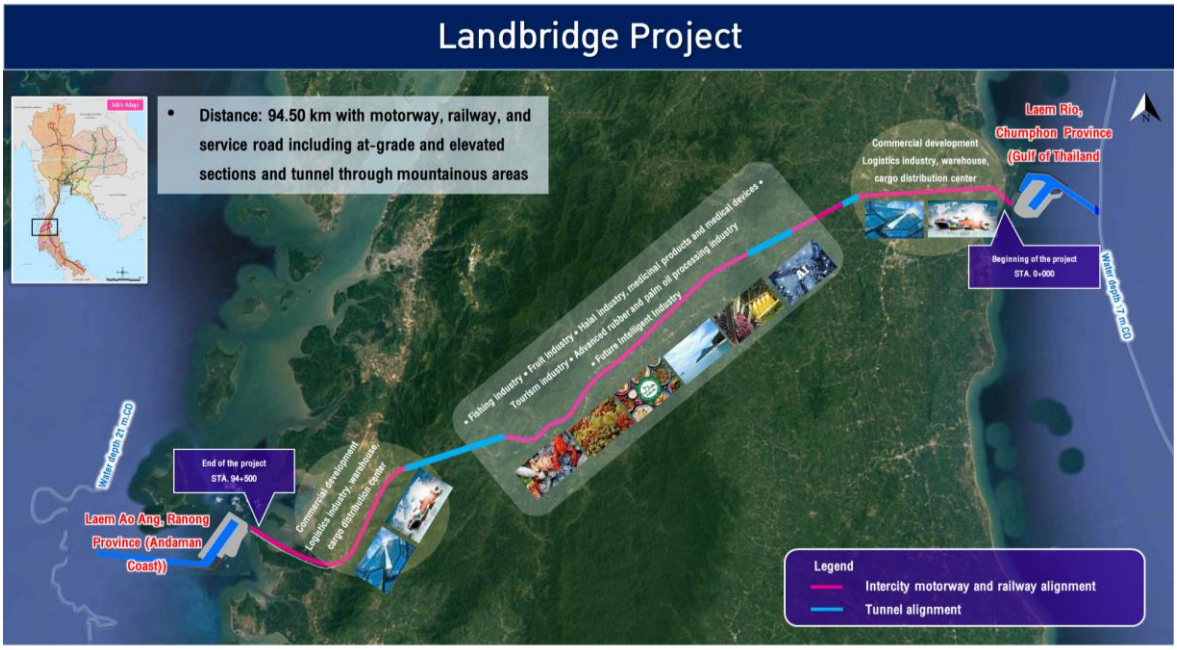


Figure 1-1 : Composition of the Landbridge

Chapter 2

The strategies for logistics system development to develop transportation linkage between Gulf of Thailand and Andaman Sea in the Southern Economic Corridor

2.1 Determination of the appropriate roles of port and goods types having opportunity to use the port of project

2.1.1 Landbrdige' roles of project

The determination of the appropriate role of port is intended to be used for considering the products and potential target groups of the project. Thailand is located in the "Indochina Peninsula", Southeast Asia region or ASEAN region. The southern region of Thailand is flanked by two the coasts whgich are the South China Sea (Gulf of Thailand) in the east coast as a part of the Pacific Ocean, and the western Andaman Sea as a part of the Indian Ocean. There is the Strait of Malacca that connects the Indian and Pacific Oceans. Moreover, Landbridge also positions itself to be the connection of trade lande as shown in **Figure 2-1** Therefore, the possible roles in the development of the port of the project are follows;

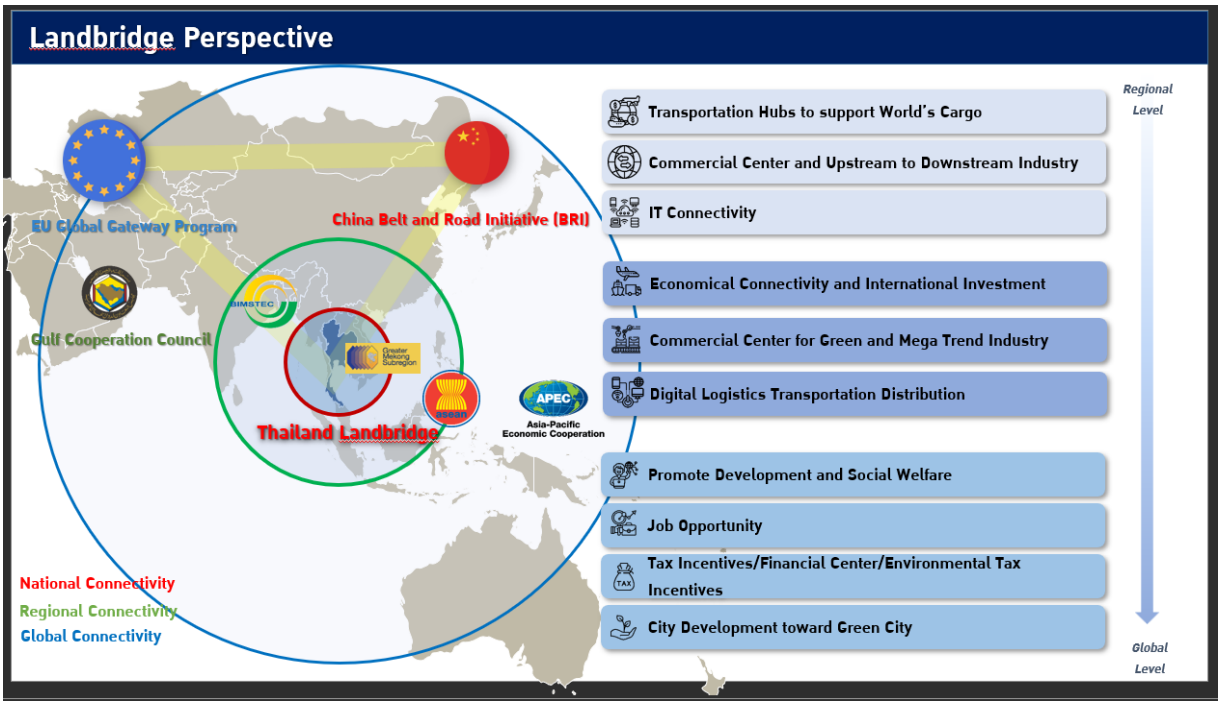


Figure 2-1 : Landbridge's Trade Lane Connectivity

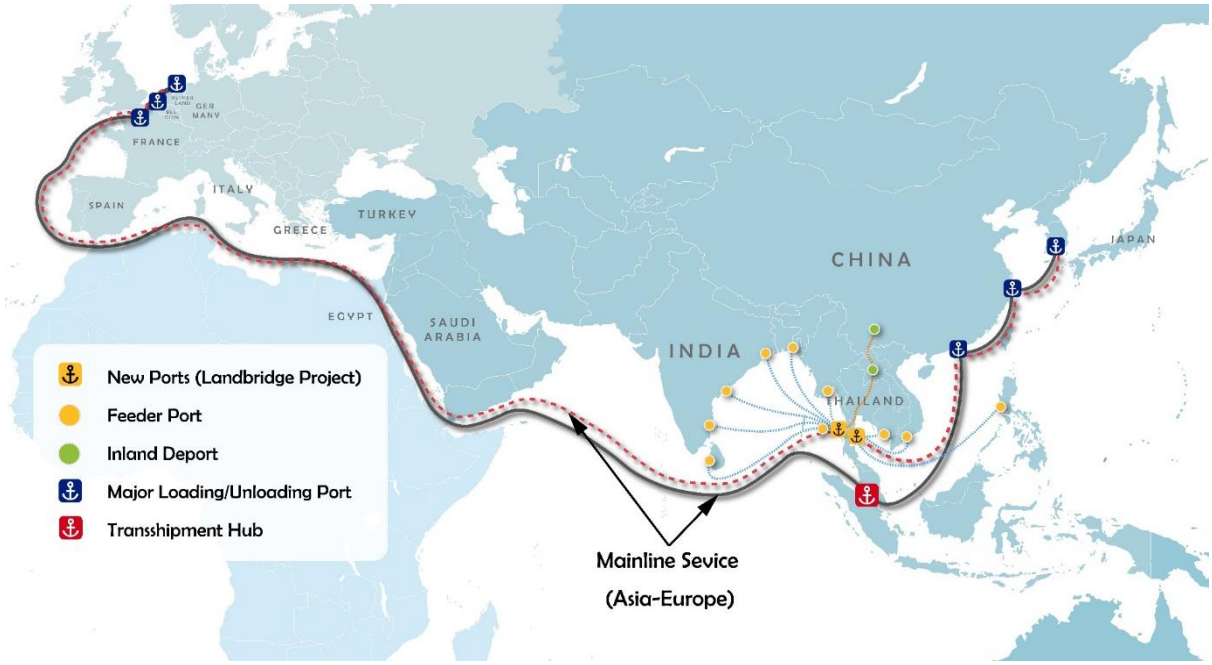
(1) Ports for Thailand's export and import According to export and import statistics of Thailand, it is indicated that the major trading partners are divided into two groups. The first group is the countries on the Indian Ocean including countries in South Asia, Middle East, Europe, and Africa region. The second group is countries on the Pacific Ocean including the countries in East Asia. Currently, the Laem Chabang Port and the Bangkok Port which are located in the upper area of the Gulf of Thailand become the main trading gateway for exports and imports. The transportation route between Thailand and the countries on Indian Ocean must be transported through the Straits of Malacca. It is because there is not west coast port.In addition, some of the southern-based products will be exported and imported via the Songkhla port. The rest will be transported via ports in Malaysia and Singapore. The details of each port's roles are as follows;

1.1) Ranong port is to support the exports and imports in each region of Thailand, and also support the countries along the Indian Ocean coast which are included the countries in South Asia, Middle East, Europe, and Africa. The exports and imports will be not passing through the the Strait of Malacca

1.2) Chumphon Port is to support exports and imports in each region of Thailand, and also support the countries in the Pacific Ocean coast which are included the countries in East Asia. It is especially for the products that are sourced and consumed in the south of Thailand.

(2) Ports for collecting and distributing products of the region or neighboring countries.

(3) Transshipment Port between the countries in the east coast (Pacific Ocean) and the west coast (Indian Ocean).



Source : Consultant

Figure 2-2 : Guideline for development and determining port roles for the project

2.1.2 Product types having opportunity to use the ports of project

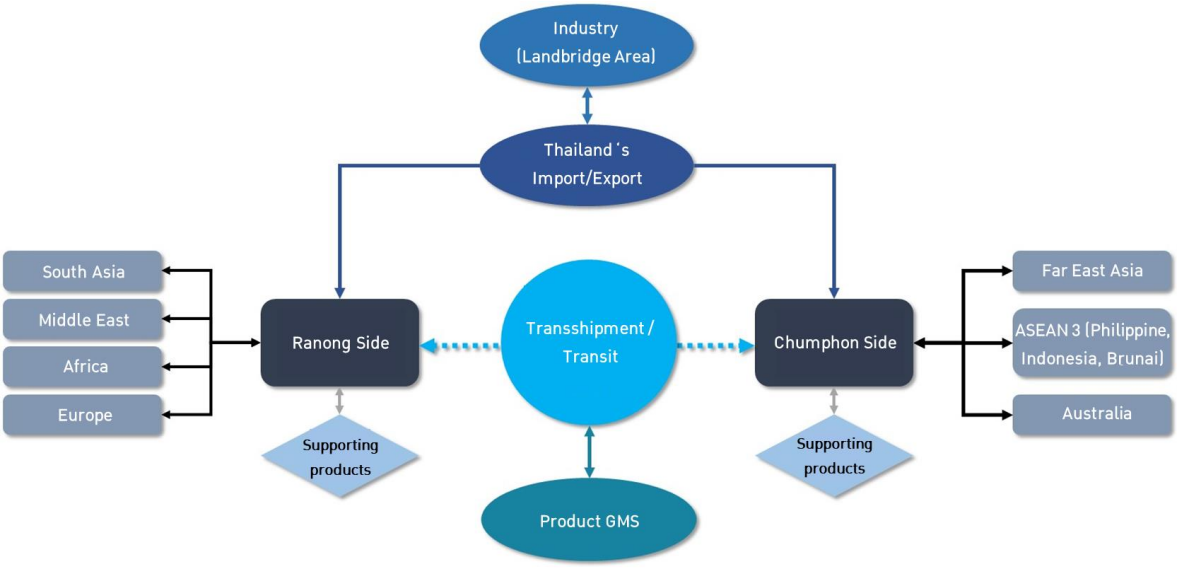
From the results of the development strategies analysis, and the guidelines for development and determining port roles for the project are indicated that Chumphon Port and Ranong ports will be served as the ports for Thaiand's export and import, as well as the regions/surrounding countries. These two ports also serve as Transshipment Port between the countries in the east (Pacific Ocean), and the west coast (Indian Ocean). The cargo types that are likely to use the port of project are follows;

(1) Thailand's export and import products: it is mainly transported through the Laem Chabang Port, especially for the routes with its origin/destination in South Asia, Middle East, Europe and Africa via the Strait of Malacca, or for the route with its origin/destination in East Asia, East part of ASEAN (Philippines, Indonesia, Brunei) and Australia.

(2) Transshipment and Transit products: it is currently transported via the Strait of Malacca. Products do not have an origin/destination in Thailand.

(3) Products from Landbridge's Industrial Estate Development such as Halal industry, Cold Chain industry: such products will be transported both for the routes with its origin/destination in South Asia, Middle East, Europe and Africa, and for the routes with its origina/destination in East Asia, East part of ASEAN (Philippines, Indonesia, Brunei) and Australia.

(4) Supporting products: it is such as Bunker Service Industry



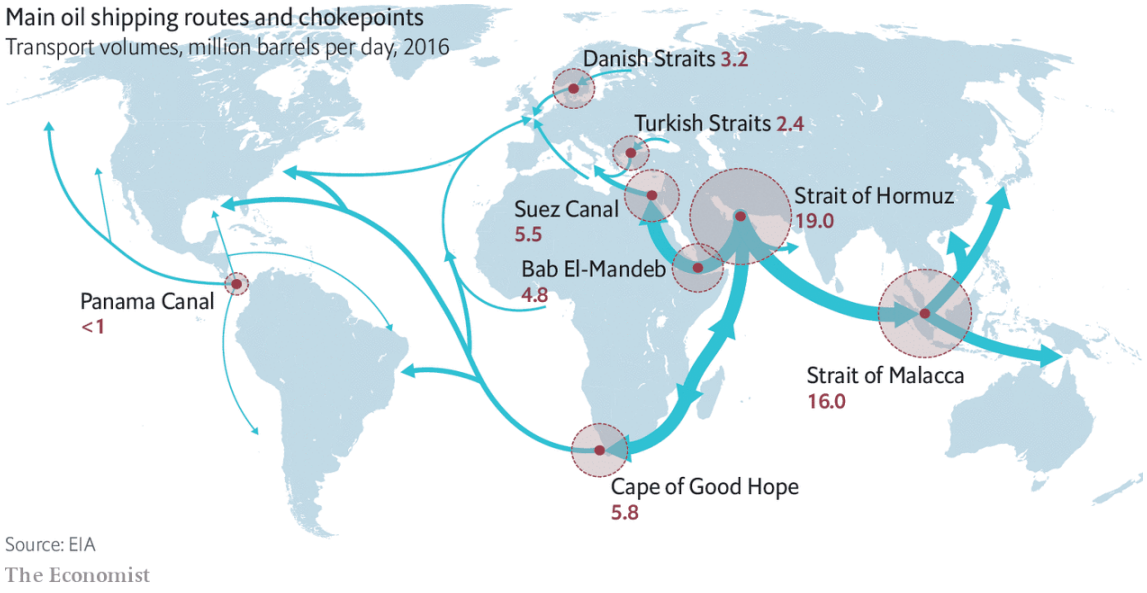
Source : Consultant

Figure 2-3 : Study scope of product types having opportunity to use the ports of project

From the above review, it can be draw conclusion that the Strait of Malacca has a significant cargo at ports (only the ports of Malaysia and Singapore) about 63.64 million TEUs. It has the tendency to increase the volume of shipments for 3.00% per year.

