Final thesis

How Spatially Resilient is the port expansion Terminal Teluk Lamong against current and future threats of climate change?

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Foreword

This thesis is the result of following the program of Delta Management at the HZ University of Applied Sciences for four years. In the end I had been given the opportunity to partially conduct the research for my thesis in the the city of Surabaya, Indonesia, in collaboration with the Institut Teknologi Sepuluh Nopember. Living and working in Indonesia has been an experience which I will cherish for a long time.

Living and working in Indonesia is completely different from what I am used to in the Netherlands. With regard to certain aspects Indonesian culture tends to be more formal compared to Dutch culture. In other aspects however it is significantly more informal; for example, asking someone you have not met for something simply by using WhatsApp is not uncommon. The Indonesian people have been very helpful and were also very willing to help throughout the time I spent in Indonesia. Both student and lecturers received us with open arms, which contributed to a feeling of welcomeness

I would like to thank Mrs. Geerling for pointing out the opportunity to conduct the final thesis in Indonesia and for her feedback on my work throughout this period. Other people whom have greatly contributed to this thesis are: Galuh Nifar, the student who often drove us to Terminal Teluk Lamong and in the beginning also served as a translator; Ms. Mahydrana Putri and Mr. Robin of Terminal Teluk Lamong, who welcomed us to the terminal and helped us to settle so that we were able to acquire the data. Last but not least, I want to thank professor Haryo Dwito Armono who helped in order to get in contact with the people of Terminal Teluk Lamong.

Abstract

In recent years' investments in infrastructure in Indonesia have been a much neglected. In order to achieve high rates of economic growth, the country has to move away from commodities and towards manufacturing. To make this shift viable, investments in infrastructure on a national level are necessary. The port of Surabaya, Tanjung Perak, serves as a gateway to the hinterland of Eastern-Indonesia. However, this port has already reached, and surpassed, its maximum capacity. Therefor a new terminal, Terminal Teluk Lamong has been built in the Selat Madura (Strait of Madura). Ports and other coastal zones these days, and in the future even more, are at risks of the effects of climate change. Because of Indonesia's goal of economic development, it is interesting to see if a long term goal like that is accompanied by long-term plans to protect the drivers of this economic development against the threats of climate change. To do so, research into the following has been done: how spatially resilient is the port expansion Terminal Teluk Lamong against current and future threats of climate change?

Located on East-Java in the Strait of Madura terminal Teluk Lamong is already suffering from the effects of climate change; in the future this will only become worse. Currently heavy storms, and high wind speeds which are associated with them; in addition to precipitation this can lead to postponing terminal operations or a delay in terminal operations. The most important reasons for this are the fact that when the wind is too strong ships cannot be on loaded and off loaded and that the Jalan Tambak Osowilangun (road to the terminal) is flooded during heavy precipitation.

In the future the effects of climate change will become more severe and a rise in sea level will pose a more real and serious threat than it does nowadays. For Terminal Teluk Lamong this is also the case. The combination of sea level rise with extreme weather events like La Niña or heavy storms can result in a wave height which can easily overtop the terminal. This in turn can lead to damage to terminal infrastructure and property. At the same time high wind speeds and heavy precipitation remain a threat. The terminal has already performed several measures which should minimize damage to equipment as a result of high wind speeds. At the same time, it remains hard to fight this because there is only so much they can do to continue operations during events with high wind speeds. For the future there are plans to build a monorail connecting Terminal Teluk Lamong with Tanjung Perak. There are also plans to build a flyover near the terminal so that it will be connected to the highway. This way the terminal will decrease its dependency on the Jalan Tambak Osowilangun.

As for now the terminal qualifies as a spatially resilient one, with the exception of the Jalan Tambak Osowilangun. This is the result of redundancy and robustness, two principles which have been incorporated in the design of the terminal. In the future however, the terminal might not be as resilient as it is now. With the monorail and the flyover, this problem that is the Jalan Tambak Osowilangun might be solved. However, the terminal itself will become more prone to the effects of climate change when no additional measures will be taken.

