Adaptive Port Planning for Phase II of New Priok Development in Indonesia

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IPC
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Preface

I would like to thank Professor Tiedo with all his generosity to guide and response all my needs in doing the research abroad. Special appreciation for my daily supervisor, Dr. Poonam, who has guided and inspired me a lot about the main content of the study (APP frameworks originally belong to her PhD dissertation). Thank you, Dr. Jarit and Mr. Abrari for their reviews and comments in making this report more complete and compact.

People in IPC and Port Authority (Ministry of Transportation) which are really kind and responsive to answer all my questions, especially *Pak* Delon as my company supervisor. Thanks to my Bachelor senior in *Teknik Kelautan*, *Kak* Irfan, *Kak* Gerhard in guiding me at the field observation. Thank you for all your support, success for your career.

All colleagues, Indonesian families, and Indonesia fellows which I cannot mention each of you. *Pak* Deden and his family who has accepted me as his own son that made my life in NL is much easier.

My study in TU Delft and this research are fully funded by LPDP (*Lembaga Pengelola Dana Pendidikan*) from the Indonesian government. Thank you for all LPDP's members who have given that responsibility to me, this study is also for you and for the country I am proud of.

To close, I would like to quote words from one of our founding fathers, Mohammad Hatta, about the influence of ocean trading in shaping the nation characters of Indonesia in one of his speech in the year of 1960.

(Indonesian Version)

"Bangsa-bangsa asing yang sering singgah di Indonesia dalam melakukan perniagaan dari negeri ke negeri, mendidik nenek moyang kami ini dalam pelbagai rupa, memberi ia petunjuk tentang jalannya perniagaan. Last but not least, pertemuan-pertemuan yang tetap dengan bangsa-bangsa asing itu, orang hindi, orang arab, orang tionghoa and banyak lainnya, mengasah budi pekertinya dan menjadikan bangsa kami jadi tuan rumah yang peramah. Pada bangsa pelaut ini, keinginan untuk laut besar membakar jiwa senantiasa. Dengan perahunya yang ramping, dilayarinya lautan besar dengan tidak mengenal gentar, ditempuhnya rantau yang jauh dengan tiada mengingat takut"

(Mohammad Hatta, 1960)

(English Version)

Foreigners, who often stopped by in Indonesia and doing business, had educated our ancestors in various ways on how to do a good trading. Last but not least, those interactions with the Hindus, the Arabs, the Chinese and many others have sharpened our mind and made our nation a genial host. In this sailor nation, the desire to wade through the great sea is always burning in the soul. With their slender boats, they sailed through the vast sea with boldness and traveled far away with a valiant.

(Mohammad Hatta, 1960)

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Summary

> *"Advancing the port is one of the main pillars of the development of archipelagic country like Indonesia"*

Introduction

The initial masterplan of New Priok Development in Indonesia was developed in 2012 and is being updated to cater to new throughput demands. The masterplan of Phase I will be done as planned in which CT 1 was already operated since 2016 and CT 2 and CT 3 are in the final phase of land reclamation (based on a site visit on April 2017). Based on the terminal evaluation, already since 2014, there was a lack of cargo capacity in Port of Tanjung Priok, therefore, expansion is clearly needed. New Priok Development Phase I (2012) was aimed to deal with this condition.

In the new masterplan (2017), Phase II of the development will start in 2030 – onwards, depending on future conditions. However, whether the development of Phase II (continuation of Phase I) will be needed is still a question for the Port Authority. Hence, this study is about creating robust terminal masterplan of Phase II (2030 – onwards) which will remain functional under future uncertainties.

Methodology: Adaptive Port Planning (APP)

The methodology/framework being discussed is Adaptive Port Planning (APP) which is considering flexibility design of port masterplan. Flexibility is very relevant for projects with high investment and surrounded by future uncertainties. Generally, the operationalization of APP framework was for the general case of the planning (making masterplan from nothing). In addition, this framework works better for short-term planning in which the best alternative has to be chosen through analysing its business case.

In this study, considering the long-term project characteristics, the framework of Adaptive Port Planning (APP) Scenario-Based planning is developed. As a definition, the scenario-based approach helps to open up the perspective of the future condition of the port as a horizon of possibility and it gives chance to anticipate the vulnerabilities. Basically, this framework is trying to give the various perspectives of the future of New Priok and how the port could adapt the planning.

Applying Adaptive Port Planning (APP) Scenario-Based Planning

Phase II of New Priok has to be defined at first regarding its objectives, definition of success, major assumptions, time horizon, and strategy of approach. Those variables have partly been identified in the masterplan document of the project. However, in order to gain holistic insight, clarifying from some related government, corporate, external organization documents have to

be done. Site visit to IPC (Indonesia Port Corporation) and PORInt (Port Rotterdam International) has also widened the perspective of this step.

The future uncertainties which are relevant for the case study have to be analysed. Those uncertainties are elaborated based on related reports, government's documents, and study of the future of the port. Each uncertainty will be categorized whether it is going quickly, steadily, and slowly based on the intention of the government or corporation to adapt with it.

Developing the scenarios are based on defined critical uncertainties using a 2x2 matrix approach. The economy (related to cargo performance) and environment are defined to be the axes of the matrix. The outcome is four plausible scenarios: Green Growth, Business As Usual, Moderate Expansion, and No Expansion. The next steps are examining these scenarios through some analysis to look at the characteristics and the promising industries in each scenario. In order to get the terminal needs in each scenario, traffic analysis in Port of Tanjung Priok is required; identifying the key influential cargos and commodities. There will also be a projection of containers based on defined scenarios.

Producing the robust masterplan will lead us to a monitoring system and contingency planning for some highly relevant signposts. These signposts are the relevant future uncertainties which are not covered yet in the defined alternative layouts. Each of the signposts has to be analysed to prepare the contingency plans, mostly for IPC and some others for related stakeholders, either by taking defensive actions (DE), corrective actions (CR), capitalizing (CP), or Reassessment (RE).

Closing

In conclusion, this study proposes the adaptive framework of planning the terminal design for Phase II of New Priok, namely Adaptive Port Planning (APP) Scenario-Based Planning. It gives sequential work flow on designing future masterplan of the port, especially for the case of Phase II of New Priok. The alternative layouts and adaptive actions for IPC are some important outcomes of the framework. The port has to realize that uncertainties persevere and are very likely to influence the decision making for future layouts. Instead of ignoring uncertainties, the port needs to make contingency planning to deal with them. Hopefully, this study has benefits to make a robust terminal masterplan for Phase II of New Priok Development.

List of Symbols and Abbreviations

APP = Adaptive Port Planning
BAU = Business As Usual
BPS = *Badan Pusat Statistik* (National Statistic Centre of Indonesia)
CBA = Cost Benefit Analysis
BVB = *Buro Voorlichting Binnnenvaart*
CBL = *Cikarang Bekasi Laut* (Canal)
CBS = Central Buro Statistics
CFS = Container Freight Station
CT = Container Terminal
CY = Container Yard
Doms = Domestic
DWT = Dead Weight Tonnage
FAOStat = Food and Agriculture Statistics
GDP = Gross Domestic Product
ICCT = International Council on Clean Transportation
Intl = International
IPC = Indonesia Port Coperation
JICT = Jakarta International Container Terminal
KAI = *Kereta Api Indonesia* (National Train Operator)
LWS = Low Water Spring
Loa = Length over all
MP3EI = *Masterplan Percepatan Pembangunan Ekonomi Indonesia* (masterplan of accelerating of economic development of Indonesia)
NPCT 1 = New Priok Container Terminal 1
OPEC = Organization of the Petroleum Exporting Countries
PA = Port Authority (*Otoritas Pelabuhan*)
Pelindo = Pelabuhan Indonesia
PT = Product Terminal
PT PPI = *PT Pengembang Pelabuhan Indonesia*/Port Developer
RET = Renewable Energy Terminal
TEUs = Twenty-foot Equivalent Units
TOE = Tonnes Oil Equivalent
USD = United States Dollar

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When you leave a port, ask yourself two questions: what mark you have made on that port and what have you learned from that port?

-Mehmet Murad Ildan

Chapter 1 New Priok Development

1.1 Introduction

In this chapter, the profile of IPC (Indonesia Port Corporation) and PT PPI (Port Developer) as a subsidiary of the corporation will be explained. They are needed to get information of the corporation involved in this study. This chapter also points the wave reform frameworks of IPC and future vision of the corporation; these explanations will be the problem definition for APP frameworks analysis.

There will be an explanation of the masterplan of New Priok in 2012 (PM38) and Draft Masterplan 2017. They are important to get the complete description of the case study which is Phase II of New Priok Development. Analysing both documents has shown the changing of the planning.

The next couple sub chapters, there will be design and structure of the study, consisting of the objectives, scopes, questions, methodology, and outline of the research.

1.2 Pelindo II/ IPC (Indonesia Port Corporation)

Based on the new state regulation[1], there are two major parties involved in every port in Indonesia, Port Authority and Port Operator. Port Authority is a body or representative of Ministry of Transportation that responsible govern and publish regulation of the port. Port operator is responsible for operating and maintenance of the port, PT Pelindo II/IPC is a port operator in the port of Tanjung Priok.

There are four Pelindo, whose jurisdiction corresponds to the geographic/area coverage of ports. **Figure 1-1** shows the four main ports for Pelindo I-IV. Pelindo II, also known as IPC (Indonesia Port Corporation), is located in Java Island that has the populous population in Indonesia. Tanjung Priok is the main port of IPC and at the same time the biggest port of Indonesia.

[1] State Regulation (*Undang-Undang*) No 17, 2008

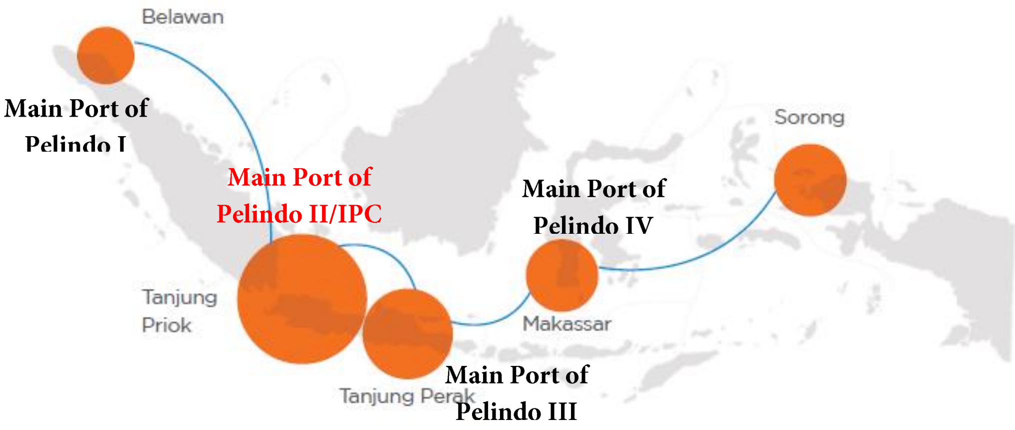

Figure 1-1 Port in Indonesia (Annual Report IPC 2015)

There are 12 ports being managed by IPC as depicted in **Figure 1-2**, they are:

1. Port of Teluk Bayur, West Sumatra
2. Port of Pulau Baai, Bengkulu
3. Port of Jambi, Jambi
4. Port of Palembang, South Sumatra
5. Port of Pangkal Balam, Bangka Belitung
6. Port of Panjang, Lampung
7. Port of Tanjung Pandan, Bangka Belitung
8. Port of Banten, Banten
9. Port of Sunda Kelapa, DKI Jakarta
10. **Port of Tanjung Priok, DKI Jakarta**
11. Port of Cirebon, West Java
12. Port of Pontianak, West Kalimantan

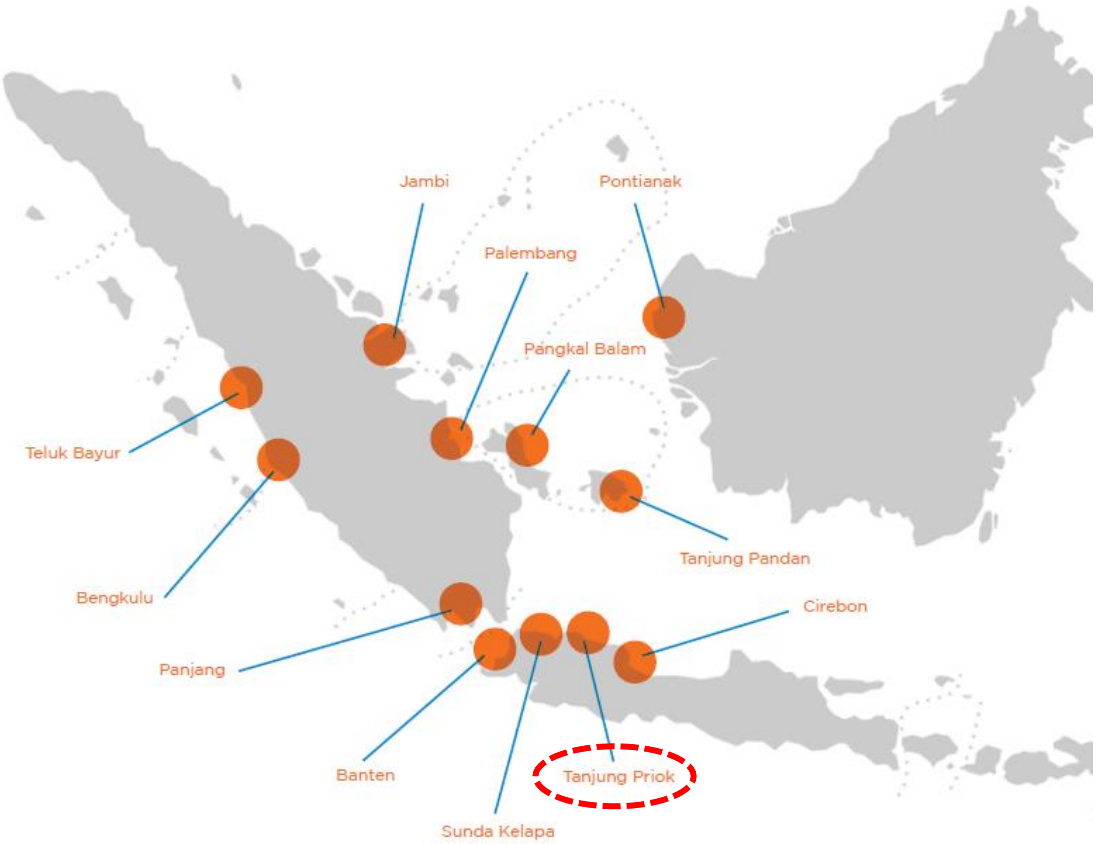

Figure 1-2 Operational areas of IPC (Annual Report IPC 2015)

Significant reforming in IPC as a company occurred in response to globalization challenges. It is divided into three waves (phases), depicted in **Table 1-1**, 2013 as building a foundation, 2015 as providing premium service to the customer, and 2017 as a quantum leap. As can be seen, between 2013-2017, the company wanted to develop the new culture and image of the port through operation, management, human resource, internal and external company's communications, claiming company's assets, etc, called them as soft infrastructure. From 2017 and beyond, the company wants to go to the next level, which is developing hard infrastructure through expansions and building new terminals, including New Priok Terminals.

Table 1-1 IPC company reformation (Annual Report IPC 2015)

(Wave 1; 2013) Building Foundation	***(Wave 2; 2015) Providing Premiun Service to Customer***	***(Wave 3; 2017 -onwards) Quatum Leap***
• ***Strengthen the major operational activities***	• Completing New Priok Container Terminal 1	• Completing New Priok Development
• ***Strengthen human resource capabilities***	• Being consistent with the service excellent to customer	• Making better connection Port of Tanjung Priok to its hinterland
• ***Reaching asset growth up to 20%***	• Giving the best standard of port's service in Indonesia	• Successfully completing the transformation of company
	• Encouraging asset growth up to 20%	• Encouraging the growth of the company
	• Developing an integrated logistic business	• Improving Logistic Performance Index (LPI) of Indonesia (expected to be lower than rank 20 in the world)
	• Taking active role in 'Marine Highway' government program	
	• Encouraging the growth of the company	

1.3 Port Developer/PT PPI (Pengembang Pelabuhan Indonesia)

Figure 1-3 gives the structure of IPC and the state of Port Developer (PT PPI) in the organization. PT PPI is the subsidiary company which organizing planning and construction projects under the responsibility of IPC.

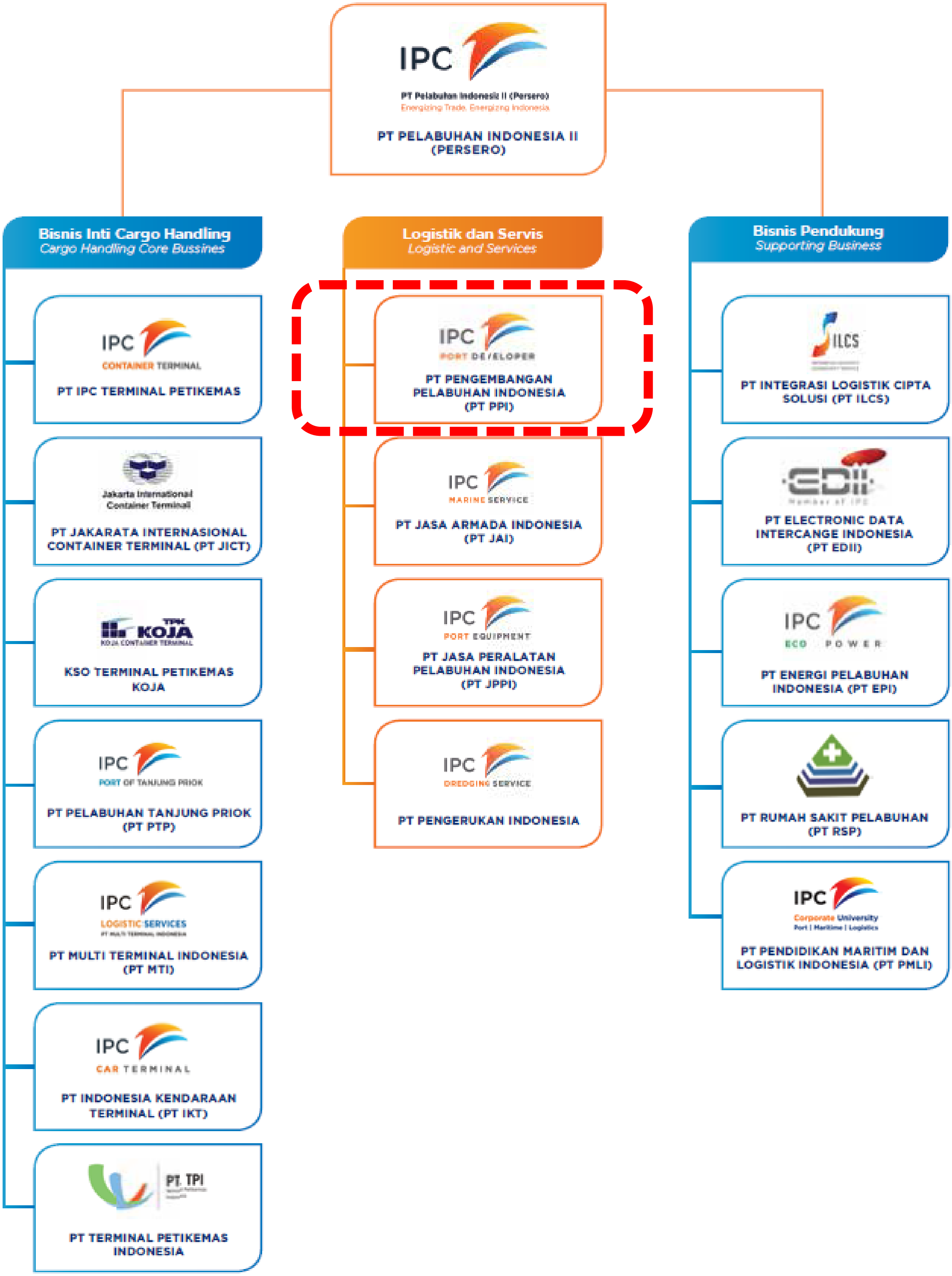

Figure 1-3 The state of PT PPI as subsidiary of IPC (Annual Report IPC 2015)

PT PPI's vision is "*Being a comprehensive solution in the development of port infrastructure in Indonesia*". Some of the company's missions are:

a. Building port infrastructure according to international standards.
b. Creating port facilities which are innovative, superior, and competitive.

c. Increasing national logistic connectivity.
d. Building a successful and mutually beneficial relationship with partners of the company.
e. Providing sustainable added values for all shareholders.
f. Improve the competence, professionalism, and well-being of employees.

Since 2014, PT PPI has been in charge of construction and supervision of New Priok Terminals Development, consisting the development of jetty, yard (deck on piles), dredging and reclamation, access road, and terminal support facilities.

1.4 New Priok Development

1.4.1 Project Masterplan

The development of New Priok/Kalibaru Terminal as an expansion of the old port of Tanjung Priok has been being done by the IPC (Indonesia Port Cooperation)/Pelindo II together with a subsidiary company which is Port Developer (*PT Pengembang Pelabuhan Indonesia*). As stated in the masterplan, from two phases that had been proposed, Phase I has shown its form and Container Terminal 1 has been operated in August 2016. The development process will be divided into Phase I consisting of three container terminals and two product terminals and Phase II.

The old port consists of Terminal I - Terminal III operated for domestic containers traffic, JICT (Jakarta International Container Terminal) operated for export-import, TPK (Terminal Peti Kemas) Koja operated for container service within the port area, and a Car Terminal. **Figure 1-4** shows the old port of Tanjung Priok in Jakarta, Indonesia. **Table 1-2** shows the detail of the terminals in the planning.

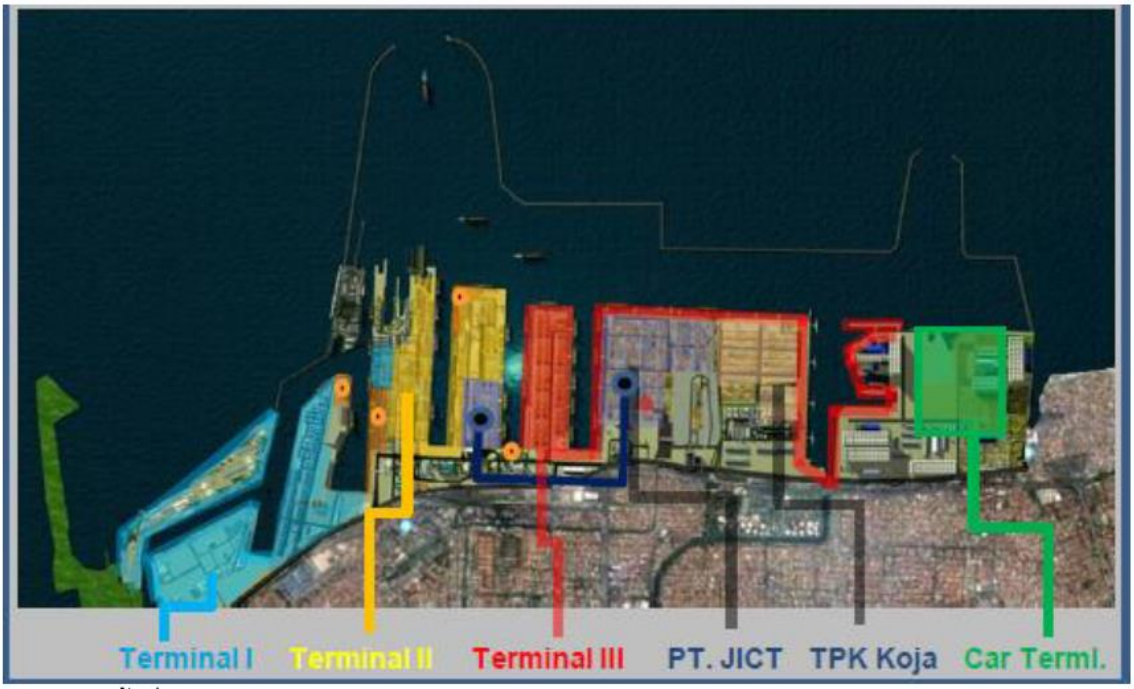

Figure 1-4 Old Port of Tanjung Priok (*http://www.indonesiaport.co.id/*)

Table 1-2 New Priok Development Plan Masterplan (Draft Masterplan 2017)

Terminal	Capacity	Draft	Quay length	Planned operated
Container Terminal 1	1,500,000 TEU/yr	16 m[2]	850 m	2016
Container Terminal 2	2,000,000 TEU/yr	16 m[3]	800 m	2023
Container Terminal 3	2,000,000 TEU/yr	16 m[4]	800 m	2024
Product Terminal 1	5000,000 m^3	16 m[5]	800 m	2027
Product Terminal 2	5000,000 m^3	16 m[6]	800 m	2027
Phase II		2030-onwards		

	Phase I
	Phase II

The benefits of the construction of the new terminals of Kalibaru are:

1. Increase the original capacity of 7-8 million TEUs to 13.5 million TEUs (Phase I).

[2] Available to be dredged until -20 m
[3] Idem
[4] Idem
[5] Idem
[6] Idem

2. Tanjung Priok Port is able to serve ships above 10.000-15.000 TEUs with channel's depth of -16 m (or more).
3. There will be adequate terminals to serve products (oil and gas) with a terminal's capacity of 10 million m^3. These terminals are also planned to be buffer stock for the western region of Indonesia.
4. Create jobs during and after construction.
5. Increasing the land value of reclaimed land and its surrounding.
6. Encourage foreign investors to invest in the operation of the terminals.
7. Create a good image of IPC as a port and company internationally.

The masterplan of Tanjung Priok of 2012 has been evaluated and updated to deal with future (unpredictable) challenges. In the latest update of the masterplan, the focus of the planning will be in Phase I of development to optimize all the terminals. Phase II (2030-onwards) is intentionally left untouched due to a large number of uncertainties in the future. Phase I is divided into three sub-phases and correspond to following time periods (see **Figure 1-5** - **Figure 1**-7):

1. Short term: 2016-2020. Land reclamation for all container terminals (CT I, CT II and CT III), deepening of inner basin, and dredging waterways to -16 m LWS.
2. Middle term: 2020-2025. Land reclamation for product terminals, deepening outer basin, and waterways to -20.5 m LWS.
3. Long term: 2025-2030. Dredging waterways to -20 m LWS.

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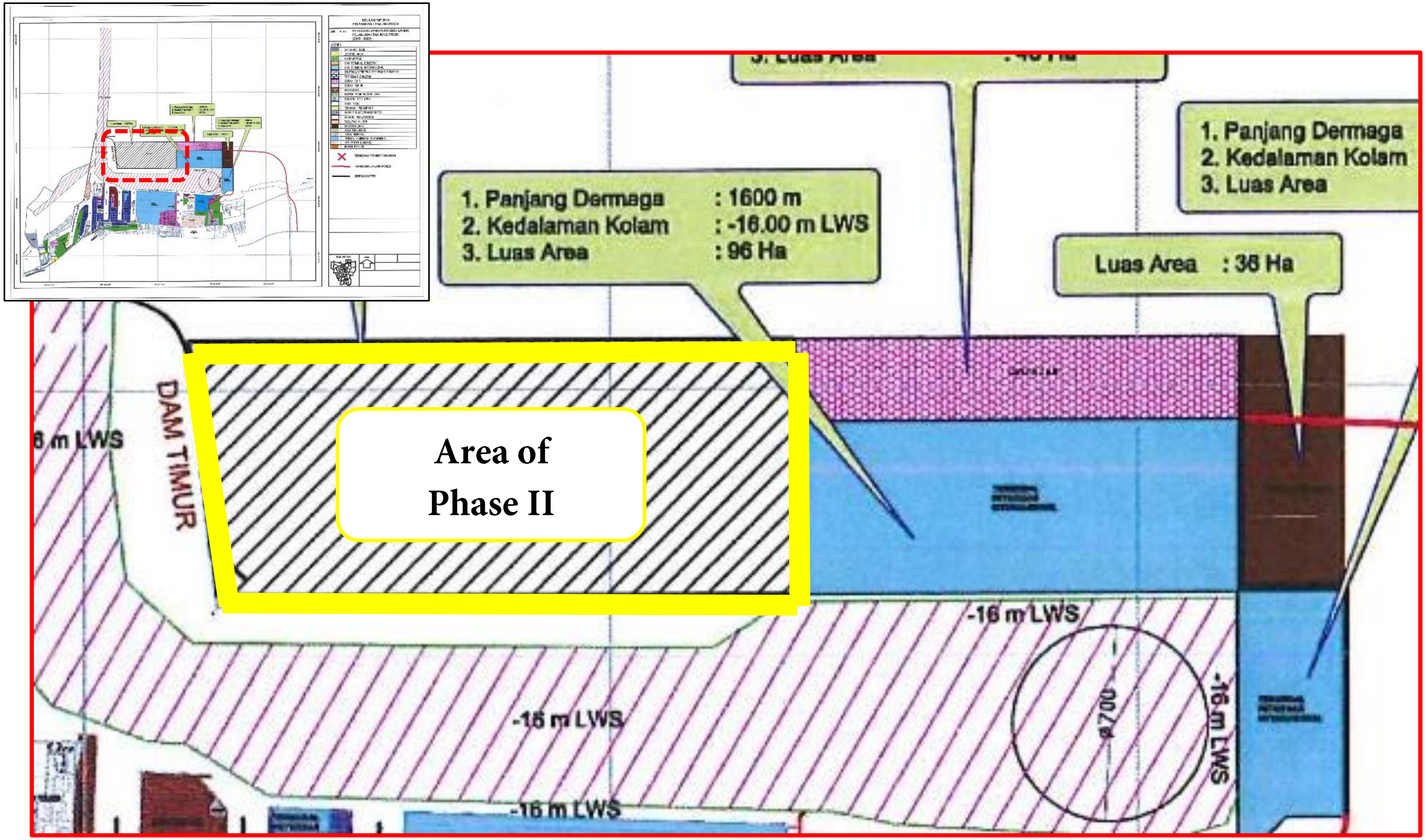

Figure 1-5 Short-term planning of Tanjung Priok (2015-2020)

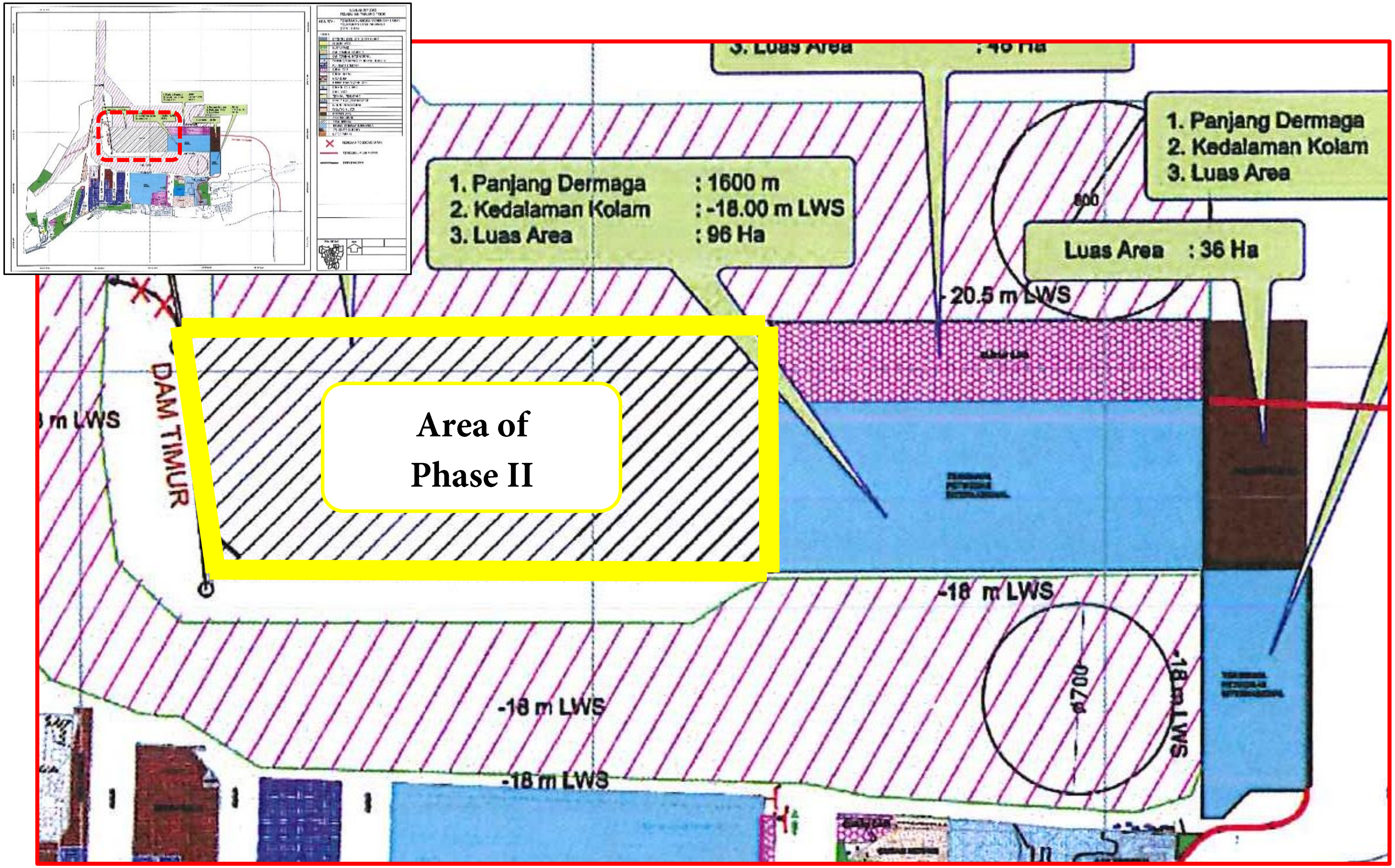

Figure 1-6 Mid-term planning of Tanjung Priok (2020-2025)

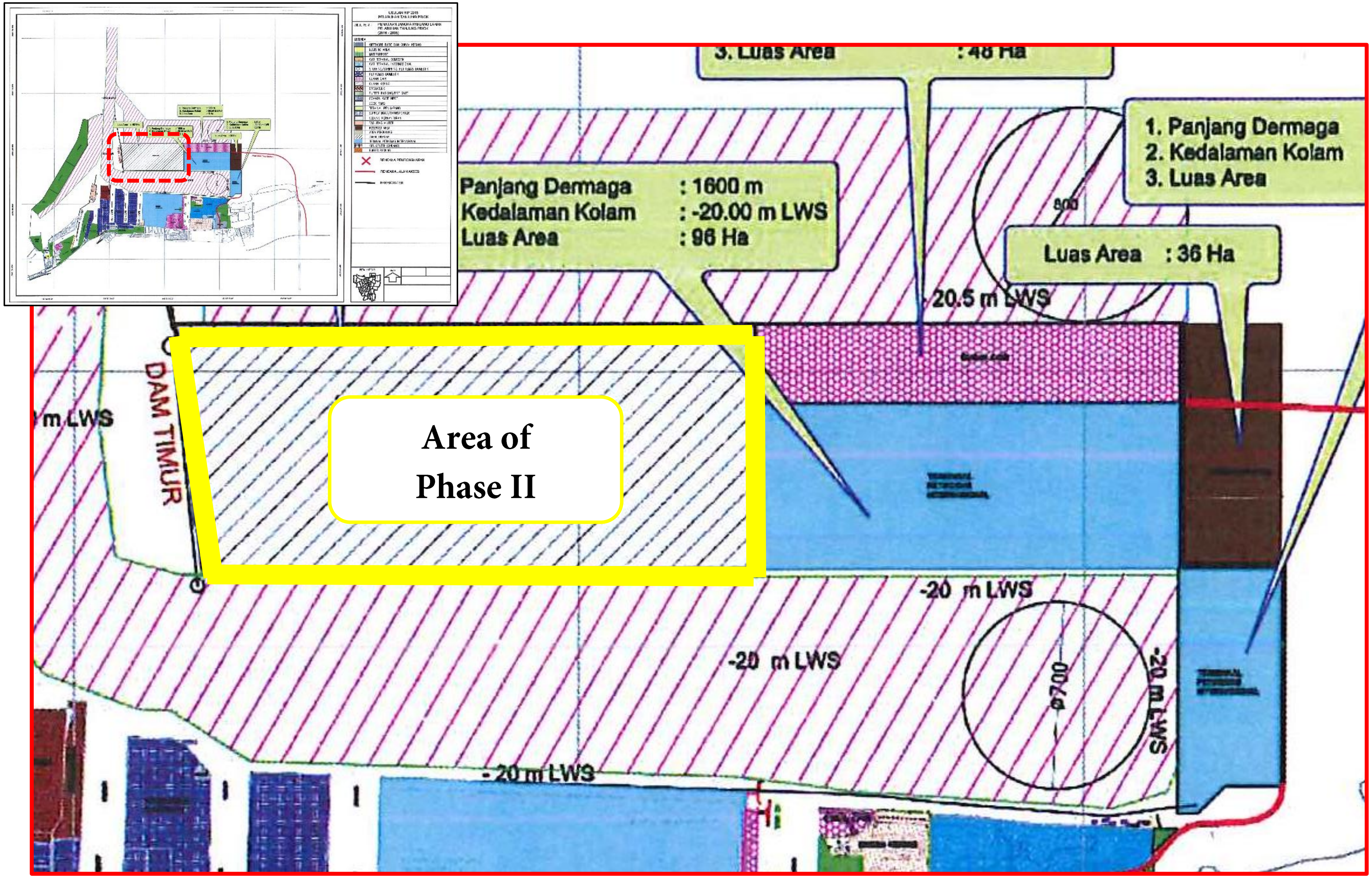

Figure 1-7 Long-term planning of Tanjung Priok (2025-2030)

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1.4.2 Capacity Evaluation

In Tanjung Priok, the domestic containers are served in Domestic Terminals A and B operated by PTP (*Pelabuhan Tanjung Priok*) and MTI (*Multi Terminal Indonesia*). The international containers are served in International Terminals A and B operated by TPK (*Terminal Peti Kemas*) Koja and JICT (Jakarta International Container Terminal). **Table 1-3** shows the specification and evaluation of all existing container terminals in 2014. It is clearly shown the lack of capacity at international terminals.