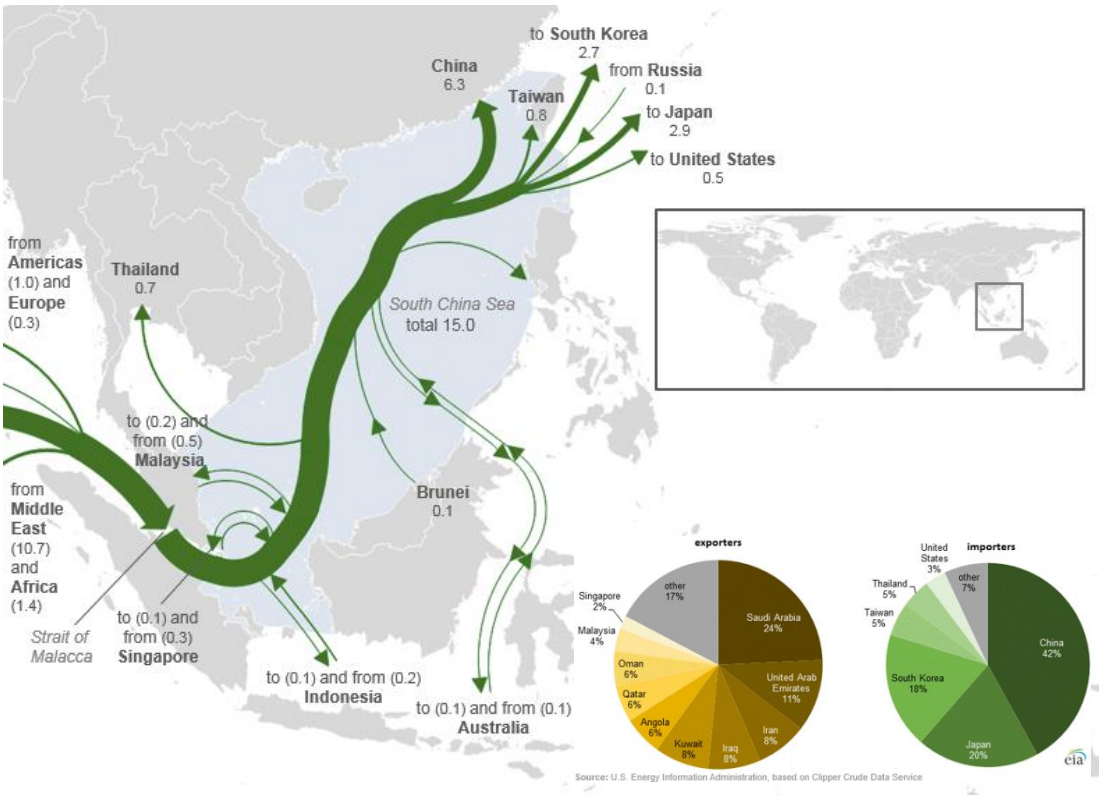
For the oil and petroleum products transportation as shown in **Figure 2-4**, it is indicated that, in 2016, oil transportation from the Strait of Hormuz in the Middle East

to the Strait of Malacca was approximately 16 millions barrels/day. Almost 80 percent of which is transported to the East Asian countries (Far East), including China, Japan and South Korea.



Source : U.S. Energy Information Administration (EIA)

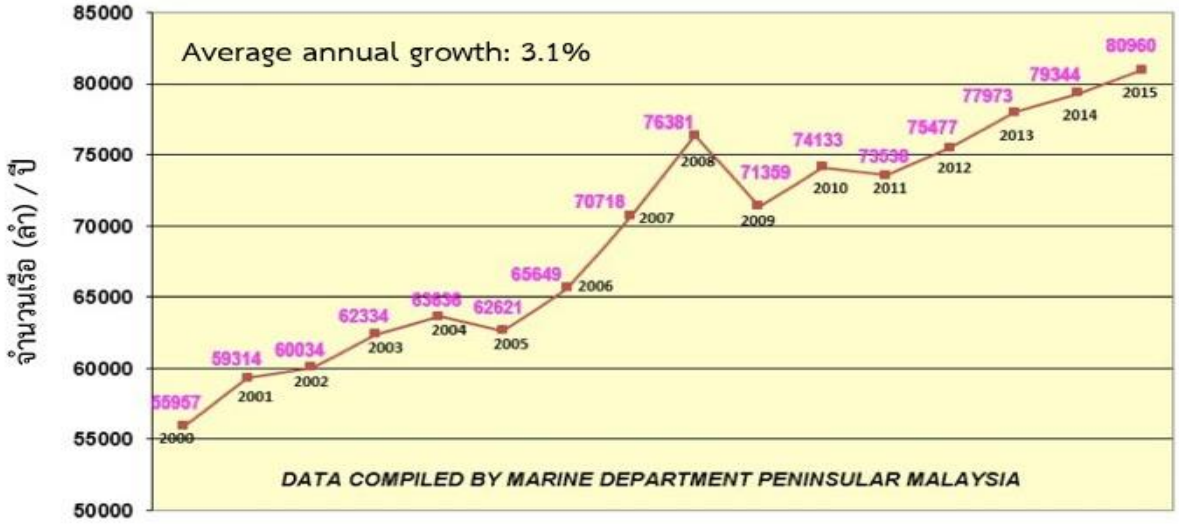
Figure 2-4 : Energy and petroleum transportation



Source : U.S. Energy Information Administration (EIA)

Figure 2-5 : Map of energy and petroleum products distribution

Regarding the number of ships passing through the Strait of Malacca, it indicates that the trend of cargo ships passing through the Strait of Malacca has increased every year due to the increase of international trade. It is expected that shipping via the Strait of Malacca may face more problems in the future, and it will require more time for shipping. The Strait of Malacca is expected to reach its full capacity by the year of 2030 (calculated by HM Ibrahim and Mansoureh Sh of the Maritime Institute of Malaysia - MIMA, the Strait of Malacca can accommodate about 122,640 ships per year). According to the study of United Nations, it predicts that number of ships passing through the Strait of Malacca will be increased by four times in 2050 compared to in 2000, as shown in the **Figure 2 -6** Moreover, World Bank forecasts that 122,500 ships will pass through the Strait of Malacca by 2025, which will reach the full capacity of the Strait of Malacca.



Source : Marine Department, Malaysia

Figure 2-6 : Statistics and forecasts on number of ships passing through the Strait of Malacca and Singapore

2.1.3 Data Collection and data review concerning transported cargo via the Straits of Malacca

From the review of global trade data, it turns out that APEC which comprises the group of countries in Pacific Ocean has the highest trade proportion in the world, followed by Europe and India, a group of countries in the Indian Ocean. Taking the value of exports and imports by country in the top 20 into account, it shows that the exports and imports proportion is more than 50% of the total value of the top 20. It could be said that the countries in the Far East, and Europe are the major and the large economies countries. Considering of geography, it is found that the countries in Far East are located in the east of Thailand (Pacific Ocean), while the European countries are located in the west of Thailand (Indian Ocean). If the cargos are transported between them by ships, it must pass through the Straits of Malacca. Thus, this study is emphasized the study of export and import condition (origin/destination) of Far East countries, especially China, South Korea, Japan, and ASEAN countries. The linking trade and product transportation of the Indian Ocean countries will be transported via the Strait of Malacca.

Table 2-1 : Top 30 highest average export products of China during the year 2016 - 2020, exporting to the countries in Indian Ocean

No.	HS CODE	Product	Average export volume between 2016 - 2020 (million tons)				
			South asia	Middle East	Europe	Africa	Total
1	HS85	Electrical equipment and parts	8.347	1.578	11.033	3.668	24.627
2	HS72	Iron and steel	4.797	4.942	4.753	4.998	19.491
3	HS27	Petroleum-derived fuels and oil-derived products	4.757	2.122	4.616	2.937	14.433
4	HS84	Machinery, mechanical appliances and its parts	2.454	1.931	6.459	1.979	12.824
5	HS73	Product made of iron or steel.	1.641	2.753	3.747	3.012	11.153
6	HS39	Plastics and products made of plastic	1.677	1.300	3.616	1.935	8.527
7	HS31	Fertilizer	6.700	0.377	0.577	0.797	8.451
8	HS69	Ceramic Products	1.292	1.894	1.346	2.643	7.175
9	HS29	Organic Chemicals	2.291	0.743	3.467	0.561	7.061
10	HS28	Inorganic Chemicals	2.192	1.253	1.651	1.896	6.991
11	HS25	Salt, sulfur, soil, rock, lime and cement.	2.494	0.495	1.498	1.754	6.240
12	HS95	Toys and sports equipment	1.647	0.436	2.673	0.347	5.103
13	HS94	Furniture	0.333	0.797	2.894	0.772	4.796
14	HS68	Products of stone, plaster, cement, asbestos, mica or similar materials.	0.469	1.080	2.460	0.547	4.557
15	HS96	Miscellaneous products	0.538	0.398	2.256	0.875	4.068
16	HS54	Artificial Long Fibers	0.932	0.483	1.165	1.424	4.004
17	HS44	Wood and wooden products	0.309	1.399	1.446	0.835	3.989
18	HS90	Optical equipment and devices	0.661	0.407	2.160	0.732	3.961
19	HS87	Vehicles, components and accessories	0.379	0.650	1.877	1.054	3.960
20	HS61	Knitted or crocheted clothing	0.230	0.554	2.304	0.756	3.844
21	HS70	Glass and glassware	0.723	0.695	1.268	0.855	3.540
22	HS40	Rubber and articles made of rubber	0.270	0.885	1.221	0.985	3.360
23	HS48	Paper and cardboard	0.774	0.890	1.075	0.485	3.224
24	HS38	Miscellaneous Chemicals	0.541	0.381	1.193	0.666	2.781
25	HS76	Aluminum and aluminum products	0.337	0.483	1.075	0.596	2.492
26	HS63	Textile	0.131	0.281	1.387	0.531	2.330
27	HS55	Artificial short fibers	0.734	0.276	0.480	0.660	2.150
28	HS60	Knitted or crocheted fabrics	0.753	0.274	0.381	0.494	1.902
29	HS26	Ore, dregs	0.512	1.156	0.064	0.146	1.879
30	HS62	Non-knitted or crocheted clothing	0.087	0.265	1.097	0.391	1.840
		No. 1 – 30 in total	**49.002**	**31.178**	**71.239**	**39.331**	**190.753**
		Others	**3.798**	**3.278**	**12.358**	**6.813**	**26.244**
		Total	**52.800**	**34.456**	**83.597**	**46.144**	**216.997**

Source : UN Comtrade

Taking the HS CODE, of Origin and Destination from all potential region, which are Asia Far East, ASEAN, South Aisa, Middle East, Africa, Europe, this includes landlock/hinterland countries. The example, as products with the top 30 highest export volume between Japan and the Indian Ocean countries by continent/region, or economic Cooperation, For the HS CODE category with the top 30 highest import volume between Japan and the Indian Ocean Countries by Continent/Region or Trade Partnership

In addition, the consultant has also studied the HS CODE products of top 30 highest export and import volume between Japan and APEC (countries in the Pacific Ocean). The counties that may change the transshipment in the Strait of Malacca are Vietnam, Indonesia, the Philippines, and Australia, as shown in **Table 2-2**

Table 2-2 : Example of Top 30 highest average export products of Japan during the year 2016 – 2020, exporting to the countries in Indian Ocean

No.	HS CODE	Product	Average export volume between 2016 - 2020 (million tons)				
			South asia	Middle East	Europe	Africa	Total
1	HS26	Ore, dregs	0.998	2.961	0.502	0.617	5.078
2	HS72	Iron and Steel	2.398	0.546	0.576	0.905	4.424
3	HS87	Vehicles, parts and accessories	0.200	0.771	1.686	0.326	2.984
4	HS84	Machinery, mechanical equipment and components	0.242	0.240	1.085	0.100	1.666
5	HS27	Petroleum-derived fuels and oil-derived products	0.513	0.035	0.621	0.057	1.225
6	HS25	Salt, sulfur, soil, rock, lime and cement	0.633	0.003	0.020	0.433	1.090
7	HS39	Plastics and products made of plastic	0.542	0.065	0.365	0.044	1.016
8	HS28	Inorganic Chemicals	0.803	0.040	0.052	0.057	0.953
9	HS89	Boats and floating structures	0.001	0.000	0.134	0.714	0.849
10	HS73	Products of iron or steel	0.116	0.385	0.213	0.057	0.772
11	HS40	Rubber and rubber products	0.068	0.169	0.357	0.085	0.679
12	HS29	Organic Chemicals	0.222	0.037	0.312	0.015	0.585
13	HS85	Electrical equipment and parts	0.038	0.039	0.208	0.013	0.298
14	HS48	Paper and cardboard	0.108	0.025	0.042	0.003	0.178
15	HS03	Fish and aquatic animals such as shrimp and crabs	0.002	0.000	0.015	0.116	0.133
16	HS38	Miscellaneous Chemicals	0.025	0.009	0.062	0.003	0.099
17	HS74	Copper and copper products	0.079	0.000	0.009	0.000	0.088
18	HS55	Artificial short fibers	0.010	0.011	0.026	0.025	0.072
19	HS34	Soap, organic surfactants	0.027	0.002	0.024	0.001	0.054
20	HS54	Artificial long fiber	0.010	0.006	0.023	0.004	0.043
21	HS15	Fats and oils from animals or plants	0.000	0.000	0.043	0.000	0.043
22	HS90	Optical equipment and devices	0.005	0.002	0.034	0.001	0.042
23	HS68	Products of stone, plaster, cement, asbestos, mica or similar materials	0.003	0.005	0.027	0.003	0.037
24	HS70	Glass and glassware	0.005	0.006	0.025	0.001	0.037

No.	HS CODE	Product	Average export volume between 2016 - 2020 (million tons)				
			South asia	Middle East	Europe	Africa	Total
25	HS32	Tanning or dyeing extracts	0.008	0.001	0.021	0.003	0.033
26	HS96	Miscellaneous products	0.002	0.003	0.028	0.000	0.033
27	HS21	Miscellaneous edible preparations	0.000	0.002	0.026	0.000	0.029
28	HS76	Aluminum and aluminum products	0.009	0.005	0.012	0.001	0.027
29	HS37	Items used for photography or filming	0.003	0.003	0.019	0.001	0.026
30	HS22	drinks, alcohol	0.000	0.011	0.014	0.000	0.026
		No. 1 – 30 in total	**7.07**	**5.382**	**6.581**	**3.585**	**22.619**
		Others	**0.078**	**0.022**	**0.154**	**0.034**	**0.288**
		Total	**7.148**	**5.404**	**6.735**	**3.619**	**22.907**

Source : UN Comtrade

2.2 Summary of types of goods and volume of demand for international goods transported through the Strait of Malacca

From the review mentioned above, it can be concluded that in the year 2021, there will be cargo via the Strait of Malacca at the major ports which are included Port of Singapore, Port Klang, Port Tanjung Pelepas, Penang Port, Tanju Port. The cargo volume is approximately 70.39 million TEUs, with the tendency for increasing of volume by 3.27 % per year. If taking only the shipment through the ports of Singapore and Malaysia, there will be a volume about 63.64 million TEUs, with the tendency for increasing of volume by 3.00 % per year. Thus, the tendency of cargo volume passing through the Strait of Malacca will be increased every year. According to the World Bank's forecast, the Strait of Malacca will accommodate the 122,500 ships by 2025, and it will reach the full capacity of this Strait.