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1. Introduction

1.1 Introduction

After being elected as the 7th president of Indonesia, Joko Widodo claimed he wanted Indonesia to return to a 7% annual growth rate of GDP, which was last seen before the Asian financial crisis in the late 1990's. In order to do so, the country's economy should move away from commodities, towards manufacturing. Compared to other Asian countries Indonesia has some major advantages: an average manufacturing job in Indonesia pays about $253 per month, compared with $369 in Thailand and $403 in China. Demographics are also in its favor: its' median age is 29.2, which is well below those of Thailand (36.2) and China (36.7). On the other hand, infrastructure has been much neglected since the time Suharto's was president. As a result companies have to spend 50% more on logistics compared to Thailand and twice as much as those in Malaysia (The Economist, 2015). After the Asian financial crisis of 1997, Indonesia failed to keep up infrastructural investments with its economic expansion. Therefore it is not surprising that Indonesia is currently ratcheting up infrastructure spending to upgrade roads, ports, water facilities and power plants (International Finance Corporation , n.d.).

Transportation costs in and out the province of East Java, in which Surabaya is located, are higher compared to other regions. As for other parts of Indonesia, these high costs are caused by inadequate infrastructure. To improve infrastructure, the provincial government is implementing several projects which include (new) ports (Oxford Business Group, 2013, p. 319). The port of Surabaya, Tanjung Perak Port (TPP), plays an important role in these developments. As an indication of its importance: Surabaya has more shipping routes than Jakarta and Indonesia's largest three shipping lines are all based in Surabaya. Despite TPP being the countries busiest port, it is being held back by a shallow draught and limited dock capacity. In order to tackle these shortcomings TPP is undergoing major reconstruction. A new port will be built at Teluk Lamong. Pelindo III (the state owned seaport operator of Tanjung Perak) will deepen the Surabaya access channel. Pelindo III also plans to double the channels width to 200 meters and a new liquid terminal will be built (Oxford Business Group, 2013, p. 319). From an economic point of view, the port of Surabaya is also very important. The port is one of the main contributors to economic development of East-Java and other Eastern parts of Indonesia (Graf & Huat, 2009, p. 101).

The development of the new port in Surabaya, Teluk Lamong, is therefore likely to be a direct result from the wish of the Indonesian president to shift the economy towards manufacturing. In order to create a more competitive industry and to catalyze the economy, the government is taking major microeconomic reforms first (Domínguez, 2014).

1.2 Problem formulation.

In today's world climate change is becoming an even more important aspect to take into account when (re)developing areas, especially when these areas are at risk of the

consequences of climate change. The port of Surabaya is one of the sites which has the potential to be affected by the impacts of climate change. In order to successfully withstand and recover from these events it is important for ports to be resilient. Ports which are resilient against the threats of climate change have the potential to gain a competitive advantage over ports which are not well protected against these threats. A resilient port will still function, even after it is being struck by one of the effects of climate change. This research is being carried out to see how resilient the Terminal Teluk Lamong is against these threats.

1.3 Research question and sub questions.

In order to conduct research into the subject which has been described above, a research question and sub questions to support the research question have been formulated. In the scheme below these questions can be found, starting with the main question.

Main question	How spatially resilient is the port expansion Terminal Teluk Lamong against current and future threats of climate change?
Sub question 1:	What is spatial resilience?
Sub question 2:	What are the current and future impacts of climate change on the Surabaya (port) region?
Sub question 3:	How do the effects of climate change affect the port expansion of Teluk Lamong?
Sub question 4:	How do the current plans for the expansions take climate change into account? What measures/strategies are being taken/applied to minimize the effects of climate change?

***Table 1.1** list of research question and sub questions*

1.4 Objective

The goal of this research is to review the current spatial resilience of the Teluk Lamong port expansion. At the end of this research it will be clear how the port expansions Terminal Teluk Lamong took climate change into account while developing this new terminal. When this information has been gathered and processed it will be possible to make claims of how spatially resilient this terminal is.

1.5 Relevance

Climate change is a worldwide phenomenon which affects everyone on the planet and most severely the poor. People suffer from or notice the effects of climate change either directly or indirectly. In order to prepare for the future, it is important to adapt to the new circumstances. As a gateway to East-Java the port of Surabaya plays a very important role in reaching millions of Indonesians. Events which would disturb the constant flow of goods is therefore highly undesirable.