Table 1-3 Capacity evaluation of all terminals in Tanjung Priok (Draft Masterplan 2017)

Year	Capacity		Terminals			
			Domestic A	Domestic B	International A	International B
2014	Quay area	(unit)				
	Quay length	m	9,364	404	650	2,150
	Depth	m	-8	-8	-14	-12
	(un)loading speed	box/hr/gang	30	30	30	30
	Gang capacity	M	100	100	100	100
	BOR	%	60%	60%	60%	60%
	Quay capacity	TEUs	9,708,180	418,867	673,920	2,229,120
	Container throughput	TEUs	3,404,566	251,232	872,508	2,355,904
	Area evaluation[7]	TEUs	+6,303,614	+167,635	-198,588	-126,784
	Land area	(unit)				
	Existing CY	m^2	742,101	54,020	257,500	596,700
	Needed CY	m^2	373,103	27,532	95,617	258,181
	Needed CFS	m^2	89,990	6,641	23,062	62,272
	Needed parking area	m^2	29,364	2,167	7,525	20,320
	Area evaluation[8]	m^2	+249,643	+17,680	+131,295	+255,927

= lack of capacity

Evaluation:

1. Domestic Terminal A. Basically, it does not have any problem with capacity and land facility. Although for the long term, the land area for CY, CFS and parking place need to be evaluated.
2. Domestic Terminal B. Although this terminal is much smaller compare to the domestic terminal, it does not face the problem in term of capacity.

[7] Area evalutaion = quay capacity – container throughput

[8] Area evalutaion = quay capacity – container throughput

3. International Terminal A. Already in the year of 2014, the terminal could not handle the cargo in term of capacity. The high rate of international container growth will emphasize the need for construction the new terminals immediately.
4. International Terminal B. Again, similar to the previous terminals, it needs an additional capacity for the export-import container is urgent for Port of Tanjung Priok.

1.5 Hinterland Description

Hinterland areas that are served by Port of Tanjung Priok cover Jakarta, West Java, Banten, and some areas in East Java Provinces, see **Figure 1-8**. Based on the study, most of the container flow to/from Tanjung Priok goes to/from the factories in Karawang and Bekasi (all of them in West Java Province). Basically, all nearest areas (three provinces and twelve cities/regencies) as the concentration of container of Tanjung Priok activities is usually called Greater Area Jabodetabek, contributing to the 60% of national export-import activities (MP3EI, 2011).

This hinterland description points the high potential of the hinterland of Port of Tanjung Priok; the centre of economic activity in Indonesia. Numerous industrial areas in satellite cities surrounding Jakarta are contributing to cargo flow in Tanjung Priok. Karawang and Bekasi as two main industrial areas in the hinterland of the port are about 30 km and 50 km away respectively. Although the distances are relatively not far, road capacity could not handle the vehicles anymore and cause heavy congestion. Therefore, finding an alternative way of distributing transported goods is obviously urgent to parse bottlenecks in the roads.

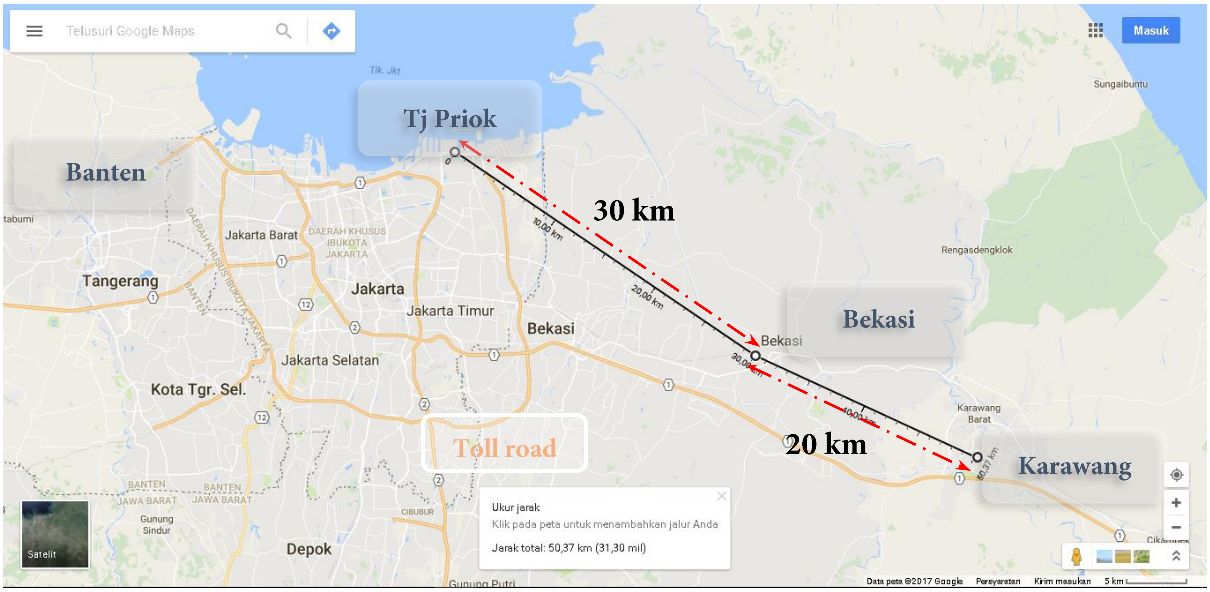

Figure 1-8 Hinterland area of Tanjung Priok (Google Maps, 2017)

As shown in the following graph, in **Figure 1-9**, there are too many vehicles on the toll road and could not be handled by the road capacity already since 2008. The toll road is still the main option of cargo transport in this area, although heavy traffic has to be faced.

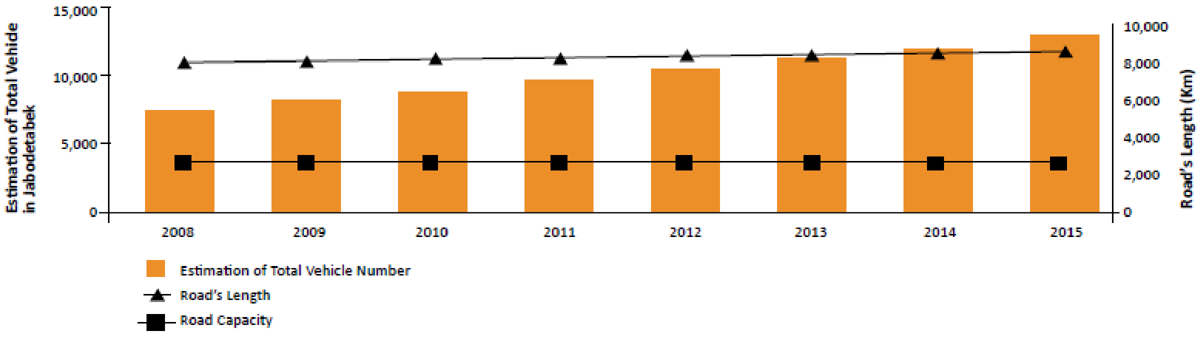

Figure 1-9 Vehicle and road estimation in Jabodetabek (MP3EI document)

1.5.1 Karawang

According to Bappeda (regional development council) in 2014, there were 25 industrial areas in Karawang Regency, but not all of them has operated optimally.18 recorded industrial areas occupied 14000 ha consist of various products, see in **Table 1-4**. Those areas are about 50 km in a straight line from Port of Tanjung Priok. The distribution of type of commodities is shown in **Figure 1-10**.

Table 1-4 Industry list in Karawang (Draft Masterplan 2017, with modification)

No	Industry	Area (Ha)	Type of Industry
1	PT Mitra Karawang Jaya	400	Developer/industrial area (58 industries)
2	PT Kujang Cikampek	100	Fertilizer
3	PT Maligi Permata Industrial Estate	400	Developer/industrial area (58 industries. consist of construction, manufacture, machinery, etc).
4	PT Karawang Jabar Industrial Estate	400	Developer/industrial area
5	PT Hab & Son	350	Developer/industrial area
6	PT Indotaise Indah Development	500	Developer/industrial area (31 industries)
7	PT Mandala Pratama Permai	302.5	Developer/industrial area (2 industries)
8	PT Bintang Puspita Dwi Karya	400	Developer/industrial area (2 industries)
9	PT Surya Cipta Swadaya	1,400	Developer/industrial area (108 industries)
10	PT Hutan Pertiwi Lestari	7,100	Developer/industrial area
11	PT Karawang Tata Bina	300	Developer/industrial area
12	PT Sumber Air Mas Pratama	417	Developer/industrial area

13	PT Rasindo Prakasa	583	Foods
14	PT Pradidana Anugerah	250	Developer/industrial area
15	PT Daya Kencanasia	200	Developer/industrial area
16	PT Canggih Bersaudara	300	Developer/industrial area
17	PT Persada Nusa Makmurindo	300	Developer/industrial area
18	PT Sejati Buana Jaya Darma	200	Developer/industrial area
Total		**13,902.5**	

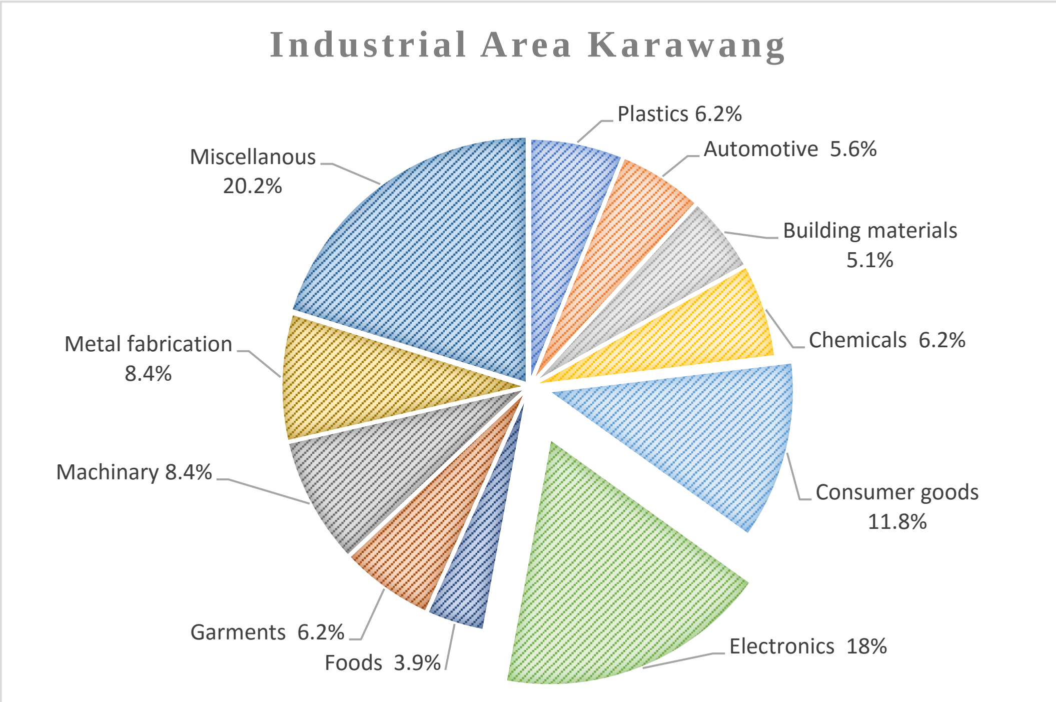

Figure 1-10 Type of industry in industrial area Karawang (BPMPT, 2015)

1.5.2 Bekasi

There are about 16 industrial areas in Bekasi Regency that contribute to more than 75% of PDRB Bekasi (BPMPT based on data BKPM (regional investment coordinator), 2012); contributing to more than 6200 ha area. These areas are spread in the district of Cikarang Pusat, Cikarang Timur, Cikarang Barat, Cikarang Utara, Cikarang Selatan, Tambun Selatan, etc. Their products are very diverse, but most of them export-oriented manufacture. These industrial areas are supported by foreign and domestic investment.

Table 1-5 Industrial areas in Bekasi Regency (Draft Masterplan 2017, with modification)

No	Industry	Area (Ha)	Type of Industry
1	Industrial Area Jababeka	790	Developer/industrial area
2	Industrial Area Jababeka II	250	Developer/industrial area
3	Bekasi Fajar Estate	700	Developer/industrial area
4	Megapolis Manunggal Development	760	Developer/industrial area

5	Lippo City Development	427.4	Developer/industrial area
6	East Jakarta Industrial Park (EJIP)	320	Developer/industrial area
7	Hyundai Inti Development	200	Developer/industrial area
8	Rawa Intan	100	Developer/industrial area
9	Patria Manunggal Jaya	90	Developer/industrial area
10	Jatiwangi Utara	20	Developer/industrial area
11	Gobel Dharma Nusantara	54	Manufacture
12	YKK Zipper Indonesia	20	Textile
13	Kawasan Darma Industri	18	Developer/industrial area
14	Indo Kargomas Persada	230	Developer/industrial area
15	Gerbang Teknologi Cikarang	240	Service
16	Puri Delta Lestari	2,000	Developer/industrial area
Total		**6,219.4**	

1.6 Problem Definition, Research Objectives, and Research Scope

1.6.1 Problem Definition

The development of New Priok as an expansion of Port of Tanjung Priok will be doing in two phases, Phase I will be done up to the year of 2030 and Phase II will be left untouched for 2030-onwards. This research is studying the masterplan of New Priok Development in order to create robust terminals masterplan for Phase II of development. Phase I of development is assumed to be done as planned in 2030. The hinterlands of Tanjung Priok have been congested with the road traffic and need to be considered as well in the masterplan.

1.6.2 Research Objectives

Study the existing masterplan (especially masterplan 2017) of New Priok Development and create a robust terminal masterplan for Phase II of development by implementing Adaptive Port Planning (APP).

1.6.3 Research Scope

The scope of this research is limited to terminal layout for Phase II of the masterplan of New Priok Development at Port of Tanjung Priok, Jakarta, Indonesia. The methodology being used is scenario-based planning in the Adaptive Port Planning (APP) with taking into account related uncertainties of the future confronting by the Port of Tanjung Priok. APP produces an adaptive masterplan by assuming that the future is unknown.

1.7 Research Questions and Sub-questions

According to **Problem Definition, Research Objectives, and Research Scope**, the main research question is:

"How to apply Adaptive Port Planning (APP) in order to develop a robust terminal masterplan for Phase II of New Priok Development?"

To answer this question, some derivative research questions are listed as follow:

RQ 1. What is the current state of terminal development of New Priok Development?
RQ 2. What are the future uncertainties might be faced by IPC during Phase II of New Priok Development?
RQ 3. What are the possible future scenarios of economic, environmental, and social states that need to be considered by IPC for Phase II of New Priok Development?
RQ 4. What is cargo flow and projection for Phase II of New Priok Development based on developed scenarios?
RQ 5. How would Adaptive Port Planning (APP) be addressed in the terminal design layout for Phase II of New Priok Development?

1.8 Research Methodology

In order to complete the research, **Figure 1-11** shows the methodology of the research. The main idea of the research is applying APP framework in order to get the final layout design for Phase II of New Priok Development which will be built later. The outcomes of the research are the study of possible layouts for Phase II and guidance in implementing flexibility concept in IPC.

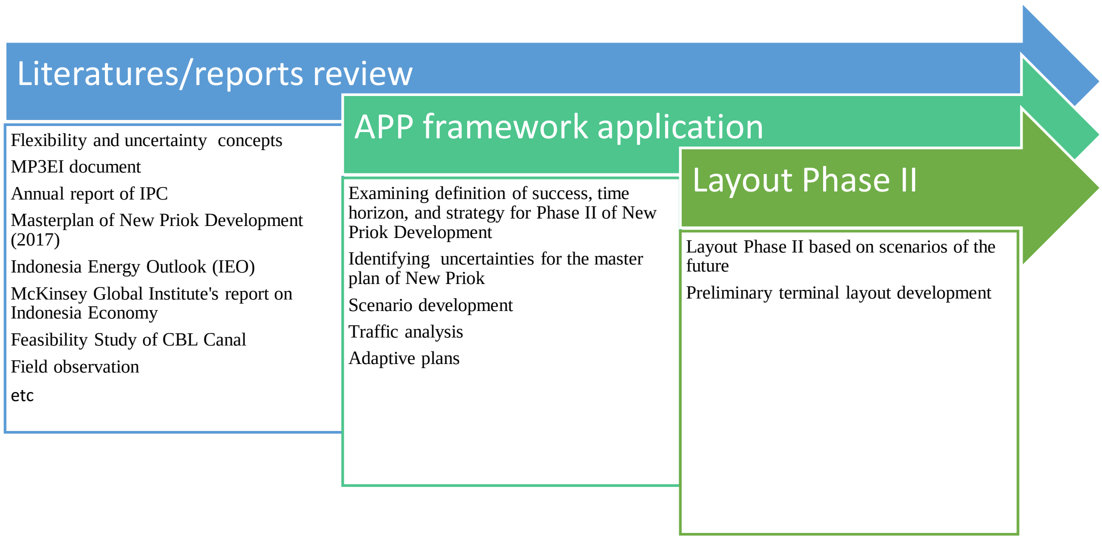

Figure 1-11 Research methodology

1.9 Thesis Outline

There will be some categories of major points of discussion in this research and further shown in **Figure 1-12**, they are:

1. Background and problem definition.
2. Literature reviews of flexibility, APP frameworks, and scenario-based planning.

3. Application of the APP framework to Phase II of New Priok Development.
4. Conclusions and reflections

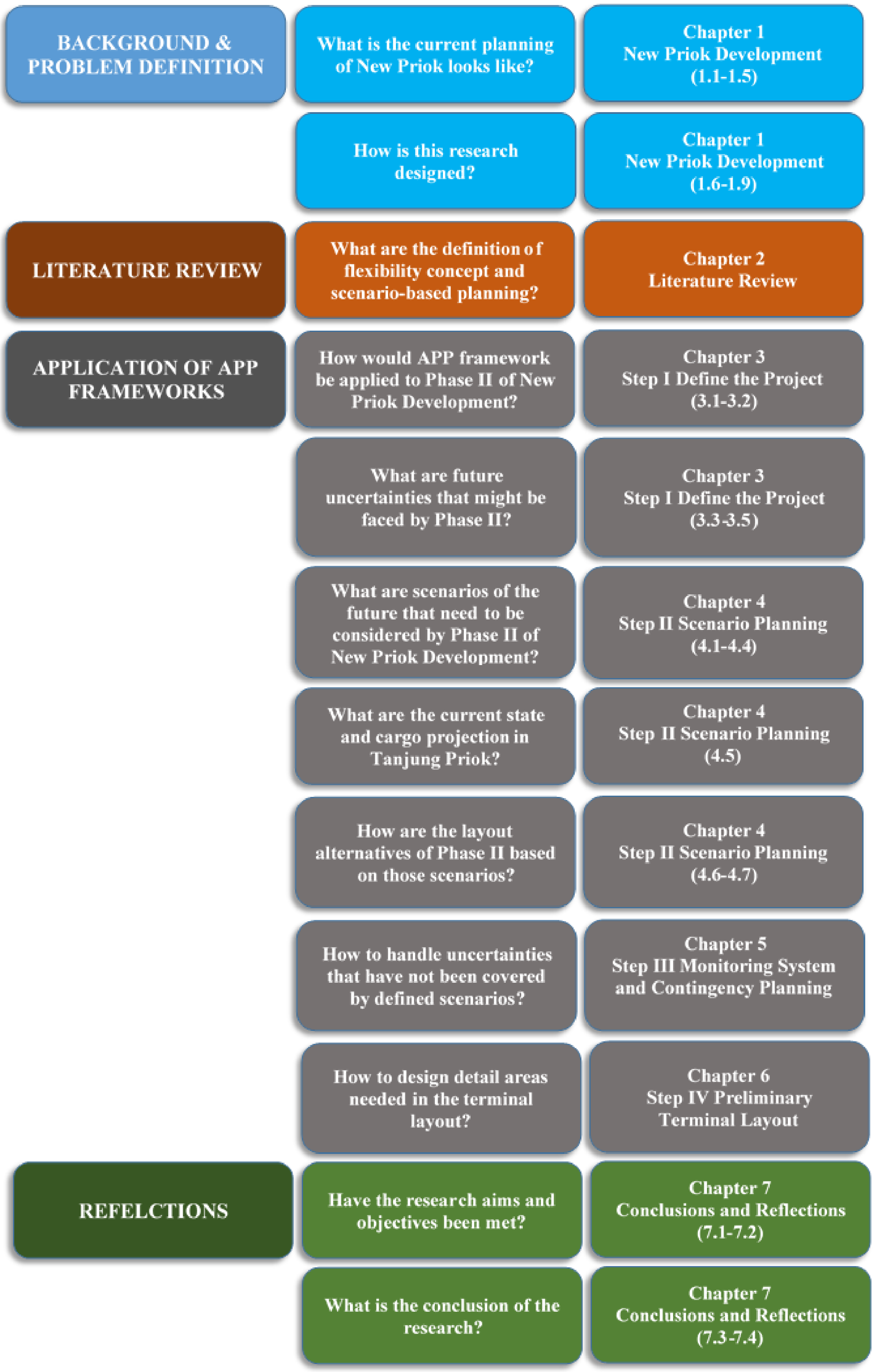

Figure 1-12 Outlines of the research

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Chapter 2 Literature Review

The most beautiful thing we can experience is the mysterious. It is the source of all true art and science

-Albert Einstein

Chapter 2 Literature Review

2.1 Introduction

In this chapter, there will be some literature reviews related to the definition of flexibility, Adaptive Port Planning (APP) framework, and scenario-based planning. Flexibility is important to be implemented in the long-term project like Phase II of New Priok Development. There are three layers of flexibility consist of physical, operations/procedures, and services layer; each layer has its own components to apply flexibility. This chapter is also shown the drivers, barriers, and enablers of flexibility in the port.

In order to implement flexibility, the APP framework is proposed in this study. This framework is basically a combination of two existing methods, which are Assumption-Based Planning and Adaptive Policy Making. The complete framework that used in this study is the result of PhD dissertation of Poonam Taneja (Taneja, 2013) that will be explained further in this chapter.

There are several tools used in APP frameworks, such as brainstorming, scenario-based planning, and Evaluation and Modeling Analysis (EMA). Since the study is about the planning of the long-term infrastructure/port development under uncertainties, APP framework scenario-based planning is applied. In the last part of this chapter, scenario-based planning is explained related to its urgency in the planning, benefits, the area of applying, and the process of applying (matrix approach).

2.2 Flexibility Concept

Ports are beset with many uncertainties about their futures. They are confronted with new demands in terms of functions and scales, new external constraints, and changed expectations, and yet must ensure functionality, capacity and service quality during their design lifetime (Taneja, 2013). The inability to do so can mean costly adaptations for a port or loss of cargo and competitive position. Thus, planning ideally needs to anticipate on unexpected future developments and to ascertain that the infrastructure, once built, continues to function well.

Flexibility has to be a major goal in such a large infrastructure project in New Priok in order to deal with and manage future uncertainties. The phasing of project needs to be adapted and re-look frequently before becoming irrelevant to future challenges. **Figure 2-1** shows three layers of flexibility, consisting of physical, operations/procedures, and services.

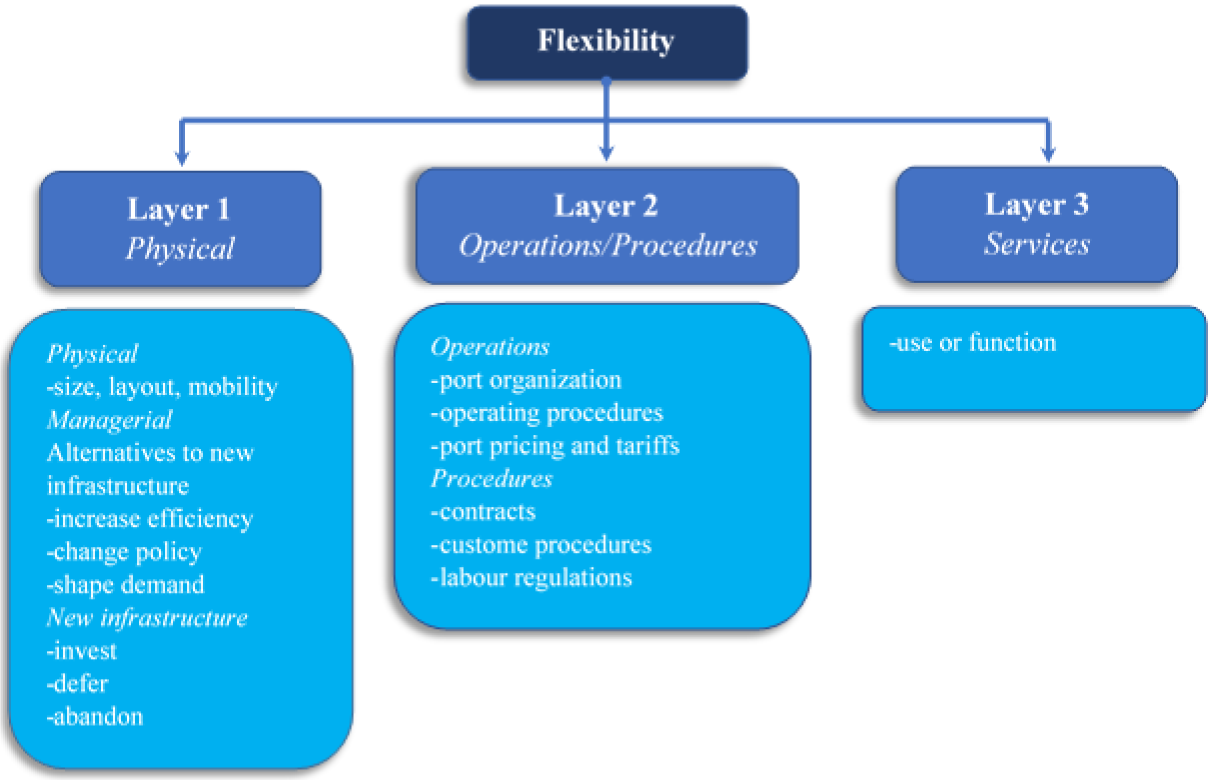

Figure 2-1 Layers of flexibility in port (Taneja, 2012)

Flexibility can also be driven, ceased, and enabled through some items and trends in port planning. Following diagram, as depicted in **Figure 2-2**, shows some indicators of drivers, barriers, and enablers of the flexibility.

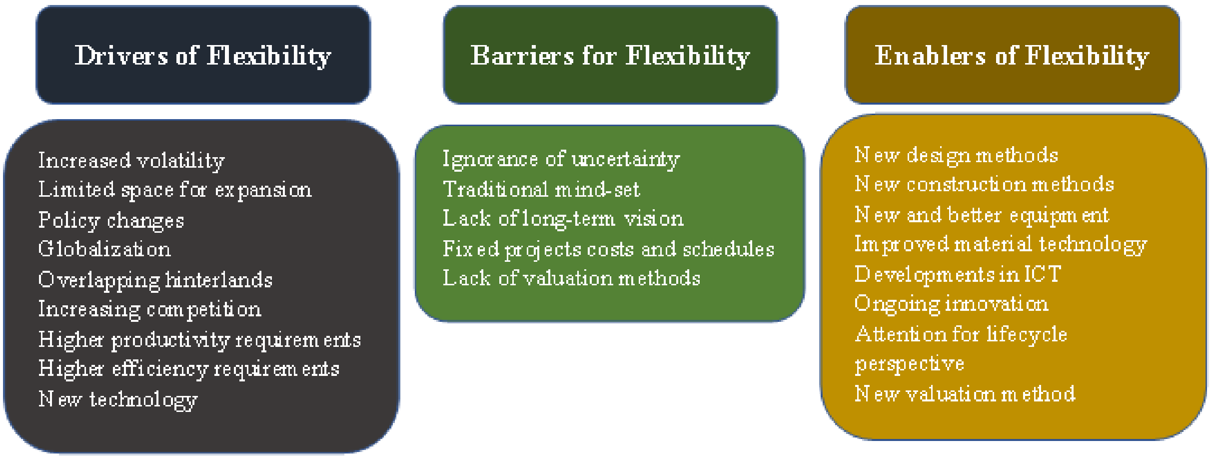

Figure 2-2 Drivers, barriers, and enablers of flexibility (Taneja, 2012)

Solutions of flexibility can be divided into: [1] Physical solutions, all the items related hard infrastructure in the projects. The common things in this type of solution are using modularity, standardization, multifunctional, shorter and longer design lifetime, reusability, etc. [2] Non-physical solutions, these solutions usually related to the planning processes, decision-making, and management of the projects.

The traditional masterplanning does not take any uncertainties into account beyond those included in the scenarios that form the basis of the forecasts. The layouts are prepared for the middle scenario and when the actual development deviates from this scenario, the port is often able to accommodate this by postponing or accelerating the next phase. However, this does not work in case of very drastic changes, such as for instance a strong reduction of coal imports due to the closure of coal-fired power plants.

A new planning approach is required that aims at developing plans that take uncertainties more explicitly into account, and allow for change, learning, and adaptation over time-based on new knowledge and changing circumstances. Such flexible or adaptable plans allow the port to be altered or employed differently, so as to be functional under new, different, or changing requirements in a cost-effective manner.

Analysing planning and design considerations, as explained in **Table 2-1** and **Table 2-2**, are adjusted to address flexibility. The traditional approach is a common practice in the most of the real field of the port projects. New approach proposes the next level approach considering future uncertainties.

Table 2-1 Approach to design and planning projects (Taneja, 2011)

Planning considerations	Traditional approach	New approach
Front-end phase	Not much attention for front-end phase of a project: short-term functional requirements are directly translated into technical specification	More attention for front-end phase of a project: future scenarios are created to investigate long-term requirements
	Design based on fixed specifications	Design based on a range of specifications (includes identifying options that can be translated into strategies for dealing with unexpected events)
Decision making	Premature commitments and lock-ins	Postpone decisions and locking in, leaving room for maneuvering (also known as flexible decision making)
Project appraisal	Evaluation of a single alternative (point-based design)	Keep many alternatives alive (set based design) keeping in mind the uncertainty
	Project business case	Port business case or business case that includes a portfolio of related projects

	Unit of analysis is the project	Unit of analysis includes a wider context than the project
	Evaluate the design using usual cash flow analysis	Evaluate the design and associated flexibilities using a form of options analysis if the design is modular/adaptable or if the project is modular
	Examine the response of future users to the project	Examine the response of future users and society as a whole to the project (this applies to larger projects)

Table 2-2 Design considerations (Taneja, 2011)

Design considerations	Traditional approach	New approach
Terms of reference	Similar projects in similar situations, no room to look at cutting edge technology	Monitor external environment to clear uncertainty and learn from state of the art technology
Specifications	Standards	Additional functional requirements as to safety, sustainability, availability
Design scenarios	One scenario of the most plausible condition	Many scenarios and a range of conditions
Design type	Specific design	Generic design Minimum design
Indicators	Usability Constructability	Maintainability, flexibility, recyclability, availability/usability
Use of resources	Building in redundancy (use of extra resources thought to be more cost-effective compared to later major changes)	Propose flexible resources as being more cost-effective
Costs	Lifecycle costing, including maintenance	Lifecycle costing, including cost and benefits from reuse of structure, components, and materials

2.3 Planning Strategies

Depending on the time horizon of the project, the type of planning that can be distinguished as shown in **Table 2-3**. Phase II of New Priok Development is indeed a master planning of the long-term port project.

Table 2-3 Type of planning based on time horizon (Ligteringen, 2012)

No	Type	Time horizon (years)	Example
1	Long-term	>20	Masterplan
2	Medium-term	5-15	First phase of a masterplan
3	Short-term	1-5	Minor layout changes

Planning strategies can be divided into some terms/periods of related projects. Some elements of related to uncertainty condition, functional requirements, strategy, forecasting, alternatives, project appraisal, and outcomes which are characterized in **Table 2-4**.

Table 2-4 Planning strategies (Taneja, 2013)

	Short term	Medium term	Long term
Uncertainty	Fairly certain	Uncertain	Uncertain
Funtional requirments	Deterministic	Uncertain	Uncertain
Strategy	Predict and act	Adaptive Port Planning	Scenario planning
Forecasting	Single point forecasts with uncertainty margins	A few likely (relevant) scenarios that can be specified well enough	Comprehensive vulnerabilities analysis
Alternatives	Few alternative layouts and designs	Define vulnerabilities and opportunities of alternative(s) within each scenario	Define vulnerabilities and opportunities of alternative(s) within each scenario
Project appraisal	Deterministic business case/decision tree analysis in addition to a MCA (Multi Criteria Analysis)	Stochastic business case including real options	Qualitative evaluation of alternatives in each scenario to arrive at a robust solution
Outcomes	Optimal plan for given assumptions	Adaptive plan robust in many scenarios	Plan with 'static robustness'

Low uncertainty (single future)

This applies to a short-term project, under the assumption that the system is stable, so that forecasting can be carried out based on the extrapolation of current trends. The management objective is clear, and in such a case, the traditional `predict and act' planning approach is adequate (Taneja, 2013). Forecasting method, in this case, could use one forecasting with some margins of uncertainties. The business analysis could be done by using DCF (Discounted Cashflow Method). In order to get the final solution of some alternatives, multi criteria analysis (with weights value determined on the basis of expert opinion) is adequate in decision making. In the end, in this case, few alternative layouts and designs could be produced to get into the optimal plan based on some assumptions.

Medium uncertainty (multiple futures)

For a middle- to a long-term project, scenarios of different futures need to be created (ranking the scenarios or assigning probabilities to them, however, is difficult). The first step is to identify the variables in the system (Taneja, 2013). In uncertain conditions of the future, Adaptive Port Planning has to be applied to the project planning. Forecasting method has to involve scenarios to represent future uncertainties. When carried out within the framework of APP, planning is an iterative and continuous process in which regular updating and reassessment are included.

Deep uncertainty (multiple futures)

For a long-term project involving deep uncertainty, use of scenarios is to be recommended, even though it is hard to attach its probabilities. Scenario planning simplifies the avalanche of data into a limited number of possible states. Each scenario tells a story of how various elements might interact under certain conditions (Taneja, 2013). A detailed narrative could direct some important aspects related to the defined scenarios. Defining vulnerabilities and opportunities need to be done and prepare action plans to adapt the planning.

2.4 Adaptive Port Planning (APP)

One of the frameworks that have been developed by experts in port planning is Adaptive Port Planning (APP). The idea behind APP framework is the adaptation that might be needed at any moment as an answer to a challenge. It is a continuous procedure that aims to increase the lifespan of waterborne transport infrastructure by increasing flexibility in the planning, contracting and design phases (Arecco P, 2015).

The Adaptive Port Planning (APP) frameworks fundamentally have some steps of approaching the planning. This method combines two existing methods in the planning of infrastructure under uncertainty, namely Assumption-Based Planning and Adaptive Policy Making, APP produces an adaptive masterplan by assuming that the future is unknown.

Adaptive Port Planning (APP) aims to achieve flexibility by bridging the gaps in the traditional practices of port planning by incorporating uncertainty and flexibility considerations (Taneja, 2013). It provides a framework for the planner to generate plausible alternatives in the context of the planning objectives; identify critical uncertainties (vulnerabilities and opportunities); and then, to explore, value, and incorporate flexibilities for handling these uncertainties. Subsequently, actions can be taken in the planning stage, or actions can be prepared in advance and taken as events occur. Next, the planner evaluates the alternatives and makes a selection (the value of flexibility is included in the evaluation). During the implementation phase, actions are taken in response to triggers from a monitoring system set up for the selected alternative. Such a monitoring system scans the external environment for new developments and alerts planners of the need to modify or reassess the plan (Taneja, 2013). In the year of 2013, Poonam Taneja explains in more comprehensive in her PhD thesis (Taneja, 2013) about this concept that simply depicted in the diagram in **Figure 2-3**.

Nevertheless, this framework is relatively too general for a specific case issue. In the case of creating masterplan, a financial evaluation to select single alternative are not relevant. The idea of making future planning in our case study is to give the views of future conditions and how to deal with them. Therefore, adapt this framework to Phase II of New Priok Development is one of the important outcomes in this study.