For the product types transported via the Strait of Malacca, the consultant has grouped the large volumes of cargoes that are transported via the Strait of Malacca. It can be divided into 4 groups: agricultural products, Raw Materials, Oils, and Manufacturing Products.

Source : Analysis by consultant

Figure 2-7 : Summary of cargo types and demand for international cargoes passing through the Strait of Malacca

2.2.1 Forecast of international freight demand that is likely to be used in the project

1) Original – Destination Point

The consultant applies the principle of original-destination or OD to match the countries that have opportunity to use the Port of Landbridge Project. The matching criteria is made by the countries that have OD as trade partners and it is currently pass through the Strait of Malacca, as shown in the **Figure 2-8** It then considers the reference products according to UN Comtrade (UNCTAD)'s HS Code to be paired in the form of O - D Matrix table for each country / product transported by Container. The O-D pair also considers the opportunity to use the port in Ranong province only, or the port in Chumphon province only, or both, as shown in the **Figure 2-9** The average cargo volume for each O - D pair is shown in the **Figure 2-10** to **Figure 2-12**

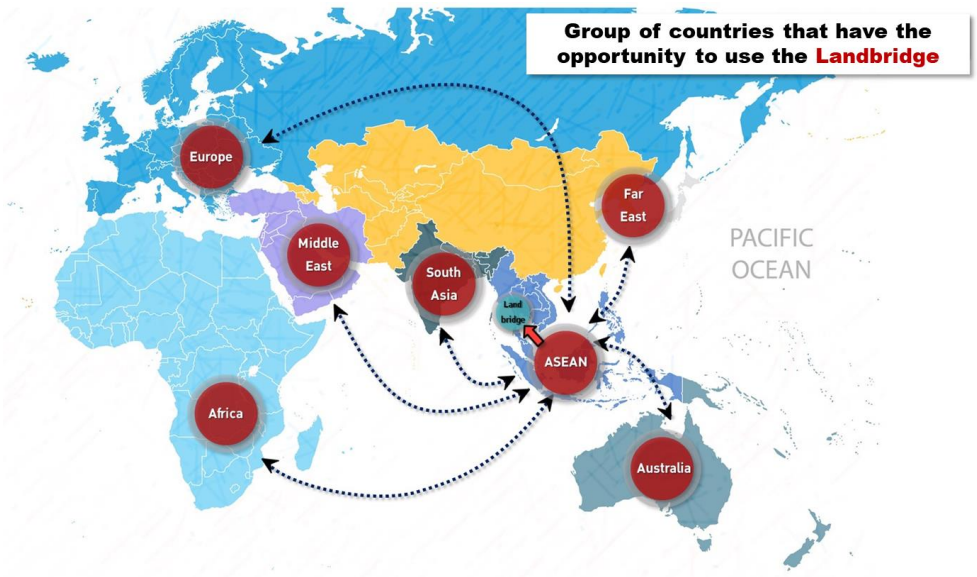
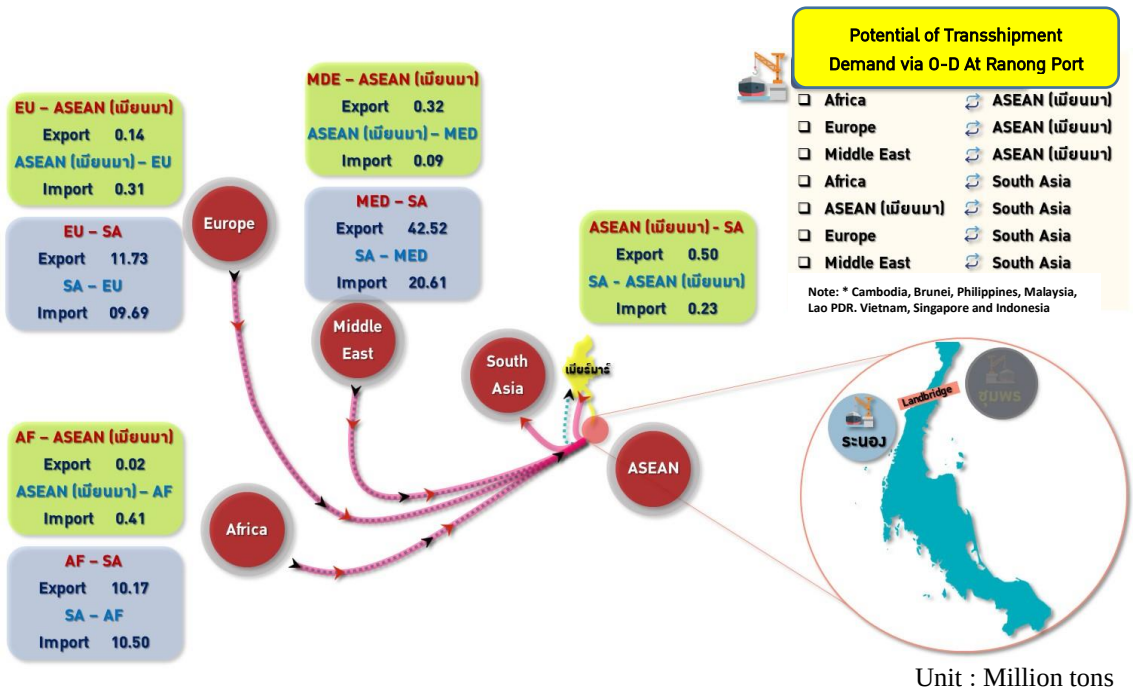


Figure 2-8 : Assumptions analysis based on Original – Destination principles

Figure 2-9 : Assumption of countries having opportunity to use the port of Project LB classified by the ports in Ranong and Chumphon province



Unit : Million tons

Figure 2-10 : Average transport volume for each O - D pair of Ranong port

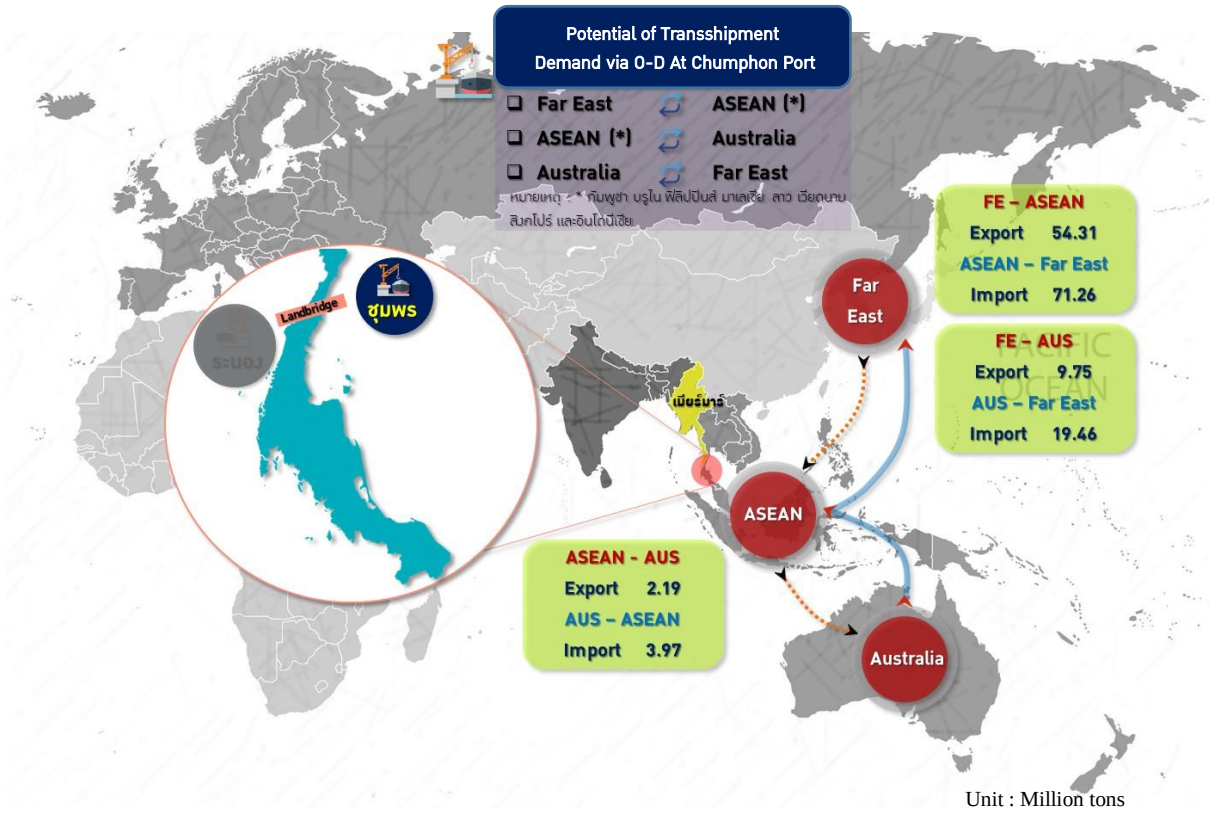


Figure 2-11 : Average transport volume for each O - D pair of Chumphon port

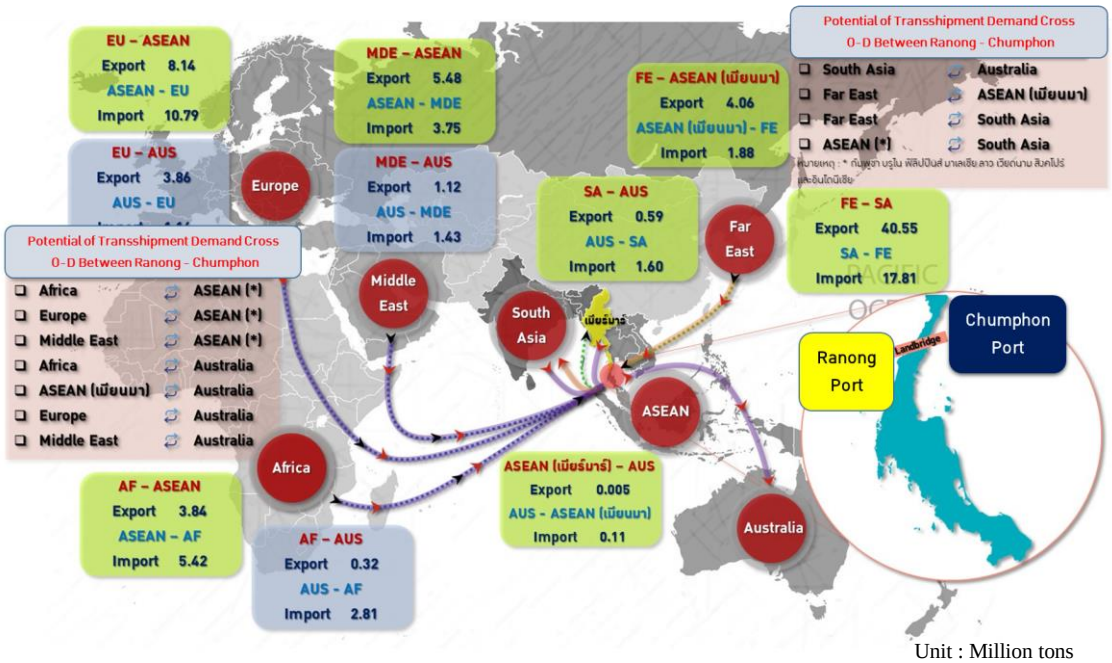
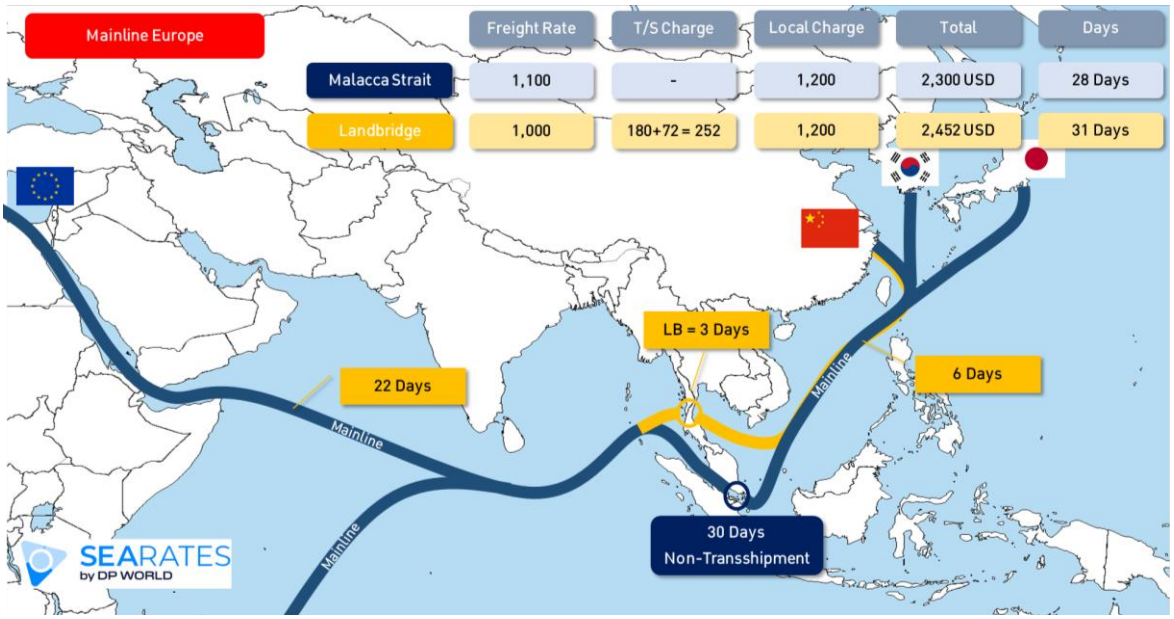


Figure 2-12 : Average transport volume for each O - D pair of Ranong port - Chumphon port

2.2.2 Comparison of time and cost of international shipping

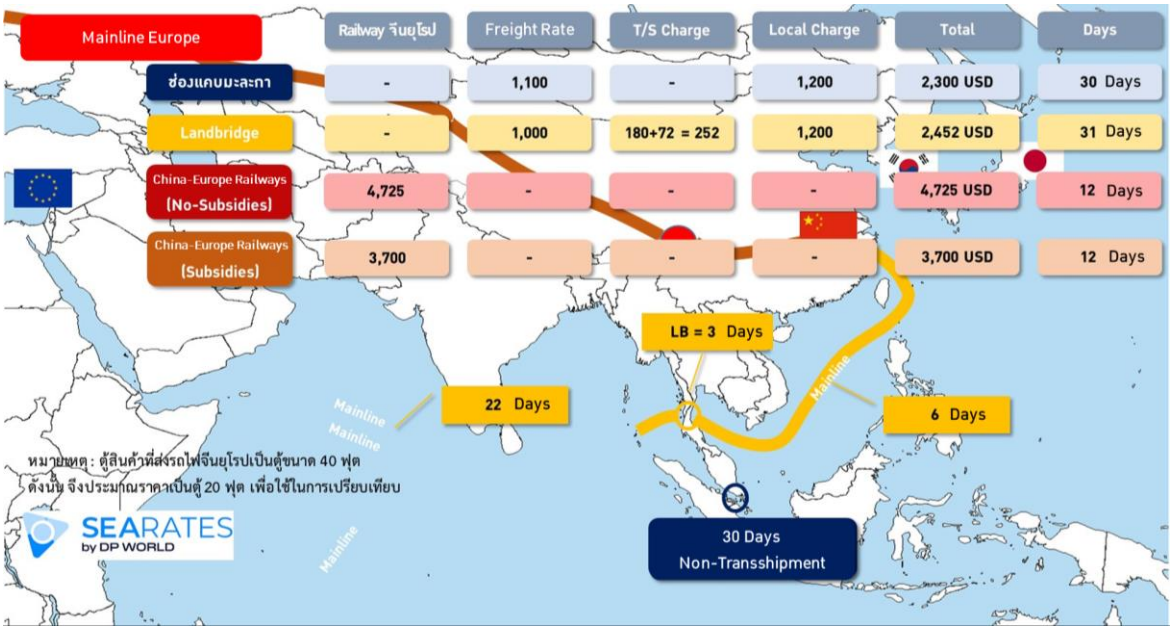
Cost of freight is a utility which is an important factor for carrier or cargo owner to choose the route or transport type. It can be divided into two main groups : Moving Cost and Handling Cost. These two costs are directly related to the cargo volume, distance, and number of transit. In addition to considering the Transit cost, it must also consider the Transit time.