2. Theoretical framework

2.1 Conceptual framework

The framework which has been used throughout this research is the one indicated below. This conceptual framework is a synergy framework which is the result of the climate change vulnerability framework devised by the *IPCC, n.d.,* the 4+1 model by *Onderzoekgroep Waterveiligheid en Ruimtegebruik., 2015* and the resilience framework by *Walker et al., 2004.* Below the framework is shown, what is meant with all the different terms and how it is used is explained below the framework.

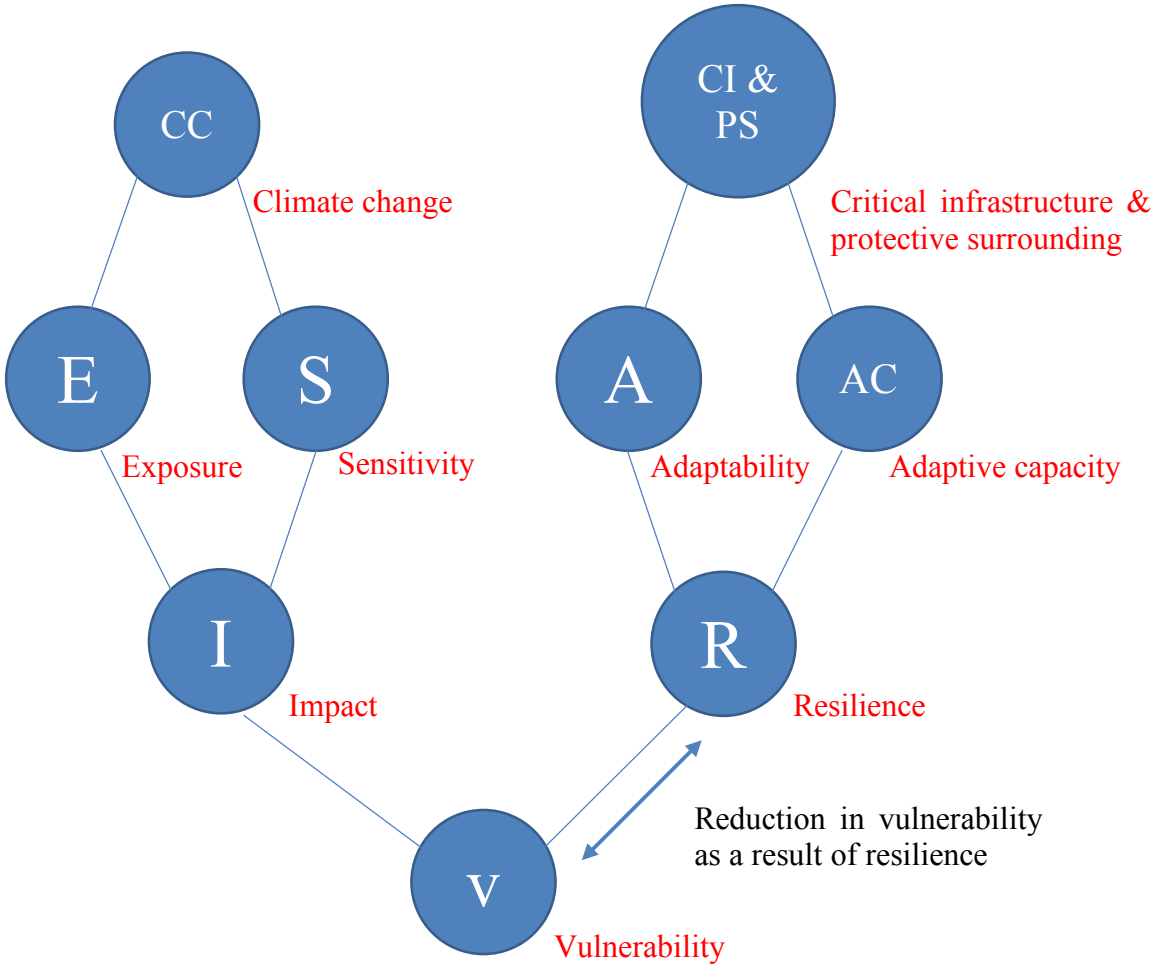

Figure 2.1 *Conceptual framework*

Climate change: Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC, 2007).

Exposure: The nature and degree to which a system is exposed to significant climatic variations (this includes the degree and duration of these variation) (IPCC, 2007).