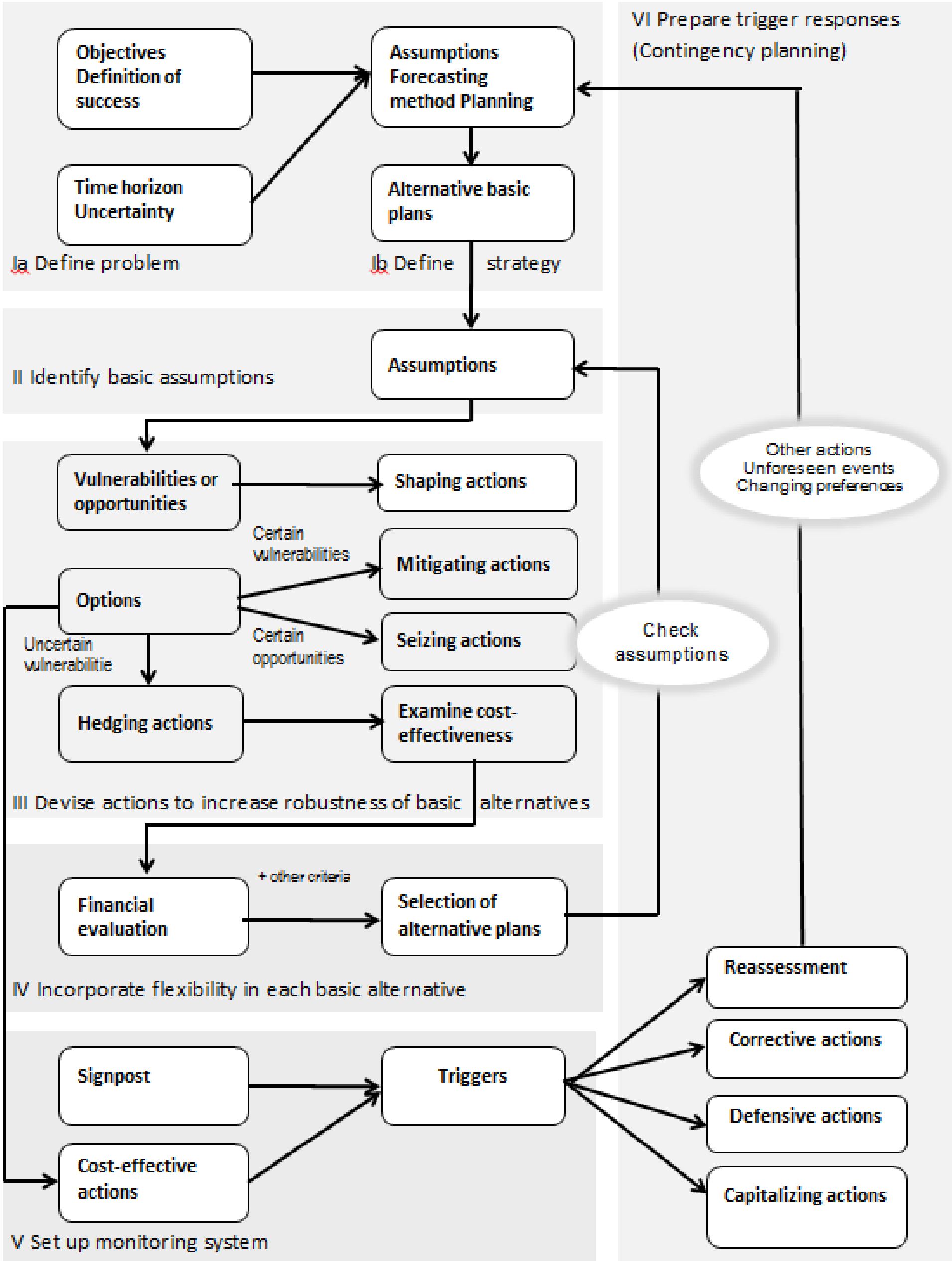

Figure 2-3 Adaptive Port Planning framework (Taneja, 2013)

2.4.1 Step Ia Define the problem/project

The first step involves studying the objectives of the organization and the needs of the stakeholders in order to formulate the goals of the project (Taneja, 2013). Definition of success could be based on the vision and mission or company reform strategy. Certain issues regarding the project could also come from related uncertainties confronting the project. This step has to be defined clearly especially for long term/duration projects.

2.4.2 Step Ib Define strategy and formulate alternatives

Once the project objective is defined, various alternatives can be formulated. In the case of port projects, these can relate to the various port layouts, infrastructure designs or the complete Masterplan (Taneja, 2013). Scenario analysis needs to be done in this process and play an important role. The alternatives are defined based on numerous assumptions and scenarios themselves.

2.4.3 Step II Identify basic assumptions

Identification of assumptions involves thinking about the future, for plausible developments that could occur in the lifetime of a plan and cause the plan to fail (Taneja, 2013). The assumptions come up with regarding the uncertainties, either in favour of the project (opportunities) or drawbacks with the project (vulnerabilities).

2.4.4 Step III Devise actions to increase robustness of basic alternatives

In this step, alternatives are increased through specific actions. There are two basic ways of preparing a plan for vulnerabilities and opportunities, either by taking actions now (in the planning and design phase) or by preparing actions in advance that can be taken in the future, if necessary (Taneja, 2013).

1. A shaping action is an action taken now that is intended to affect the vulnerability of a critical assumption, either by reducing it or changing its nature. shaping actions work either to prevent a (threatening) development from taking place or to steer events towards a preferred scenario. Of course, by far not all developments can be shaped and other actions are required, as discussed below.
2. A mitigating action is an action taken in the current planning cycle to reduce the practically certain adverse effects of a plan
3. A hedging action is an action to spread or reduce the risk of highly uncertain adverse effects of a plan in the current planning cycle, and
4. A seizing action is taken to seize available opportunities that are fairly certain.

2.4.5 Step IV Evaluate and select alternatives

In order to compare the alternatives and choose the most preferred one, it is needed to do an evaluation. Usually, this evaluation related to the financial evaluation (cost-benefit analysis) since the port is usually typical high-investment infrastructure. In any case, the qualitative evaluation could also be done to give strategic views of a project. Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Balanced Scorecard (BSC) can be a tool of non-financial performance measures to traditional financial metrics to give managers and executives boards a more `balanced' view of organizational performance.

2.4.6 Step V Step up monitoring system

Even with actions taken in advance, there is still the need to monitor the performance of the selected alternative and take action if some of the assumptions are failing. This requires an identification of signposts. Signposts specify information that should be tracked in order to determine whether the plan is on course to achieving its success (Taneja, 2013).

2.4.7 Step VI Prepare trigger responses

In this step, the selected alternative is further enhanced by including adaptive elements. A contingency plan is a provision in the plan that specifies how a vulnerability will be handled, in case events or changes cause the vulnerability to appear (Taneja, 2013).

Trigger response critical values of the signpost variables that lead to the implementation of defensive or corrective actions or to a policy reassessment. There 4 types of contingency actions, which are:

1. defensive actions (DA) are actions taken after the fact to clarify the plan, persevere its benefits, or meet external challenges in response to specific triggers that leave the basic plan unchanged;
2. corrective actions (CR) are adjustments to the basic plan in response to specific triggers;
3. capitalizing actions (CP) are actions taken after the fact to take advantage of opportunities that further improve the performance of the plan, and
4. reassessment (RE) is a process to be initiated or restarted when the analysis and assumptions critical to the plan's success have clearly lost validity.

2.5 Tools for Adaptive Port Planning (APP)

2.5.1 Brainstorming Sessions

Brainstorming is a popular approach for encouraging practical innovations in an organization. The participants are theorists, practitioners, and if possible, management. Ideas are generated, subsequently graded by the participants, and only a few survive. Most of the surviving ideas make incremental contributions to the field, and on a rare occasion, there is a breakthrough contribution. An important step within APP is to identify the (relevant) developments that could plausibly happen within the horizon (Taneja, 2013). Most often, this step is done for the first step in APP framework, defining the mutual objective of the project/organization, the definition of success, strategy, etc. If all stakeholders can sit together to discuss all perspectives about project, comprehensive formulation of the project will be achieved and improve the readiness of the project to cope with obstacles.

2.5.2 Probabilistic Approaches

Among other tools, APP uses tools that employ a probabilistic approach. This involves assigning probability distributions to many of the uncertain parameters in the system model, either from empirical data or through eliciting expert opinion (Taneja, 2013). A probabilistic approach is a concept of including all uncertain variables of historical data to support decision making of the future. Although, doing this approach really needs a careful attention of independent and repeated variables which are usually coming up in natural science but not in social science.

2.5.3 Exploratory Modelling and Analysis

Exploratory Modelling and Analysis (EMA) is a technique for analysing the behaviour of a system facing deep uncertainty. It employs the computational power of computers to create a large ensemble of plausible future scenarios, and then uses computer visualization and search techniques to extract information from this ensemble of scenarios that are useful in distinguishing among alternative decision choices (Taneja, 2013). This approach is useful to know comprehensive insights of a system and how it behaves to future uncertainties. In order to do so, complete input about the system is required and it is challenging.

2.5.4 Scenario-Based Approach

Traditional policy analysis compares static equilibria and assumes well-characterized systems capable of manipulation 'from outside'. However, for most real-world policy problems, disequilibrium dynamics are key, uncertainties about the future are real and fundamental, policy-makers have only limited sovereignty, and the best language to capture our understanding of process may not be the best language to debate judgments about outcomes (Walker, 2012). Uncertainties persevere in the real field and they need realize that in the planning process. The current planning practice might not quite enough robust to handle the uncertainties of the future in planning the project.

The scenario-based approach is one of tool/technique in Adaptive Port Planning, besides brainstorm session which is also used in this study as an initial action in the study, probabilistic approaches and Explanatory Modeling and Analysis (EMA) (Taneja, 2013). The scenario approach is about creating the stories about plausible future and preparing for the uncertainties of the future. Scenarios are a set of reasonably plausible, but structurally different futures (Heijden, 2005). Scenarios help to open up the future as a space of possibilities and give the port authority and the port planners a wide-view of the range and impact of uncertainties; see an illustration of scenario perspective in **Figure 2-4**.

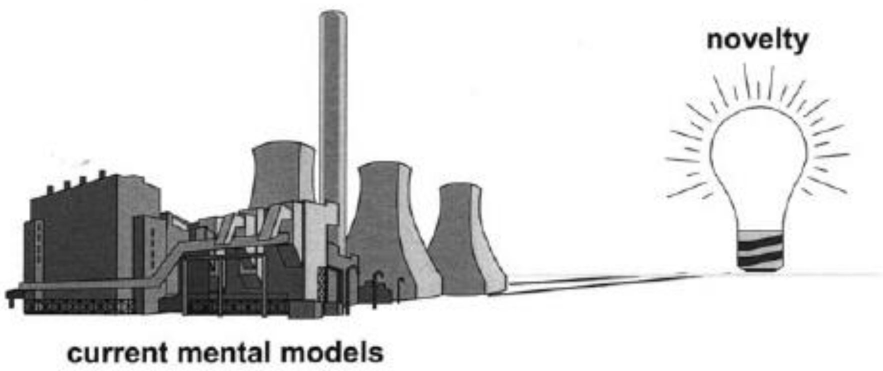

Figure 2-4 Scenario development perspective (Heijden, 2005)

The benefits from using scenarios in long-term planning are threefolds. First, it helps to deal with situations in which there are many sources of uncertainty. Second, it allows examining the `what ifs' related to scenarios. Third, scenarios provide a way to explore the implications of uncertainty by identifying possible future problems and identifying (static) robust strategies for dealing with the problems (Walker, 2012). By successfully identifying the possible scenario of the future, an organization can prepare early the strategic forces to deal with the problem.

Most of the scenario-based planning use "Matrix Approach". It is particularly appropriate in situations of considerable uncertainty, where a few dimensions delineate much of what we know about the situation in the future. The scenarios tell the stories of how the world moved on from history and the current reality to arrive at these very different situations as specified in terms of the scoping outcomes of the scenario dimensions in the horizon year (Heijden, 2005).

Scenario-based planning has an important and direct role in master planning. As masterplans tend to be of a long-term nature there will be a lot of uncertainty to be considered in their development. The master planner can improve his/her understanding of the potential and uncertainty involved in developing a number of suitably focused scenarios through which masterplans can be tested (Heijden, 2005).

2.6 Conclusion

Literature review shows that flexibility/adaptability is extremely needed for long-term projects with deep uncertainty (multiple futures) and massive port projects. Adaptive Port Planning (APP), a combination of adaptive policy making and assumption-based planning, offers a comprehensive framework to make robust port master planning. One of the tools of APP is scenario-based planning which is about creating a plausible story of the future.

There are six steps in the basic framework of APP which are defining problem and strategy, identifying basic assumptions, devising actions, selecting alternatives, creating monitoring system, and making the contingency plan. However, in order to operationalize this framework, we need to modify it in order to be fitted in a specific context. The modified framework of APP can be found in the next chapter, **Chapter 3**.

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Chapter 3 Step I Define the Project

It is not enough to do your best.
You must know what to do and then do your best

-W Edwards Deming

Chapter 3 Step I Define the Project

3.1 Introduction

In this chapter, the framework of Adaptive Port Planning (APP) Scenario-Based Planning for the terminal masterplan for Phase II of New Priok Development is developed. This framework is simpler by taking out the step III (devise actions) and IV (selection of alternatives) from the original framework of APP in the analysis.

This chapter is also about the application of step I of Adaptive Port Planning (APP) framework Scenario-Based Planning. It defines one of the important components in APP framework, uncertainties of the future of Tanjung Priok which determine scenario development in the next step of the framework. Based on the definition of major future unknown parameters and related documents/reports, ten uncertainties have been defined. Each uncertainty will also be explored based on recent data in Indonesia in general and Tanjung Priok in specific.

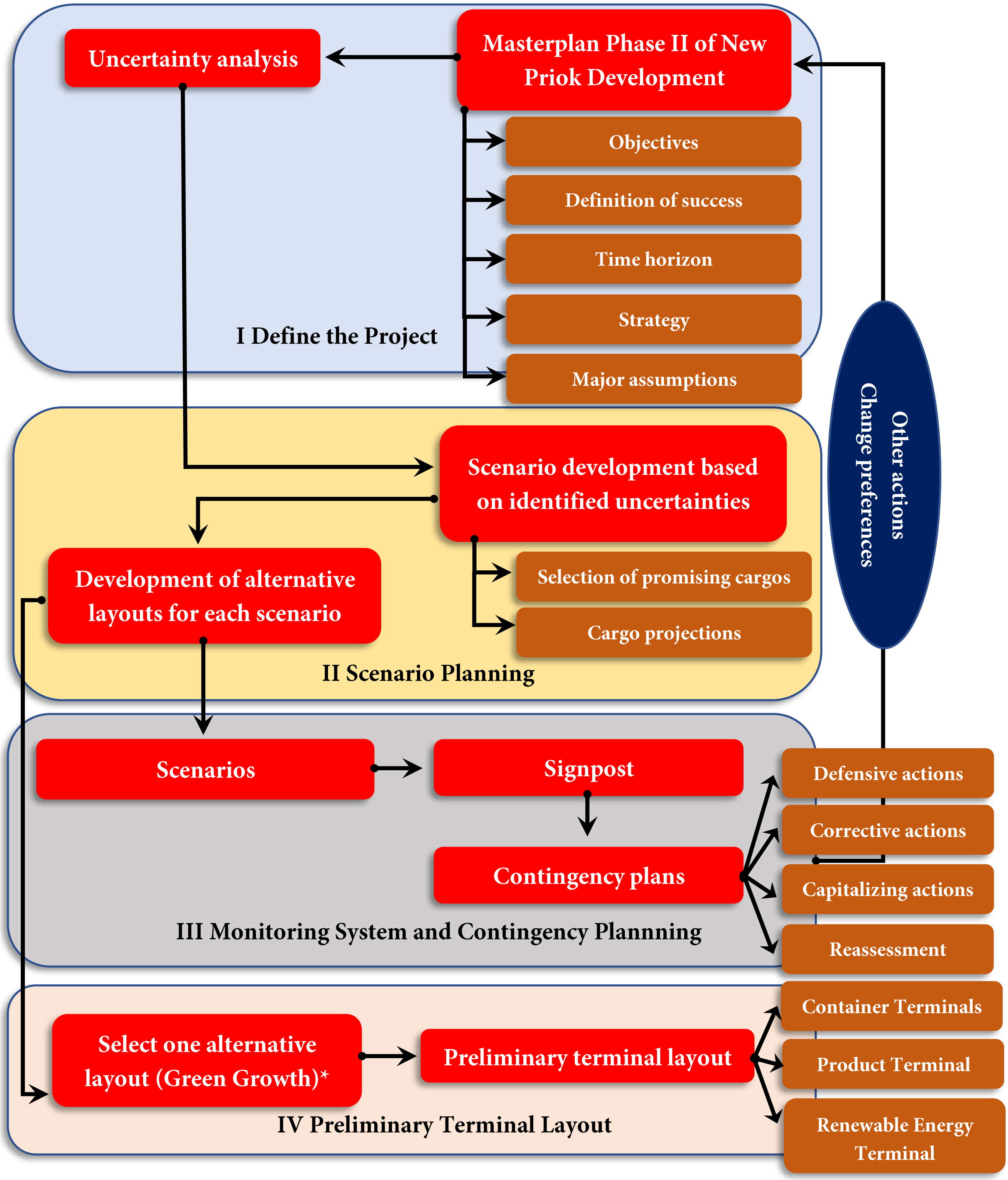
3.2 Framework of Adaptive Port Planning (APP) Scenario-Based Planning

An appropriate and suitable framework for the case study (deep uncertainty) in this research is Adaptive Port Planning (APP) Scenario-Based planning. This study gives the perspective of the future through scenarios, hence, some steps in the original working flow are not used, step III (devise actions) and step IV (selection of alternatives). Those steps are considered not relevant to the analysis of scenario-based approach. The framework of APP Scenario-Based Planning that used in this study is depicted in **Figure 3-1**.

This framework will be applied step by step regarding the context of the case study. In each step, detail sub-steps will be depicted before the further explanation. In the other words, this framework also shows the work flow of the analysis in this study as a whole. Basically, there are four basic steps in this framework:

1. Step I: Define the project. This step will explore more detail about the aims of the project and how it is approached. The uncertainty analysis has to be done in this step in which it will be the basis of the scenario development in the next step.
2. Step II: Scenario Planning. This step will develop scenarios of the New Priok in the future. The scenarios will be the basis of doing projection in the most promising cargos in the port (containers). In the end, projections can be translated into dedicated areas for the layout of the port.
3. Step III: Monitoring system and contingency planning. We have realized that not all of the uncertainties could be covered in the scenarios. This step is aimed at monitoring the signposts (those uncertainties which are not covered yet by scenarios) and prepare for contingency planning, either by doing a defensive action (DE), corrective action (CR), capitalizing action (CP), or reassessment (RE).

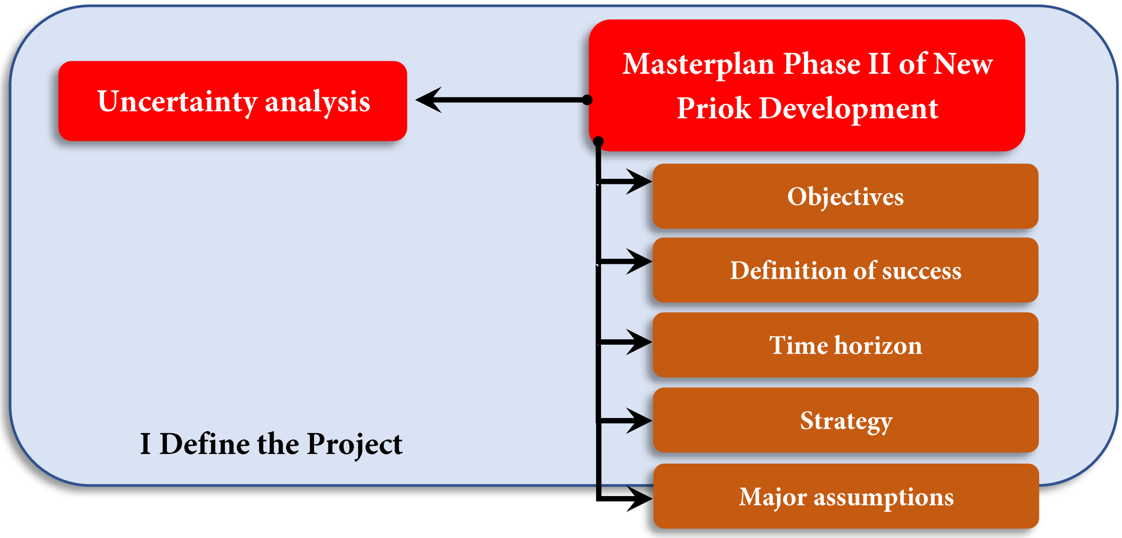
4. Step IV: Preliminary terminal layout. Alternative layouts could have been detailed for each cargo in this step. Some elements, ship design, handling, and storage areas in the terminals, have to be considered in the design.



Notes:
*selection of one scenario for demonstration purpose only

Figure 3-1 APP framework Scenario-Based Planning

3.3 Step I Define the Project



Some documents that are relevant to be studied:

1. Masterplan of Tanjung Priok, PM38 and Draft Masterplan 2017 as basic plans of New Priok Project which was made by Ministry of Transportation of Republic Indonesia as Port Authority of Port of Tanjung Priok.
2. MP3EI (Masterplan of acceleration and expansion of Indonesia economic development 2011-2025). This document tells economic's planning of Indonesia for a long-term period which was made by Coordinating Ministry for Economic Affairs of Republic Indonesia.
3. McKinsey's report on Indonesia maritime economy, 2012. This document analyses the economic condition and the planning of maritime transportation of Indonesia for the future.
4. Indonesia Energy Outlook 2016. This document is an energy planning for a long-term period of Indonesia which was made by National Energy Council (*Dewan Energi Nasional*).
5. Feasibility study of CBL canal, 2016. This document is a feasibility study of the development of CBL (*Cikarang Bekasi Laut*) Canal which was made by PT PPI.

The objective of this study has been explained in research objective, creating the robust terminal masterplan for Phase II of New Priok Development. The objective could be met (in which we call the definition of success) through several processes, which are:

- Creating scenarios of the future,
- Developing the alternative layouts,
- Setting up monitoring system and contingency planning

Time horizon of this planning related to Phase II of New Priok Development, is 2030 - onwards.

In this study, the strategy for New Priok to cope with future uncertainties is developed by using Adaptive Port Planning (APP). As discussed in **Chapter 2**, there are several tools used in APP framework, such as brainstorming, probabilistic approach, scenario-based planning, and Evaluation and Modeling Analysis (EMA). Since this study is about the planning of the long-term infrastructure/port development under uncertainties, APP framework Scenario-Based Planning is applied.

We have recognized that it is not possible to define the future as one picture, and we need several alternatives/scenarios. Each scenario tells a story of how various elements might interact under uncertain condition (Taneja, 2013).

Some major assumptions which are related to the current masterplan of the project are:

1. The vessel sizes consideration.
2. The traffic volume of the future for Phase II of New Priok Development.
3. The choice of cargo sectors to be handled in Phase II of New Priok Development.
4. The planning of modal shift of the hinterland cargo to the water transport through CBL (Cikarang Bekasi Laut) Canal is taken into consideration for scenarios development.
5. The development of Port of Cilamaya (Patimban) is not taken into consideration for scenarios development. This port will be located 100 km to the eastern part of Tanjung Priok. The discussion of the development of this port is the domain area of the Ministry of Transportation of the Republic of Indonesia. This development will directly affect the cargo volume (and projection) of Tanjung Priok since it will serve the same hinterland as Tanjung Priok. This factor will be treated as separated analysis to see its impact on planning.
6. Existing state regulation/law regarding port management in Indonesia (*undang-undang dasar no 17, 2008*) is not taken into consideration for scenarios development. This factor will be treated as separated analysis to see its effect on the company.

3.4 Uncertainty Analysis

3.4.1 Introduction

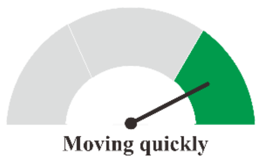
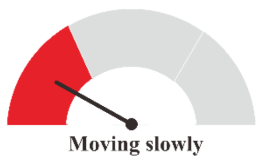
The most interesting part that port planners have to deal with is the future uncertainties. There are so many unknown things about the future states. However, we need to plan/build something at the moment. Therefore, defining those uncertainties urge to be done in order to prepare for actions plans needed.

The major unknown parameters related port planning and design are possible crises on global demand, trade, and finances; changes in global production patterns; availability and uses of natural resources; shift of economic influence to developing regions; demographic distribution, population aging in developed countries and population growth in emerging countries; scarcity of land; transport-related technological innovations; climate change and natural disasters; environmental preservation; energy costs and sustainability growth (Arecco P, 2015).

For Port of Tanjung Priok, relevant uncertainties that could affect the port planning in the future have been identified (see **Table 3-1**). Those uncertainties are extracted from the definition of major future unknowns and relevant documents that have been mentioned before. Those uncertainties are categorized on the basis of three speeds related to intention government or corporation to address the problem, which are:

1. Moving slowly. Categorized as very low willingness/actions to adapt to the uncertainties. Sometimes it could be due to lack of information.
2. Moving steadily. Categorized as relatively staying similar to the current condition. This could be seen by extrapolating recorded information from the past until present circumstance, which they stay look-alike.
3. Moving quickly. Categorized as very high willingness/actions to approach the uncertainties which are confirmed through the formal programs or documents of related stakeholders.

Table 3-1 Uncertainties for Port of Tanjung Priok

No	Uncertainties	Rate of change
1	National Connectivity Will • MP3EI document (political willingness of connectivity and investment planning in ports)	
2	Global and Regional Economy • Increasing international trades of the country • New Priok Project	
3	Cargo Growth • GDP growth could amplify cargo growth • New Priok Project	
4	Mega Ship Development • New Priok Project → deepening of basins	
5	Hinterland Connection • Feasibility study of CBL canal	
6	Sustainability Regulation • Planet and profit analysis (√) • People (×)	
7	Bonus Demography • Realize in the MP3EI • No specific programs prepared	
8	Future Energy Source • Low implementation of renewable energy • The current masterplan is high allocated for fossil resources	

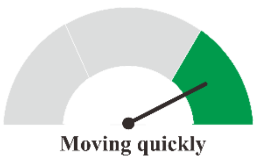
9	Future Technology of Transport • Lack of automation and robotization
10	Climate Change • No specific government body or programs to anticipate • Lack knowledge of climate change

Note: These uncertainties will be explained later

Key observations:

1. There is a strong national will to make the better (maritime) connection from the decision makers through MP3EI and capital allocation of specific sectors. This willingness is promoted by the big chance of growth of containers in the near future.
2. There will be a big chance in terms of national economic growth and capital in the coming decades. This is supported by the transformation of the demography of Indonesia. However, the last term is not clear yet on how the government or corporation will deal with demographic transformation.
3. The need to distribute the ratio of trucking in the port's hinterland is really high and make the heavy congestion diminish. The project of Cikarang Bekasi Laut (CBL) Canal is a great deal to make a much better concept of multimodal in Tanjung Priok.
4. There is a global will in applying the concept of sustainability in which each project has to consider the people, planet, and profit (PPP) simultaneously. Although at the present condition, sustainability factor is still often abandoned in Indonesia, the future generation will probably take it into main consideration.
5. There will be a big chance of changing the pattern of energy fulfilment in the future, especially when the Phase II of New Priok is built in 2030. Perhaps, the era of fossil fuel will end and sustainability demand will become high. Considering this change, the port has to be adaptive and the need of product terminal in the present masterplan might shift to renewable energy terminals.

3.4.2 National Connectivity Will



MP3EI is a bundle of the document containing long-term economic planning of Indonesia development made by Coordinating Ministry for Economic Affairs. It is stressed that national connectivity is going to be the concern for the government through the economic corridor in each island of Indonesia (see **Figure 3-2**).

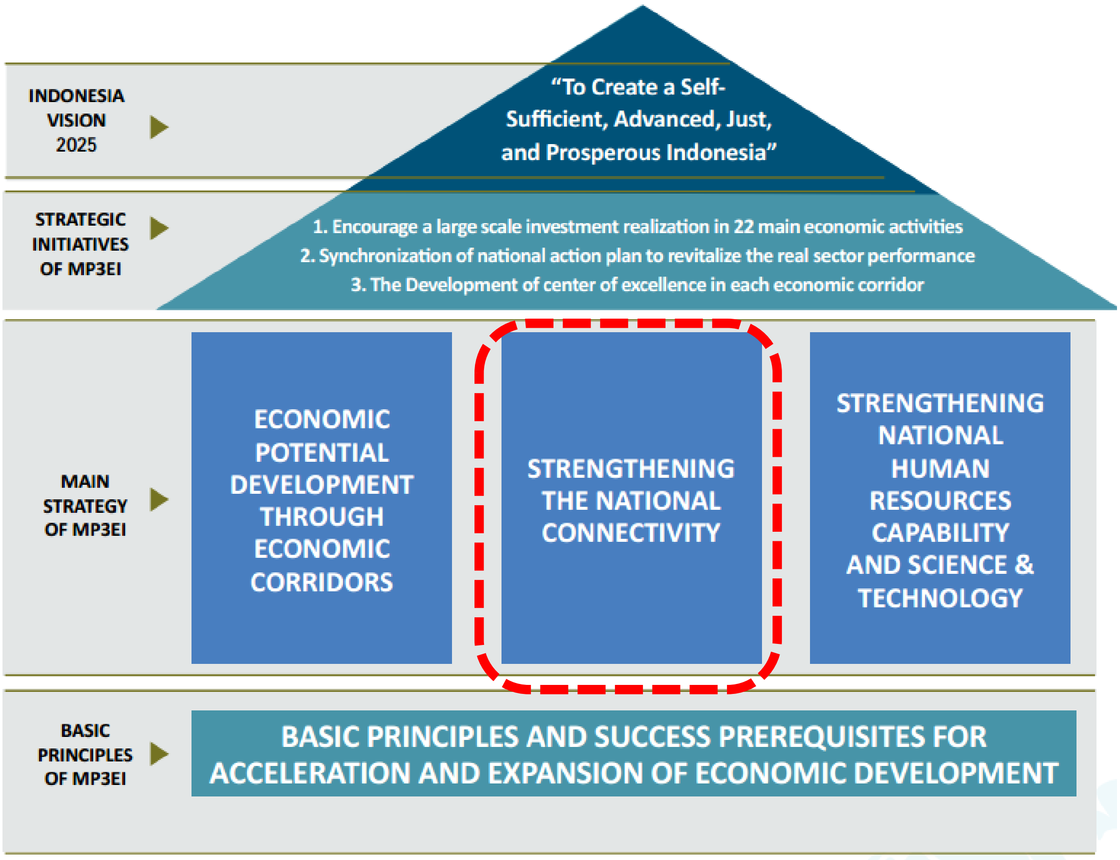


Figure 3-2 Three main strategies of MP3EI (MP3EI document)

For Java, where the IPC is serving, there are manufacturing, textiles, FMCG, shipping, military equipment and telematics industries. Most of the government investment is applied for the infrastructure development. For port itself in Java, about 45 trillion rupiahs or 30 billion euros (equal to 5.63% of total infrastructure investment in Java) has to be invested to develop and expand the ports (shown in **Figure 3-3**).

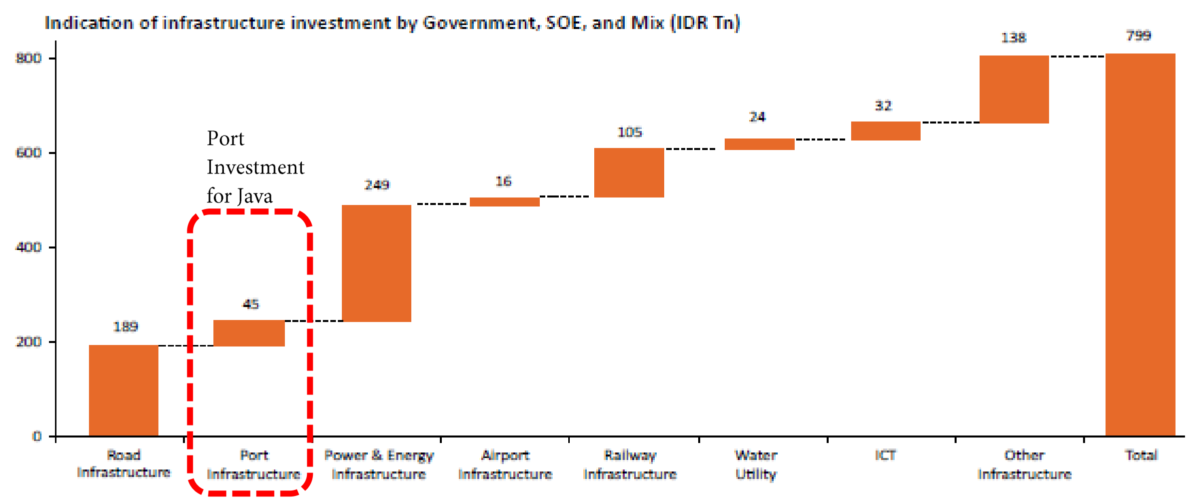


Figure 3-3 Investment indicator for Java Island (MP3EI document)

Considering these political willingness and investment planning, national (transport) connectivity will be highly significant affect Port of Tanjung Priok. Since this document is one of the main focus of incumbent government, the adaptation to national connectivity is categorized moving quickly.

3.4.3 Global Trade and Regional Economy

The rise of Asia economy has triggered the growth of economic activities for Indonesia. Indonesian export has reported significantly rise up and projected to be continuously increased. It has been stated in the data in the year of 2000, $68 billion as export activity has risen up to $127 billion in 2010, growth 7% per year. Japan is still the largest destination for Indonesia's product, followed by China, United States, and Singapore (see **Figure 3-4**).

The most interesting thing is the huge annual growth of export to China (15% per year) and India (20% per year) as the Asia's Renaissance (high economic growth as depicted in **Figure 3-5**). Both countries have been being the new big player in the global economy through their risen trade. In 2010, Indonesia exported $2.1 billion of palm oil and $3.6 billion of coal to China and $3.8 billion of palm oil and $2.1 billion of coal to India. China is currently the biggest importer of Indonesian coal (BPS, 2016).

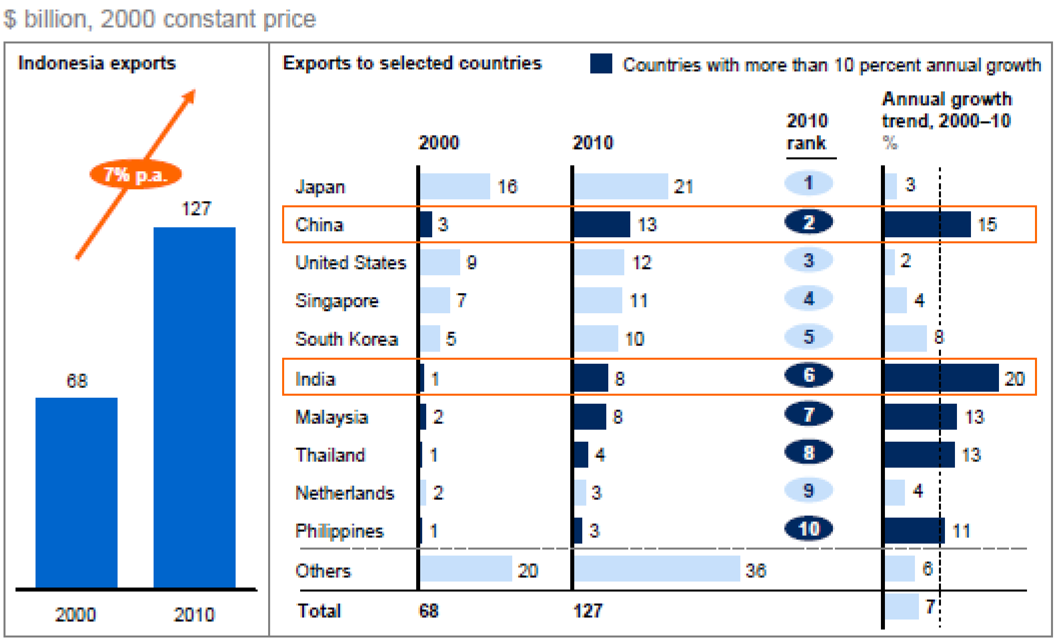


Figure 3-4 Indonesia export statistic and Risen of Asia (McKinsey Global Institute)

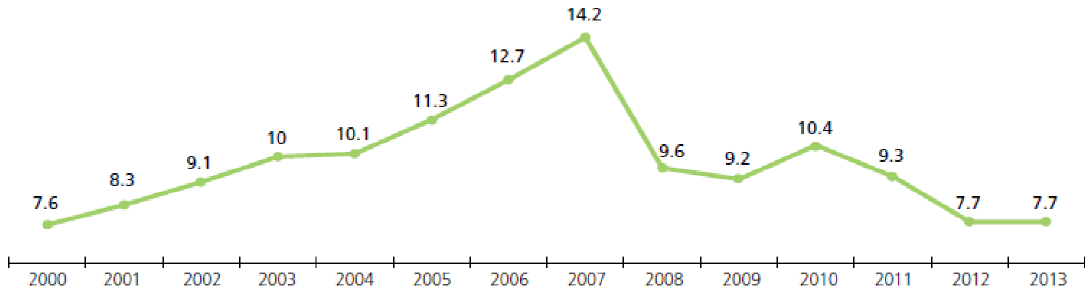


Figure 3-5 Chinese (high) growth record (world bank, IMF)

The contribution of export for GDP is about 35%, summing up commodity and non-commodity exports (McKinsey, 2012). The most significant share of GDP is domestic consumption (government and private consumption, fixed investment and inventory), which is about 65% of GDP. This condition is not the same with neighboring countries, like Thailand and Malaysia. Their GDP share is dominated by export activities (see **Figure 3-6**). This apparently explains the robustness (growth still positive although in crisis condition) of Indonesia's economy to overcome global crisis within last decades.