The consultant compared the Time and the Transit cost transporting through Ranong/Chumphon Deep Sea Port , and transporting through the Straits of Malacca, as shown in the **Figure 2-13** to **Figure 2-14**



Source : Analysis by consultant

Figure 2-13 : Comparison of costs and time of products transport via the Project and the Strait of Malacca, in case of no transshipment (Direct) between Far East - Europe



Source : Analysis by consultant

Figure 2-14 : Comparison of cost and time of products transport via the project, the Strait of Malacca, and China European Railways, in case of no transshipment between China – Europe

The consultant has compared the cost and time of transporting products through the project and the Straits of Malacca. It is divided into 2 cases, namely Direct transportation, and Transshipment transportation. For Direct transportation, it is transported via the Landbridge Project, and it has higher costs than transportation via the Strait of Malacca. It is dued to the redundant loading and Transshipment Cost (T/S) that is loading the container from the ship at one port to the ship at another port. However, China-Europe train transportation is the most costly, it is the most time-saving. In the case of Transshipment, transportation via the Landbridge Project will be cheaper than transportation via the Strait of Malacca. The difference rate of expenses depends on the point of origin and destination of transportation, as follows;

- Route between Far East (FE) and BIMSTEC, if it is transported via the Landbridge project port, it will be cheaper about 63 USD/TEU or 5%.
- Route between ASEAN and Europe, if it is transported via the Landbridge project port it will be cheaper about 31 USD/TEU cheaper, or 3%.
- Route between ASEAN and BIMSTEC, if it is transported via the Landbridge project port, it will be cheaper about 237 USD/TEU or 10%.

2.3 Summary of forecasted cargo volume having the opportunity to use the project

2.3.1 Summary of forecasted cargo volume passing through the Landbridge Project

From data collection on product types, product quantities, origin-destination points according to the HS Code, and comparisons of duration and cost of international transportation of products, the consultants therefore use Original – Destination Principle, and HS Code of UN Comtrade (UNCTAD) to be matched into O–D Matrix table for each country/product transported by container as shown in the No.3. Furthermore, there is data analysis on the possibility of goods between countries in the APEC such as China, the Philippines, Australia, Indonesia, etc., which are located on the Pacific Ocean (East of Thailand). There is also data analysis on the possibility of goods for South Asia, Middle East, Europe and Africa which are located along the Indian Ocean. (West of Thailand). Those mentioned countries and regions have traded one another across Indian Ocean and Pacific Ocean. The future targeted products that have opportunity to transport through the Ranong-Chumphon Deep Sea Port can be divided into 2 main groups. The first group is **(1) Thailand's exports and imports, including the post-port cargoes**. The goods quantity passing through Ranong port is higher comparing in the term of duration and cost. In the event that the ship frequency is the same as the country's main port, it will have an advantage in goods transportation because time and total cost will be reduced due to not passing through the Strait of Malacca. For Chumphon Port, it will be an option for entrepreneurs, especially in the SEC area and the South, to use as a port for collecting and distributing preducts from countries in Pacific Ocean without transfering the ships at the Strait of Malacca, or transporting from Laem Chabang port. This option can help entrepreneurs to save the cost of transportation. However, Chumphon Port will have more cargo, if there is some transshipment of cargo, utilization of space onboard, and frequency of ships entering the port. The Second group is **(2) Transshipment/Transit product between countries on the Indian Ocean and Pacific Ocean.** There is an assumption that Transshipment/Transit goods are transshipped at the Strait of Malacca in order to be forwarded to countries located along the Indian Ocean or west coast of Thailand, which are including countries in South Asia, Middle East, Africa, Europe. Most products will come from countries in East Asia, ASEAN, Australia. From the above review and assumptions, it can be summarized goods quantity, and empty containers quantity that have opportunity to use in the project, as shown in **Table 2-3**

Table 2-3 : Forecasted Results of total cargo volume having opportunity to use the project port

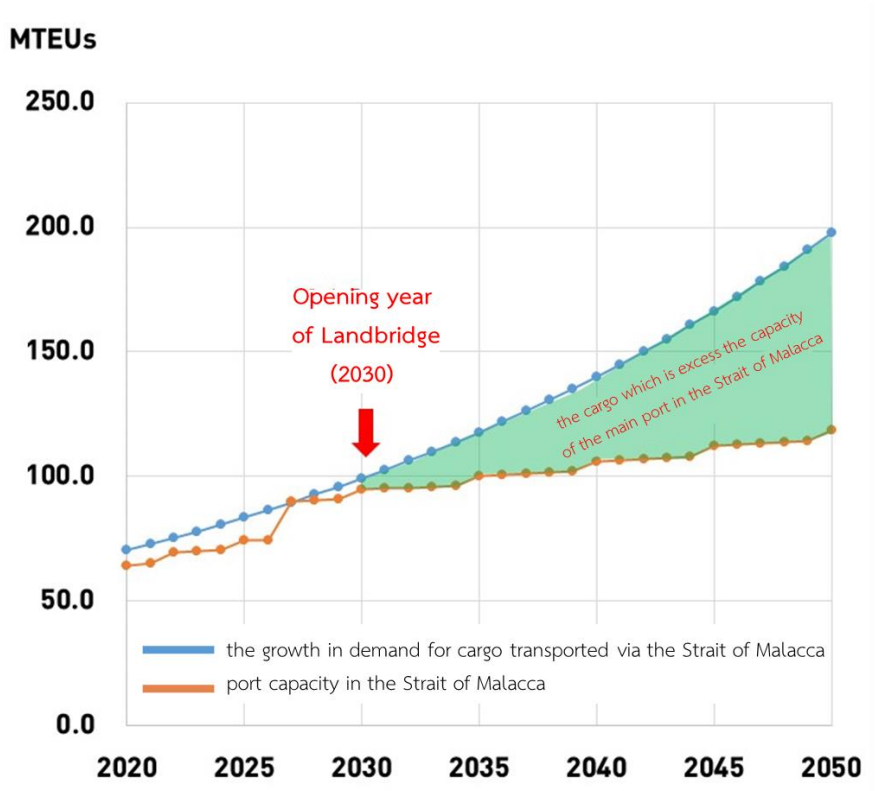
Year	Case 1 : Base case growth rate			Case 2 : High side growth rate		
	Ranong (million TEUs)	Chumphon (million TEUs)	Total (million TEUs)	Ranong (million TEUs)	Chumphon (million TEUs)	Total (million TEUs)
2030	026	0.18	0.44	0.73	0.52	1.20
2039	3.47	2.47	5.94	9.58	6.82	16.40
2049	7.18	5.11	12.29	18.48	13.15	31.63
2059	11.64	8.28	19.92	25.37	18.05	43.42
2069	19.40	13.80	33.20	30.93	22.01	52.94
2079	29.57	21.09	50.66	35.89	25.54	61.43

Source : Analysis by consultant

2.3.2 Opportunities for cargo volume and ports capacity in the Strait of Malacca

From summary of the study in **No. 2.3.1**, the consultant presents some recommendations to increase amount of goods transported via the Landbridge Project. The recommendations are based on the assumption of future growth rate of goods which are transported via the Strait of Malacca, and it based on the full capacity of port along the Strait of Malacca, as shown in **Figure 2-15**

The blue line shows the growth in demand for cargo transported via the Strait of Malacca. The current growth rate is about 3.0%, while the orange line shows port capacity in the Strait of Malacca, including Port of Singapore, Port Tanjung Pelepas, and Port Klang. Those data is from port development plan review.



Source : Analysis by consultant

Figure 2-15 : Comparison between the increasing cargo passing through the Strait of Malacca and the port development plan in the Strait of Malacca

From **Figure 2-15**, the analysis results show that there will be a cargo volume, in the year 2030, exceeding the capacity of the ports in the Strait of Malacca. This is an opportunity for the Port of Landbridge Project to support the cargo which is excess the capacity of the main port in the Strait of Malacca (green area).

Chapter 3
Conceptual Design of Landbridge Port

Transport Infrastructure Development under Southern Economic Corridor Development for Transport Connectivity between the Gulf of Thailand and the Andaman Sea Project (Landbridge Project) is a project to develop transportation infrastructure, including ports, roads and railways to connect transportation between the Gulf of Thailand and Andaman in the Southern Economic Corridor area. The concept of the project is "One Port Two Side" to connected Indian Ocean and Pacific Ocean, one of the port in Chumphon Province, Gulf of Thailand and one port in Ranong Province, Andaman.

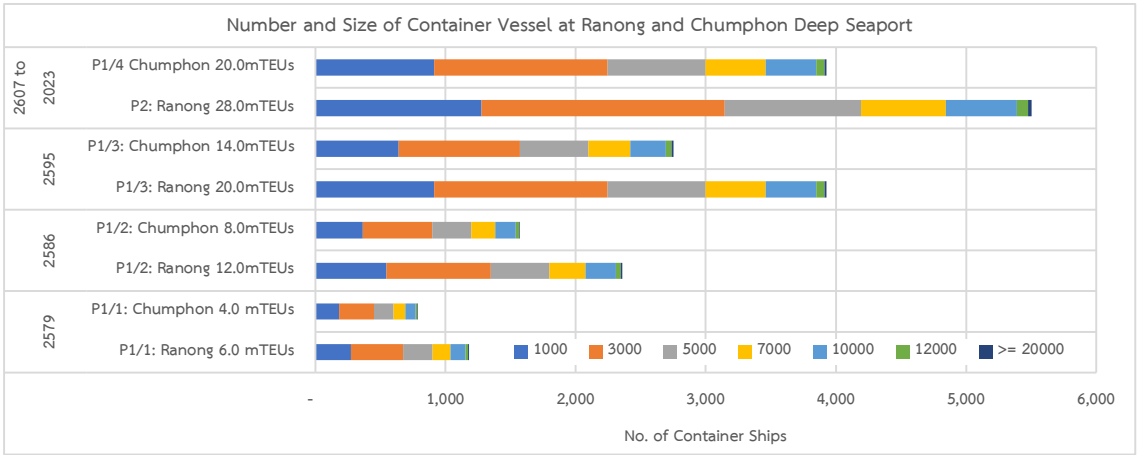
3.1 Port Capacity

Goal of port capacity of Ranong port and Chumphon Port in phase 1 has a capacity for each side of 20 million TEUS. Following the cargo throughput forecasting study with Case 2, high growth rate (High Side) base on Qiang Meng (2016) Impact Analysis of Mega Vessels on Container Terminal Operations[1], In 2024, Phase 1/1, the number of vessels calls both of Ranong port and Chumphon port approximately 1,179 and 786 vessels per year, respectively.

When the capacity of Phase 1 of both Ranong port (P1/3) and Chumphon port (P1/4) is full, the throughput will be 20 million TEUs in 2052 and 2064, respectively and the number of vessels calls will be approximately 3,927 vessels per year. **Figure 3-1** are shown the number of vessels calls all over the concession Phase1 period and the future expansion of Phase 2.

The largest-sized cargo vessels of Landbridge port can handle is Ultra Large Container Ship (ULCS), Currently, in 2022, it has been found that the ship EVER A LOT of the Evergreen, Chinese-Taiwan shipping company, sizing 400 meter long x 61 meter wide x 17 meter draft that is the size of container ships found today but the container vessels tend to be larger.

[1] Menga et al., "Impact Analysis of Mega Vessels on Container Terminal Operations", Transportation Research Procedia 25, (2017), pp. 187–204.



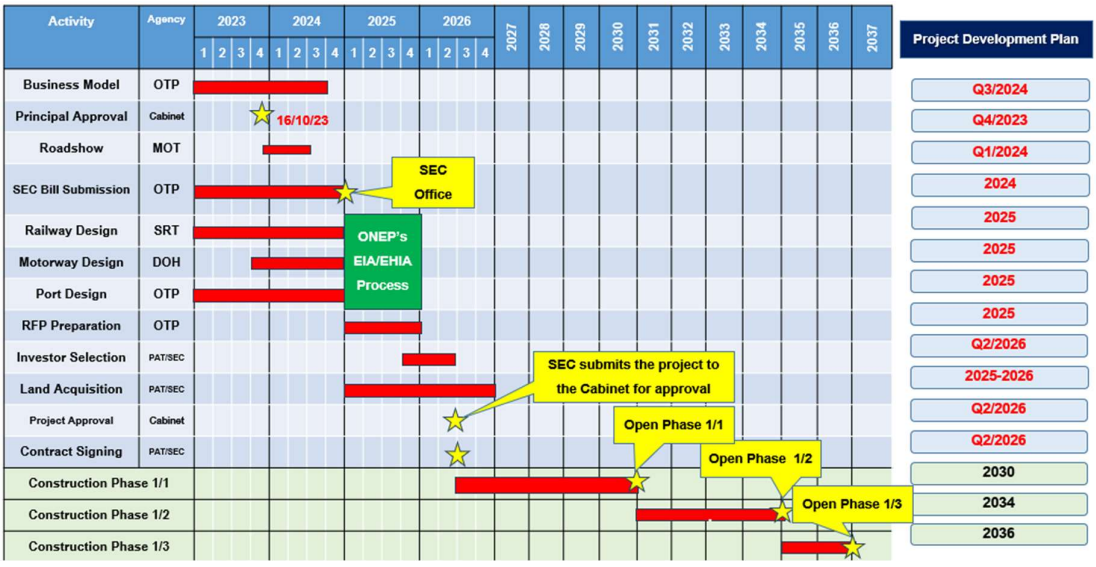
Source : Estimate by consultant

Figure 3-1 : Number of Vessel Calls at Landbridge Port

3.2 Landbridge Port Development Plan

The project development plan with assumptions in the form of a public -private joint venture (PPP). The port construction period takes 5 years, with construction starting in 2026 and operation starting in the end of 2030. The project development plan as shown in **Table 3-1**. And for the port development in the next phases P1/2 and P1/3 are in accordance with forecast the cargo throughput as shown in **Figure 3-2**.