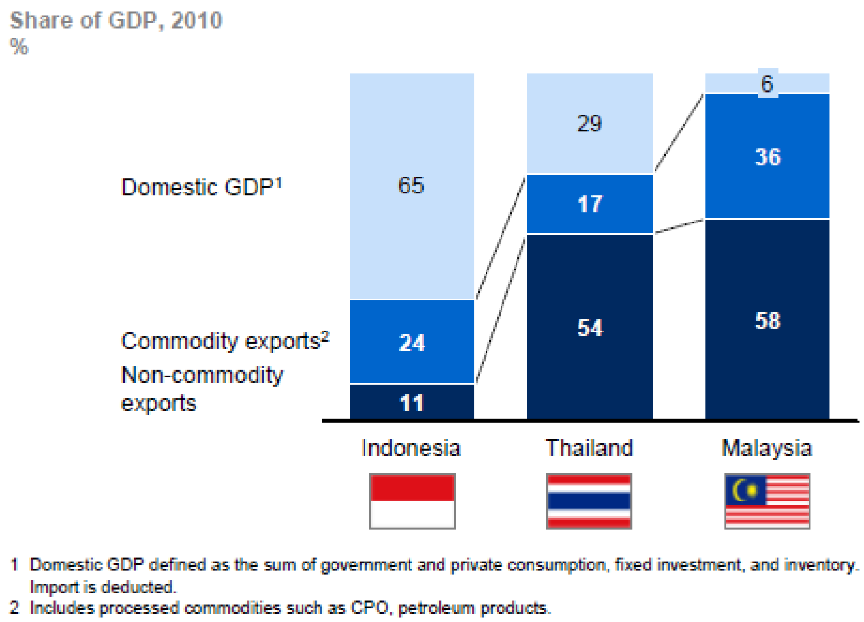
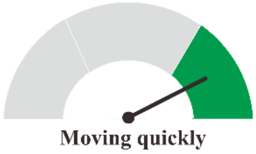


Figure 3-6 Share of Indonesian GDP (McKinsey Global Institute)

All in all, Indonesia economy is influenced by global and regional economy condition, global stability tends to stabilize domestic economy and vice versa. The good news is domestic consumption has been dominated GDP share and Indonesia does not really need to be worried about global condition, as long as they keep local circumstance work well.

Considering to the pattern of handling goods in Tanjung Priok which is dominated by International cargo instead of domestic cargo, global and regional trade will tend to make a change to Tanjung Priok. New Priok project is dedicated to the overseas trade and serving bigger container ships. Hence, adapting to global and regional economy is categorized moving quickly.

3.4.4 Cargo Growth



Port activity cannot be separated from economic activity in particular country. Therefore, talking about GDP growth is very relevant for IPC to look up the planning of the port. There is a myth that Indonesian economy is unstable and not very attractive in term of the investment. In fact, GDP of this country has been highly growth. The growth of GDP is about 5.2% with relatively small standard deviation from the year of 2000-2010 (see **Figure 3-7**).

Nevertheless, due to globalization, the port should be very careful and need to frequently see the world condition that affecting the fluctuation the national economic condition. Current economy growth is slowing down a little below 5% (BPS, 2016), lower than the government target of 6% due to its vulnerability to global economic trends.

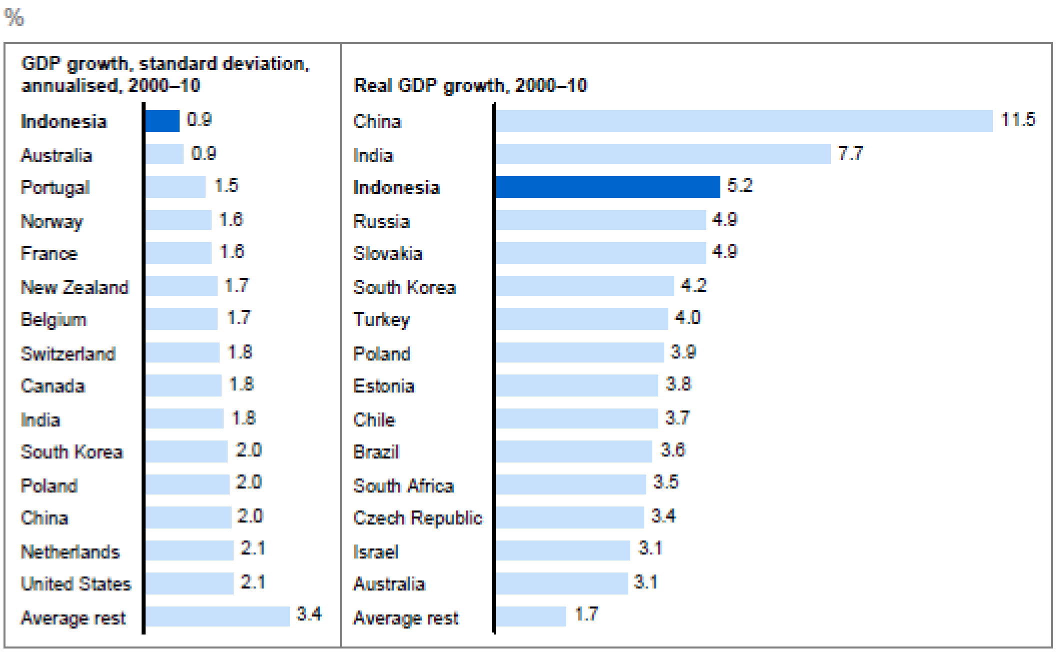
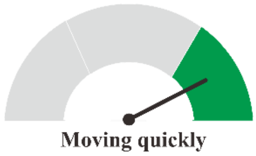


Figure 3-7 Real GDP of OECD and BRIC countries 2000-2010 (McKinsey Global Institute)

There is no direct and linear relation between cargos/containers growth related to national GDP growth. However, those two things might have an indirect correlation to each other, people tend to buy something (cargo growth) when they have money (GDP growth). Again, the masterplan of the new terminals is a strategic planning to adapt with those growths, adapting to GDP and cargo growth is categorized moving quickly.

3.4.5 Mega Ships Development



The development of the ship of the future is still an open work. **Figure 3-8** and **Figure 3-9** show the record ship dimension in time series. Especially for a container ship, the capacity of the ships has been doubled compared to two decades ago or even almost ten times larger since the first era of containerisation (the first container was discharged in 1963).

The development of ever larger ships is driven by the seeking of economies of scale by shipping companies (OECD, 2015). Specifically for container shipping industry is mainly driven by price competition. The result is a wave of investments in new very large container ships.

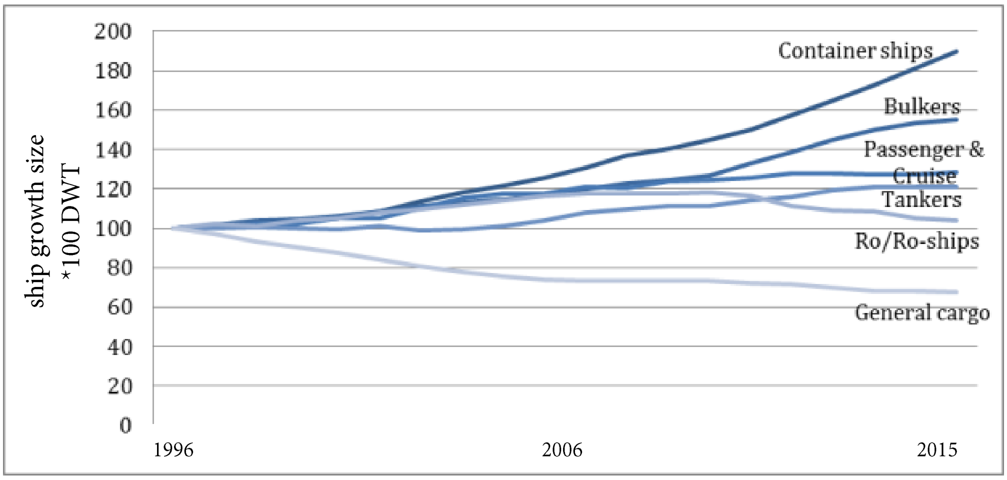


Figure 3-8 Ship size development growth 1996-2015 (ITF-OECD)

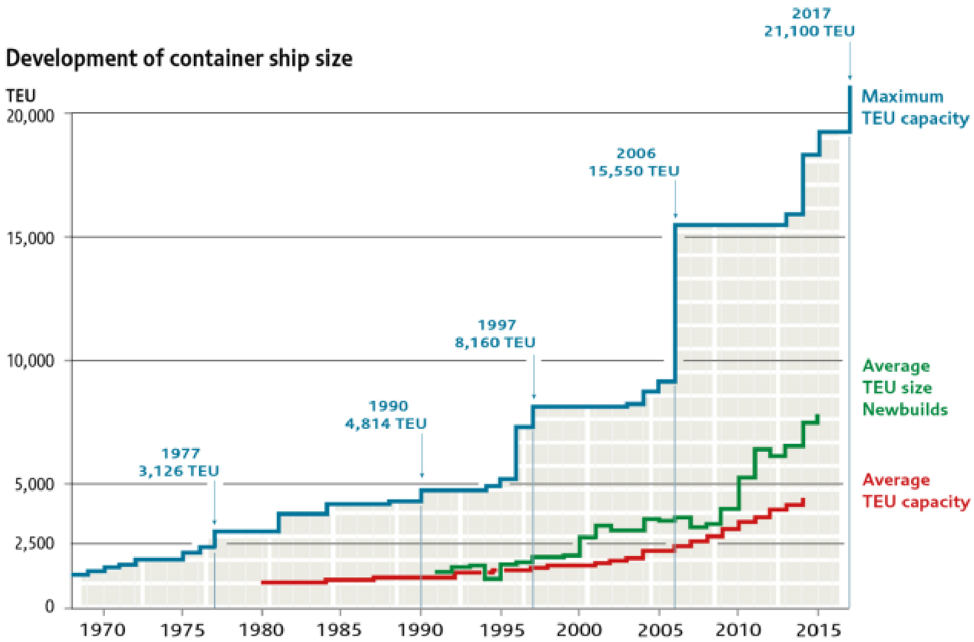


Figure 3-9 Container ship development (ITF-OECD)

In 2006, a new generation of container ships came when Maersk shipping line introduced a ship class having a capacity in the range of 11,000 to 14,500 TEUs; the Emma Maersk (E Class). They are dubbed "Post New Panamax" since they are bigger than the specifications of the expanded Panama Canal and can handle up to about 18,000 TEUs (Triple E Class).

Malacca-max is the term used for largest ships capable of passing through the Strait of Malacca. These ships are designed to negotiate with the 25m draught restriction of the Strait of Malacca. On the drawing boards, such as the "Malacca-Max" class could carry about 27,000-30,000 TEU, but they are not expected to be constructed within a decade (Rodrigue, 2017).

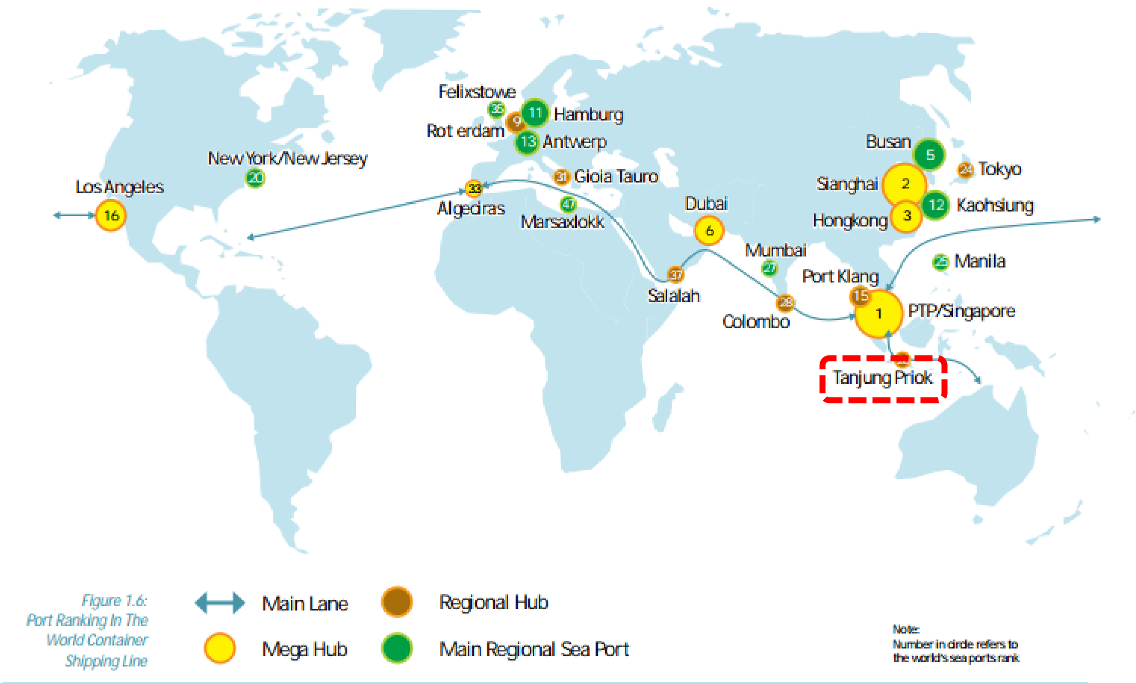


Figure 3-10 Global maritime pathway and the location of Tanjung Priok (MP3EI document)

For Indonesia itself, this ship's development is really relevant. It can easily be seen at the position of Indonesia in the competition of the South China Sea and Malacca Strait (see **Figure 3-10**). Indonesia's port industry relatively lag behind compared to neighbouring countries like Singapore and Malaysia. The masterplan of New Priok is a great work to welcome this challenge by expanding the land for (un)loading, making larger basin and waterways and having a possibility of making them deeper. Hence, adapting to mega ship development is categorized moving quickly.

3.4.6 Hinterland Connection

Moving steadily

Connecting the the expanded port to the hinterland, specifically to the industrial area is very important, see more explanation about industrial areas in **Hinterland Description**. This can be done through all modes of transportation, either by road, rail, and water (multimodal). This is quite a challenge for IPC since surrounding area of Tanjung Priok Port is already densely populated. One of the important projects, besides highway/access road to Kalibaru Terminals (eastern access), is developing Cikarang-Bekasi Laut (CBL) Canal getting alternative access to the industrial area in Cikarang (see feasibility study of CBL Canal, 2015 and the location of CBL canal in **Figure 3-11**).

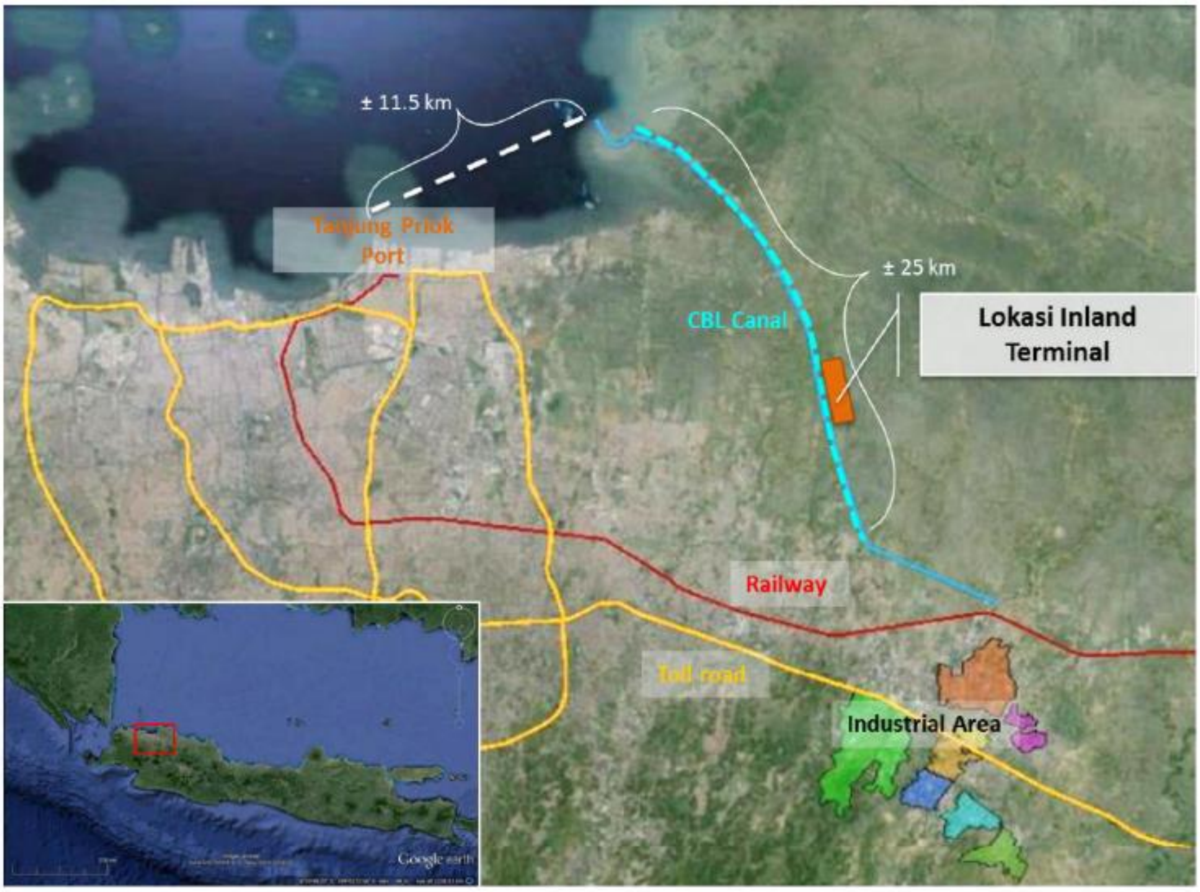


Figure 3-11 CBL Canal layout (PT PPI)

The CBL canal has been constructed in the year 1984 to act as a main drain/flood channel for the DKI Jakarta area. The intention is now to use the CBL canal also as a navigation canal accommodating barge transport and relieve congestion from Jakarta's road network and create an efficient corridor for transportation of containers between Tanjung Priok and the industrial estates in the Bekasi and Karawang. The proposed barge and canal dimension based the report are shown in **Table 3-2** and depicted in **Figure 3-12**.

Table 3-2 Barge and canal dimension of CBL canal (PT PPI)

Barge	
Type	Self-Propelled Barge (SPB)

Barge capacity	96 TEUs (70x12x2.8 m and 8x4x3 TEUs)
Sailing speed	6 km/hour
Operational	24x7x365
Canal	
Water current	0.5 m/s
Lane	2 lanes
Depth	4.0-4.5 m
Width	50-55 m
Length	17-25 km

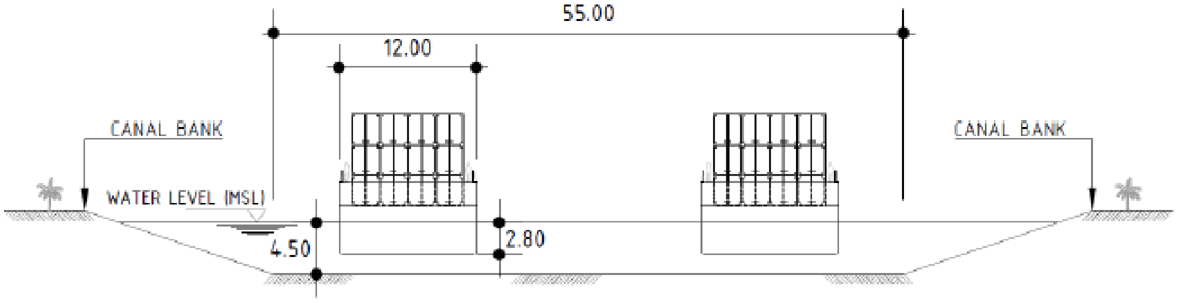


Figure 3-12 CBL canal proposed design (PT PPI)

Currently, besides via trucking, the only alternative to distributing cargo coming from and to Tanjung Priok is through rail transport under state-owned enterprise PT KAI (Kereta Api Indonesia). However, the maximum capacity of this train system is very limited due to lack of area of development. In 2013, containers throughput that handled by train were about 2,125,427 tonnages (about 141,700 TEUs)[9] and at the same year total cargo handled by the port itself 93,014,122 tonnages (about 6,200,000 TEUs)[10]. Train only contributes to about 2.28% of distributing the cargo in multimodal concept and the rest (97.72%) is going to be through road.

CBL canal will change significantly the ratio of cargo distribution in Tanjung Priok in multimodal distribution. This project will break up the heavy congestion on the road and at the same time reduce the pollution in Jakarta.

Based on its feasibility study, CBL canal has a maximum capacity around 1.6 million TEUs[11] when fully utilized. Assuming 60% of containers from Tanjung Priok go to industrial areas in Karawang and Bekasi, the canal will distribute about 24.8% of cargo distribution. If PT KAI could rise up their capacity up to 3% through additional train cars, Tanjung Priok will have a much better multimodal ratio (shown in **Table 3-3**) and could reduce the logistic cost in Indonesia.

[9] Assuming 1 TEU = 15 tonnage (maximum gross mass of 20” container).
[10] Idem
[11] Document says the capacity of CBL canal will be 1,600,000 TEUs/year and it will be fully utilized in 2025.

Table 3-3 Modality distribution in Tanjung Priok Port (own elaboration)

Condition	Road (%)	Barge (%)	Rail (%)
Current condition (without CBL)	97.72	0	2.28
With CBL Canal	72.20	24.8	3

Rationally, the higher portion of barge and rail transport should be better as they have better performance economically and environmentally. **Figure 3-13** shows the evaluation of cost per TEU per km of each transport mode in Netherland, it is clearly shown that barge (water transport) is cheaper than rail and road. **Figure 3-14** shows the evaluation of emission of each mode in Netherland, rail and water transport is comparable to among all items of evaluation, but not with the road transport (clearly not preferable environmentally).

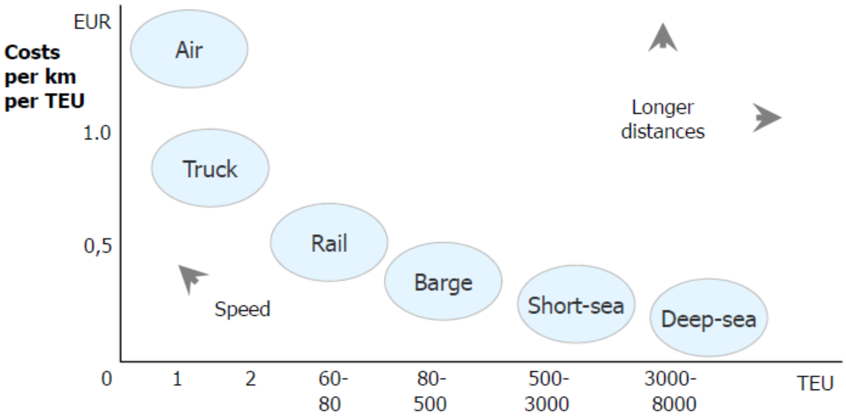


Figure 3-13 Cost per km per TEU on each transport mode in Netherland *(numbers are collected from Buro Voorlichting Binnenvaart (BVB) and Central Buro Statistics (CBS))*

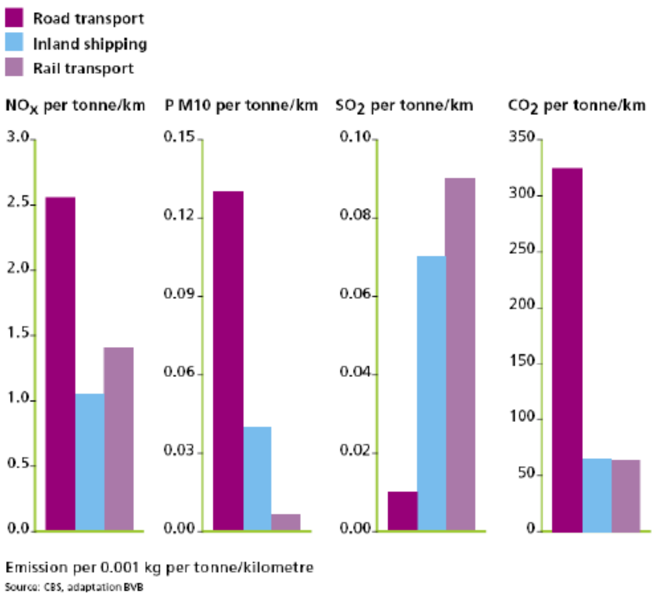


Figure 3-14 Emission evaluation in each transport mode in Netherland *(numbers are collected from Buro Voorlichting Binnenvaart (BVB)* **and** *Central Buro Statistics (CBS))*

There is no strictly rule of the best ratio in each mode of transport. As a comparison, the following table, **Table 3-4**, shows the current condition and target of multimodal distribution in Port of Rotterdam, The Netherlands.

Table 3-4 Modality distribution in Port of Rotterdam (Taneja, 2013)

Year	Road % (mln. TEU)	Barge % (mln. TEU)	Rail % (mln. TEU)
2006	48 (1.9)	39 (1.6)	13 (0.5)
2009	47.5 (2.1)	39 (1.7)	13.5 (0.6)
2030	35 (5)	45 (7)	25 (3)

Mln: million

The good news is corporation realize the importance of modality shifting through this feasibility study of CBL Canal. Translating the concept of CBL Canal into an action plan with the port authority still remains a dispute. Therefore, improving hinterland connection is categorized moving steadily.

3.4.7 Sustainability Regulation

Sustainability is usually associated with carbon footprints, greenhouse gasses, and ecosystems. Those factors are the environmental aspects of sustainability. Two additional aspects are generally recognized as contributing to sustainability: the economy and social factors. Together these three pillars of sustainability are often referred to as the triple bottom lines or PPP (People, Planet, and Profit), see more detail in triple bottom lines. Sustainability is a balancing act where business decisions take into account the impact they may have on those three aspects of sustainability.

For IPC, as stated in the masterplan, environmental aspects have been considered in the design; consist of air quality and water quality. Some chemical parameters have been examined through field's observation and they have to be lower than the regulatory threshold. **Table 3-5** shows the evaluation of chemical items in Port of Tanjung Priok. The port needs to monitor their actions that might impact this quality.

Table 3-5 Environmental analysis of Tanjung Priok (Draft Masterplan 2017)

No	Type of quality	Items	Threshold	Observation
1	**Air quality**	SO_2	900 $\mu g/Nm^3$	30 $\mu g/Nm^3$
		NO_2	400 $\mu g/Nm^3$	40 $\mu g/Nm^3$
		CO	30000 $\mu g/Nm^3$	3500 $\mu g/Nm^3$
		H_2S	0.02 ppm	0.003 ppm

		NH_3	2 ppm	Below threshold
		Dust	230 $\mu g/Nm^3$	Above threshold
		Noise	70 dB	65-75 dB
2		Brightness	3 m	0.2-2 m
		Smells	n.a	No smell
	Water quality	Suspended solid	80 mg/l	Above threshold
		Oil layers	5 mg/l	Below threshold
		Ammonia	0.3 mg/l	Above threshold
		Fenol	0.002 mg/l	Above threshold
		Copper	0.06 mg/l	0.0005 mg/l
		Lead (Pb)	n.a	n.a
		Zinc	0.1 mg/l	One station above threshold

= Above threshold = Below threshold

Although the land of the port is officially owned by the government, the surrounding area of the port is occupied by densely social entities, including the residential villages. This condition happens for most of the ocean infrastructure in Indonesia, the regulation of social aspects still lag behind and tend to be forgotten. Considering this partial application of sustainability concept, implementation of sustainability regulation is categorized moving steadily.

3.4.8 Bonus Demography

Moving steadily

As developing country and as one of the biggest population in the world (rank 4th), Indonesia has a very good potential demographically. Working age (15-64 years) has been always dominant for Indonesia. According to forecasting, this group gradually increases and reaches its peak in 2025. Years of 2010-2025 is called demography bonus period in which Indonesia has large numbers of domestic workers (about 70% of total population). At the same time, the children age (0-14 years) slowly decreases and elderly age (more than 65 years) slowly increase, see more in **Figure 3-15**.

This pattern represents the potential of working condition in this country and the need of basic (transportation) infrastructure and energy resource to support their life. Moreover, this group may trigger new technological innovation that might influence the pattern of transportation in the near future.

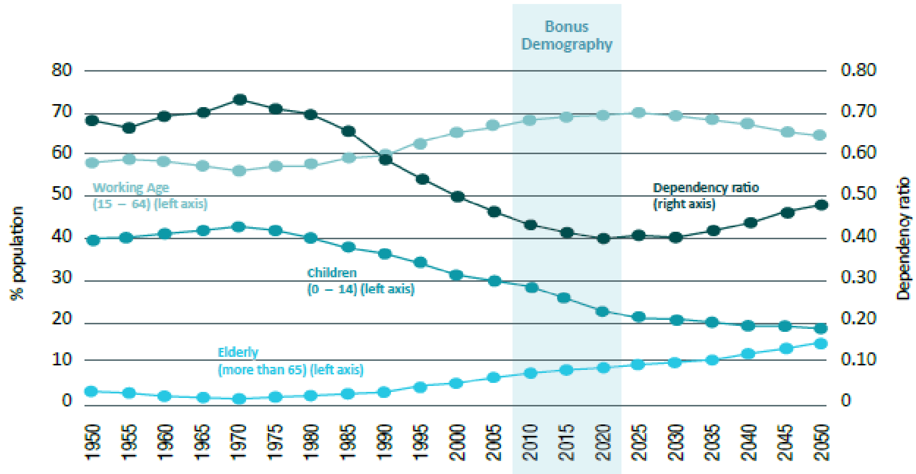


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Figure 3-15 Forecasting of population pattern in Indonesia (MP3EI document)

The government of Indonesia has to prepare for this demographic shifting. Based on the background of MP3EI document, there is an awareness of welcoming this new era of human resource (see **Figure 3-2**) through science and technology, but still, no specific programs have been prepared. Hence, welcoming bonus demography is categorized moving steadily.

3.4.9 Future Energy Source

Moving slowly

The demand of energy is still going to be high due to the growth of Indonesia's population. Whether the fulfilment of this demand will be through conventional resource (oil and gas) is still a big question. The declining of the resource is an undeniable fact. A combination of regulations on polluting emissions, the mainstreaming of renewable energy on land and looming emission reduction targets has seen a further push to invest in alternatives to bunker fuel, with LNG gaining the most traction as a near-term solution. In long term, renewable energy is also going to come up in the discussion. There are two types of Indonesia renewable energy purpose: a source of electricity and a source of fuel oil. This renewable energy consists of solar, wind, waterpower, ocean, geothermal, biodiesel, bioethanol and commercial biomass (Indonesia Energy Outlook 2016).

Figure 3-16 shows the projection this sector which will contribute to 23% of total demand in 2023 and 31% in 2050 (Indonesian Energy Outlook 2016). **Table 3-6** explains the sources of renewable energy and the low application those sources in the real life in 2016. That is one of the reasons why the masterplan of New Priok is still fixated to fossil resource with the high capacity allocated to product terminals. Political willingness will play important role in applying here in.

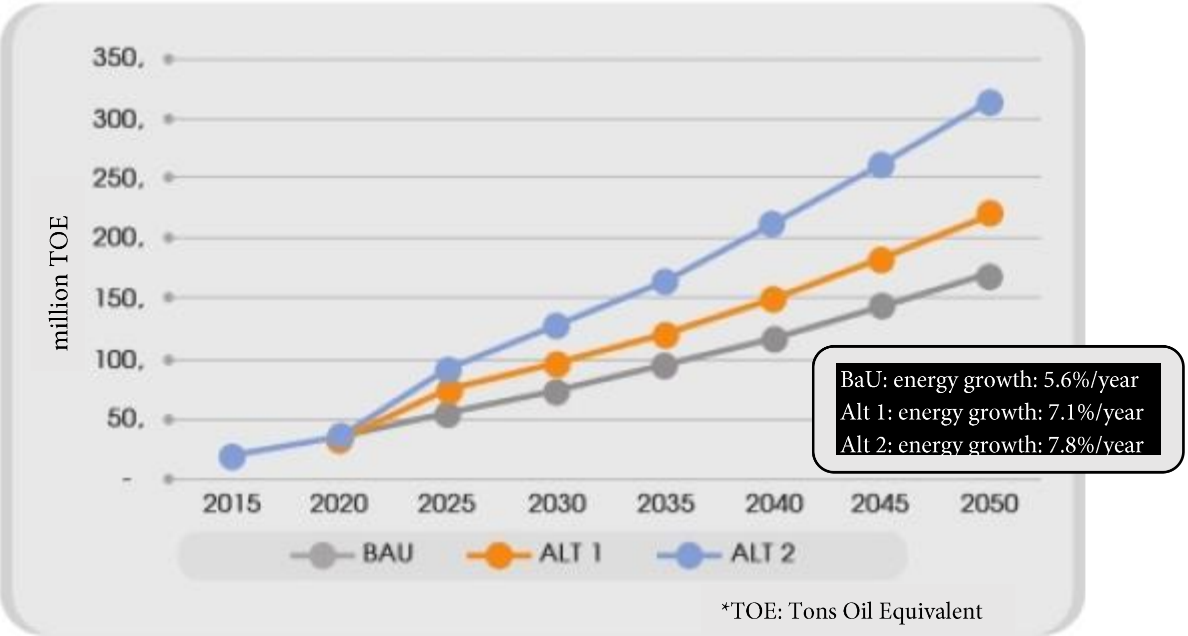


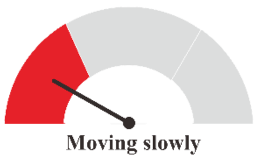
Figure 3-16 Indonesian renewable energy projection (Indonesia Energy Outlook 2016)

Table 3-6 Renewable energy application in Indonesia (Indonesia Energy Outlook 2016)

No	Type of energy	Source	Applied source	Utility
1	Waterpower	94,476 MW	5,024 MW	5.3%
2	Geothermal	29,544 MW	1,403.5 MW	4.8%
3	Bioenergy	32,000 MW	1,740.4 MW	5.4 %
4	Solar	207.9 GW	78.5 MW	
5	Wind	60 GW	3.1 MW	
6	Ocean energy	61 GW	0.01 MW	

Considering the low utility of renewable energy and its implementation in the masterplan, adapting to future energy sources is categorized moving slowly.

3.4.10 Future Technology of Transport



Future handling technology could be very different compared to what people have today. Consequently, in anticipation of future demands, improvements in crane design and research into innovative handling concepts have been continued. (Taneja, 2013). Automation and robotization will become important issues in the future of handling system in ports.

Process automation contains technologies that typically replace clerical labor such as identification, inspection, registration, and similar tasks. The most common application is gate automation in the port (Saanen, 2016). Robotization is automated decision-making in which all data of terminal process has been collected to make the ability of the system to take a decision.

The logistic's world has been transformed in some different level, shown in **Figure 3-17**, based on the function of manual and software operation in its process. Ports in Indonesia are mostly in the mechanization process and they are trying to go to automation in some ways. Future ports logistic is clearly the implementation of automation and robotization.

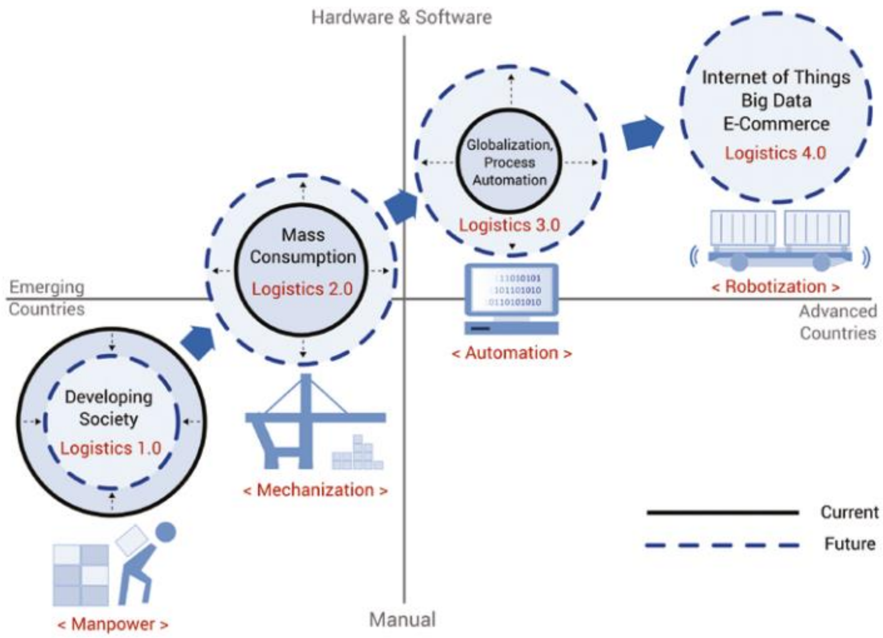
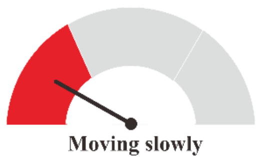


Figure 3-17 The transformation of logistic's world (Saanen, 2016)

Automation and robotization in handling technology in Tanjung Priok are still far from massive implementation. Hence, adapting to future technology of transport is categorized moving slowly.