Table 3-1: The Project Development Plan



3.3 Port Components

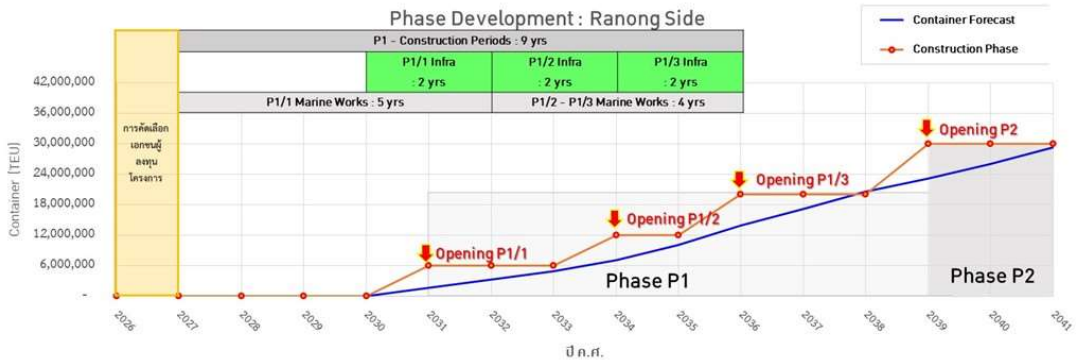
Following the cargo throughput forecast study in Case2, the throughput have been arranged to be consistent with development of the port with phasing for support the increase of throughput all over 50 years of the port's operation. The details are as follows.

(1) Ranong Port

From the port development plan, the master plan of Ranong port, Phase 1 for capable of handling containers 20 million TEUs as shown in **Figure 3-3**. The sequence of development has the following details:

Phase P1/1 (Case 2 : Operation starting in 2030 – 2033)

In the first phase of port's development is dredging of navigation channel and berthing basin with reclamation for port's area of phase 1. In the Phase P1/1, the length of port is 2,550 meter with a crane will be installed along the apron area. The container yard is 2,550 meters long, breakwater 4,800 meters long and port bridge 4,500 meters long. The capacity for loading and unloading is 6 million TEUs.



(1)

(2)

Figure 3-2 : Port development period compared to throughput in case 2 for supporting excess throughput of full capacity of ports in the Malacca Strait (1) Ranong Port (2) Chumphon Port

Phase P1/2 (Case 2: Operation starting in 2034 – 2035)

As throughput approaches the capacity of P1/1 (6 million TEUs) that expected in 2035, construction of port expansion will be required in advance by carried out over a period of 5 years for operation starting in 2036. In this phase, the construction consists of additional 2,550 meter long container yard with equipment for loading and unloading 12 million TEUs. For reclamation and construction of apron area are finished in Phase P1/1 development stage.

Phase P1/3 (Case 2: Operation starting in 2036 – 2038)

In this Phase, construction additional apron to increase the length from P1/2 by 3,400 meter for increasing throughput 8 million TEUs. There will be a container yard with total length of 8.5 kilometers for capable of handling containers 20 million TEUs.

Phase 2

In case of the throughput increases beyond the Port Capacity, the next phase of development of the Ranong port in Phase 2 can still be expanded in the future expansion area with additional dredging and reclamation for area in Phase 2 including extend the breakwater for 2,500 meters and increase the width of the port bridge for support increase traffic and the maximum port capacity become 40 million TEUs.

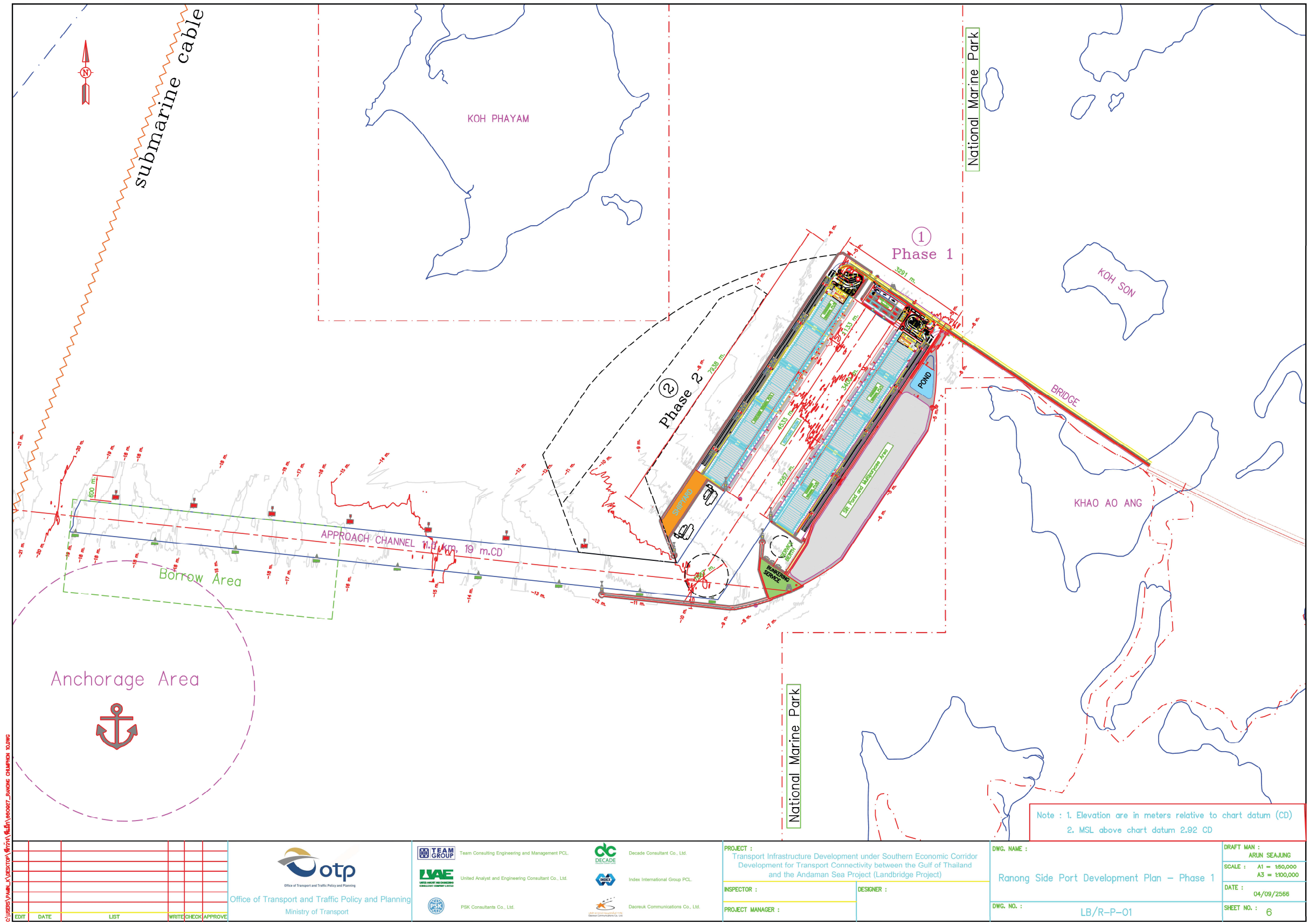


Figure 3-3 : Master Plan of Ranong Port for capable of handling containers 20 million TEUs in Phase 1

(2) Chumphon Port

From the port development plan, the master plan of Chumphon port, Phase 1 for capable of handling containers 20 million TEUs as shown in **Figure 3-4**. The sequence of development has the following details:

Phase P1/1 (Case 2: Operation starting in 2030 – 2033)

In the first phase of port's development is dredging of navigation channel and berthing basin with reclamation for port's area of phase 1. In the Phase P1/1, the length of port is 1,700 meter with a crane will be installed along the apron area. The container yard is 1,700 meters long, breakwater 4,800 meters long and port bridge 2,600 meters long. The capacity for loading and unloading is 4 million TEUs.

Phase P1/2 (Case 2: Operation starting in 2034 – 2035)

As throughput approaches the capacity of P1/1 (4 million TEUs) that expected in 2035, construction of port expansion will be required in advance by carried out over a period of 5 years for operation starting in 2036. In this phase, the construction consists of additional 1,700 meter long container yard with equipment for loading and unloading 8 million TEUs. For reclamation and construction of apron area are finished in Phase P1/1 development stage.

Phase P1/3 (Case 2: Operation starting in 2036 – 2038)

As throughput approaches the capacity of P1/2 (8 million TEUs) that expected in 2040, construction of port expansion will be required in advance by carried out over a period of 11 years for operation starting in 2041. In this phase, the construction consists of additional 2,550 meter long container yard with equipment for loading and unloading 14 million TEUs.

Phase P1/4 (Case 2: Operation starting in 2039 – 2079)

In this Phase, construction additional apron to increase the length from P1/3 by 2,550 meter for increasing throughput 6 million TEUs. Total capable of handling containers 20 million TEUs.

Phase 2

In case of the throughput increases beyond the Port Capacity, the next phase of development of the Ranong port in Phase 2 can still be expanded in the future expansion area with additional dredging and reclamation for area in Phase 2 including extend the breakwater for 1,600 meters and increase the width of the port bridge for support increase traffic and the maximum port capacity become 40 million TEUs.

3.4 Estimation of Costs of Port Development

Construction cost estimation is a very important issue for financial analysis. The preliminary cost is not only to find a budget but is also the main point for setting suitable investment values. Preliminary cost estimate includes:

- Operation costs and profits are 15% of the construction cost
- Contingencies are 10% of the construction cost

Preliminary cost of the project for Case 2 as shown in **Table 3-2** and **Table 3-3**. The investment cost of Ranong port is approximately 450,465 million baht and Chumphon port is approximately 422,989 million baht.

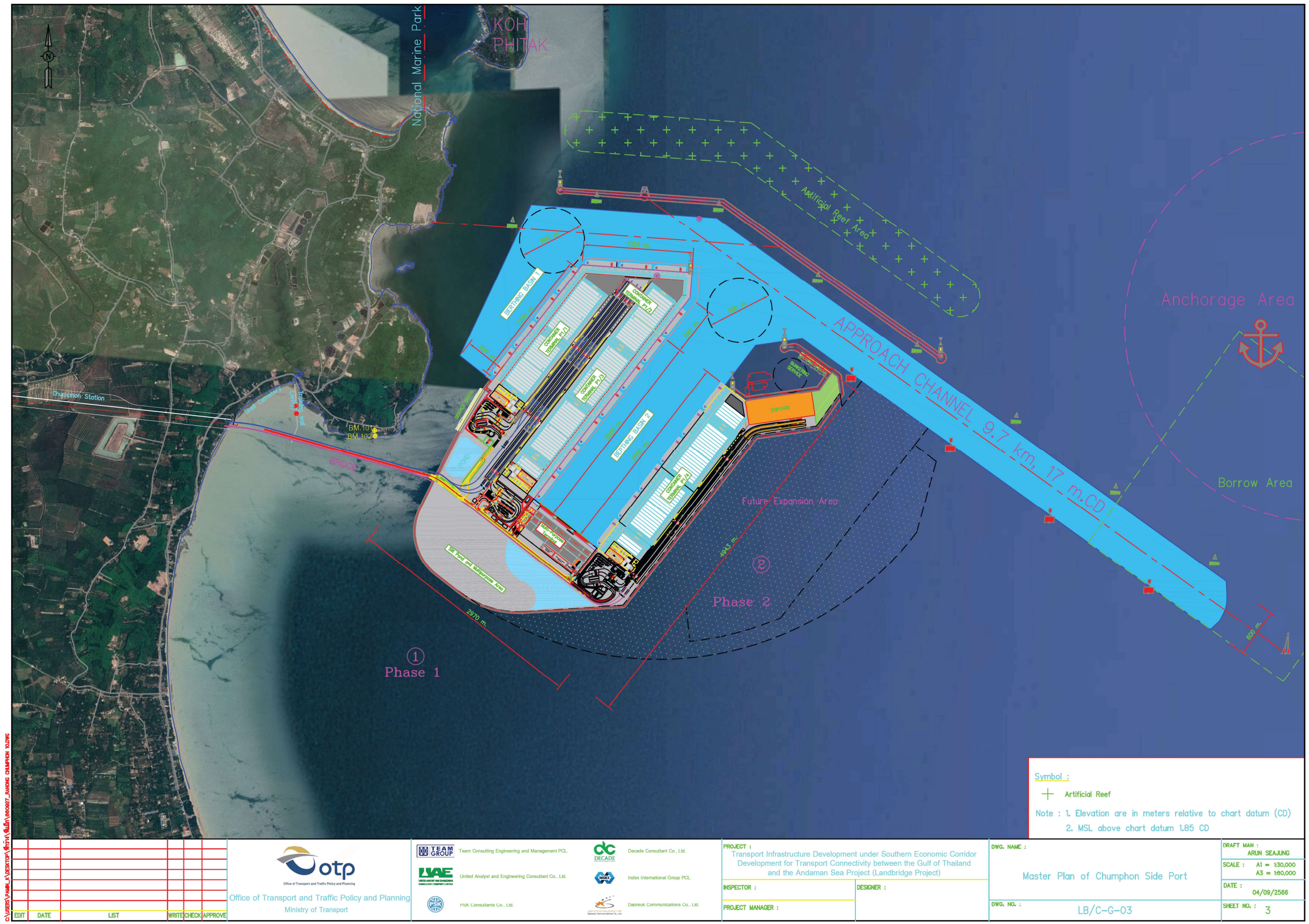


Figure 3-4 : Master Plan of Chumphon Port for capable of handling containers 20 million TEUs in Phase 1

Table 3-2 : Preliminary cost of Ranong Port

Ranong Port					
Item	**Description**	**Phase 1/1**	**Phase 1/2**	**Phase 1/3**	**Total**
A	**Pre-Construction Works**	3,466.69	1,742.09	2,833.57	8,042.36
B	**Civil Works**	83,992.98	24,494.21	48,653.20	157,140.39
B1	Design and Preliminary Works	4,302.98	1,517.61	3,014.44	8,835.03
B2	Marine Works	65,585.19	5,812.90	17,033.80	88,431.89
B3	Port Infrastructure & Utilities	11,442.44	17,163.70	28,604.96	57,211.10
B4	Navigation Aids	2,662.36	0.00	0.00	2,662.36
C	**M&E Works**	32,153.58	32,153.58	44,340.38	108,647.54
D	**Environmental Measures**	11,037.60	9,270.37	11,121.54	31,429.50
E	**Contingencies 10%**	11,065.17	5,504.54	8,981.07	25,550.77
Estimated total initial cost (Include VAT)		141,716.01	73,164.78	115,929.76	**330,810.56**
F	**Operation & Management**	41,866.09	8,101.43	12,640.07	62,607.59
Area for Single Rail Transfer Operator (SRTO)					
Item	**Description**	**Phase 1/1**	**Phase 1/2**	**Phase 1/3**	**Total**
	SRTO	22,779.11	13,454.00	18,472.52	54,705.63

Table 3-3 : Preliminary cost of Chumphon Port

Chumphon Port						
Item	**Description**	**Phase 1/1**	**Phase 1/2**	**Phase 1/3**	**Phase 1/4**	**Total**
A	**Pre-Construction Works**	3,016.27	1,183.57	1,830.38	1,753.30	7,783.52
B	**Civil Works**	80,022.75	17,489.89	24,852.35	26,438.46	148,803.44
B1	Design and Preliminary Works	4,510.32	1,083.63	1,539.80	1,638.06	8,771.80
B2	Marine Works	62,460.63	5,068.19	6,098.28	7,692.09	81,319.20
B3	Port Infrastructure & Utilities	11,414.79	11,338.06	17,214.27	17,108.30	57,075.43
B4	Navigation Aids	1,637.01	0.00	0.00	0.00	1,637.01
C	**M&E Works**	21,705.68	21,078.83	34,580.01	30,746.34	108,110.86
D	**Environmental Measures**	4,125.47	2,150.01	6,178.60	3,796.61	16,250.69
E	**Contingencies 10%**	9,649.33	3,742.45	5,780.65	5,545.52	24,717.95
Estimated total initial cost (Include VAT)		118,519.50	45,644.75	73,221.99	68,280.22	**305,666.44**
F	**Operation & Management**	36,804.79	5,296.62	8,058.38	7,740.97	57,900.76
Area for Single Rail Transfer Operator (SRTO)						
Item	**Description**	**Phase 1/1**	**Phase 1/2**	**Phase 1/3**	**Phase 1/4**	**Total**
	SRTO	38,113.45	10,498.30	20,888.52	16,897.57	86,397.84

Chapter 4
Conceptual Design of Landlink

4.1 Engineering Suitability Study

The consultant has studied and created a concept model of the transportation link between the Gulf of Thailand and the Andaman. To develop the Southern Economic Corridor Development Project, various alternatives were prepared, and the most suitable alternative route was selected to be used for conceptual design. The elements of the Landlink include :

- The motorway is for connecting and transporting containers between both sides of the sea. In addition, there are connections to the highway network in the southern region of Thailand.
- The railway is for supporting container transportation to the port on both sides of the sea and connecting to the southern region and the upper regions of the railway network of the State Railway of Thailand.