3.4.11 Climate Change



We are currently on an emissions pathway consistent with the 'worst case' scenario from the Intergovernmental Panel on Climate Change (IPCC), which forecasts a possible global average temperature rise of 1.5 degrees by 2040. The impact on the port industry, especially for Port of Tanjung Priok, is likely to be significant and widespread, including sea level rise.

The main problem of Jakarta being observed actually is the land subsidence due to excessive groundwater withdrawal. Apparently, there is also an additional impact from sea level rise in the Java Sea threatening the sinking the area around the port, but physically less significant compared to subsidence.

There is no formal concept or Indonesian governmental body to deal with this issue by far. Current knowledge about the impact of climate change specific to the maritime sector also remains insufficient for identifying specific needs for change. Hence, the factor of adapting to climate change is categorized moving slowly.

3.5 Conclusion

In this section, Adaptive Port Planning (APP) Scenario-Based Planning for Phase II of New Priok Development is presented. There are four basic steps in this framework, starting with defining the project and relevant uncertainties for the project. After that, scenario planning can be applied and producing dedicated areas for the alternative layouts. Step III is about creating a monitoring system and contingency planning for the uncertainties that have not been covered by alternative layouts. Last but not least, preliminary detail layout of terminals could be presented.

Step I of Adaptive Port Planning (APP) has been applied, defining the project. All relevant factors are set based on related documents and reports of Port of Tanjung Priok. The ten major uncertainties that will probably affect the planning of Port of Tanjung Priok have been listed, which are:

1. National connectivity will.
2. Global and regional trade.
3. Cargo growth.
4. Mega ships development.
5. Hinterland connection.
6. Sustainability regulation.
7. Bonus demography.
8. Future energy sources.
9. Future technology of transport.
10. Climate change.

Considering of those uncertainties, government and corporation are really well prepared for better future of Indonesia economy (indicated by ‘moving quickly’ uncertainties). Unfortunately, in terms of implementation of sustainability and environmental concept, the government still lag behind. There is no specific political will, concept, or regulation in making the port to be well-being environment. It is good that the port has a standard in relevant chemical's threshold (see **Table 3-5**) that need to be monitored in the port. However, engaging and rearranging the social entities around the port are obviously not in the concept yet.

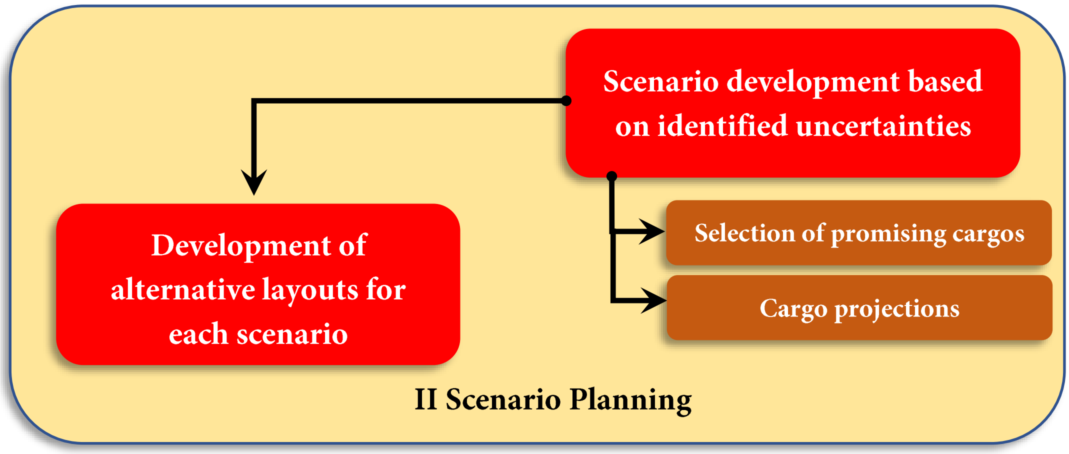
Chapter 4 Step II Scenario Planning

Engineering is the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind

-Accreditation Board for Engineering and Technology (ABET)

Chapter 4 Step II Scenario Planning

4.1 Introduction



This chapter continues the application of steps in Adaptive Port Planning (APP) framework Scenario-Based Planning. Basically, in this chapter, the scenarios for Phase II of New Priok Development are developed based on relevant uncertainties of the future of Tanjung Priok (see **Uncertainty Analysis** in **Chapter 3**) and they are translated into alternatives layouts based on scenarios.

Promising cargos are defined in New Priok through score card analysis based on some related reports and expert discussion. Traffic analysis of the promising cargo (mostly related to containers) is done to see future throughput for New Priok. This projection will be one of the bases of terminal layout development for Phase II of New Priok.

4.2 Scenario Development

The uncertainties confronted by Tanjung Priok have been explained in detail in **Uncertainty Analysis**. The critical uncertainties with regard to the future of port of Tanjung Priok can be divided into two main axes, which are economic growth and environmental and sustainability required by government and society.

Table 4-1 shows the relationship of each future uncertainty to critical uncertainties (axes). Some uncertainties are only related to economic growth or environmental and sustainability. There are also some uncertainties that influenced by both axes which are improving hinterland connection, demography, and future technology of transport. The future energy source is not (directly) considered in the scenarios yet and will be treated separately in the next step/chapter, see **Step III Monitoring System and Contingency Planning** (**Chapter 5**).

Table 4-1 Uncertainty category

No	Uncertainties	Critical uncertainties	
		Economic growth	Environmental and Sustainability
1	National connectivity will of the government of Indonesia		
2	Global and regional economy		
3	GDP and cargo growth		
4	Mega Ships development		
5	Hinterland connection		
6	Sustainability regulation		
7	Bonus demography		
8	Future technology of transport		
9	Climate change		

The vertical axis (y) represents the rate of growth of the economy of Indonesia. This factor triggers the growth of cargos (especially containers) and the development of transport technology, or the other way around. Considering the trend of current Indonesia economy and some relevant factors that support it, such as social, political and demography, the economic growth of Indonesia will remain positive in the long period. However, the variation or how high of this growth still remains a question, either low (adjusted to be <3%) or high (adjusted to be >3%).

The horizontal axis (x) shows the awareness of Indonesian in relation to the environmental and sustainability issues. This (high) awareness will trigger the government to take action through regulations and programs in order to achieve sustainability. The existing condition is Indonesia still applying the partially sustainable concept. Whether this circumstance will remain the same or subject to additional improvement is not known yet. The world is changing and exposure of globalization will more or less intervene the Indonesian mindset on sustainability.

Based on those critical uncertainties, four scenarios are proposed related to future of New Priok Development: Green Growth, Business As Usual, Moderate Expansion, and No Expansion (see **Figure 4-1**). Each scenario will be explained more in scenario narratives below.

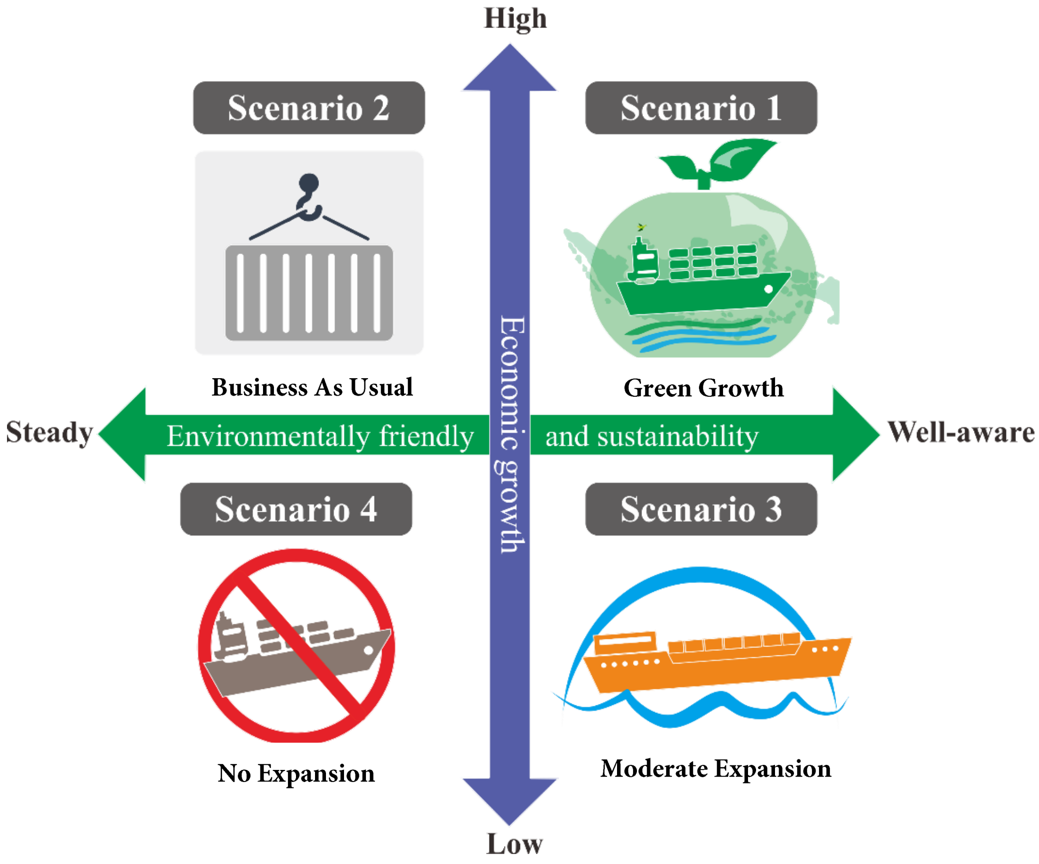


Figure 4-1 Scenario of the future Port of Tanjung Priok

4.3 Scenario Narratives

4.3.1 Scenario 1. Green Growth

The first scenario is green growth scenario, an ideal one. Society and government are well-aware to sustainability matters and at the same time, economy and cargo grow significantly. In this scenario, the containers are highly significant for Port of Tanjung Priok, either importing to fulfil Java needs of goods or exporting local commodities such as textiles, food-beverages, shipping, transportation equipment (MP3EI, 2011).

This scenario is also projected the high investment in every infrastructure sector, including port development. Hence, financially, the need of money to expand extra (reclaimed) land is not really an obstacle. This investment could come from government or engage public sector through Public Private Partnership.

People are highly aware of the importance of implementing sustainability concept in this scenario. The development of the port project, especially New Priok Project, has to be very friendly to the environment and society, besides profit oriented. This scenario is not only complying to a (chemical) waste threshold and management in the port but also building the community centre, i.e., tourism, sports activity, fishery, etc. That is the main idea of the triple bottom lines of sustainability or PPP (People, Planet, and Profit).

Another characteristic in this scenario is (transport) modality shifting requisite. People need more clean and healthy environment. One of the prominent problems faced by Port of Tanjung Priok is the abundance of trucks to distribute cargo and make heavy congestion on the road. Therefore, the construction of Cikarang Bekasi Laut (CBL) Canal is paramount to increase the contribution of inland water transport in distributing the cargo. PT KAI as an operator of rail transport in Indonesia has to add the proportion of rail to the multimodal ratio, either by adding the train cars or build extra rails in eastern access toll road in Kalibaru Terminal.

The energy mix might be different in this scenario. As the high attention on sustainable and environment issue, the state regulation will support more on applying renewable energy. Therefore, terminals that allocated for biodiesel and bioethanol as renewable energy sources (based on a projection of Indonesia Energy Outlook, 2016) could be needed to serve this change. Some areas might also be needed for assembling supporting activity of renewable sources, such as assembling area for a windmill, solar photovoltaic, ocean energy.

4.3.2 Scenario 2. Business As Usual

This scenario seemingly represents the existing condition of Indonesia, specifically for Port of Tanjung Priok. One axis shows the promising growth of economic and container sectors and another axis displays sustainable issue still lag behind. Containers growth is expected to be high that supported the by the immense growth of the economy. A huge amount of investment will be put on ports, hence, money is not going to be the issue to expand the existing port.

Trucking will persevere to do cargo distribution as a multimodal concept is not to be a concern. Port Authority tends to fear in making a change of the huge ratio of road transport and remain as business as usual. Consequently, high investment on road construction will be needed. Probably, multilevel roads concept will apply in Tanjung Priok to deal with the increase of trucking. However, the heavy congestion will remain to occur and induce the uncompetitiveness of logistic cost of Indonesia.

Regarding product terminals, oil and gas will still be needed in this scenario to comply the high demand of energy in the future. Practically, this terminal will be built if the specific client has requested to do so. Therefore, if it is assumed that two product terminals will be operated in the Phase I to fulfil the demand energy until 2030, the same amount of terminals will be urged to the next phase of development. The investment on renewable energy terminal has to be very carefully observing at the future demand.

4.3.3 Scenario 3. Moderate Expansion

In this scenario, the economic growth is still positive but with relatively smaller value. This will have an impact on the medium-low investment on port infrastructure in Indonesia. There will be a need for expanding the container terminals but with medium-low growth scenario. Again, the investment has to be studied very carefully considering the cargo trends and the occupancy of terminals in Phase I.

People will be aware of sustainability and environmental issue, apparently, there will be a specific government body and regulation to control it. Therefore, the development of Cikarang Bekasi Laut (CBL) Canal in applying multimodal shifting will probably be required. However, due to lack of financial support, this canal will not reach its maximum capacity. At least, it could reduce the proportion of trucking in Port of Tanjung Priok.

The development of technology in renewable energy will be intensive in this scenario. Some terminals in renewable energy activity, instead of just fossil fuel terminal, will be needed. Although this is really depending on business to business deal between port operator/authority with renewable energy business entities.

4.3.4 Scenario 4. No Expansion

This is the worst case scenario. In the future, people tend to put aside the sustainable issues and at the same time, the economic condition is not really supportive of doing development. Probably there is no need to expand container terminals. Optimizing the existing container terminals in Phase I and old port in the land would be a rational answer to the small growth of containers.

Renewable energy development will not be very attractive in this scenario. Therefore, there is no need to build a specific terminal for this commodity. The growth of fossil fuel perseveres but apparently, the energy demand could be handled by the product terminals in Phase I. Multimodal concept is far beyond the concern of Port Authority of Tanjung Priok since no excessive investment as well. Hence, simply there is no need extra terminals addition at all in this scenario. Optimizing the existing terminals will be more preferred for the port to deal with the condition.

Table 4-2 resumes the characteristic of each scenario with their degree of attractiveness in some criteria of the axes of scenarios.

Table 4-2 Scenario characteristics

	Scenario 1 *Green Growth*	**Scenario 2** *Business As Usual*	**Scenario 3** *Moderate Expansion*	**Scenario 4** *No Expansion*
Containers growth	High	High	Medium-Low	Low
Investment on port	High	High	Medium-Low	Low
Environmental awareness	High	Medium-Low	Medium	Low
Sustainability discussion	High	Medium-Low	Medium	Low
Needs of modal shifting	Yes	No	Yes	No

CBL Canal needs	Yes	No	Yes	No
Energy mix	Renewable + Fossil	Fossil	Renewable + Fossil	Fossil

4.4 Selection of Promising Cargos for All Scenarios

Table 4-3 shows the comparison of commodities in each scenario. Promising industries are listed in column 1 and 2 of the table. General cargo and solar energy industries are added to the list. The robustness of the industry is assessed using an index with scale 1-10 (the higher the number, the most promising that particular industry in each scenario). In order to compare the industries within the scenario, they have also been evaluated using -, 0, +, and ++ (indicating lower to higher performance).

The fulfilment of this evaluation is adjusted from related government's/corporate's institution reports and projections. Port of Tanjung Priok is a gateway port that mostly handled mostly containers instead of industrial port (handle petrochemical products) or transhipment port, see **Appendix B Site Visit and Visiting PORInt (Port Rotterdam International).** There is a potential of energy port for buffer stock/storage purpose only.

The containers are interesting in scenario 1 and scenario 2 since cargo and economy will grow significantly, while they are not the condition for other scenarios. The liquid bulk explains the existing energy sources to support the development. However, the high economic activity in scenario 1 will be supported also by renewable energy (as an alternative source of energy) instead of only depending only on the fossil fuels (scenario 2). The evaluation shows that container is the highly promising industries among others, followed by liquid bulk, and renewable energy.

General cargo and solar energy industries are included in the table to test their performance (in each scenario) to the port. New Priok terminals are aimed for modern and international commodities, therefore general cargo is not relevant. Indeed, some domestic cargos are still general cargo at the moment in Tanjung Priok. Solar energy is potential for Indonesia as a tropical country. However, using its implementation in Tanjung Priok's hinterland (on the roof of the houses) to be the basis of preparing specific terminals in the port is not acceptable.

Table 4-3 Comparison of industrial alternatives in four scenarios

Alternative cargo sectors		**Scen. 1** *Green Growth*		**Scen. 2** *Business As Usual*		**Scen. 3** *Moderate Expansion*		**Scen. 4** *No Expansion*		**Total**
Containers		++	10	++	10	+	6	-	2	28
Liquid bulk	Oil	+	6	+	6	0	3	-	2	17
	Gas	+	6	+	6	0	3	-	2	17
Renewable energy	Bioenergy	+	6	-	2	0	4	-	2	14
	Windmill	++	6	-	2	0	4	-	2	14

Others	General Cargo	-	2	-	2	-	2	-	2	8
	Solar	-	2	-	2	-	2	-	2	8

Scen. = scenario

4.5 Other Possible Matrices

In this study, the development of scenario axes (critical uncertainties) is based on general terms from the summing up of (almost) all dimension of uncertainties, therefore, we arrived at **Figure 4-1** regarding the four relevant scenarios for Phase II of New Priok. Some detail dimensions of uncertainties and factors that cannot be covered by scenarios are discussed in the monitoring step and contingency planning (see **Chapter 5**).

In some cases, probably there will be a need for company to see some specific critical uncertainties (generally between two critical uncertainties for matrix 2x2), hence, they need to create other matrices of scenarios, for example:

1. To see the type of government (in this case: Port Authority) approach (either control or going with the market demand) to the port and the favourability of economic growth.

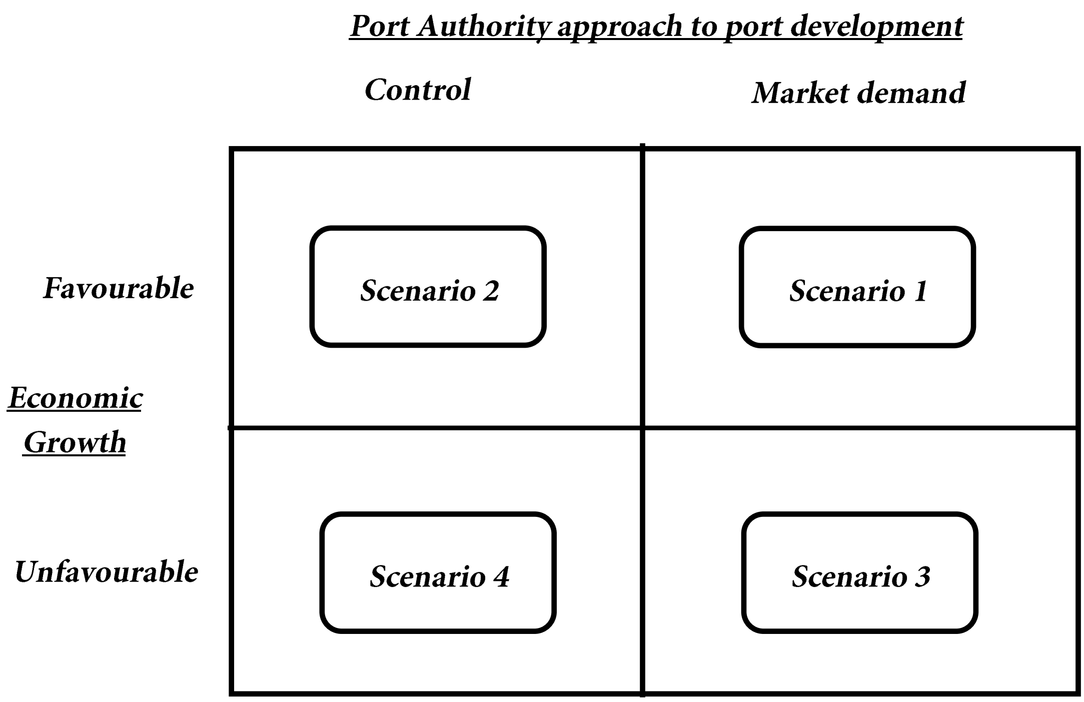


Figure 4-2 Scenario of Port Authority approach to port development

2. To see the type of trend of energy terminal development (either intervened by the government will or going with the market trend) and the sustainability of the future.

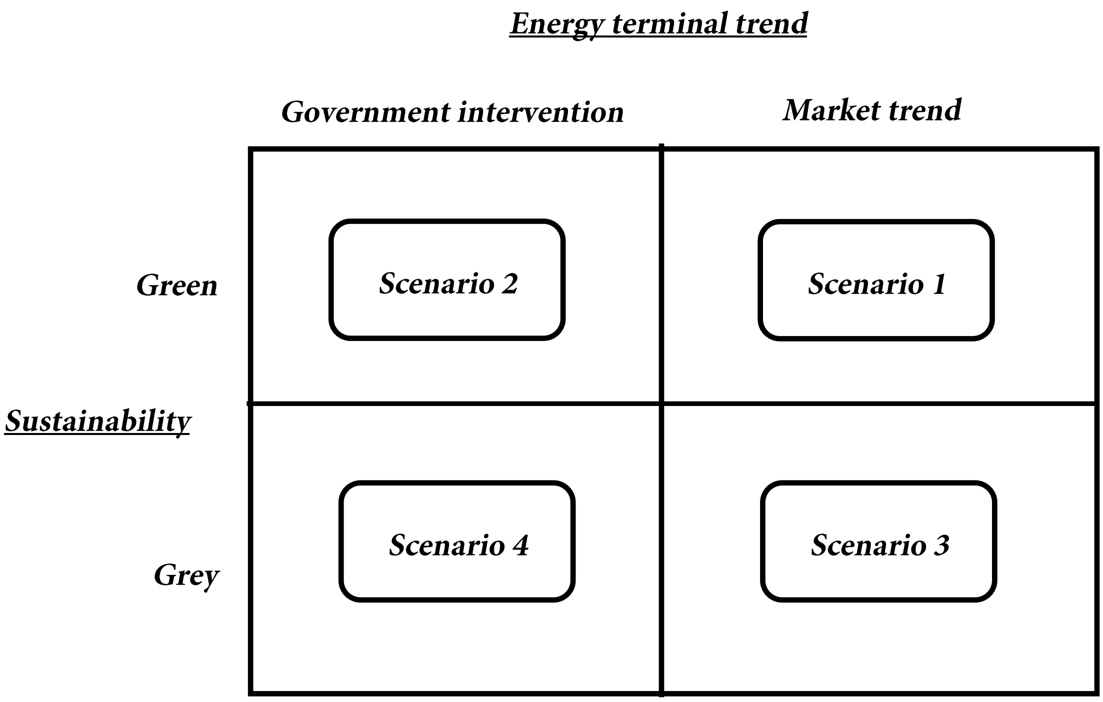


Figure 4-3 Scenario of government approach to energy terminal development

4.6 Traffic Analysis

Traffic in Port of Tanjung Priok consists of many kinds of freight transport. Transported goods consist of general cargo, bag cargo, liquid bulk, dry bulk, container, and others. Some kinds of vessels are also transported via Tanjung Priok to meet the demand in Indonesia.

All in all, the cargo shows the increasing trend as the improvement of Indonesia's economy, especially for regional Jakarta and West Java Province. Some terminals show stagnancy and the others are slowing down. Detail numbers are explained in **Appendix A Traffic Analysis.**

4.6.1 Cargos in Tanjung Priok

The following graph, **Figure 4-4**, shows the recorded (2014 and before) cargo in Port of Tanjung Priok in tonnage. The type of cargo is still dominated by containers (around 60% in 2014). General cargo, bag cargo, dry bulk, liquid bulk[12], and others just contributed to the small percentage (lower than 15% each) of total cargo, showed by **Figure 4-5**.

[12] In this study, liquid bulk will be translated to be product terminals in layout design.

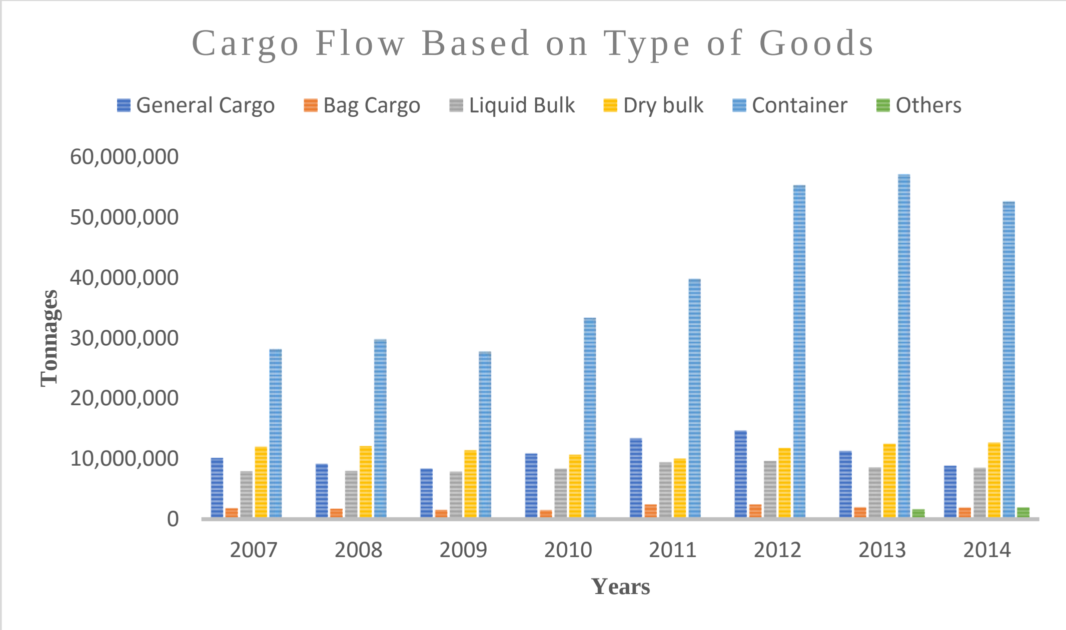


Figure 4-4 Cargo trend in Port of Tanjung Priok (Draft Masterplan 2017)

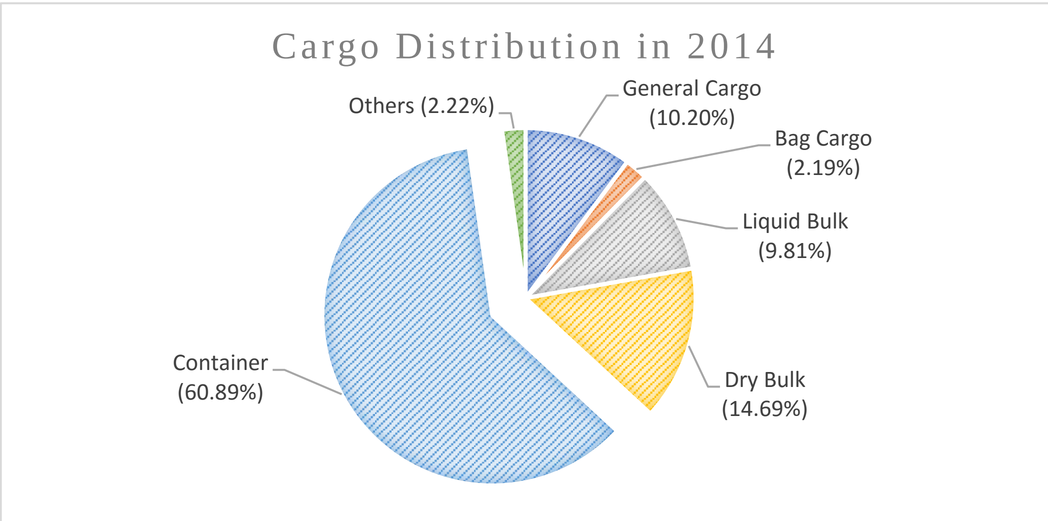


Figure 4-5 Cargo percentage in 2014 at Tanjung Priok (Draft Masterplan 2017)

All cargo is expected to be increasing in the future as the growth of Indonesia economic activity, especially for containers and general cargos. However, the projection needs an evaluation since the vulnerability of economy might come up and cannot be predicted.

4.6.2 Containers Throughput Projection

The forecasting of future cargo includes a lot of works and it is impossible to produce the exact numbers as in reality. In this study, those projections are defined based scenarios that have been developed. **Figure 4-6** shows containers throughput projection for Phase I and II (up to 20600 of New Priok Development which included assumptions/conditions as follow:

1. Scenario 1 (green growth), economic and social condition are well-supported the growth of economy and cargo. In this scenario, throughput is assumed to be growth 5.5% yearly.
2. Scenario 2 (business as usual), economic growth and social condition are also well-supported the economic growth but environmental issues tend to be put aside. In this scenario, the throughput growth is assumed to be 5% yearly.
3. Scenario 3 (moderate expansion), this is medium-low growth in which throughput is assumed to be growth 2.5% yearly.
4. Scenario 4 (no expansion), as the worst condition, the throughput is assumed only growth 1% yearly in the future New Priok.

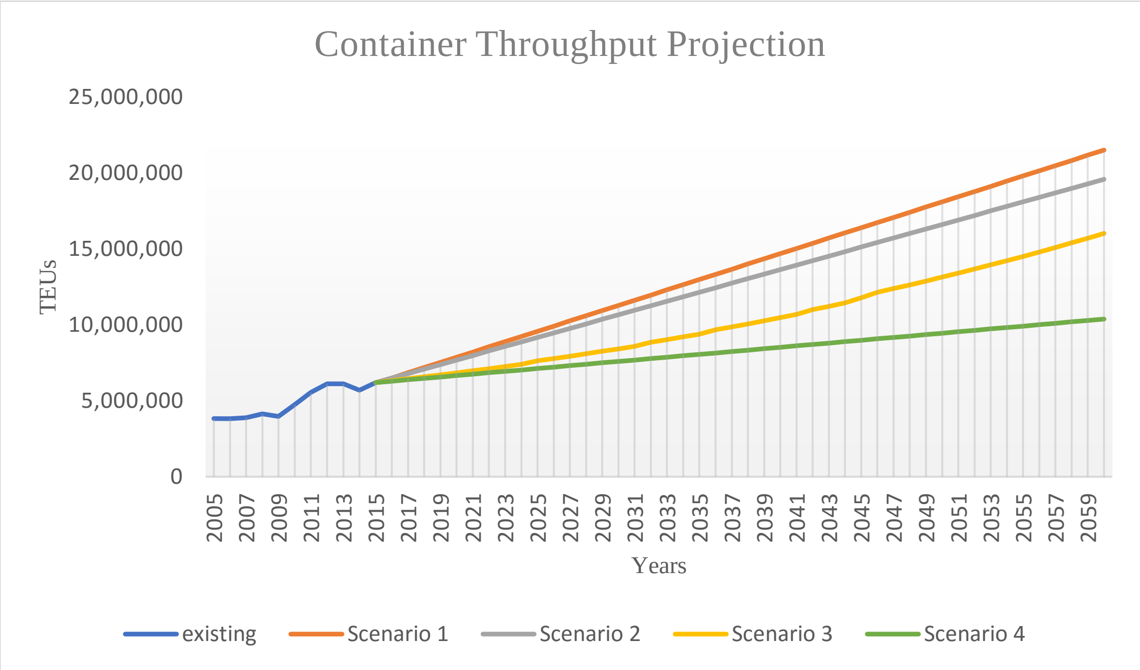


Figure 4-6 Containers throughput projection for Phase I and Phase II of New Priok

4.7 Development of Alternative Layouts based on Scenario Planning

In this section, we propose the possible design for terminals for Phase II by considering the scenarios that have been discussed in **Scenario Narratives,** containers throughput projection in **Figure 4-6**, and promising cargos in **Table 4-3**. The terminal needs are displayed in **Table 4-4**, together with the dedicated terminals area.

Container's terminal areas in Phase II are transformed by taking the reference of container's terminal areas in Phase I with some adjustments. Terminal areas of product terminal and renewable energy terminal are simply taken from the remaining areas in Phase II with some adjustments.

Scenario 1 shows that containers play an important role with the high projection of growth following the high growth of the economy. Therefore, in this scenario, it takes dominant areas in the layout, followed by product terminal and renewable energy terminal in the energy sector.

In scenario 2, low attention on environmental and sustainability makes the energy terminals are all for fossil fuel resource, the others are basically the same with scenario 1. Scenario 3 gives more modest expansion due to low growth of the economy, but the era of sustainability emerges. Scenario 4 is simply with no hope of expansion due to low economy projection and lack of attention in sustainability issues.

Table 4-4 Terminals areas in Phase II based on scenario planning approach

No	Scenario	Terminals	Capacity	Dedicated area
1	**Scenario 1** *Green Growth*	Container Terminal 4	4,000,000 TEUs	70 ha
		Container Terminal 5	2,000,000 TEUs	40 ha
		Container Terminal 6	2,000,000 TEUs	40 ha
		Product Terminal 4	10,000,000 m^3	20 ha
		Renewable Energy Terminal		20 ha
2	**Scenario 2** *Business As Usual*	Container Terminal 4	4,000,000 TEUs	70 ha
		Container Terminal 5	2,000,000 TEUs	40 ha
		Container Terminal 6	2,000,000 TEUs	40 ha
		Product Terminal 4	10,000,000 m^3	20 ha
		Product Terminal 5		20 ha
3	**Scenario 3** *Moderate Expansion*	Container Terminal 4	4,000,000 TEUs	70 ha
		Energy Terminal	NA[13]	30 ha
4	**Scenario 4** *No Expansion*	No Additional Terminals		

Figure 4-7 and **Table 4-5** show the designed terminal's capacity and throughput projection in Phase II of New Priok Development for scenario 1 (green growth) and scenario 2 (business as usual). In order to handle with that container's projection, mid-term development (2030-2045) for CT 4 (4 million TEUs) and long-term (2045-2060) for CT 5 (2 million TEUs) and CT 6 (2 million TEUs) are proposed.

Energy demand is assumed to be the same amount of demand as in Phase I, 10 million m^3, by the end of 2060. The only difference is a mixed of fossil fuel terminal and renewable energy terminal in scenario 1.

[13] Not available. It is hardly to be defined. It depends on future condition.

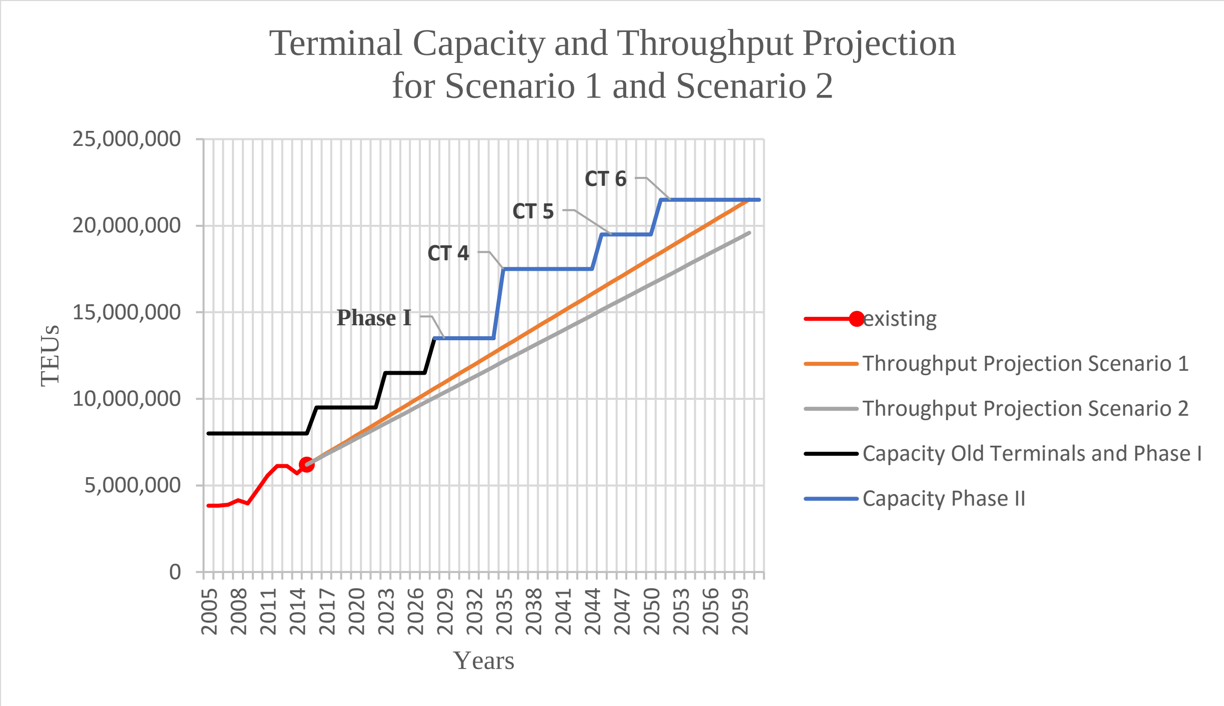


Figure 4-7 Terminal capacity and throughput projection for scenario 1 and scenario 2

Table 4-5 Terminal capacity versus commodity projection for scenario 1 and scenario 2

Years	Cargos				Phasing
	Containers			Energy	
	Terminal Capacity[14]	Scen. 1 Projection	Scen. 2 Projection	Terminal Capacity	
2017	9.5m TEUs	6.8m TEUs	6.5m TEUs		Phase I
2020	9.5m TEUs	7.8m TEUs	7.6m TEUs		
2025	13.5m TEUs	9.6m TEUs	9.2m TEUs	10m m^3	
2030	13.5m TEUs	11.3m TEUs	10.6m TEUs		
2045	17.5m TEUs	16.5m TEUs	15.2m TEUs		Mid-term Phase II
2050	19.5m TEUs	18.2m TEUs	17m TEUs		Long-term Phase II
2060	21.5m TEUs	21.5m TEUs	20m TEUs	10m m^3	

Notes: numbers are in millions
Scen. : Scenario

	Phase I (2016-2030)		Mid-term Phase II (2030-2045)		Long-term Phase II (2045-2060)

[14] Assumed total capacity of old Tanjung Priok is 8 million TEUs. Terminals capacity in Phase I are: CT 1 (1.5 million TEUs), CT 2 (2 million TEUs), and CT 3 (2 million TEUs).

Figure 4-8 and **Table 4-6** show the designed terminal's capacity and throughput projection in Phase II of New Priok Development for scenario 3 (moderate expansion) and scenario 4 (no expansion).

The throughput in scenario 3 is projected to be 17.5 million TEUs in 2060, hence, the development of CT 4 (only) will be sufficient to handle the future throughput. Due to lack of data available about energy projection with this scenario, the detail of capacity will depend on future condition.

However, some dedicated areas (30 ha) would be available to develop energy terminals. In scenario 4, the throughput is projected to be lower than 13.5 million TEUs (total capacity old port and Phase I) by the end of 2060, therefore there is no need to be extra expansion (Phase II) in the future.

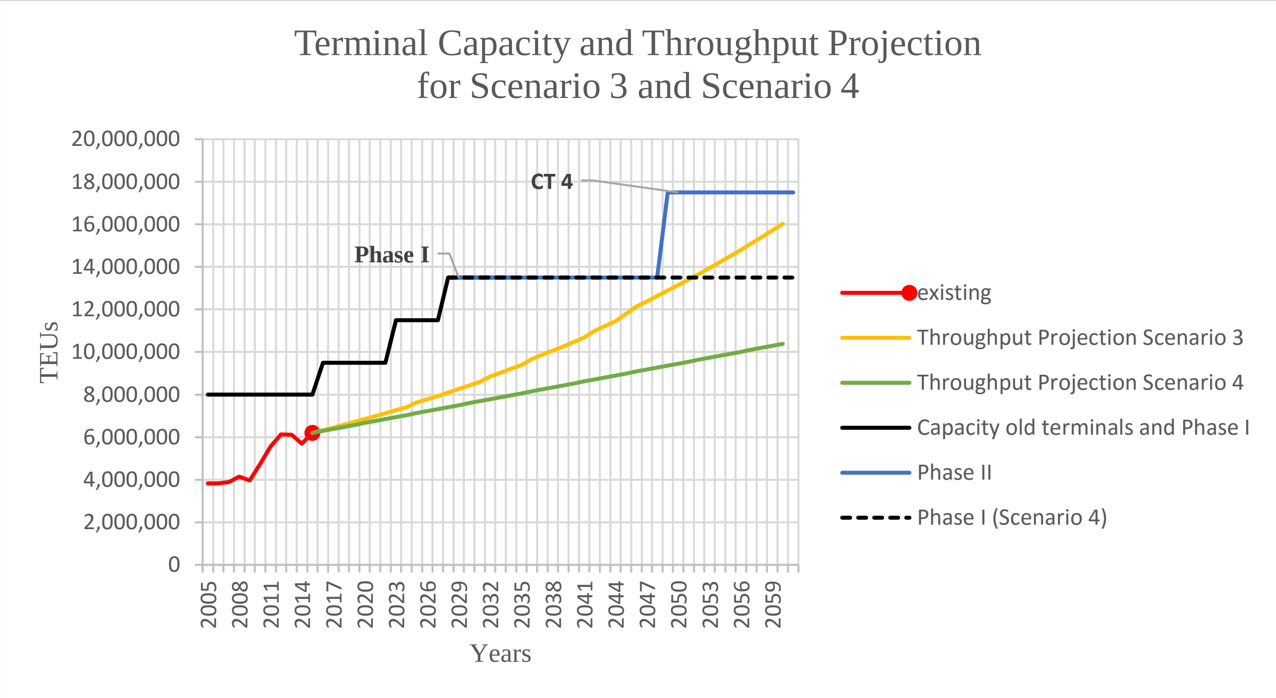


Figure 4-8 Terminal capacity and throughput projection for scenario 3 and scenario 4

Table 4-6 Terminal capacity versus commodity projection for scenario 3 and scenario 4

Years	Cargos				Phasing
	Containers			Energy	
	Terminal Capacity	Scen. 3 Projection	Scen. 4 Projection	Terminal Capacity	
2017	9.5m TEUs	6.5m TEUs	6.3m TEUs		Phase I
2020	9.5m TEUs	7m TEUs	6.6m TEUs		
2030	13.5m TEUs	8.5m TEUs	7.6m TEUs		
2060	17.5m TEUs	16.4m TEUs	10.5m TEUs		Phase II

Notes: numbers are in millions
Scen. : Scenario

	Phase I
	Phase II

Figure 4-9, **Figure 4-10**, and **Figure 4-11** show the proposed design layouts for Phase II New Priok Development based on dedicated areas for related scenarios.

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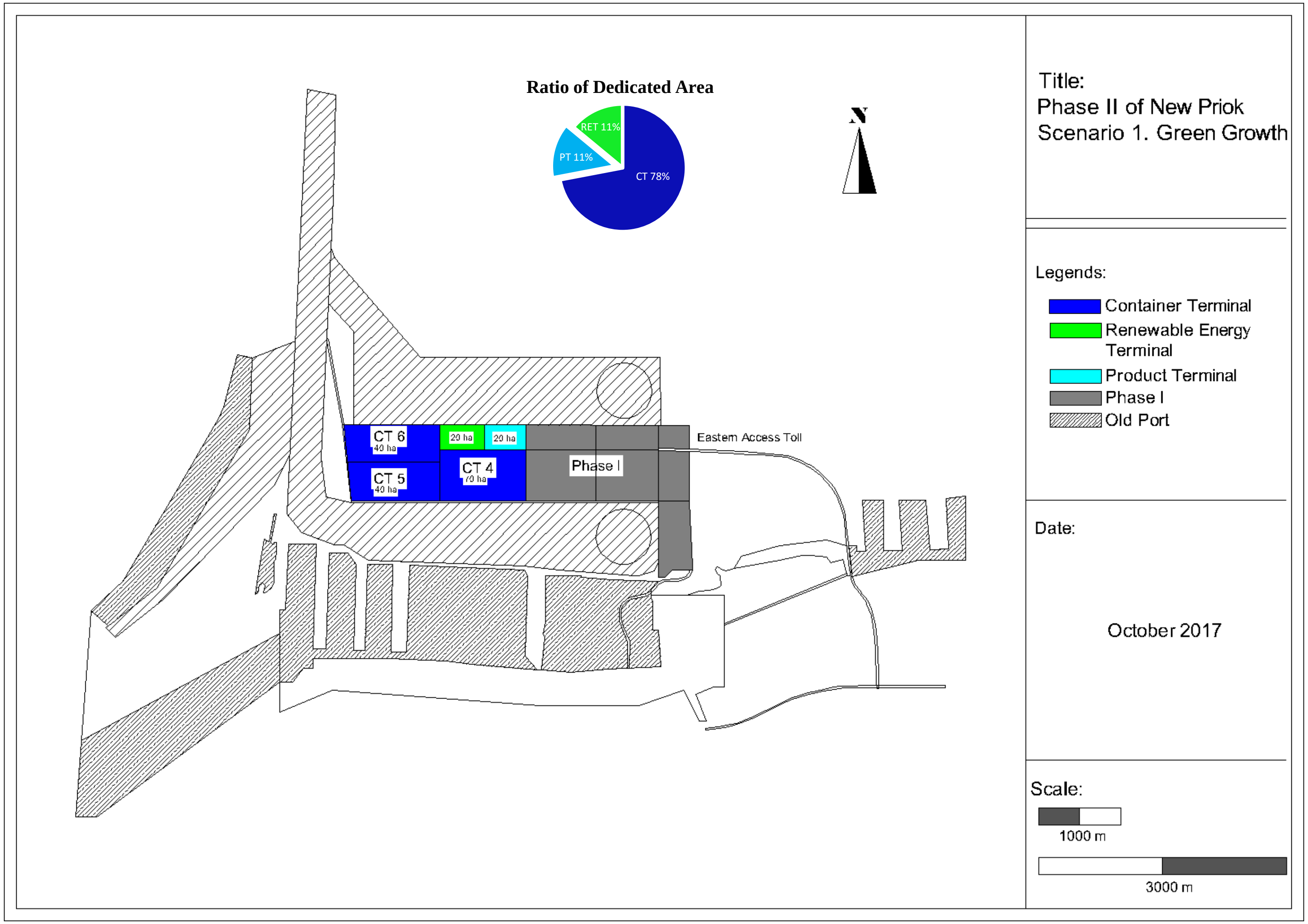

Figure 4-9 Proposed New Priok Phase II layout based on scenario 1

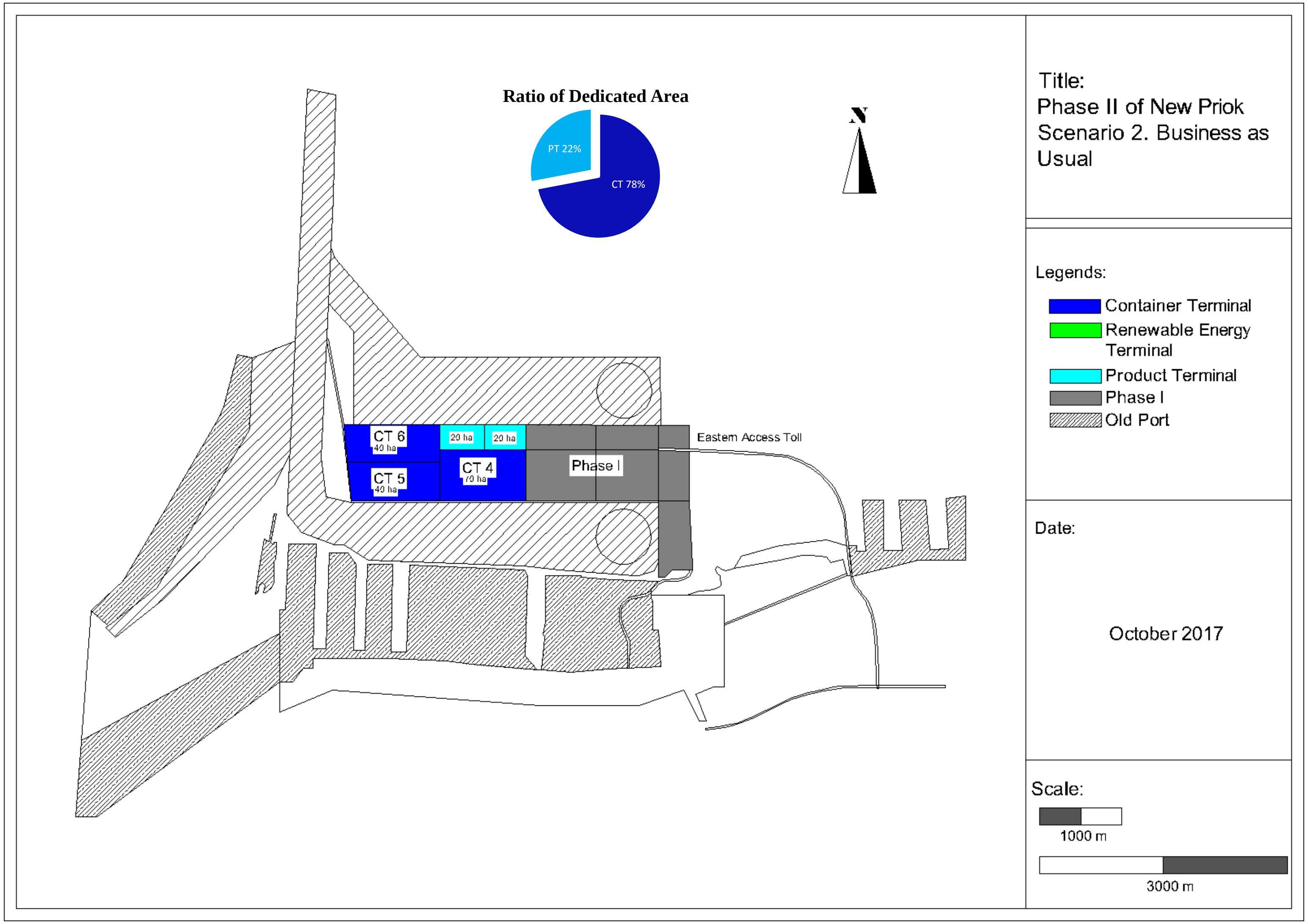

Figure 4-10 Proposed New Priok phase II layout based on scenario 2

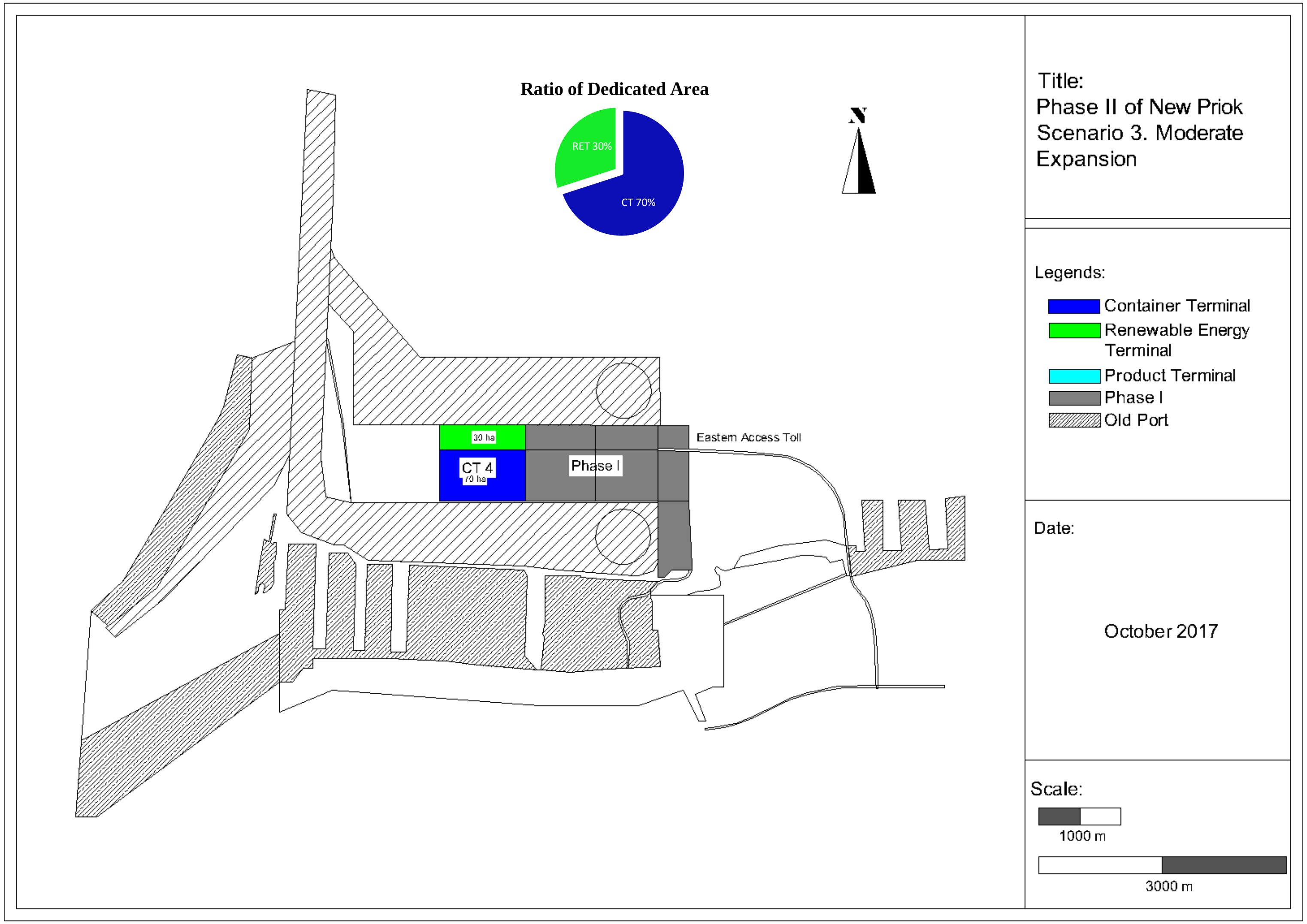

Figure 4-11 Proposed New Priok phase II layout based on scenario 3

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4.8 Conclusion

Having applied step II scenario planning for Phase II of New Priok Development, several plausible scenarios of the future state of New Priok based on listed uncertainties, they are green growth, business as usual, moderate expansion, and no expansion. Those scenarios are based on axes of economic growth and environmental and sustainability awareness which are placed on 2x2 scenario matrix.

Analysis of promising cargos has given the containers to be a preferable terminal to be built, followed by product terminal (liquid bulk), and renewable energy terminal. Various commodities and industries are served by Port of Tanjung Priok. From recorded data, it is clearly shown that containers are the most significant for the port; contributing huge revenue economically for IPC (60% of total cargos). The containers are expected to be growth in the future, although it is very difficult to produce the exact numbers to show the future projection. The projection of throughput is done based on conditions related to scenarios that have been developed. IPC has some alternatives of making the layouts for Phase II regarding the scenarios.

In scenario 1 (green growth) and scenario 2 (business as usual) in which economic and cargo growth are expected to be high, all areas in Phase II will be constructed for terminals. There is the difference between those scenarios in energy terminals where renewable energy is coming up in scenario 1. In scenario 3 (moderate expansion), due to medium-low of cargo growth, some areas are used for terminals and some others are not (left empty). There is also a possibility of implementing renewable energy as an energy source. In scenario 4 (no expansion), a very low of cargo growth induces the no expansion planning for Phase II. The capacity of Phase I would be sufficient to handle future cargo projection of New Priok in this scenario.

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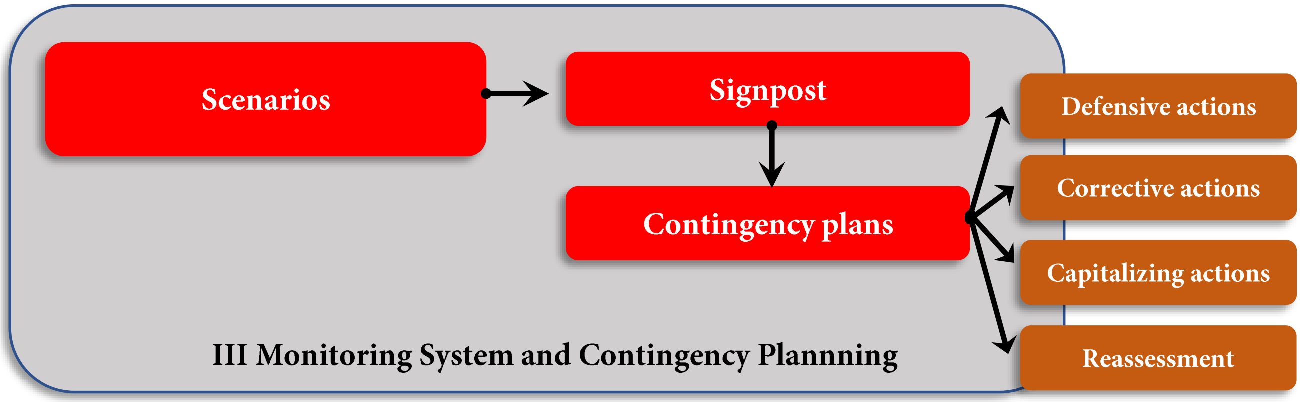
Chapter 5 Step III Monitoring System and Contingency Planning

Bad times have a scientific value. These are occasions a good learner would not miss

-Ralph Waldo Emerson

Chapter 5 Step III Monitoring System and Contingency Planning

5.1 Introduction



In this chapter, related future uncertainties are analysed into contingency plans so that the scenarios become more robust. The idea behind this step is controlling the possible uncertainties that have not been covered by the scenarios and the alternative layouts. The port competitors, future renewable energy sources, and port policy related to shipping law in 2008 are some relevant signposts that have not been dealt with proposed layouts. This chapter also discusses the fluctuation of container growth in Port of Tanjung Priok in the last decades and analyse its influence factors.

This step is involving contingency planning for each signpost. There are some contingency plans (adaptive plans) in this step that need to be identified in order to make robust planning, which are Defensive Action (DA), Corrective Action (CR), Capitalizing Action (CP), and Reassessment (RE), see **Step VI Prepare trigger responses (Chapter 2)** for definitions.

5.2 Throughput Projection

There is no direct correlation between GDP growth in Indonesia and container throughput growth in Tanjung Priok, see **Figure 5-1**. Naturally, the good economic growth of a country tends to drive the good growth of container throughput in the port. However, in Tanjung Priok, it does not seem like that, jumping down of throughput growth in 2008 and 2009 reflects the effect of the global economic crisis. The throughput was suddenly risen after that due to reform of management in the port and driven by crisis rebound.

The graph is decreasing to minus level again in a period of 2013-2014 and it relates to jumping down of oil price although GDP growth seems does not change much at that years, and it is a proven of the high portion of domestic consumption in Indonesia economy, see **Figure 3-6**.

We cannot say something about throughput projection of the future of New Priok based on one independent variable, i.e. national GDP growth. The container throughput is a sum of complex relation of multiple variables in the port (international economic condition, oil price, internal management of the company, etc). Therefore, monitoring for all of those possible factors is recommended for port planner of New Priok in order to predict the throughput.

In the future, we could expect relatively high GDP growth (4%-6% per year) so that it maintains the conducive economic atmosphere of Indonesia. Basically, the throughput growth in New Priok is expected to be positive if there are no extraordinary events in the future. This possibility is already covered by the vertical axis of scenarios (see **Figure 4-1**) and it has been transformed into throughput projection (see **Figure 4-6**) and later on to be alternative layouts (**Sub-chapter 4.7**).

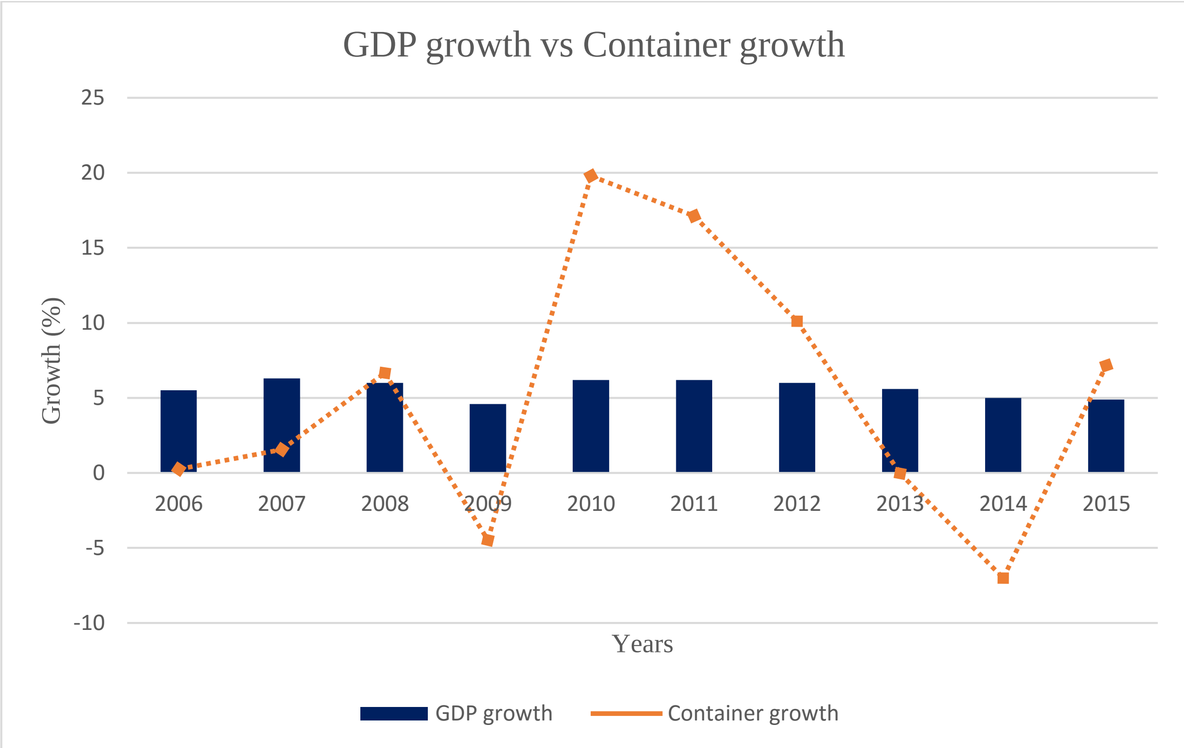


Figure 5-1 GDP growth of Indonesia and container throughput growth in Tanjung Priok (various sources, own elaboration)

5.3 Port Competitors

The planning of development of Port of Cilamaya/Patimban (see **Figure 5-2**) as a share of container handling in Port of Tanjung Priok is coming up from Port Authority (Ministry of Transportation). This port is planned to be built up to 2030. The capacity of this port is assumed to be 30% of total container throughput in Tanjung Priok (Draft Masterplan 2017).

This planning is contradictive with the idea of strengthening the Port of Tanjung Priok and making New Priok competitive. Moreover, the hinterland of Port of Cilamaya is the same as New Priok (industrial areas in Karawang and Bekasi). However, for IPC, as the operation company of Port of Tanjung Priok, they need to prepare for this kind of uncertainty (the development planning of new port as planned by Port Authority).

Figure 5-2 Location of Port of Cilamaya

Figure 5-3 shows the monitoring system and contingency planning of a port competition issue from the view of IPC. If the development of Port of Cilamaya is done, several consequences could impact the New Priok and IPC could prepare adaptive plans for that condition.

Firstly, the development of Port of Cilamaya could also lower down the throughput projection of New Priok in the future. In its optimum capacity, the share of throughput in Tanjung Priok could be divided into up to 30% of projected throughput as depicted in **Figure 4-6** before. This condition would likely to impact to the development planning for Phase II of New Priok. **Figure 5-4** shows the projection containers throughput of New Priok Phase I and Phase II without port competition for all scenarios (straight lines) and with port competition (dashed lines). The upperline is the capacity of the terminals in Phase I and Phase II of New Priok.

If Port of Cilamaya is done as planned, some corrective action (CR) could be done regarding the terminal development planning of New Priok. In scenario 1 and scenario 2, the development CT 4 (only) is enough to handle the projection with port competition condition and CT 5 and CT 6 are not needed, see dashed line of adaptive line in **Figure 5-4**. In scenario 3, the projected throughput is lower than the capacity of the old port and Phase I (13.5 million TEUs), therefore, the development of Phase II is not needed.

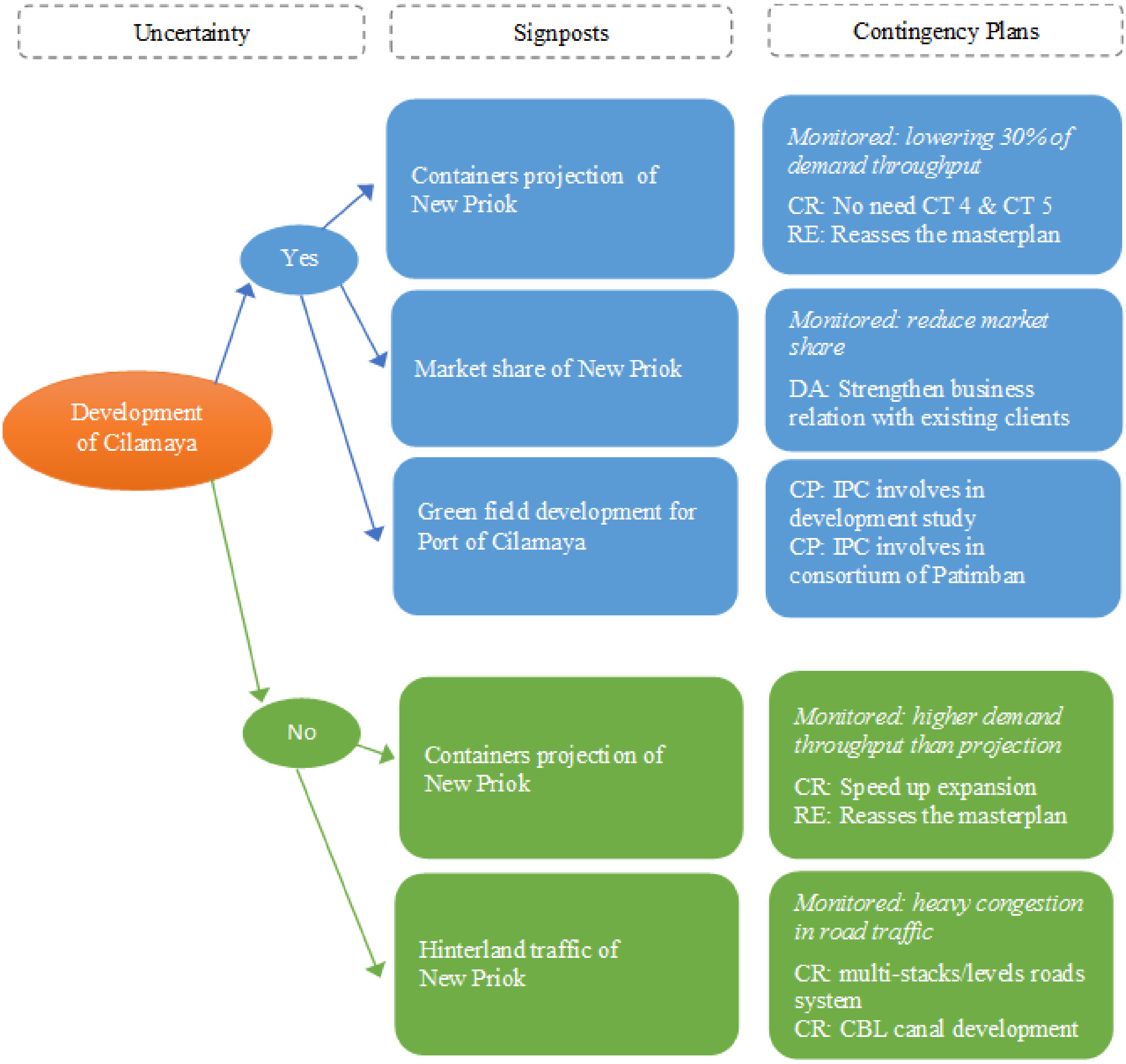


Figure 5-3 Development of Cilamaya monitoring and contingency planning

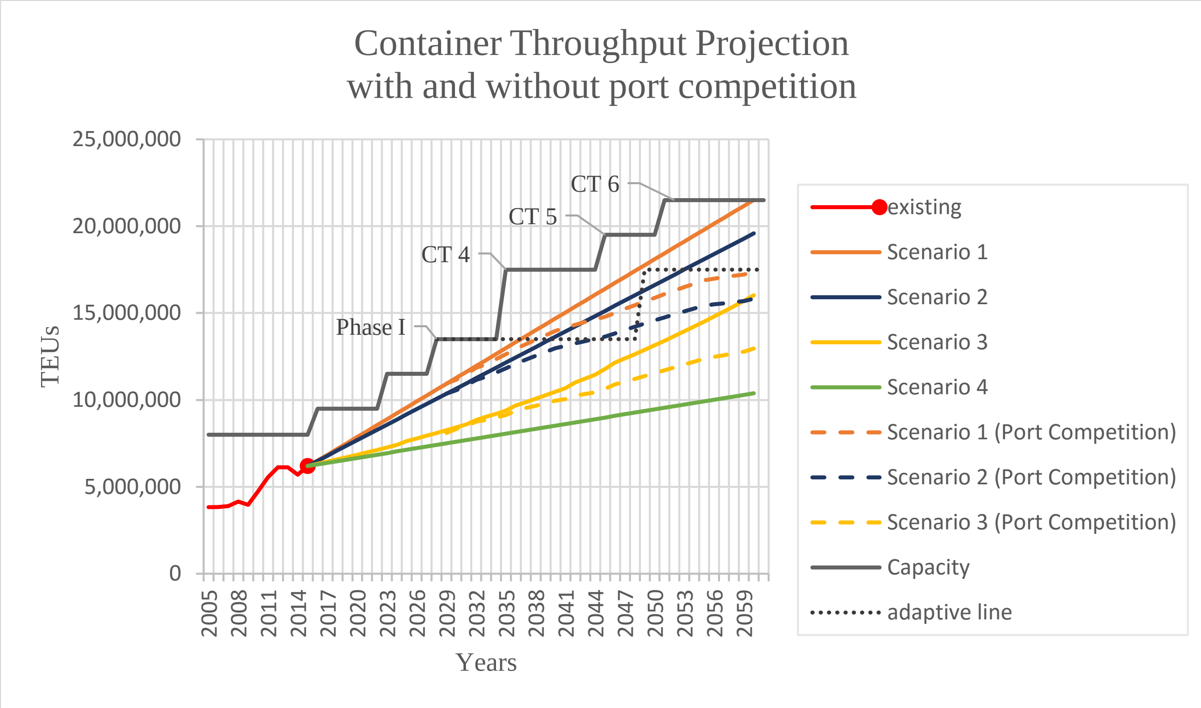


Figure 5-4 Terminal capacity and throughput projection (with Port of Cilamaya) scenarios

Secondly, this development could reduce the market share of New Priok due to the same serviced hinterlands. Therefore, maintaining and strengthening the business relationship with the existing business clients of Tanjung Priok could be a defensive action (DE) that needs to be done.

Thirdly, since Port of Cilamaya is a green field development (building infrastructure from nothing), this is also an opportunity for IPC (through subsidiary company PT PPI/Port Developer) to assess the development of this port by taking into account longstanding building experience of IPC. IPC could involve in the study process of development of the new port, this is capitalizing action (CP).

If the development of Port of Cilamaya is not favoured, then it could concentrate the throughput to Port of Tanjung Priok and rise up the throughput growth, especially in scenario 1 and scenario 2. Speed up the development is needed for New Priok as a corrective action (CR). The other problem is hinterland congestion as a consequence of the huge throughput. For that reason, IPC is highly recommended to find solutions to this traffic issue, whether implementing multi-stack road system or canalisation in Cikarang and Bekasi (CBL Canal) as corrective actions (CR).

All in all, the development of Port of Cilamaya as a port competitor obviously influences the development of New Priok. However, some adaptive plans could be prepared by IPC, such as maintaining existing business, new business opportunity, and adaptive terminal development. In the other hand, if the development of competitor port is suspended for some reasons, the concentration of cargo will be in New Priok. IPC also needs to prepare some actions related to the effect of this condition.

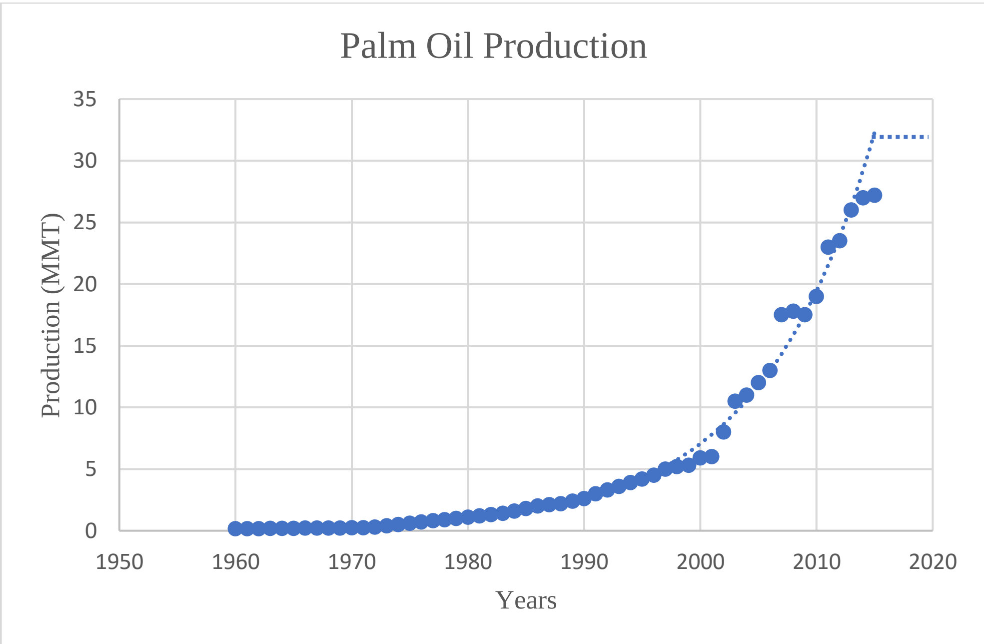
5.4 Future Renewable Energy Sources

In this study, there are two types of renewable energy projected to be potential for Phase II, bioenergy and wind energy. Bioenergy is mainly biodiesel from palm oil plantation in Sumatera, Kalimantan, Sulawesi, etc. Wind energy also has a bright future in Indonesia and Java will be the centre of development of renewable energy technology.