Therefore, the consultant considers the matter of transport network connection to reduce the impact on communities or areas that require large amounts of expropriation as well as avoid steep areas. Therefore, various limitations must be considered to determine the project route and compare the selection of the most suitable route by considering engineering, economic, investment, social, and environmental impacts.

The most suitable route is 94.50 kilometers as shown in **Figure 4-1**

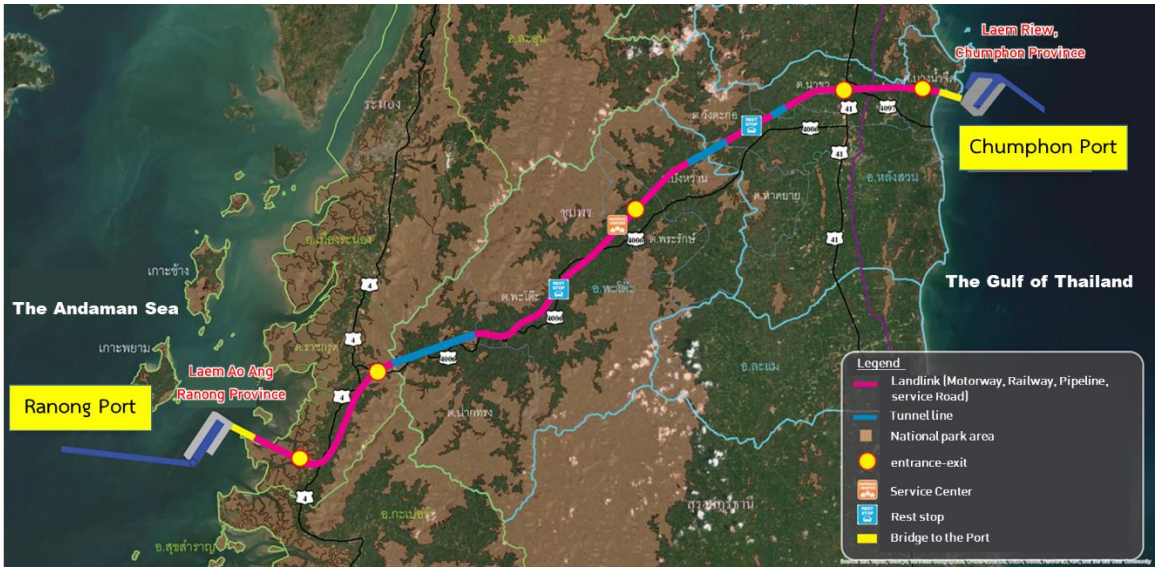


Figure 4-1 : The most suitable route for Landlink.

4.2 Engineering Design

To design the motorway, the consultant used standards that were set by the Department of Highways, which include special highway design standards, National Highway Design Standards, and the design manual of the Bureau of Survey and Design, in addition to the standards of the Department of Highways. Other international standards that will be used are :

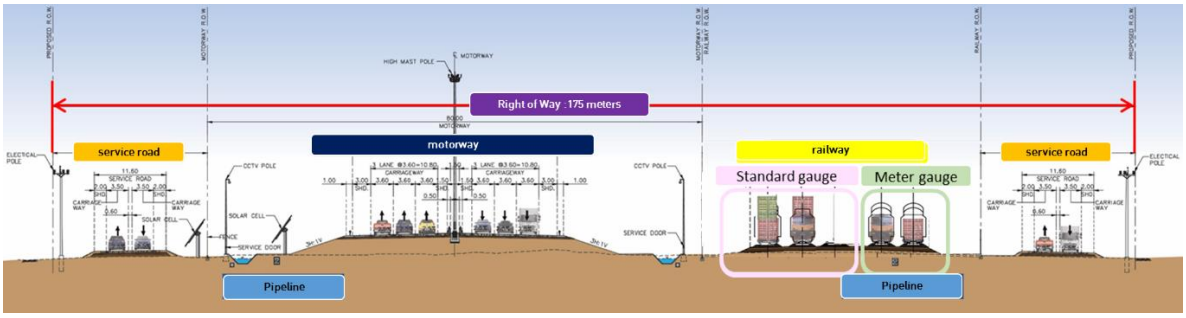
(1) AASHTO - A policy on Geometric Design of Highways and Street 2011

(2) TRB - Highway Capacity Manual 2000

The geometric design of the railway is according to the detailed design criteria and standards, which are based on the standards of the State Railway of Thailand. and consistent standards from internationally recognized organizations such as European Norm, British and American Standards, the International Standards Organisation (ISO), the Union Internationale des Chemins de fers (UIC) bax, and AREMA (American Railway Engineers and Maintenance of Way Association).

The motorway and railway route Chumphon – Ranong calls Landlink. There is an economic route development project called Landbridge, which has different types of route cross sections, including: at grade, elevated, and tunnel. The route passes through 2 provinces and 3 districts, namely Lang Suan District and Phato District, Chumphon Province, and Mueang Ranong District, Ranong Province.

The typical cross section of the route includes 6 lanes of motorway, 4 tracks of railway, which are 2 tracks of standard gauge railway and 2 tracks of meter gauge railway, and 2 lanes of each direction service road. Standard gauge railway tracks can accommodate double-stacked container loads, as shown in **figure 4-2**. To support the increased volume of rail transportation and service roads, the motorway will run parallel to the new railway line along the entire route.



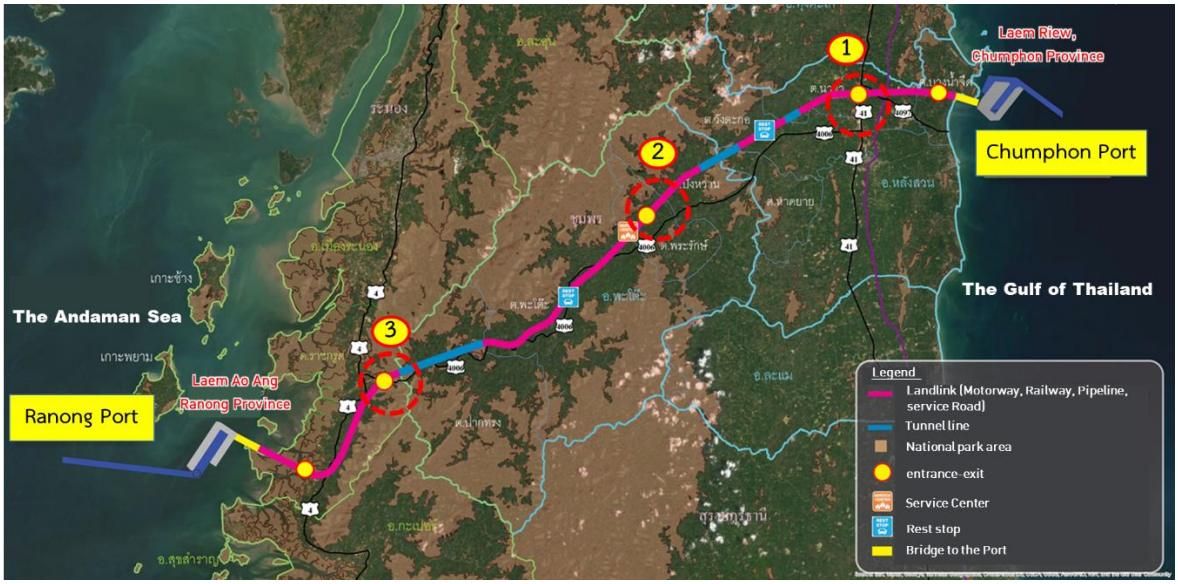
Source : Pre-Feasibility study of Motorway and Railway (MR Map), Department of Highway

Figure 4-2 : Typical cross section of Landlink

Along the route of the motorway, intersections connecting to various highway roads have been determined and designed in the form of interchanges or overpasses with entrance-exit routes to allow traffic to pass easily and smoothly. It meets the engineering principles required for highways with complete access control and the lowest impact on buildings. The connection location of the project with important highways has been determined, which are :

1) Bang Nam Chuet Interchange (intersects with Highway 41)
2) Phato Interchange (intersects with Highway 4006)
3) Ratchakrut Interchange (intersects with Highway 4006)

As shown in the **Figure 4-3**

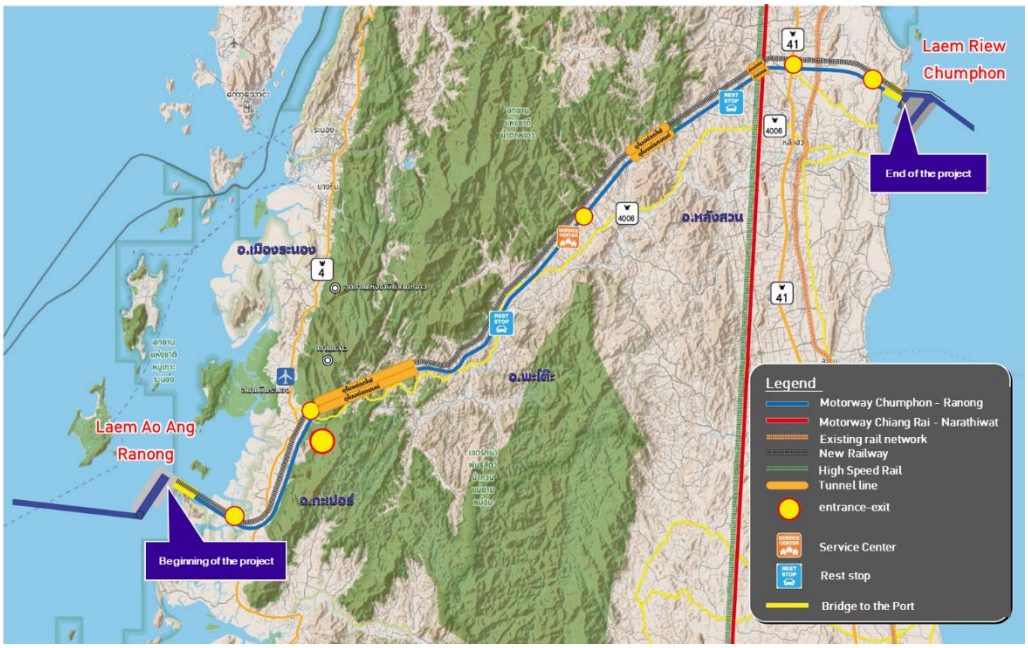


Source : Pre-Feasibility study of Motorway and Railway (MR Map), Department of Highway

Figure 4-3 : Interchanges Location

Rest area along the motorway, studied from the Royal Gazette, Volume 134, Special Section 46 D, page 85, dated February 15, 2017, Department of Highways regulations regarding standards and characteristics of rest areas in special main road areas and Concession Highway 2017. Rest areas on the Chumphon-Ranong motorway are divided into two types, and consultants have determined the location of roadside rest areas as shown in **Figure 4-4**, consisting of :

1. Service Center
   - Phato Subdistrict, Phato District, Chumphon Province.
2. Rest Stop
   - Wang Tako Subdistrict, Lang Suan District, Chumphon Province.
   - Phato Subdistrict, Phato District, Chumphon Province.



Source : Pre-Feasibility study of Motorway and Railway (MR Map), Department of Highway

Figure 4-4 : Rest Area Location

4.3 Estimation of Costs of port linkage

The summary of estimated investment value and development cost for port linkage between Chumphon Port and Ranong Port is to cover the investment value and development cost of both roads and railways network which is originated from the project's conceptual design, as shown in **Table 4-1**.

Table 4-1 : Summary of the estimation of investment value and expenses for the development of Landlink.

Unit: Million Baht

Landlink						
No.	**List**	**Phase 1/1**	**Phase 1/2**	**Phase 1/3**	**Phase 1/4**	**Total**
1	Consultant fees for designing and arranging land ownership and compensation for buildings	6,212.00	-	-	-	6,212.00
2	Motorway	123,040.00	2,500.00	-	-	125,540.00
3	Railway (Meter gauge) (Invested by State of Railway Thailand)	43,600.00	3,625.00	-	-	(47,225.00) Not included in the project investment
4	Railway (Standard gauge)	57,464.00	-	-	-	57,464.00
5	Pipeline	-	19,410.00	-	-	19,410.00
6	Railway bridges and motorway bridges (route 4 kilometers)	15,000.00	-	-	-	15,000.00
Total investment cost for Landlink		**201,716.00**	**21,910.00**	**-**		**223,626.00**

Source : The Economic, Engineering and Environmental Feasibility Study of Chumphon Railway - Ranong Deep Sea Port by The Consultant

Table 4-2 : Project operation and maintenance costs.

	Year	Landlink		Total (Unit : Million Baht)
		Motorway	Railway	
Monetary value	**2573**	621.1	638.3	1,259.4
	2582	956.1	802.3	1,758.4
	2592	1,216.2	1,060.7	2,276.9
	2602	1,424.3	1,403.6	2,827.9
	2612	1,727.5	1,790.6	3,518.1
	2622	2,080.5	2,283.1	4,363.6
	Lifetime of Project	**64,357.4**	**139,547.6**	**203,905**
Economic value	**2573**	587.2	9,326.5	9,913.7
	2582	738.1	19,406.7	20,144.8
	2592	975.8	30,068.6	31,044.4
	2602	1,291.3	37,691.7	38,983
	2612	1,647.4	42,389.3	44,036.7
	2622	2,100.5	37,001.0	39,101.5
	Lifetime of Project	**128,383.8**	**1,638,048.1**	**1766,431.9**

Note : Value, base year 20

Chapter 5
Feasibility Study and Public Private Partnership Study

5.1 Estimation of Investment Costs and Expenses of Port Development

The project development is divided into 4 phases in order to support the products according to the expected goals. Its total investment value is 1.00 trillion baht which is consisting of investment for port 0.64 trillion baht, investment for SRTO 0.14 trillion baht, and investment for port linkage route 0.22 trillion baht, (For investment cost of the railway work concerning the meter gauge, invested by the State Railway of Thailand (SRT), is not included in the project), as shown in **Table 5-1**, with the following details;.