5.4.1 Bioenergy

The increase of palm oil production has been very massive in Indonesia since the last two decades. Currently, Indonesia is the largest palm oil producer in the world (FAOStat, 2014). This production accounts for half of global production (see **Figure 5-5**). Indonesia's palm oil production overtook Malaysia's around 2006 due to the rapid expansion of its oil palm plantation area.

Increasing domestic use of palm oil biodiesel is a strategic issue for Indonesia. Diesel fuel accounts for about 43% of Indonesia's land transportation energy demand, and almost 40% of Indonesia's diesel fuel is imported. The need for oil imports to supply the high demand for diesel is a major driver behind government support for palm biodiesel (ICCT, 2014). Although, this production needs to be limited at some point by the government due to environmental impact caused by palm plantation (see dashed line in graph **Figure 5-5** as a proposed limitation of the production of palm oil for Indonesia).



MMT: Millions Mega Tons

Figure 5-5 Palm oil production in Indonesia (FAOStat, 2014)

5.4.2 Wind Energy

Wind energy potential sites can be found in the almost entire territory of Indonesia. However, they are relatively far away from the centre of population. Based on collected data, about 166 sites in Indonesia had been measured for the wind energy potency and the result showed that 35 sites have good potential wind energy, with the average of annual wind speed is above 6 m/s (Martosaputro et al, 2014). In addition, about 34 sites also have sufficient wind energy to be developed; with the average of annual wind speed is ranging between 4 – 5 m/s (**Table 5-1**). The research centres on wind turbine technology are mostly located in Java, such as WhyPGen and LAPAN. Therefore, this business will be significant for Phase II of New Priok.

Table 5-1 Indonesia wind data summary (LAPAN Wind Data)

Resources Potential	Wind speed at 50 m (m/s)	Wind power density at 50 m, (W/m^2)	Number of sites	Provinces
Marginal	3 – 4	< 75	84	Maluku, Papua, Sumba, Mentawai, Bengkulu, Jambi, East and West Nusa Tenggara, South and North Sulawesi, North Sumatera, Central Java, Maluku, DIY, Lampung, Kalimantan
Fair	4 – 5	75 – 150	34	Central and East Java, DIY, Bali, Bengkulu, East and West Nusa Tenggara, South and North Sulawesi
Good	Above 5	Above 150	35	Banten, DKI, Central and West Java, DIY, East and West Nusa Tenggara, South and North Sulawesi, Maluku

5.4.3 Contingency Plans on Future Renewable Energy Sources

Implementing palm trees as biomass sources needs really careful attention on sustainability issues. Expanding palm plantation means reducing rainy forest of Indonesia at the same time. This condition is obviously not acceptable in scenario 1 (green growth) and scenario 3 (moderate expansion) in which society is really concern about sustainability.

Further research on sustainable and green palm oil concept needs to be done by related stakeholders (government and palm oil industries) to deal with the huge impact of palm plantation to the environment. Otherwise, land restriction and better spatial arrangements have to done to minimize the worst damage on environmental. This is categorized as corrective actions (CR).

Although the great potential of wind energy, the implementation in the real field (utilization) is still low and even still in research level, see **Table 3-6**. Again, further research on wind energy is highly needed to get into the implementation of this kind of energy as efficient as possible, corrective action (CR).

The development of solar energy has also great potential for Indonesia as a tropical country. For Java and hinterland of New Priok, the implementation of the huge areas (solar farm) of solar panel is not possible due to lack areas available. Hence, dedicating specific port's terminal for the handling of solar energy system is not relevant. However, making use of this energy source for self-sustainable energy generation for inside the port is highly recommended, this is capitalizing action (CP).

5.5 Port Policy

5.5.1 Shipping Law No 17 2008

Shipping law no 17 2008 pointed out the changing of organizing of ports in Indonesia, including Port of Tanjung Priok. Previously, Port of Tanjung Priok was governed and operated by Pelindo II/IPC (public service port). In those days, there was a kind of monopolistic system of port governance in Indonesia by state-owned company (Kent, 2012). At the moment, this behaviour has to be shifted to landlord port model in which Port Authority (government employees from Ministry of Transportation as *Otoritas Pelabuhan*) is separated from operating function (IPC).

As an outcome of this law, the organizational structure of Port of Tanjung Priok is depicted in **Figure 5-6**. Port authority is related to the function of ownership, policy making, and regulation of the port. Port operators cover commercial functions which are absolutely necessary to the functioning of ports:

1. Handling (loading/unloading cargo to/from ships)
2. Storage and warehousing within the port limits
3. Services to ships including pilotage, towage, mooring

Worldwide one can distinguish four different forms of organization of the public ports:

1. The public service port: all services including cargo handling and storage are provided by the port authority. This form was common in the old times and can still be found in some developing countries. It was often characterised by bureaucracy and red tape and can only survive in case there is a natural hinterland without the competition of other ports.

2. The tool port: the port authority remains responsible for providing the main ship-to-shore handling equipment (usually light to medium multipurpose cranes), while cargo handling is carried out by private companies under licenses given by the port authority.
3. The landlord port: the port authority owns the land and gives concessions to private sector companies for the provision of cargo handling and storage services. The port authority is responsible for the infrastructure, the nautical safety and access, including maintenance of approach channel and basins.
4. The private service port: private port authority is owning and operating the port. In some cases, port infrastructures are financed/built by the private sector.

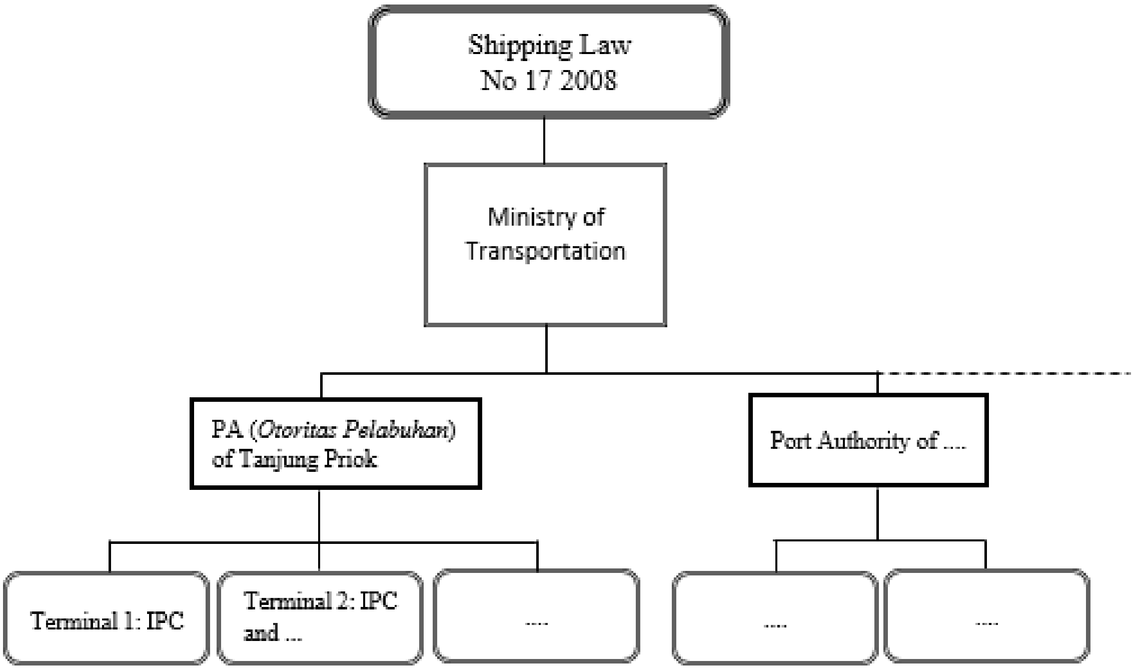


Figure 5-6 Port organizational structure in Indonesia based on Shipping Law no 17 2008

Table 5-2 shows the strength and weakness analysis of all port models. The idea of changing the model of Port of Tanjung Priok from public service port to landlord port (shipping law 2008), see **Table 5-3**, is making more open for market competition so that can clients gain more benefits from logistic activities in the ports. On the other hands, this law also has a risk of unfair competition among port's business players.

Table 5-2 Strengths and weaknesses of port models (Turpin, 2013)

Port model	Strengths	Weaknesses
Public service port	Superstructure development and cargo operations under the responsibility of a unique organization	Not user/market oriented. Lack of internal competition leading to inefficiency. Strong interferences of government (labor and

		investment planning). Lack of innovation due to limited role of private sector
Tool port	Good coordination between investments in port infrastructures and equipment	The conflict between port authority (owns equipment) and private firms (operate equipment). Limited involvement of private sector (low innovation and may lead to inefficiency)
Landlord port	Port authority focus on governing functions. Commercial activities by private firms are more market oriented and competition has driven (favour efficiency and innovation)	Risk of duplication of equipment as a result of pressure from private operators on port authority to oversize the infrastructure
Private service port	More flexible, more market oriented development strategy	Risk of private firms taking undue advantage of a monopoly position. Government risks on poor control on strategic issues on governing functions. If full privatization, there is a risk of speculation on high-value port land

Table 5-3 Trend of port models in the world (Turpin, 2013)

No	Port model	Trend
1	Public service port	Used to be dominant until the late 80s
2	Tool port	Used to be common
3	Landlord port	Becomes the dominant model in this day
4	Private service port	Generally limited to specific cases

5.5.2 Contingency Plans on Shipping Law 2008

For IPC as a port operator in Tanjung Priok, this shipping law influences much on how the company facing the business in the future. The new regulation has already followed the global trend on the port model (landlord port model becomes more common). IPC has to adapt to be well-serviced and competitive port operator company as for defensive action (DE). On the other side, Port Authority has to create a fair atmosphere of competition through clear regulation on ports in Indonesia.

IPC could not expect to be the only player in Port of Tanjung Priok in the future, especially in New Priok, they have to invest in soft infrastructure (human resource) and hard infrastructure (terminal equipment, water areas service equipment, etc) in order to be the main reference port operator in Indonesia (capitalizing action (CP)).

5.6 Conclusion

Having identified possible scenarios, monitoring the signposts of the system has to be done in order to make the scenario plausible. These signposts are chosen from future uncertainties that are not covered yet by scenarios. Four signposts have been analysed to develop relevant contingency plans that needed to make the planning more robust, which are the port competitors, future renewable sources, and port policy. One signpost related to the fluctuation of container throughput, it has also been examined in order to emphasize its role in planning.

If the development of Port of Cilamaya (new port) is supported, there are two vulnerabilities for New Priok (Phase II) which are lowering cargo up to 30% and reducing the competitiveness; one opportunity is taking financial advantage of green field construction of Port of Cilamaya. If the development of new port is not supported, one vulnerability is a heavy congestion in the hinterland of New Priok and one opportunity is a higher throughput growth. Eventually, some actions plans have been explained in this chapter in order to adapt to those possible conditions to the terminal masterplan.

Related to renewable energy, it still needs to be done further research in order to get into implementation level of those resources (bioenergy and wind energy). As a tropical country, adopting a solar system for port's power generators are also interesting for New Priok. The changing of port policy regarding the role of IPC in Tanjung Priok as the port operator has to be a major consideration to design the company in the future.

All in all, the monitoring system and contingency planning are designed to prepare the port facing uncertainties in the future holistically. By doing so, we can see how the design alternatives deal with uncertainties and how adaptive planning is applied for the terminal masterplan for Phase II of New Priok Development.

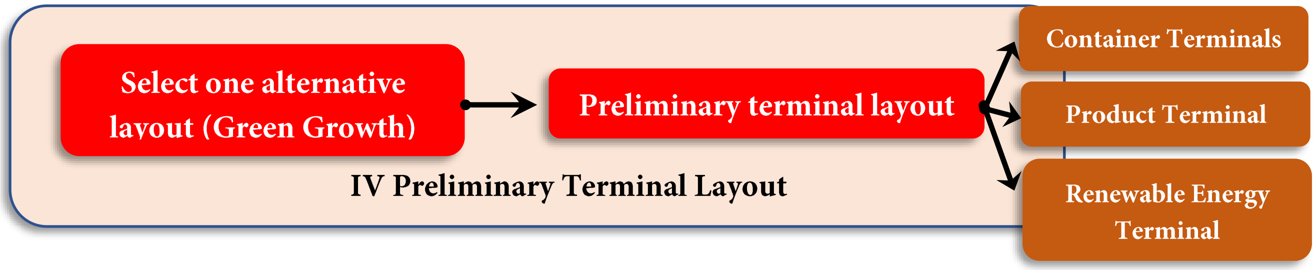
Chapter 6 Step IV Preliminary Terminal Layout

At its heart, engineering is about using science to find creative, practical solutions. It is a noble profession

-Queen Elizabeth II

Chapter 6 Step IV Preliminary Terminal Layout

6.1 Introduction



In this chapter, the last step of the framework is demonstrated. The three terminals that have high relevancy to Phase II of New Priok Development are detailed in layout design which are container terminal, product terminal (oil and gas), and renewable energy terminal (bioenergy and wind energy). The preliminary terminal layout development of each terminal will be explained related to required quay length (design ship), handling methodology, and storage areas. Each of those variables is estimated to which one that will be suitable for Phase II of New Priok.

In the end of this section, there will be a detail of terminal's layout of scenario 1 (green growth). The scenario 1 is chosen because it includes all cargo sectors in the layout design. This section will give more insight about the terminal layout in detail for each related commodity.

6.2 Container Terminal

6.2.1 Container Ship

The development of container ships has grown significantly since the era containerization. **Table 6-1** shows recorded ship dimension for post panamax vessel. The future development of the ships is still a question and categorized as one of the sources of uncertainty.

The latest mega container ships have reached 20,000 TEU capacity, although seemingly the longest ship length remains in about 400 m. This ship's length determines the quay length of container terminals and New Priok will be able to cope with this parameter (available quay length for Phase II of New Priok in each terminal is about 1000 m).

The future container ship's width is not going to be more than 70 m which it determines the channel width for ships in New Priok. Channel width is also considered not to be the problem since the available width of channel basin inside the port reaches 1000 m.

In the future, the maximum ship's draught (D) is considered to be maximum 18 m. This ship's draught requires channel depth for Phase II of New Priok, which is about 19.8 m[15] through dredging.

Table 6-1 Container ship dimension (various sources)

Container Ships	Ls (m)	Bs (m)	D (m)	Capacity (TEU)
APL C-class (1988)	275	39.4	12.5	4,340
NYK Altair (1994)	300	37.1	13	4,740
Maersk S-class (1996)	318	42.8	14.5	7,000
OOCL Shenzen (2003)	320	42.8	15.9	8,000
Maersk E-class (2006)	400	53	16	14,000
Maersk Triple E-class (2013)	400	59	15	18,000
MOL Triumph (2017)	400	58.8	16	20,170
Madrid Maersk (2017)	399	58.6	16.02	20,568

6.2.2 Cargo Flow

Figure 6-1 points the basic process of cargo inbound-outbound in container terminals. It also shows the information collection and change of cargo in each process. The incoming cargos are handled in the quay and are stacked in the storage afterwards. Cargos are either transported to the consignee or are stacked for some reasons in the CFS (Container Freight Station) before outbound.

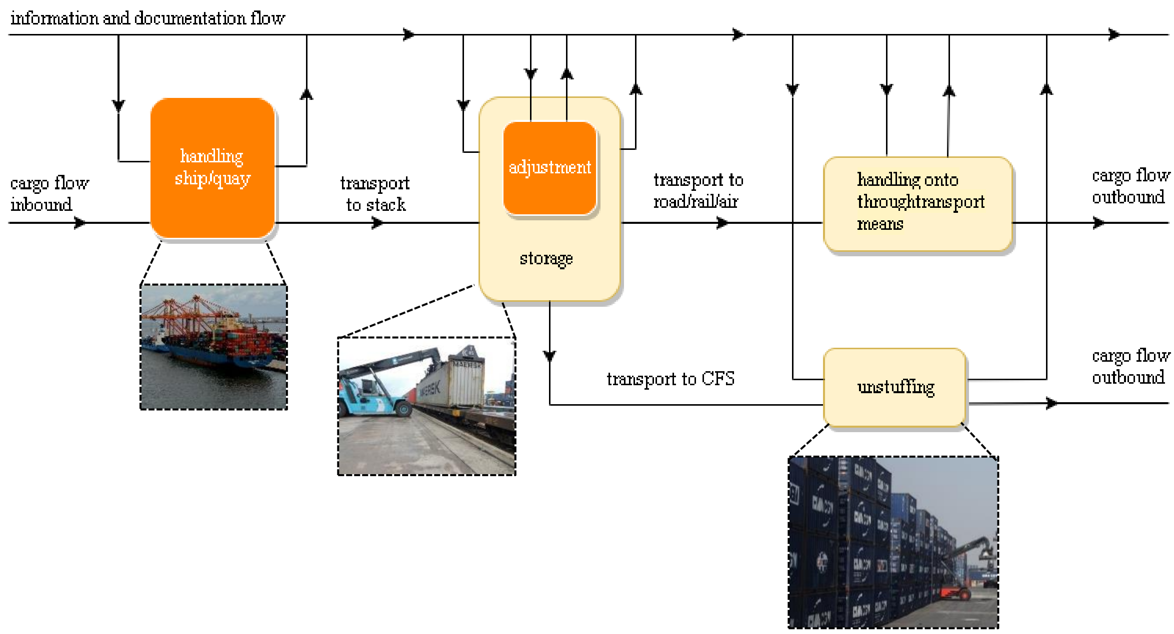


Figure 6-1 Cargo flow process in container terminal (various sources)

[15] Common practice for designing channel depth (h) = 1.1 x D (Ligteringen, 2012)

6.2.3 Handling Technology

6.2.3.1 At The Quay

At the quay, immediately after the ship has made fast at the berth, the ship-to-shore gantry cranes (portainers) start unloading. Usually, the portainers design will be adjusted by the ship's development, especially in the design of crane booms. **Figure 6-2** shows the adjustment of the crane booms (together with channel draft and quay length) to deal with mega ships. The crane is possibly reaching 24 rows of container booms, outreach up to 60 m, and the ship draft up to 19 m.

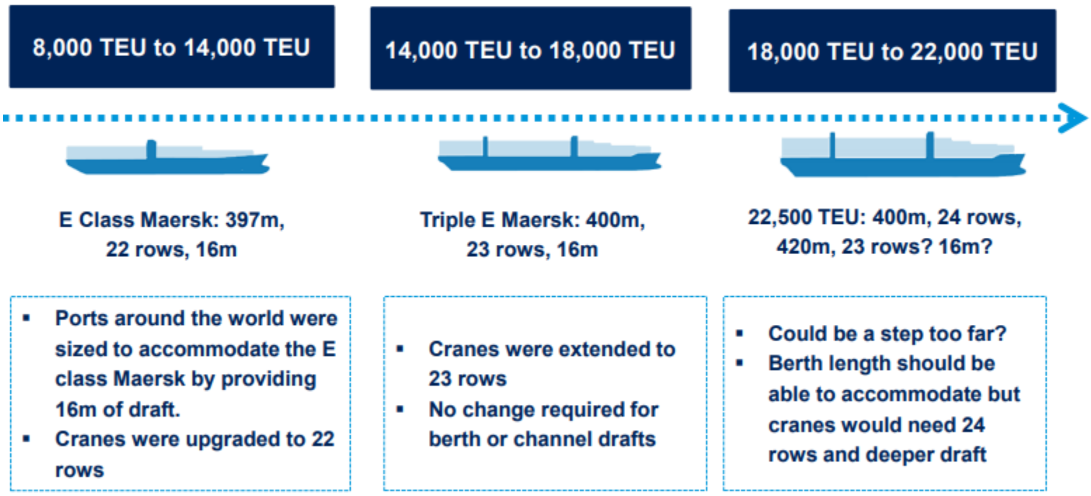


Figure 6-2 Adjustment of crane technology (Parson Brinckerhoff, 2017)

6.2.3.2 Between Quay and Storage Yard

Table 6-2 shows the comparison of handling systems between quay and storage area. For future terminals like Phase II, straddle carriers and MTS might be relevant; handling high throughput capacity efficiently. Nevertheless, it is also possible to apply AGV system depending on the ability of the port to buy it.

Table 6-2 Quay to storage transport systems comparison (Ligteringen, 2012)

Advantages	Drawbacks
Forklift truck/Reach stacker	
• **Slow investment equipment** • **Simple/flexible in operation** • **Mostly used for empties**	• Much storage space • Labour intensive • Only for 20" containers
Terminal chassis	
• **Low investment pavement** • **Low maintenance costs** • **Simple/flexible in operation**	• Much storage space • Large number of chassis needed • Low throughput capacity • Labour intensive

Straddle carrier	
• **High throughput capacity** • **One type of equipment for entire terminal**	• Complicated equipment • High investment and maintenance costs • Highly qualified personnel needed • Labour intensive
Multi-Trainer System (MTS)	
• **Less labor needed** • **High throughput capacity** • **Traffic peaks easily absorbed**	• Less flexible in operation
Automatic Guided Vehicle (AGV)	
• **Minimum labour cost** • **High throughput capacity**	• High investment and maintenance costs • Complicated and sensitive equipment

6.2.3.3 Within storage area

Within storage area, containers need to be handled and stacked. Some common equipment and their comparison are shown in **Table 6-3**. Certainly, for Phase II, RMG will be very relevant regarding the reliability, low maintenance, and soil condition[16]. ASC also has a possibility to be implemented regarding its technology development and the financial ability of the port.

Table 6-3 Within storage transport systems comparison (Ligteringen, 2012)

Advantages	Drawbacks
Rubber Tyred Gantry (RTG)	
• **Good space utilization** • **Flexible, high occupancy rate** • **High productivity**	• High maintenance • Needs good soil condition • Highly qualified personnel needed
Rail Mounted Gantry (RMG)	
• **Good space utilization** • **Reliable, low maintenance** • **Automation possible**	• High investment • Inflexible
Automated Stacking Crane (ASC)	
• **Minimum labor costs** • **High capacity**	• High investment and maintenance costs

[16] Soil condition in offshore area of Tanjung Priok is dominated by muddy clay.

6.2.4 Layout Areas

6.2.4.1 Quay Length

The quay length of terminals is determined the ship design. For single berth, it depends on largest vessel length. For multiple berths, the quay length is based on the average vessel.

$L_q = L_{s,max} + 2 . 15$ *for n= 1* .... *eq. 1* (Ligteringen, 2012)

$L_q = 1.1 . \; n . (L_s + 15) + 15$ *for n> 1* .... *eq. 2* (Ligteringen, 2012)

For container terminals, the design ship is:

- L_{oa} = 400 m
- B = 70 m
- D = 18 m

Then, the required quay length for 2 berths is 928 m per terminal.

6.2.4.2 Storage Area

The storage yard is usually divided into separate stacks for export, import, reefers, hazardous cargo, and empties. The basic formula to calculate the area is shown as follow.

$A = \frac{N_c \, t_d \, A_{TEU}}{r_{st} \, 365 \, m_c}$ .... *eq. 3* (Ligteringen, 2012)

A = required area (m^2)
N_c = number of containers per year in TEU's
t_d = average dwell time (days)
A_{TEU} = required area per TEU inclusive of equipment travelling lanes
r_{st} = ratio average stacking height over nominal stacking height
m_c = acceptable occupancy rate

6.2.4.3 Container Transfer Area and Buildings

The trucks that bring containers or come to collect them, enter the terminal through the gate. The three functions of the gate in handling cargo are:

1. Administrative formalities related to the cargo, including customs inspection and clearance.
2. Inspection of the boxes themselves (for possible damage).
3. Instruction of the drivers to the location in the container transfer area.

The office building and the workshop for repair and maintenance of the equipment are also needed in the terminal. The requirement areas are flexible and vary per terminal.

6.2.5 Summary of The Result

Container terminal layout areas are based on terminal needs in **Table 4-4** in which Container Terminal 4 (4 million TEUs), Container Terminal 5 (2 million TEUs), and Container Terminal 6 (2 million TEUs). Some factors in storage area formula (eq.3) are adjusted for future terminals, see detail in **Appendix C Terminal Development Calculation. Table 6-4** shows the summary of the result of surface areas calculation for container terminals.

Table 6-4 Summary of areas in container terminals

Container Terminal 4 (CT4)			
Type of Storage	Throughput	Dwell time (days)	Required area (ha)
Import	2000000	3	29.2
Export	1200000	3	17.5
Empties	800000	6	23.4
	Total area CT4		**70.1**
Container Terminal 5 (CT5)			
Type of Storage	Throughput	Dwell time (days)	Required area (ha)
Import	1000000	3	14.6
Export	600000	3	8.8
Empties	400000	6	11.7
	Total area CT5		**35.1**
Container Terminal 6 (CT6)			
Type of Storage	Throughput	Dwell time (days)	Required area (ha)
Import	1000000	3	14.6
Export	600000	3	8.8
Empties	400000	6	11.7
	Total area CT6		**35.1**

6.3 Product Terminal

6.3.1 Tanker Ship

Figure 6-3 shows the view of LNG carrier belongs to Evergas. The dimension of oil tankers is displayed in **Table 6-5**. The ship's dimension is required to design the quay length and water areas.

Figure 6-3 LNG Carriers operated by Evergas (Arup, 2017)

In the future, the maximum draught of tanker ship is not going to exceed 24 m as this number is also the limitation of Malacca Strait, ship's length reaches 400 m, and ship's width reaches 70 m. For product terminals which are located in the offshore part of New Priok, all of the limitation related to ship's dimensions are not relevant.

Table 6-5 Dimension of oil tankers (Ligteringen, 2012)

DWT (t)	Water displacement (t)	L_{oa} (m)	Width (m)	Draught[17] (m)	Freeboard[18] (m)
20,000	26,000	175	21.4	9.2	2.9
50,000	65,000	230	31.1	11.6	3.7
70,000	87,000	245	35.4	12.8	4
100,000	125,000	272	39.7	14.6	4.6
150,000	185,000	297	44.2	17.1	5.5
200,000	240,000	315	48.8	18.9	6.4
250,000	295,000	338	51.8	20.1	7.3
325,000	375,000	346	53.4	23.7	7.3
442,000	500,000	379	68	23.5	9.5

6.3.2 Handling Methods

Handling methods of oil and gas will distinguish the type of product terminal. There are 2 types of handling methods used to apply in practice, which are:

[17] Fully loaded condition
[18] Idem

1. Offshore buoy mooring

Offshore buoy mooring will be applied if the water depth between the large ships to the storage is insufficient. Single point mooring (SPM) represents single buoy in transporting the products. Multiple buoys mooring (MBM) represents more than one buoy involve in the process of transporting, it is certainly more efficient. **Figure 6-4** is an example of SBM (single buoy mooring)/SPM in Puthuvype, India.

Figure 6-4 SPM in Puthuvype, India (Arup, 2017)

2. Jetty Structure

In this method, the berth is handled by dolphin structure through fendering and bollard systems. The product is transported through pipeline above the structure to the storage area. **Figure 6-5** shows the dolphin structure in LNG storage in Canada.

Figure 6-5 Aerial views of jetty structure in Canaport, Canada (Prasad, 2014)

The choosing between defined handling methods will definitely depend on some required and output conditions related to wind speeds, tide effects, number of hoses, mooring conditions, assistance, etc (see **Table 6-7**). **Table 6-6** shows the limitation of wave heights for several handling methods. It has been shown that allowable wave heights for buoy mooring are higher than jetties structure.

Table 6-6 Limiting wave heights for jetties and buoy moorings (Ligteringen, 2012)

	During berthing without swell (m)	During berthing with swell (m)	During loading or discharging (m)
Jetty	1.5 – 2	1 - 1.5	2 - 3
Buoy moorings	2 - 3	2 - 3	4 – 6

Table 6-7 Comparison of three mooring systems (Ligteringen, 2012)

	Jetty structure	Multiple Points Moorings (MPM)	Single point mooring (SPM)
Access from shore	Direct (pipelines)	By sea	By sea
Number of hoses	1-8	1-4	1-3
Time between arrival and start of pumping	2 hours	5 hours	2 hours
Mooring possible with wind up to 30 knots and head waves of:	1 – 2 m	1 m	2 – 2.5 m

Oil unloading with wind up to 40 knots and head waves of:	1.5 – 2 m	2 – 2.5 m	3 – 4.5 m
Ship has to leave berth with wind of 60 knots and waves higher than:	-	2 – 3 m	3.5 – 5 m
Possible tide effects	Yes	No	No
Damage sensitive parts	Fenders	Buoy chains	Hoses
Assistance during berthing and mooring	Tugs and flats	Flats	Flats
Assistance for the departure	Tugs and flats	Flats	Flats

For Phase II of New Priok, considering its offshore location (water depth is sufficient for berthing mega ships) and fast handling requirement for future industries, the jetty structure is more relevant. The wave heights are assumed to be less than 2 m in where the location of Jakarta Bay is relatively in a calm sea (Java Sea).

6.3.3 Layout Areas

6.3.3.1 Quay Length

The quay length of product terminal is determined through equations as already explained eq.1 and eq.2. Considering the maximum ship's is:

- L_{oa} = 400 m
- B = 70 m
- D = 24 m

Then, the required quay length for Product Terminal (PT) for one berth is 430 m.

6.3.3.2 Storage Area

Liquid gas storage is more dangerous than oil storage and requires special safety provisions; any escaping liquid from pipeline or tank rupture should be contained in as small as possible an area to minimize the evaporation surface. As a guideline for space requirement, an LNG terminal with a throughput 6 million m^3 per year requires 15-20 ha storage, in 4 tanks 60,000 to 80,000 m^3 each. (Ligteringen, 2012).

In this study, since the projection of energy demand is assumed to be 10 million m^3 in the year of 2060 in scenario 1. From this projection, half of the demand is assumed to be production oil

(LNG) and another half is renewable energy. Hence, the dedicated area of 20 ha is proposed for a product terminal.

Figure 6-6 LNG tanks (Arup, 2017)

6.4 Renewable Energy Terminal

6.4.1 Transport Process of Bioenergy

The transport process of producing biodiesel in Indonesia is followed in **Figure 6-7**. Plantations of palm oil in Indonesia are located on outside Java Island, such as Sumatera, Kalimantan, Sulawesi, etc. Therefore, the palms need to be processed at first in the plant and be transported to the storage in Phase II of Tanjung Priok before being used for energy fulfilment in Java.

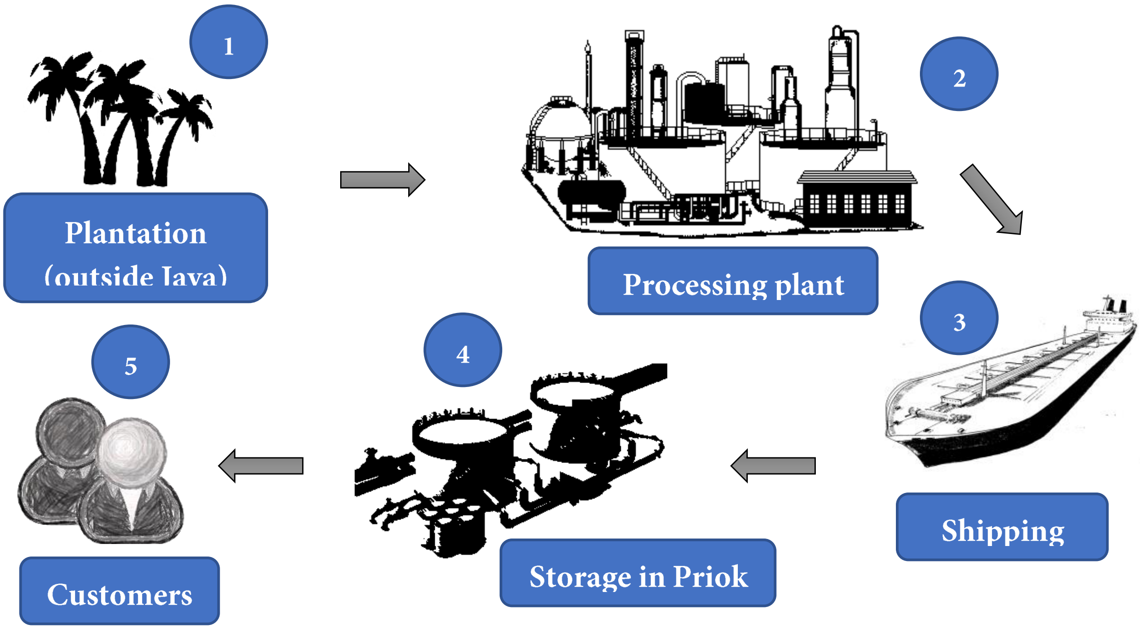


Figure 6-7 Transport process flow of bioenergy for Phase II (various sources)

6.4.2 Transport Process of Wind Turbine

As opposed to the transport process of biodiesel, the wind turbines are needed to carry outside Java Island (research centres are in Java). Therefore, the business model for Phase II of New Priok is a centre of assembling and handling of wind turbines and then will be transported to the wind sites where mostly are located outside Java (see Indonesia potential wind sites in **Table 5-1**). **Figure 6-8** shows the illustration of transportation flow for Phase II New Priok and **Figure 6-9** shows the role of Belfast Harbour as the centre of assembling and handling of wind turbines.