Project development Phase 1 (2030 - 2033), investment value 522,844.08 million baht

- Chumphon port construction for 118,519.50 million baht (accommodating cargo 4 million TEUs).
- Ranong port construction for 141,716.02 million baht (accommodating cargo 6 million TEUs).
- Area for Single Rail Transfer Operator (SRTO) in Chumphon port, 38,113.45 million baht.
- Area for Single Rail Transfer Operator (SRTO) in Ranong port, 22,779.11 million baht.
- Construction and expropriation for port linkage, 201,716.00 million baht

Project development Phase 2 (2034 - 2035), investment value 164,671.83 million baht

- Chumphon port construction for 45,644.75 million baht (accommodating more cargo 4 million TEUs).
- Ranong port construction for 73,164.78 million baht (accommodating more cargo 6 million TEUs).
- Area for Single Rail Transfer Operator (SRTO) in Chumphon port, 10,498.30 million baht.
- Area for Single Rail Transfer Operator (SRTO) in Ranong port, 13,454.00 million baht.
- Construction and expropriation for port linkage, 21,910.00 million baht

Project development Phase 3 (2036 - 2038), investment value 228,512.79 million baht

- Chumphon port construction for 73,221.99 million baht (accommodating more cargo 6 million TEUs).
- Ranong port construction for 115,929.76 million baht (accommodating more cargo 8 million TEUs).
- Area for Single Rail Transfer Operator (SRTO) in Chumphon port, 20,888.52 million baht.
- Area for Single Rail Transfer Operator (SRTO) in Ranong port, 18,472.52 million baht.

Project development Phase 4 (2039 - 2079), investment value 85,177.77 million baht

- Chumphon port construction for 68,280.20 million baht (accommodating more cargo 6 million TEUs).
- Area for Single Rail Transfer Operator (SRTO) in Chumphon port, 16,897.57 million baht.

Project development Phase 1-4 (2030 - 2079), investment value 1,001,206.47 million baht

- Chumphon port construction for 305,666.44 million baht (accommodating cargo 20 million TEUs).
- Ranong port construction for 330,810.56 million baht (accommodating cargo 20 million TEUs).
- Area for Single Rail Transfer Operator (SRTO) in Chumphon port, 86,397.85 million baht.
- Area for Single Rail Transfer Operator (SRTO) in Ranong port, 54,705.62 million baht.
- Construction and expropriation for port linkage, 223,626.00 million baht

Table 5-1 : Summary of estimated project investment cost

Unit: Million Baht

Detail	P1/1	P1/2	P1/3	P1/4	Total
Port					
- Construction of Chumphon port	118,519.50	45,644.75	73,221.99	68,280.20	305,666.44
- Construction of Ranong port	141,716.02	73,164.78	115,929.76	-	330,810.56
Port Investment Value	**260,235.51**	**118,809.53**	**189,151.75**	**68,280.20**	**636,477.00**
Area for Single Rail Transfer Operator (SRTO)					
- Area for Single Rail Transfer Operator in Chumphon	38,113.45	10,498.30	20,888.52	16,897.57	86,397.84
- Area for Single Rail Transfer Operator in Ranong	22,779.11	13,454.00	18,472.52	-	54,705.63
Single Rail Transfer Operator Investment Value	**60,892.56**	**23,952.30**	**39,361.04**	**16,897.57**	**141,103.47**
Port linkage route					
Investment value of port linkage route	**201,716.00**	**21,910.00**	**-**	**-**	**223,626.00**
Investment value of Landbridge	**522,844.08**	**164,671.83**	**228,512.79**	**85,177.77**	**1,001,206.47**

5.2 Economic feasibility study

1) Assumptions and requirements for study and operational guidelines

The feasibility study of the economic project is conducted under the assumptions and requirements as follows;

- The cost of the project is the fixed price as of the year 2023
- The period of project feasibility study is equal to the construction period combined with duration of project implementation for 50 years
- Investment opportunity cost is equal to 12% per year (this is the rate that has been studied about the cost of investment in Thailand conducted by World Bank and

National Economic and Social Development Council. It is also the rate that is currently used in studying government projects in many agencies, such as Department of Highways, Expressway Authority of Thailand, State Railway of Thailand, and Office of Transport and Traffic Policy and Planning, etc.)

2) Study concept of economic benefits

The comparison between "With - Project Situation" and "Without - Project Situation" is an important part of economic benefit assessment. After the project, the consultants will study the changes of various factors which is raised from the project implementation at national level to regional level. The study of changes in various factors are such as traffic models, product movement model, and cargo ships so that it can be used as data to assess the economic benefits of Thailand. Moreover, it will be used to study economic feasibility for the next project. The details are as follows.

2.1) Benefits from Service Fee

It is a project's direct benefit return in the form of fees that the port receives from those who come to use the service. After having a project connecting the Andaman Sea and the Gulf of Thailand, this project will attract more ships to use port service in Thailand. This project will be an option instead of traveling through the Strait of Malacca, and other ports in Singapore or Malaysia which is currently very congested. As a result, the domestic ports will have more income from service fees and freight charges as well. This is a significant direct economic benefit from the project development. Thus, the assumption of service fee benefits assessment is shown as follows.

Table 5-2 : Project revenue assumptions

Project revenue assumptions			
Toll fee	1.25	Baht/Km.	Source: Department of Highways
Rail freight for Chumphon - Ranong	1,500	Baht/container	Source: The State Railway of Thailand
Port entrance fee by road	100	Baht/container	Source: The Port Authority of Thailand
Port entrance fee by railway	35	Baht/container	Source: The Port Authority of Thailand
Terminal handling charge	2,800	Baht/container	Source: The Port Authority of Thailand
Fee from unloads container from truck into container yard of the port operator	500	Baht/container	Source: The Port Authority of Thailand
Fee from container lifting at SRTO to the container yard of the port operator	376	Baht/container	Source: The Port Authority of Thailand
Fee from unloads container from ship at destination port	1,545	Baht/container	Source: The Port Authority of Thailand
Service rate adjustment			
service rate adjustment	3%	Every 5 year	

2.2) Traffic benefits

The development of project for transportation linkage between the Gulf of Thailand and Andaman Sea is possible effectively. The important factors of transportation linkage are land transportation infrastructure systems which includes road or rail. It must have a development plan to support personal travel and product transportation. It is considered to improve the efficiency of the transportation network that it can provide benefit in traffic, not only for transportation service provider but also for the regular service users. The benefits consist of Vehicle Operating Cost Saving, Value of Travel Time Saving, and Accident Cost Saving. In this regard, the consultant will assess the traffic benefits by the following methods.

(1) Vehicle Operating Cost Saving

Vehicle Operating Cost (VOC Saving) is an important economic benefit to improve transportation network. The cost analysis of vehicle use must be appropriate cost with the actual conditions in terms of geography, traffic, and the proportion of different vehicles used in the project area. It is based on calculation of HDM 4. The cost of vehicle use is obtained by the cost of chosen vehicle use multiplying with the total distance traveled by road users (VKT).

(2) Value of Travel Time Saving

The value of travel time means the value (equivalent to money) that is lost on a trip. Such lost time can be used to do something that can add value to the economy. The project linkage between Andaman Sea and Gulf of Thailand will create a transportation infrastructure. This project also provides more efficient traffic for both transportation and traveling, and it can save time for transportation. The benefits assessment in terms of travel time savings is to use the study result of the total system duration which is used to calculate the value difference from travel time saving between the case with the project and the case without the project. The result of such different conditions will be the benefit in travel time saving by vehicle users arising from the project.

(3) Accident Cost Saving

The damage which is caused by accidents to the traffic network system is a part of the project economic cost. It is because accidents can cause loss of life and property. For project development to improve efficiency of transportation network and standards, it can reduce the chance of accident. Thus, evaluation of economic benefits arising from the project should take accident cost into account.

2.3) Benefit from economic growth through an economic multiplier effect

The development of transportation linkage projects between the Gulf of Thailand and the Andaman Sea will cause a number of cargo ships to change their transportation route. The cargo ships that have to pass through the Strait of Malacca and use port services in Malaysia and Singapore can have another option to use the Landbridge route of Thailand instead. This is an important factor to stimulate economic development in the provinces of southern Thailand. This project will generate the businesses and industries related to the maritime industry, cargo transportation, as well as other related industries in

the port and surrounding areas. Thus, it can cause the large employment in the southern region. This is an important benefit arising from the development. In this regard, the consultant has assessed the benefits of employment in the area. It will be calculated from the

economic multiplier effect by using the Input - Output Table of the Office of the National Economic and Social Development Council (NESDC).

Regarding economic benefits mentioned above, the consultant has evaluated the benefits of the project in terms of economic value as shown in **Table 5-3**.

Table 5-3 : Estimated Benefits of the Project

Year	Fee income				Traffic Benefits				Economic Growth Benefits	Total Benefits (Unit : Million Baht)
	Motorway	Rail	Port	Total	Vehicle Operating Cost Saving	Value of Travel Time Saving	Accident Cost Saving	Total		
2030	8.0	902.4	4,603.4	5,513.8	419.4	647.8	222.5	1,289.7	667.5	7,471.0
2039	250.8	28,417.1	148,428.5	177,096.4	1,976.9	3,859.9	1,141.4	6,978.2	106,664.0	290,738.6
2049	319.3	36,183.2	193,408.3	229,910.8	4,237.6	9,867.7	1,439.1	15,544.4	141,874.7	387,329.9
2059	322.5	36,546.7	195,351.1	232,220.3	5,959.0	13,137.1	1,769.6	20,865.7	209,813.6	462,899.6
2069	325.7	36,913.8	197,313.4	234,552.9	7,674.9	17,059.8	2,100.2	26,834.9	310,312.3	571,700.1
2079	329.0	37,284.7	199,295.5	236,909.2	9,219.2	20,590.4	2,397.8	32,207.4	441,363.9	710,480.5

Source : Analysis by consultant

3) Study of project economic feasibility

The study of the project economic feasibility project is to compare the project cost and all other expenses with the benefits throughout the project, or compare one project with another project. The consultant will present the study results of project economic feasibility with its economic indicators as follows.

1) Net Present Value (NPV)
2) Benefit-Cost Ratio (B/C)
3) Economic Internal Rate of Return (EIRR)

In this regard, results of project economic feasibility analysis has various economic indicators which are Net Present Value (NPV) at 257,453 million baht, Benefit-Cost Ratio (B/C) at 1.35, and Economic Internal Rate of Return (EIRR) at 17.43 %. This is to indicate that the project is economically viable, and it is well suited for investment in order to generate benefits in the macro-economic aspect of Thailand.

5.3 Financial feasibility Study

The financial feasibility study is to compare construction costs and operating cost with project iincome. It then will be calculated for the project's financial return indicator. There are financial analysis assumptions as shown in **Table 5-4**.

Table 5-4 : Financial Assumptions

Detail	Rate	Unit	Remarks
General assumptions			
Base year (B.E.) 2022			
Rate of inflation	2.00%	Per year	
Construction period			
The Landbridge Project Port			The Landbridge Project Port
Phase 1/1	5		Phase 1/1 Construction 2026 - 2030
Phase 1/2	3		Phase 1/2 Construction 2033 - 2035
Phase 1/3	3	Year	Phase 1/3 Construction 2038 - 2040
Phase 1/4	3		Phase 1/4 Construction 2049 - 2051
Transportation network	4		Transportation linkage network construction 2027 - 2030
Project duration	50	Year	After commencement of Phase 1/1 2030 - 2079
Financial Discount Rates	5%		
Project income assumptions			
Service rate			
Toll fee	1.25	Baht/Km.	Source: Department of Highways
Rail freight for Chumphon - Ranong	1,500	Baht/container	Source: The State Railway of Thailand
Port entrance fee by road	100	Baht/container	Source: The Port Authority of Thailand
Port entrance fee by railway	35	Baht/container	Source: The Port Authority of Thailand
Terminal handling charge	2,800	Baht/container	Source: The Port Authority of Thailand
Fee from unloads container from truck into container yard of the port operator	500	Baht/container	Source: The Port Authority of Thailand
Fee from container lifting at SRTO to the container yard of the port operator	376	Baht/container	Source: The Port Authority of Thailand
Fee from unloads container from ship at destination port	1,545	Baht/container	Source: The Port Authority of Thailand
Service rate adjustment			
service rate adjustment	3%	Every 5 year	

Source : Consultant

The estimation of project's revenue from transportation services can be divided into 3 groups. The first group is Transshipments of Goods between Chumphon port and Ranong port. The second group is import-export in Thailand. The Third group is the transportation from southern China via rail to the Landbridge port. It is as shown in **Table 5-5**.

Table 5-5 : Estimated revenue of the project

Year	Service revenue group 1			Service revenue group 2			Service revenue group 3			Total Revenue (Million Baht)
	Motorway	Rail	Port	Motorway	Rail	Port	Motorway	Rail	Port	
2030	-	616.0	3,604.0	8.0	210.7	826.4	-	75.7	173.0	**5,513.8**
2034	-	5,973.7	34,948.8	77.2	2,043.6	8,013.8	-	733.6	1,677.3	**53,468.1**
2039	-	19,398.5	116,142.2	250.8	6,636.3	26,682.0	-	2,382.3	5,604.3	**177,096.3**
2044	-	24,576.8	150,505.2	317.7	8,407.9	34,639.1	-	3,018.2	7,299.9	**228,764.7**
2049	-	24,699.9	151,259.2	319.3	8,450.0	34,812.6	-	3,033.3	7,336.5	**229,910.8**
2054	-	24,823.7	152,017.0	320.9	8,492.3	34,987.0	-	3,048.5	7,373.2	**231,062.7**
2059	-	24,948.0	152,778.6	322.5	8,534.9	35,162.3	-	3,063.8	7,410.2	**232,220.3**
2064	-	25,073.0	153,544.1	324.1	8,577.6	35,338.5	-	3,079.1	7,447.3	**233,383.7**
2069	-	25,198.6	154,313.3	325.7	8,620.6	35,515.5	-	3,094.6	7,484.6	**234,553.0**
2074	-	25,324.9	155,086.4	327.4	8,663.8	35,693.4	-	3,110.1	7,522.1	**235,728.1**
2079	-	25,451.8	155,863.4	329.0	8,707.2	35,872.3	-	3,125.7	7,559.8	**236,909.1**
Throughout project	**-**	**1,081,875.2**	**6,611,475.0**	**13,985.5**	**370,115.2**	**1,521,392.1**	**-**	**132,861.9**	**320,524.6**	**10,052,229.4**

Source : Analysis by consultant

The analysis of financial suitability throughout the 50-year operation is 5% discount rate. The results are summarized in **Table 5-6**.

Table 5-6 : Project's financial suitability

Detail	FIRR (%)	NPV (Unit : Million Baht)	Payback Period (year)
Overview of Landbridge Project	8.62%	759,985	24
Consideration of separate project's components			
Ranong port	9.85%	244,564.7	23
Chumphon Port	9.36%	208,371.6	24
Transportation Network	7.22%	103,942.0	29

Source: Analysis by consultant

5.4 PPP Scheme and project return

The selection of investment partnership models between the government and private sector for the development of transportation infrastructure to enhance the economic corridor in the southern region, connecting transportation between the Gulf of Thailand and the Andaman Sea (Land Bridge Project), is crucial. This is due to the operations of deep-sea ports, railways,

expressways, and the development of post-port areas, which involve various specialized expertise. It is necessary to have a group of specialized companies, including international firms, collaborating in project development, service provision, and maintenance.