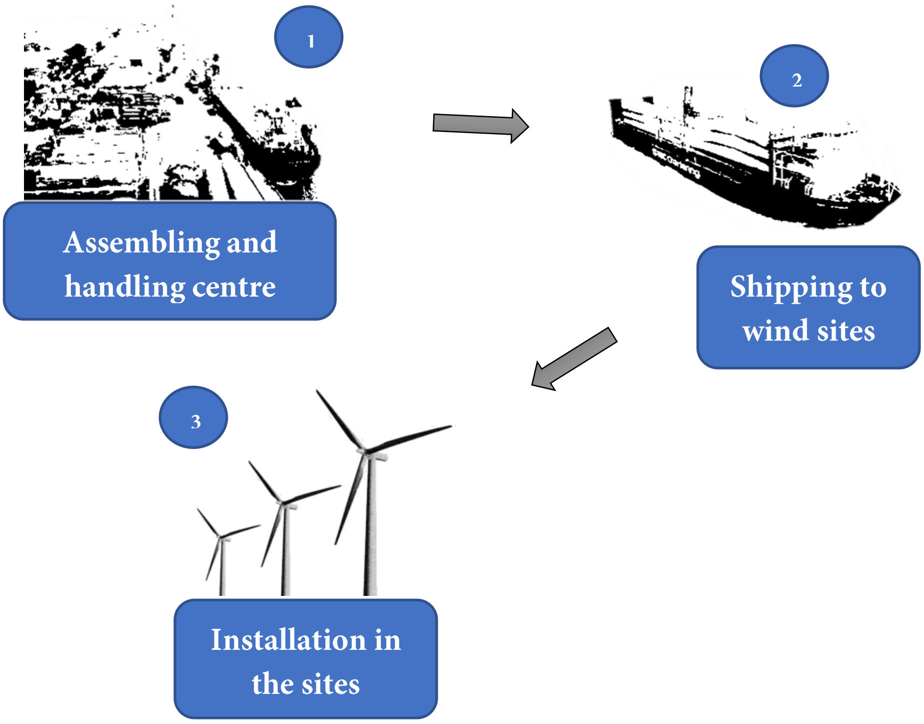


Figure 6-8 Transport process flow of wind turbines for Phase II (various sources)

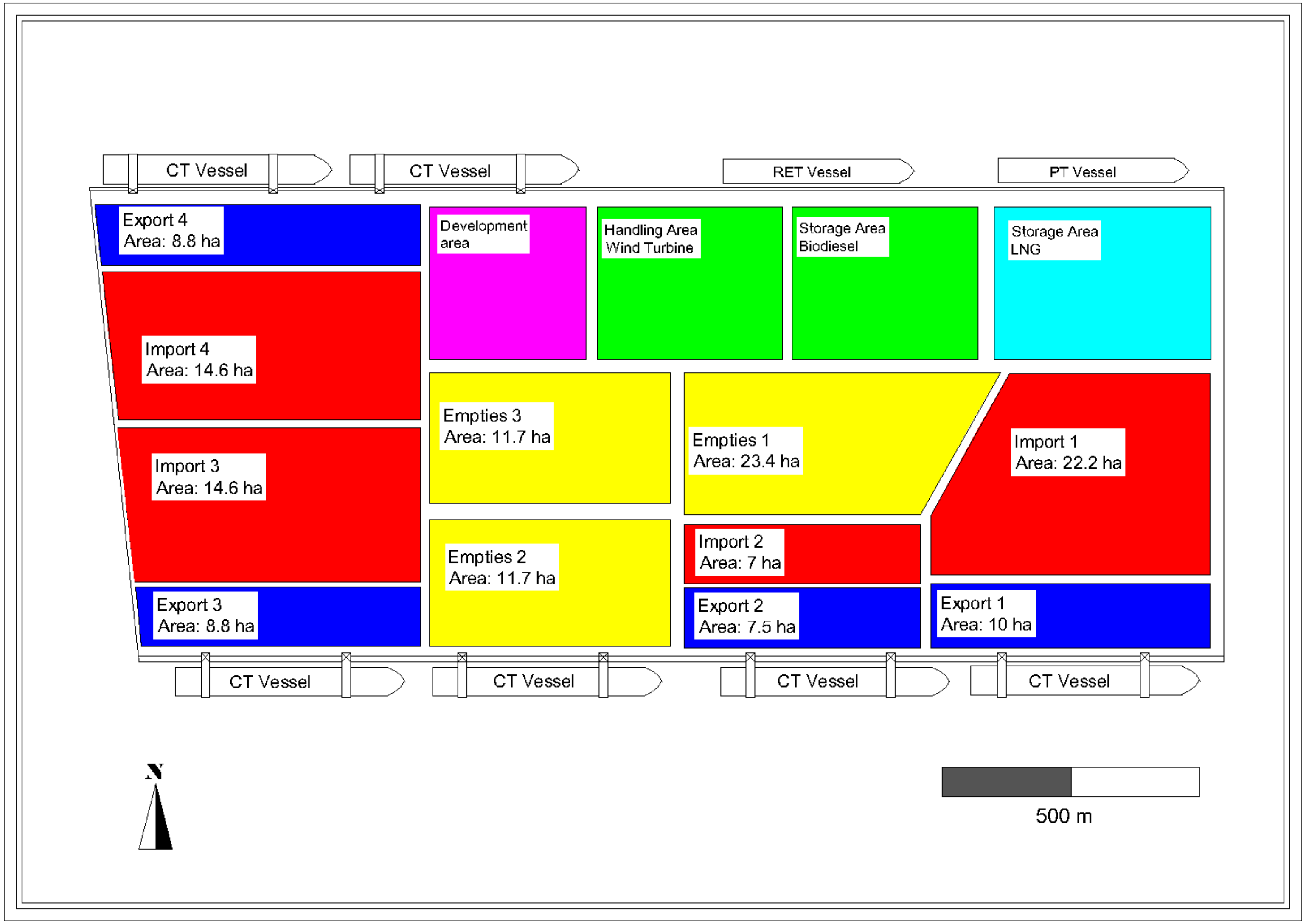
Figure 6-9 Transportation of wind turbines in Belfast Port in the United Kingdom (belfast-harbour.co.uk)

6.4.3 Storage Areas

The quay length of renewable energy terminal will depend on the ship design dimension of the related terminal. The relevant ship design for transportation purpose is a tanker ship for biodiesel and a Multi-Purpose Vessel (MPV) for wind turbines. Due to the lack of information of related ship in the future, it is very hard to define the dimension of design ships. However, the quay length of 500 m is available for berthing in this terminal.

Since the information of the storage areas for renewable energy terminal is also limited, it is not defined in detail in this study. The dimension of storage areas will be very related to the development of future research on biodiesel and wind turbines in Indonesia. However, the dedicated area of 20 ha (similar with product terminal) is available for the development of storage areas.

6.5 Terminal Layout



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Chapter 7 Conclusions and Reflections

Certainty is never an end, but a search; not the ordering of certainty, but its exploration

-Ashley Montagu

Chapter 7 Conclusions and Reflections

7.1 Research Questions

In this study, the following hypothesis is set:

The planning for Phase II of New Priok Development, which is about 2030-onwards, confronting a number of uncertainties of the future. A framework of Adaptive Port Planning (APP) Scenario-Based Planning is proposed to produce a robust terminal layout of Phase II.

The main research question is "***how to apply Adaptive Port Planning (APP) in order to develop a robust terminal masterplan for Phase II of New Priok Development?***" of this study:

RQ 1. What is the current state of development of New Priok Development?
RQ 2. What are the future uncertainties might be faced by IPC during Phase II of New Priok Development?
RQ 3. What are the possible future scenarios of economic, environmental, and social states that need to be considered by IPC for Phase II of New Priok Development?
RQ 4. What is cargo flow and projection for Phase II of New Priok Development based on developed scenarios?
RQ 5. How would Adaptive Port Planning (APP) be addressed in the terminal design layout for Phase II of New Priok Development?

7.2 Revisiting Research Questions

RQ1: What is the current state of development of New Priok Development?

New Priok terminals planning has been adjusted in some ways due to changing of the economic condition. According Masterplan of 2017, it was stated Phase I will be built in three container terminals and two product terminals and Phase II will be left untouched for an area about as large as Phase I, see **New Priok Development** in **Chapter 1**.

Hinterland analysis of Port of Tanjung Priok has shown that most of the cargo will go in/out serving surrounding provinces, especially Jakarta and West Java. Among all the containers, industrial areas in Karawang and Bekasi have dominant role contributing to container distribution in Tanjung Priok (these industrial areas also count among the biggest in national level). Unfortunately, the roads as the current main access are not able anymore to serve a huge number of trucks that lead to heavy congestion, see **Hinterland Description** in **Chapter 1**.

Regarding Phase I, Container Terminal 1 (CT 1) has already been operated in August 2016, while Container Terminal 2 (CT 2) and Container Terminal 3 (CT 3) are in the final phase of land reclamation. Waterways and basin have been dredged to more than -14 MLWS, some areas already -16 MLWS, see **Appendix B Site Visit and Visiting PORInt (Port Rotterdam International)** to get the visual images of the current construction.

[*RQ2: What are the future uncertainties might be faced by the port authority of IPC during Phase II of New Priok Development*]

In this study, it has been defined a set of future uncertainties (ten uncertainties) that have high relevancy for IPC, which are:

1. National connectivity will.
2. Global and regional economy.
3. Cargo growth.
4. Mega ship development.
5. Hinterland connection.
6. Sustainability regulation.
7. Bonus demography.
8. Future energy sources.
9. Future technology of transport.
10. Climate change.

This list is extracted from relevant company reports, government documents, and study of the future of Tanjung Priok. This list is important since the scope of the study is Phase II of New Priok Development (2030-onwards). From ten uncertainties, they are categorized into different speeds of the corporation/government to adapt, either moving slowly, steady, or quickly. The detail of the analysis is in **Uncertainty Analysis** in **Chapter 3**.

[*RQ3: What are the possible future scenarios of economic, environment, and social states that need to be considered by IPC for Phase II of New Priok Development?*]

As one of the important results of step 2 of the proposed framework, the critical uncertainties are shown in the Cartesian Plane with two axes (horizontal axis: sustainability and environmental issue; vertical axis: economic growth), these are based on listed future uncertainties. There are four quadrants represent the future scenarios for Phase II of New Priok Development, which are:

1. Scenario 1 Green Growth (high growth of economy and well-aware[19] of environmental and sustainability),
2. Scenario 2 Business As Usual (high growth of economy and disregard of environmental and sustainability),
3. Scenario 3 Moderate Expansion (medium-low growth of economy and well-aware[20] of environmental and sustainability), and

[19] The well-awareness condition will trigger the government to take action through regulations and programs in order to achieve sustainability.
[20] Idem.

4. Scenario 4 No Expansion (low growth of economy and disregard of environmental and sustainability).

See more detail in **Scenario Narratives** in **Chapter 4**.

RQ4: What is cargo flow and projection for Phase II of New Priok Development?

Cargo handled by Tanjung Priok consists of general cargo, bag cargo, dry bulk, liquid bulk, container and others; most of them are containers (more than 60% of total cargo). Therefore, Phase I of New Priok Development is dedicated for containers, besides product terminals, see more detail in **Traffic Analysis** (**Chapter 4**)**.** This trend is assumed to be the basis of alternative layouts development for Phase II. PORInt has confirmed that Port of Tanjung Priok is indeed a gateway port which mostly handling containers instead of industrial port (where petrochemical industries are located inside the port) or transhipment port.

Related to product terminals, they are needed to comply with the energy demand of Indonesia in the future. The economic growth requires energy as the driver of development. Future energy analysis is involved as one of the sources of the uncertainties and influences the design for Phase II of New Priok.

Renewable energy sources are included as one of the characteristics of scenarios. Bioenergy (palm oil plantation) and wind energy are considered to be opportunities for the future of New Priok. As a tropical country, solar energy is also a potential for Indonesia as renewable sources. However, in view of its (solar panel) household size, dedicating for a specific terminal is not needed. Making solar energy for self-sustainable power generator in the port is also a great opportunity for New Priok.

RQ5: How would Adaptive Port Planning (APP) be addressed in terminal design layout for Phase II of New Priok Development?

The framework of Adaptive Port Planning (APP) Scenario-Based Planning (see **Figure 3-1**) is applied in this study**.** Scenario-based approach seemingly gives plausible results since it explains the different perspective of the future of New Priok. It also accommodates several alternatives of layout design based on defined scenarios of the future. Based on scenario characteristics, promising industries in each scenario, future container throughput projection, terminals needs are listed in **Table 4-4**. The layout design is produced in the last discussion of the application of step II, see **Development of Alternative Layouts based on Scenario Planning** (**Chapter 4**)**.**

In addition, the monitoring system and contingency planning could be set up after getting alternative layouts, see **Chapter 5**. This system is helpful to examine the planning or even adapt and correct it regarding related signposts. Four signposts (uncertainties that are not covered in developed scenarios) are defined for Phase II of New Priok Development in this study, which are:

1. Throughput projection.

2. Port competitors.
3. Future renewable energy sources.
4. Port policy.

Due to the differences of future scenarios (explained in step II of the framework), this study also tried to look at its influence to the more detail of preliminary terminal layout for Phase II of New Priok Development (step IV of the framework) based on ship design, handling methods, and storage areas for each terminal, see **Step IV Preliminary Terminal Layout** (**Chapter 6**). In this study, the preliminary terminal layout is done only for layout in scenario 1 (green growth) only because it is already included all cargo sectors.

7.3 Future Research

A reflection on the unresolved issues in this research leads to recommendations for further research that are listed as followed.

Applying framework to other port projects

The framework of Adaptive Port Planning (APP) Scenario-Based Planning that has been developed (see **Figure 3-1**) in this study is proposed for a long-term project with deep uncertainty (see **Planning Strategies** for the definitions) and it has been applied specifically for the terminal masterplan of Phase II of New Priok Development. This framework is probably fitted for other similar projects in other regions of the world with some adaptations. Therefore, it is suggested to study more and implement the framework to the other port development in the future and study its adaptation.

Using this framework is also recommended for other future port development/expansion projects belongs to IPC. The project's development of Port of Kijing in Kalimantan and Port of Sorong in Papua would likely to face the a similar problem which is the uncertainty of the future.

Masterplan of the water areas

This study is limited to layout design of terminal for Phase II of New Priok Development. The study of water areas infrastructure masterplan (waterways, channel, basins, etc) is not included due to maintaining the comprehensive outcomes of the study. It has been predicted that terminal areas will need a huge action of adaptation in order to cope with future uncertainties. Other reasons are limited data and time restriction of the study. However, it has been considered briefly that water areas of future of New Priok will be able to cope with some major assumptions in the design process.

For future research, it is suggested to do also water areas masterplan development to get the holistic masterplan for Phase II of New Priok. The same framework could still be used with a wider scope of the study.

Add preference step

The idea of making scenario planning is not to produce one static alternative but present some alternative layouts with their conditions, terms, and references. Therefore, this framework is stopped by preliminary detail terminal design for Phase II of New Priok Development (Step IV), we did not make detail design of best/chosen alternative.

Having been sure enough with the scenarios (based on relevant uncertainties) and the time horizon of the project narrowing down, it is also suggested for further research to do next level step which is doing comparison through relevant tools, such as financial analysis (CBA). Hence, there will be a preferred alternative for the related future circumstance.

7.4 Conclusion

Project definition

This study is about terminal masterplanning for Phase II of New Priok Development in Indonesia (2030 – onwards) under future uncertainties. In order to do so, Adaptive Port Planning (APP) framework with the scenario-based approach is applied for the case study. Robust masterplan that considers multiple futures is one of the outcomes of the study.

Basically, the visions of New Priok Port have been defined in several documents which are Draft Masterplan 2017 of New Priok Development and Annual Report 2015 of IPC (Indonesia Port Corporation). It includes completing the construction of New Priok, integrating its hinterland, and encouraging the growth of the port in order to improve the logistic competitiveness of Indonesia. The planning in this study is developed with reference to those visions.

Scenarios of the future of New Priok

Ten uncertainties facing the port in the future have been identified and major uncertainties are related to economic activities and sustainability issues. These are made to be the basis of creating a scenario matrix. There are four related scenarios and four proposed alternative layouts (one layout with no additional terminals), are Scenario 1 (Green Growth), Scenario 2 (Business As Usual), Scenario 3 (Moderate Expansion), and Scenario 4 (No Expansion).

Based on an analysis of promising future cargos, containers are expected to grow in the future and they have to be followed by the increase in energy demand. However, since one the axes of the scenario is a function of economic and cargo growth, and the rate of that increase is different for each scenario, hence, several projections of containers in the future of New Priok are developed. These projections are the basis of making alternative layouts.

There is a possibility to implement renewable energy in Java Island (where Tanjung Priok is operated), bioenergy (palm oil plantation) and wind energy, especially for scenario 1 and scenario 3. Solar energy is a great potential for Indonesia as a tropical country. However, in the context of port handling, wind energy is more relevant for New Priok in the future. One of the sources of biomass in Indonesia is palm trees. However, relying on palm plantation as the main biomass sources needs careful attention due to sustainability issues. Therefore, further research on the feasibility of sustainable palm oil industry in the port is highly recommended for related stakeholders (government and business entities).

Adaptive actions

The monitoring system and contingency planning for five signposts have been indicated some adaptations for the planning, are throughput projection, port competitor, renewable energy sources, and port policy.

The development of Port of Cilamaya (port competitor) could impact directly and indirectly Phase II of New Priok. If the development of new port takes place, the potential decrease of containers in New Priok (30%) could be dealt with by adapting phasing of the layout planning. Instead of three container terminals until 2060, one container terminal (CT 4) can sufficiently handle demand projection in scenario 1 and scenario 2, no expansion is required in scenario 3 and scenario 4. Other impacts are related to the competitiveness of Phase II of New Priok and they could be dealt with by encouraging business relationships with current clients of IPC. On the other side, if the development of new port does not take place, in the future, New Priok still needs to handle critical issues, especially on its hinterland connection (for example by implementing multi-stack roads system or canalisation).

Due to the state regulation change in 2008, the port model Indonesia is shifted into landlord port instead public service port (in which IPC was a port regulator and an operator at the same time). IPC needs to adapt to this change and prepare for the possibility of changings the planning of New Priok since the main control system of the port will be the central government (in this case, Ministry of Transportation). Furthermore, IPC is encouraged to make better communication with Port Authority in order to gain mutual understanding on New Priok Development.

Preliminary terminal layout

The preliminary design of terminal layout based on future ship's dimension, handling methods, and storage areas is also discussed in this study. For Phase II, three terminals are relevant, i.e., Container Terminal (CT), Product Terminal (PT), and Renewable Energy Terminal (RET). In this study, the terminal layout is carried out for scenario 1 (green growth) in which all commodities are handled. A comprehensive layout including storage areas (export, import, empties, storage area product terminals assembling area wind energy, and bioenergy) has been produced in this study.

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Conferences

Parts of this thesis have proceeded in some conferences:

1. 19th International Conference on Sustainable Building and Infrastructure Engineering (ICSBIE). 27-28 July 2017. Istanbul, Turkey. (https://www.waset.org/conference/2017/07/istanbul/ICSBIE)
2. 3rd International Conference on Sustainable Infrastructure and Built Environment (SIBE). 26-27 September 2017. FTSL-ITB. Bandung, Indonesia. (www.sibe.itb.ac.id)

Appendix A Traffic Analysis

1. Cargos

Table Appendix A-1 Cargo flow in Tanjung Priok

Years	Cargo Flow						Total
	General Cargo	Bag Cargo	Liquid Bulk	Dry Bulk	Container	Others	
2007	10,124,820	1,763,415	7,933,766	12,000,546	28,155,899		59,978,446
2008	9,155,398	1,705,560	7,985,389	12,093,930	29,751,427		60,691,704
2009	8,366,494	1,483,985	7,846,171	11,400,432	27,755,049		56,852,131
2010	10,811,092	1,466,706	8,356,501	10,694,621	33,337,497		64,666,417
2011	13,381,526	2,399,903	9,398,352	10,031,728	39,788,295		74,999,804
2012	14,669,002	2,423,214	9,595,358	11,786,881	55,309,751		93,784,206
2013	11,282,729	1,939,803	8,568,864	12,501,506	57,123,956	1,597,264	93,014,122
2014	8,813,524	1,889,517	8,481,246	12,694,395	52,623,723	1,919,123	86,421,528

*numbers are in tonnage

2. Containers

Table Appendix A-2 Container flow in each terminal in Tanjung Priok

Years	Containers Flow				Total
	PTP	MTI	TPK Koja	JICT	
2007	1,165,630	135,019	702,199	1,821,292	3,824,140
2008	1,283,880	175,475	704,000	1,985,781	4,149,136
2009	1,509,338	164,060	618,827	1,671,246	3,963,471
2010	1,762,912	136,170	753,984	2,095,010	4,748,076
2011	2,228,112	214,063	823,730	2,295,264	5,561,169
2012	2,662,962	292,771	820,730	2,346,898	6,123,361
2013	2,617,147	251,232	828,755	2,424,230	6,121,364
2014	2,463,908		872,508	2,355,904	5,692,320

*numbers are in TEUs

Table Appendix A-3 Container flow in Tanjung Priok (1)

Years	Box				Total box per size		Total		Total Box
	Full		Empty				Full	Empty	
	20'	40'	20'	40'	20'	40'			
2008	658,868	184,053	195,908	30,499	854,776	214,552	842,921	226,407	1,069,328
2009	763,332	206,119	260,102	36,833	1,023,434	242,952	969,451	296,935	1,266,386
2010	826,242	251,913	328,974	51,935	1,155,216	303,848	1,078,155	380,909	1,459,064

2011	994,036	335,269	395,962	83,788	1,389,998	419,057	1,329,305	47,975	1,809,055
2012	1,180,668	38,648	480,812	114,261	1,661,480	500,741	1,567,148	595,073	2,162,221
2013	1,169,074	361,321	518,697	103,367	1,687,771	464,688	1,530,395	622,064	2,152,459
2014	1,125,153	339,103	450,259	105,145	1,575,412	444,248	1,464,256	555,404	2,019,660

Table Appendix A-4 Container flow in Tanjung Priok (2)

Years	**TEUs**		**Total**	**Total**	**Containerisation**
	Full	Empty	**TEUs**	**Tonnage**	**(Ton/TEUs)**
2008	1,026,974	256,906	1,283,880	11,109,249	8.65
2009	1,175,570	333,768	1,509,338	11,724,538	7.76
2010	1,330,068	432,844	1,762,912	13,414,539	7.60
2011	1,664,574	563,538	2,228,112	17,994,589	8.07
2012	1,953,628	709,334	2,662,962	22,788,210	8.55
2013	1,891,716	725,431	2,617,147	22,538,134	8.61
2014	1,803,359	660,549	2,463,908	20,745,041	8.41

Table Appendix A-5 Container flow based on trade type in Tanjung Priok

Year	**International (TEUs)**			**Domestic (TEUs)**			**Total**
	Import	Export	Subtotal	Unloading	Loading	Subtotal	
2007	1,452,984.00	1,038,571.40	2,491,555.40	1,052,507.53	454,500.13	1,507,007.67	3,998,563.07
2008	1,498,402.00	932,190.27	2,430,592.27	1,124,599.93	490,921.40	1,615,521.33	4,046,113.60
2009	1,376,703.93	847,183.00	2,223,886.93	1,010,170.07	556,085.07	1,566,255.13	3,790,142.07
2010	1,535,905.20	942,322.40	2,478,227.60	1,207,861.60	626,338.60	1,834,200.20	4,312,427.80
2011	1,879,189.33	962,017.73	2,841,207.07	1,125,986.93	1,032,126.27	2,158,113.20	4,999,320.27
2012	2,274,570.13	1,486,762.80	3,761,332.93	1,257,182.60	1,233,764.87	2,490,947.47	6,252,280.40
2013	2,309,768.40	1,484,595.07	3,794,363.47	1,235,264.00	1,171,314.00	2,406,578.00	6,200,941.47
2014	2,138,954.47	1,374,114.13	3,513,068.60	1,213,131.20	1,035,235.47	2,248,366.67	5,761,435.27

*numbers are in TEUs

3. Train Transport

Table Appendix A-6 Train transport in Tanjung Priok

Years	**Type of Goods (in Tonnage)**			**Total**
	General cargos	Containers	Others	
2009	606,837	268,152	125,686	1,000,675
2010	281,596	385,009	100,700	767,305
2011	283,879	550,603	69,320	903,802
2012	535,038	1,065,032	46,505	1,646,575
2013	614,869	1,462,952	47,606	2,125,427

4. Fleet

Table Appendix A-7 Fleet record in Tanjung Priok

Years	International Fleet						Domestic Fleet		State-Owned Fleet		Total	
	Regular		Non-Reguler		Subtotal		Unit	Gross Tonnage	Unit	Gross Tonnage	Unit	Gross Tonnage
	Unit	Gross Tonnage	Unit	Gross Tonnage	Unit	Gross Tonnage						
2007					5,755	61,024,000	11,908	27,591,000	146	451,000	17,809	89,066,000
2008	437	6,522,629	4,884	56,423,894	5,321	62,946,523	12,433	29,434,728	356	603,321	18,110	92,984,572
2009	387	6,261,192	4,121	55,203,840	4,508	61,465,032	11,871	29,525,940	291	587,928	16,670	91,578,900
2010	336	5,279,088	4,351	62,674,010	4,687	67,953,098	12,549	33,872,357	221	676,913	17,457	102,502,368
2011	944	13,722,112	3,545	59,425,466	4,489	73,147,578	14,199	39,194,606	226	912,991	18,914	113,255,175
2012	1,854	32,184,448	2,734	46,022,098	4,588	78,206,546	14,072	40,760,227	172	641,817	18,832	119,608,590
2013	2,566	45,703,615	1,962	33,909,750	4,528	79,613,365	13,566	44,346,132	189	810,468	18,283	124,769,965
2014	2,222	41,520,837	1,951	37,232,519	4,173	78,753,356	12,364	42,376,136	210	850,126	16,747	121,979,618

5. Container Projection

Table Appendix A-8 Container projection in Tanjung Priok (in TEUs)

NO	YEAR	EXISTING CONTAINER	PROJECTION			
			Scenario 1 (5.5%/yr)	Scenario 2 (5%/yr)	Scenario 3 (2%)	Scenario 4 (1%/yr)
1	2005	3,830,000				
2	2006	3,830,330				
3	2007	3,890,000				
4	2008	4,149,136				
5	2009	3,963,471				
6	2010	4,748,076				
7	2011	5,561,169				
8	2012	6,123,361				
9	2013	6,121,364				
10	2014	5,692,320				
11	2015	6,200,000	6,200,000	6,200,000	6,200,000	6,200,000
12	2016		6,510,000	6,497,600	6,324,000	6,293,000
13	2017		6,851,000	6,795,200	6,450,480	6,386,000
14	2018		7,192,000	7,092,800	6,579,490	6,479,000
15	2019		7,533,000	7,390,400	6,711,079	6,572,000
16	2020		7,874,000	7,688,000	6,845,301	6,665,000
17	2021		8,215,000	7,985,600	6,982,207	6,758,000
18	2022		8,556,000	8,283,200	7,121,851	6,851,000
19	2023		8,897,000	8,580,800	7,264,288	6,944,000
20	2024		9,238,000	8,878,400	7,409,574	7,037,000
21	2025		9,579,000	9,176,000	7,631,861	7,130,000
22	2026		9,920,000	9,473,600	7,784,498	7,223,000

23	2027	10,261,000	9,771,200	7,940,188	7,316,000
24	2028	10,602,000	10,068,800	8,098,992	7,409,000
25	2029	10,943,000	10,366,400	8,260,972	7,502,000
26	2030	11,284,000	10,664,000	8,426,191	7,595,000
27	2031	11,625,000	10,961,600	8,594,715	7,688,000
28	2032	11,966,000	11,259,200	8,852,557	7,781,000
29	2033	12,307,000	11,556,800	9,029,608	7,874,000
30	2034	12,648,000	11,854,400	9,210,200	7,967,000
31	2035	12,989,000	12,152,000	9,394,404	8,060,000
32	2036	13,330,000	12,449,600	9,676,236	8,153,000
33	2037	13,671,000	12,747,200	9,869,761	8,246,000
34	2038	14,012,000	13,044,800	10,067,156	8,339,000
35	2039	14,353,000	13,342,400	10,268,499	8,432,000
36	2040	14,694,000	13,640,000	10,473,869	8,525,000
37	2041	15,035,000	13,937,600	10,683,346	8,618,000
38	2042	15,376,000	14,235,200	11,003,847	8,711,000
39	2043	15,717,000	14,532,800	11,223,924	8,804,000
40	2044	16,058,000	14,830,400	11,448,402	8,897,000
41	2045	16,399,000	15,128,000	11,791,854	8,990,000
42	2046	16,740,000	15,425,600	12,145,610	9,083,000
43	2047	17,081,000	15,723,200	12,388,522	9,176,000
44	2048	17,422,000	16,020,800	12,636,293	9,269,000
45	2049	17,763,000	16,318,400	12,889,019	9,362,000
46	2050	18,104,000	16,616,000	13,146,799	9,455,000
47	2051	18,445,000	16,913,600	13,409,735	9,548,000
48	2052	18,786,000	17,211,200	13,677,930	9,641,000
49	2053	19,127,000	17,508,800	13,951,488	9,734,000
50	2054	19,468,000	17,806,400	14,230,518	9,827,000

51	2055	19,809,000	18,104,000	14,515,128	9,920,000
52	2056	20,150,000	18,401,600	14,805,431	10,013,000
53	2057	20,491,000	18,699,200	15,101,539	10,106,000
54	2058	20,832,000	18,996,800	15,403,570	10,199,000
55	2059	21,173,000	19,294,400	15,711,642	10,292,000
56	2060	21,514,000	19,592,000	16,025,874	10,385,000

Appendix B Site Visit and Visiting PORInt (Port Rotterdam International)

1. Site Visit New Priok Development

The site visit was held on Friday, March 31st, 2017 in New Priok Development. In this one day observation, people of port authority (otoritas pelabuhan) under the Ministry of Transportation of Republic Indonesia and PT PPI (Pengembang Pelabuhan Indonesia) attended. In this visiting, following question lists are asked and fundamentally all of the answers related to the questions have been included in the report.

Table Appendix B-1 Questionnaire

No	Questions	Answers
Definition of success		
1	What is the definition of success for New Priok Development?	
Phasing		
2	What is the background of current phasing periods in the masterplan of New Priok? are there scenarios involved?	
3	is this phasing periods considered to be robust for the project?	
Sustainability Issues		
4	What is your opinion about sustainability in the port?	
5	What are New Priok considerations on environmental issues in the port?	
6	What are New Priok considerations on social issues surrounding the port?	
7	How is ‘cut and balance’ in reclamation process in New Priok Development? Where are the disposal areas of the reclamation?	
8	Do you think a serious problem of climate change effect to the port of Tanjung Priok? What needs to be adapted by the port?	
Uncertainties and Opportunities		
9	What are future uncertainties that needs to be considered by the Port of Tanjung Priok?	
10	What are opportunities (from those uncertainties)?	
11	How sure you are with the cargo growth in the Port of Tanjung Priok in the near future?	

12	Is there an evaluation system of the masterplan of New priok? how is this evaluation done (periods)?	
13	How does the masterplan overcome the change of national or local government policy?	
Modalities shift		
14	How does Tanjung Priok do modality shift?	

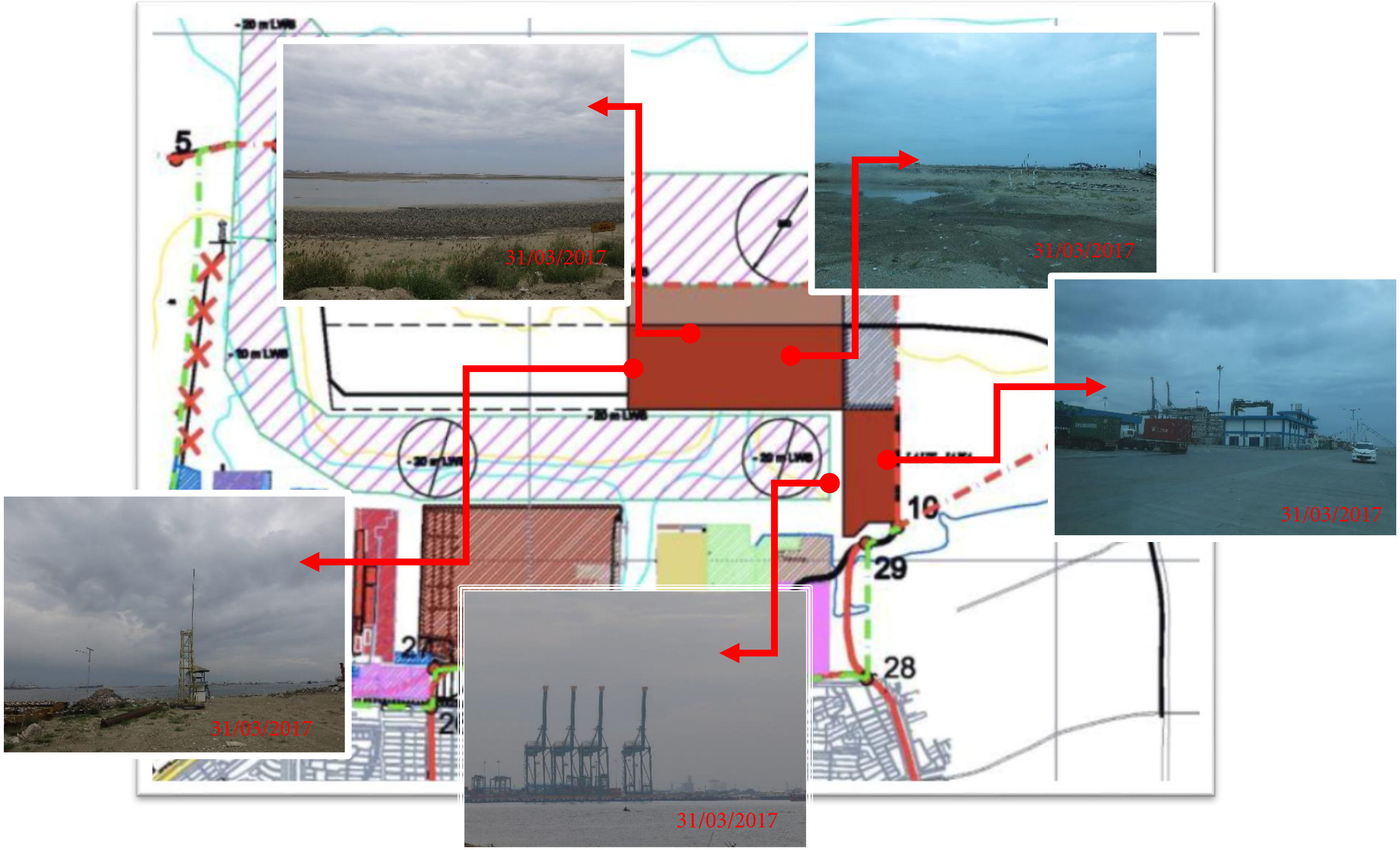
Figure Appendix B-1 Survey to the site

2. Visiting PORInt (Port of Rotterdam International)

The visiting to PORInt (Port Rotterdam International) was held on Tuesday, July 18, 2017, with Mr. Carlos O Zepeda (Project Leader). Some important points with this meeting are:

- Port of Tanjung Priok (Indonesia) is a gateway port (serving mostly containers and general cargo) instead of industry or transhipment port.
- If Port of Tanjung Priok wants to build industrial areas (for petrochemical or oil and gas) inside the port, it will need a huge amount of areas (for reference, Port of Rotterdam has almost 3000 ha for petrochemical industries). Looking at the current condition, it will be very hard to implement industrial port besides the port has to expand the area to the offshore and probably integrate with Great Garuda Reclamation Project.
- Comprehensive analysis of trends of cargo growth of Tanjung Priok shows that there might be the possibility of the worst scenario in New Priok, not needed to expand the port massively.
- Probably the port needs to consider to redevelop the old port so that it could add extra capacity, i.e. areas in Terminal II and Terminal III (see **Figure 1-4**).

Documentation of the Site Visit



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Appendix C Terminal Development Calculation

The information of composition of import, export, and empties are adjusted from data of container distribution in **Table Appendix A-3**, **Table Appendix A-4**, and **Table Appendix A-5** which explain the detail of container flow in Tanjung Priok, especially latest data in 2014. In this study, for Phase II of New Priok, container distribution is:

- Import 50%
- export 30%
- empties 20%

This distribution is assumed the same for all container terminals in all scenarios.

The information of waiting times are adjusted from dwelling time information provided by updated and a web-based official government report on Port of Tanjung Priok in https://dev.idpcs.id/dev/f?p=122:1:2643024125571::NO:::. (accessed: 25 August 2017)

Figure Appendix C-1 shows the recorded data of dwelling time in JICT and NPCT1 as international container terminals in Port of Tanjung Priok in 2017 (8 months). The average dwelling time for JICT and NCPT1 are 4.11 and 3.8 days. We could expect the improvement of these time in the future for Phase II of New Priok through some regulations and additional handling equipment. Hence, in this study, the dwelling time that used for export-import is 3 days, and for empties are doubled.

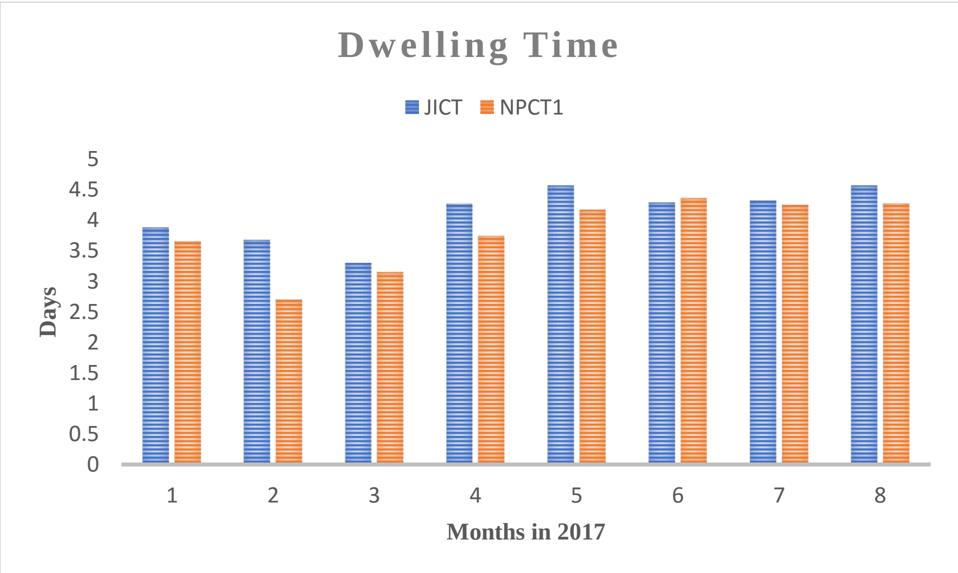

Figure Appendix C-1 Dwelling time in JICT and NPCT1 (idpcs, 2017)

Some related variables (required area perTEU, average stacking height over nominal stacking height, and occupancy rate) in the formula of storage areas for container terminals are chosen with the assumption values for the case study, as shown in **Table C-1**.

Table C-1 Container terminal calculation

Input data:

Terminal's Throughput:
CT4 = 4,000,000 TEU/yr
CT5 = 2,000,000 TEU/yr
CT6 = 2,000,000 TEU/yr

A_{TEU} = 13 (required area perTEU)
Rst = 0.9 (average stacking height)
Mc = 0.7 (occupancy rate)

CT4			
Type of Storage	**Throughput**	**Dwell time (days)**	**Required area (ha)**
Import (50%)	2,000,000	3	29.2
Export (30%)	1,200,000	3	17.5
Empties (20%)	800,000	6	23.4
	Total CT4		**70.1**
CT5			
Type of Storage	**Throughput**	**Dwell time (days)**	**Required area (ha)**
Import (50%)	1000,000	3	14.6
Export (30%)	600,000	3	8.8
Empties (20%)	400,000	6	11.7
	Total CT5		**35.1**
CT6			
Type of Storage	**Throughput**	**Dwell time (days)**	**Required area (ha)**
Import (50%)	1000,000	3	14.6
Export (30%)	600,000	3	8.8
Empties (20%)	400,000	6	11.7
	Total CT6		**35.1**