Table 5-7 : PPP Scheme and project return

PPP Scheme		PPP1 Net Cost	PPP2 Net Cost	PPP1 Gross Cost	PPP2 Gross Cost
Investment	Land Acquisition	G	G	G	G
	Civil Works	P	G	P	G
	M&E Works	P	P	P	P
	Others	P	P	P	P
	G-Government	6,212 MB	598,747 MB	6,212 MB	598,747 MB
	P-Private	994,994 MB	402,459 MB	994,994 MB	402,459 MB
Private Revenue		Project revenue	Project revenue	Fixed payment	Fixed payment
Equity IRR		**9.83 %**	**24.02 %**	**5% (Equal to WACC)**	
Equity NPV		**757,401 MB**	**318,296 MB**		

Source: Analysis by consultant

The consultancy suggests using the PPP1 Net Cost scheme to diversify revenue risks. Additionally, the private sector, with its industry expertise, has a higher potential for international marketing compared to the government. Allowing the private sector to bear the risk of usage volume would incentivize them to utilize their capabilities to attract more target customers to the project. This would lead to greater economic benefits for the country in line with the project's specified objectives.

Chapter 6
Environment and Public Paticipation

6.1 Environmental impact study and assessment

Studying and preparing environmental impact assessment reports of the transportation infrastructure development project to develop the Southern Economic Corridor to link transportation between the Gulf of Thailand and Andaman It consists of two parts of the environmental impact study : 1) the port development project and 2) the road and rail route project to connect the port. The work is carried out in accordance with the announcement of the Ministry of Natural Resources and Environment regarding the designation of projects, activities or operations. which must prepare an environmental impact assessment report and the criteria, methods and conditions for preparing an environmental impact assessment report, announced on 19 November 2018 and the announcement of the Ministry of Natural Resources and Environment regarding business project determination or operations that may have an impact on natural resources Severely affects the quality of the environment, health, hygiene, and quality of life of the people in the community. Which must prepare an environmental impact assessment report and the criteria, methods and conditions for preparing an environmental impact assessment report, announced on 19 November 2018 , including guidelines for preparing an environmental impact assessment report. Transportation for water infrastructure Prepared by the Transportation Group Office of Environmental Impact Analysis Office of Natural Resources and Environmental Policy and Planning March 2018 edition and guidelines for environmental impact analysis of land transport projects by the transportation group Office of Environmental Impact Analysis Office of Natural Resources and Environmental Policy and Planning (ONEP) 2006 also considers covering guidelines and other related laws. By studying and collecting various environmental information currently relevant in areas that may be affected by project development in all 4 areas, consisting of physical environmental resources biological environmental resources Value of human use and value of quality of life Especially the resources/environmental factors that are expected to be affected by project development. To use as basic information for evaluating the environmental impact of the project.

6.1.1 Study area

Environmental impact study area of the port project will cover an area of at least a radius 5 kilometers from the boundary of the Ranong (Andaman) port development project. and Chumphon Pier (Gulf of Thailand) For the study area of the project , road and railway routes to connect the port. It will cover an area within 500 meters from the center of the road and rail line to link the port.

6.1.2 Environmental issues studied

Environmental issues that are screened to determine the scope of study in the environmental impact assessment of the port development project include a total of 25 issues and the road and rail route project to connect the port. There are 2 8 issues in total. Details are shown in **Table 6-1** and **Table 6-2**.

Table 6-1 : Environmental issues in environmental impact studies and assessments of the port development project

Physical environmental resources	biological environmental resources	human use	Value for quality of life
1. Terrain 2. Soil resources 3. Geology and earthquakes 4. meteorological climate and air quality 5. sound and vibration 6. Hydrology and surface water quality 7. Seawater quality 8. Oceanography and coastal change	1. Biological resources on land 2. marine biological resources	1. land use 2. Transportation 3. water use 4. wastewater management 5. Drainage and flood prevention 6. Electricity use 7. Solid waste and waste management 8. Aquatic animal cultivation and fisheries	1. social economic conditions 2. public participation 3. Migration and expropriation 4. Health and Public Health 5. Occupational health and safety 6. tourism and leisure 7. Historical and archaeological sites

Table 6-2 : Environmental issues in studying and evaluating the environmental impacts of the project, road routes and Railway to link ports

Physical environmental resources	biological environmental resources	human use	Value for quality of life
1. Terrain 2. Soil resources 3. Geology and earthquakes 4. Hydrology and quality of surface water 5. Hydrology and groundwater quality 6. Seawater quality 7. Air quality 8. sound and vibration	1. Biological resources on land 2. aquatic biological resources	1. land use 2. Water for consumption 3. Transportation 4. public utilities 5. energy 6. Flood control and drainage 7. Agriculture 8. Industry 9. recreation	1. economic-social 2. Migration and expropriation 3. Health and Public Health 4. Occupational health and safety 5. division 6. social safety 7. sanitary 8. History and Archeology 9. Aesthetics/Scenery

6.2 Public Relations and Public Participation

6.2.1 preamble

The process of public participation and public relations is an essential step in the study of the project so that all relevant sectors are informed of the guidelines for preparing logistics system development strategies to develop freight links between the Gulf of Thailand and Andaman in the Southern Economic Corridor. Business Development Model Preparation drives the project plans by providing opinions and suggestions that are beneficial to the project in the field of project development; it supports and guides the development of transportation infrastructure to develop the Southern Economic Corridor to connect transportation between the Gulf of Thailand and Andaman to be concrete and will enhance the quality of life of people both at the regional and national levels.

6.2.2 objective

(1) To disseminate information about Project Progress, create awareness and understanding about the project's education to the target group, and develop an accurate and continuous understanding.

(2) To listen to opinions and suggestions from target groups for consideration in studying the project appropriately. It has minimal environmental impact and is most responsive to people's use.

(3) To build a coalition of stakeholders from various sectors to jointly push/support the implementation of the project to achieve results.

6.2.3 Target group

The consultant will analyze the role and importance of the target group to cover all stakeholders so that the project can proceed smoothly and successfully according to the project objectives. As shown in **Table 6-3**.

Table 6-3 : Target groups for project publicity and public participation

Target group	Effects /Project Involvement	The role of participation
1. Those affected by the implementation of the project		
1.1 Beneficiaries of the project	- The target group that benefits from the project; therefore, they should be used as a coalition to accept and support the project.	- Able to act as a support force to enhance the good image of the project. - If supporting the project, it will become a critical mass force to drive the project's success.
1.2 Negatively affected persons These include local people who are affected by the environment.	- Environmental and social impacts, especially those that will change their daily commuting patterns, community segregation, connectivity between both sides or areas affected by construction, such as dust, sound, vibration, etc.	- The main target group, which will provide important information in the area and comments/suggestions that cause trouble and concern. Their input will help explore and design project details, including reviewing preventive and corrective measures and reducing expected impacts as much as possible.
2. Project Owner Agency	- To be responsible for the project development policy, which needs to be continuously aware of the project's progress to	- To be a unit directly related to the project and play an essential role in providing feedback. Recommendations for studying the project for maximum benefit: It is also

Table 6-3 : Target groups for project publicity and public participation

Target group	Effects /Project Involvement	The role of participation
Office of Transport and Traffic Policy and Planning (NIA)	determine the appropriate and correct approach to education/project development.	a transport and traffic planning agency; this will enable the integration of the transportation network development plan coherently and efficiently.
3. Government agencies at various levels namely, the governor. Sheriffs, local administration executives, etc.	- These are the area owner who must be informed about the development. They are responsible for policy formulation, local development guidelines, and development plans in various aspects, including clarifying the project to the people in the area.	- Providing information and information about the project to the local owner agencies in order to achieve integration between the upcoming development in the area and the development of the project, as well as listening to opinions and suggestions from other relevant agencies in the area in order to study the project appropriately and respond to the needs of the local people effectively.

6.3 Project Media

To ensure the smooth implementation of the project and achieve the goals. It is essential to continuously disseminate information and publicize news of the project. To ensure that the public and stakeholders are informed of the movements and have accurate knowledge and understanding about the project. Each type of media to be produced is an educational medium. Build understanding and help all stakeholders in the project, including the wider public, to be informed about the correct and effective implementation of the project. It also helps to enhance the good image of the organization. Some examples of public relations media are tools to support public participation activities. As shown in **Figure 6-1**

Press Releases (Sample)

Exhibition board (Sample)

Public Relations Video (Sample)

Figure 6-1 : Public relations media for the project

6.4 Public Relations and Public Paticipation

Although the project will benefit the country as a whole, the development of the project will inevitably affect the people in the project area. Therefore, during the implementation of public participation, the consultant will disclose information in accordance with the Constitution and the Regulation of the Office of the Prime Minister on Public Hearings B.E. 2548 (2005), which specifies the details of the project development.

The implementation of public participation includes listening to opinions and suggestions for consideration and designing and determining appropriate mitigation measures; this will alleviate concerns for affected persons as well as stakeholders' needs for project development. To promote the project to operate efficiently. As shown in **Figure 6-1** the details are as follows

6.4.1 Meeting with provincial government officials

Meeting with provincial government executives aims to present detailed project information. Project Performance: Exchange of ideas, standpoints, perspectives, problems, and obstacles that are useful for the study and development of the project, with the target group consisting of heads of provincial government agencies in Chumphon and Ranong provinces. The operation occurred on November 26, 2022, in Chumphon and Ranong provinces.

6.4.2 Project Introduction Seminar

Project introduction seminars are essential activities for public engagement operations. It will be a platform to disseminate project information to create awareness and understanding of the project in the same direction and provide an opportunity for the target group to share their opinions and suggestions; it aims to improve the design of the project details appropriately. The seminar invites relevant audiences to the meeting in unison. It comprises government agencies at various levels, private business organizations, environmental NGOs, local and tertiary educational institutions, independent academics, community leaders and regional thought leaders, the media, and the public. as follows.

(1) Southern Gulf of Thailand (Chumphon Province) On Wednesday, December 8, 2021
(2) Southern Andaman Area (Ranong Province) on Thursday, December 9, 2021
(3) Bangkok on Tuesday, December 21, 2021

6.4.3 Public Relations

The project was conducted in Chumphon and Ranong provinces between December 2021 and June 2022 by dividing the activities into 2 phases: Phase 1 during the project site selection and Phase 2 after the selection of the project site. Local Administrative Organizations, Entrepreneurial Groups, Community leaders, and local residents There are 5 districts, 30 sub-districts, 178 villages in Ranong province, and Chumphon province in Lang Suan and Phato districts. 15 sub-districts and 187 villages, including attending monthly meetings of the district together with the heads of government agencies and chiefs of 7 districts of Chumphon province.

6.4.4 Focus Group Meetings

Focus group meetings are another channel that allows stakeholders to participate in the project. Therefore, the Office of Transport and Traffic Policy and Planning (NIA) has assigned the consulting firm to organize the 0th Small Group Meeting from 6 to 11 June 2022, comprising four stages in the Gulf of Thailand, Chumphon province, and four stages in the Andaman area, Ranong province, totaling eight stages, with a total of 636 participants.

Ranong Province **Chumphon Province**

Meeting with provincial government executives

Chumphon **Ranong** **Bangkok**

Project Introduction Seminar

public relations

Figure 6-2 : The climate of public relations and public participation

Attending the district's monthly meetings

Focus Group Meetings

Figure 6-2 : The climate of public relations and public participation (continued)

Chapter 7
Project Development Plan

7.1 Project Readiness and Development Plan

The Public-Private Partnership projects of Landbridge are ready to proceed under the PPP Act. Port Authority of Thailand (PAT) as the project owner also ready to facilitate and accommodate for private investors to join with PAT under its core mission.

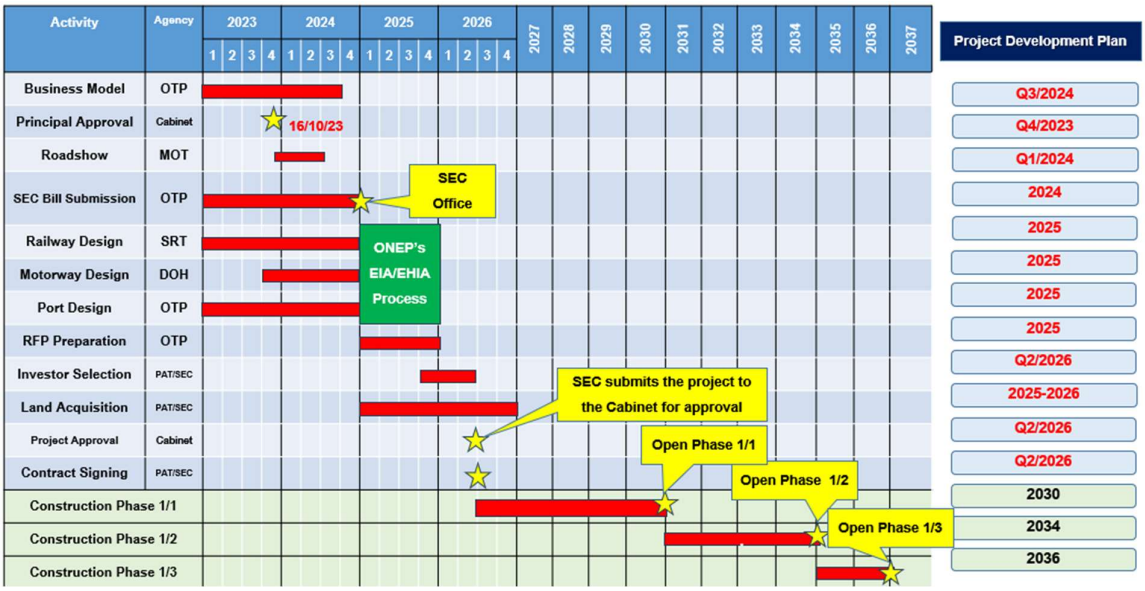
The project has been reviewed and worked collaboratively with related units, with the following details **as shown in** Table 7-1:

Table 7-1 : The Project Activities

Activities	Details
Cabinet affirms principles	16 October 2024.
Feasibility study (OTP)	Feasibility study, Conceptual design, Project component will be completed by 2024.
EIA/EHIA	ONEP will complete the EIA/EHIA review by 2025 Port: Detailed design completed, currently studying EHIA (OTP) Rail : In progress (SRT) Motorway : In progress (DOH)
Transportation and related public utilities within the project area.	Coordination of agencies in the area, road transportation, railways, and waterways and public utilities systems.
Public participation and public relations.	Introduction, subgroup meetings, on-site public relations.
Acquiring ownership rights or rights to use property.	The land will be reclaimed, with an expectation of a royal decree specifying the land areas to be reclaimed and the land rights to be organized during 2025-2026.
Propose the Special Economic Zone Act for the Southern Region	In the process of proposing the SEC Act, seeking feedback, and refining regulations. The office will be established by 2025
Draft bidding document	In progress, completed by 2025.
The project owner	Owner: Port Authority of Thailand (PAT) Regulator: Southern Economic Corridor Office of Thailand (SEC)(In progress)

The project development plan with assumptions in the form of a public -private joint venture (PPP). The port construction period takes 5 years, with construction starting in 2026 and operation starting in the end of 2030. The project development plan as shown in **Table 7-2**.

Table 7-2 : The Project Development Plan



7.2 Draft SEC Act

To drive the Land Development Project towards its objectives, Thailand has implemented laws and regulations to reduce obstacles and streamline work processes, facilitating project operations. These efforts are coupled with policies aimed at promoting investment and providing benefits to investors, along with accelerating the enactment of legislation for the Southern Special Economic Development Zone, which will create opportunities for both domestic and foreign investors. Importantly, the development of the Southern Special Economic Zone will also help increase the volume of imports and exports for the Land Bridge project.

Initially, investors in the Land Bridge project will receive no less than the benefits outlined in the Eastern Economic Corridor Special Development Zone Act, including tax reductions, exemptions, and land ownership rights. The draft Securities and Exchange Commission Act has also stipulated benefits not less than those of the Eastern Economic Corridor Special Development Zone Act.