Sensitivity: Degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response or a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due or sea level rise) (IPCC, 2007).

Impact: A combination of both the exposure of a system and the sensitivity. This is the potential impact of climate change on a system (IPCC, 2007).

Critical infrastructure: Critical infrastructure is an asset or system which is essential for the maintenance of vital societal functions. The damage to a critical infrastructure, its destruction or disruption by natural disasters, terrorism, criminal activity or malicious behavior, may have a significant negative impact for the security of the EU and the well-being of its citizens (European Programme for Critical Infrastructure Protection, 2016).

Protective surrounding: No definition or clear meaning for the aspect protective surrounding was found. What however is meant with this are all the factors in the surrounding that serve as protection against the threats of climate change. This can be hard infrastructure, like dikes and sea walls, but also mangroves or breakwater.

Adaptive capacity: The ability (or potential) of a system to adjust successfully to climate change (including climate variability and extremes) to: (i) moderate potential damages; (ii) to take advantage of opportunities; and/or (iii) to cope with the consequences (IPCC, 2007).

Adaptability: The capacity of actors in a system to influence resilience. (Capacity of actors to influence system or manage the system) (Walker, Holling, Carpenter, & Kinzig, 2004).

Resilience: The capacity of a system to absorb disturbance, and reorganize, while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks. There are four crucial aspects of resilience. The first three can be applied both to the whole system or the sub-systems that make it up:

- Latitude: the maximum amount the system can be changed before losing its ability to recover.
- Resistance: the ease or difficulty of changing the system.

- Precariousness: the current trajectory of the system, and how close it currently is to a limit or "threshold" which, if breached, makes recovery difficult or impossible.
- Panarchy: how the above three attributes are influenced by the states and dynamics of the (sub)systems at scales above and below the scale of interest. (Walker, Holling, Carpenter, & Kinzig, 2004)

Vulnerability: The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2007).

Starting from the top left of this framework is climate change. What this shows is that everything that comes after climate change is related to the topic of climate change, e.g sensitivity and exposure to the effects of climate change. On the top right it says critical infrastructure and protective surrounding. These are ways to deal with the effects of climate change and to adapt to them. Hence, the aspects mentioned on the left side will determine how vulnerable the port expansion is to the effects of climate change. Additionally, on the right side different aspect are mentioned which can potentially reduce this vulnerability; eventually both sides will meet. This is when the true vulnerability of the port expansion against the threats of climate change can be measured, keeping in mind everything that is done to minimize the effects. Because this thesis is about spatial resilience the goal is to learn how the resilience of the terminal minimizes its vulnerability to the effects of climate change.

2.2 4+1 model

Another framework, or rather model, which is also be used is the 4+1 model by *Onderzoekgroep Waterveiligheid en Ruimtegebruik., 2015.* The choice for this model is motivated by the fact that it mentions aspects that make up the concept of resilience. Important is the critical infrastructure and the aspects of which it consists. The 4+1 model is the basis of the critical infrastructure part, which is found at the top right of the conceptual framework. The model is shown on the next page:

Figure 2.2 *Simplified version of the 4+1 model in Vue graph*

The 4+1 model shows that resilience is made up out of four plus one different subsystems. Those subsystems are: social capital, use of space, economic sub systems, vital infrastructure and governance. However, the 4+1 model is used to test the resilience of communities within the province of Zeeland. In order to test the resilience of a community different aspects are testing compared to testing the resilience of a port. Because of the fact that this research is concerned with the spatial resilience of a port, the indicator of this model that is used is that of vital infrastructure. Within the model, vital infrastructure is made up out of different aspects. Below the aspects which are considered to be relevant for the topic of spatial resilience are listed:

- Energy: electricity, gas, oil.
- Telecommunication and ICT: telephone connection, radio, broadcasting and internet
- Transport: main roads, shipping routes

Spatial resilience is not limited to the aspects mentioned above. An important aspect that is missing, but will be taken into account, is the protective surrounding structures. The protective surrounding structures can be defined as structures that are directly aimed to reduce vulnerability. Some examples are the structure's height, breakwater, storm surge barriers and dykes.

In order to measure spatial resilience, the aspects mentioned above are looked into. During the data collection phase information about these aspects will be gathered. This is information on: how important infrastructure is protected, how the use of protective surroundings structures is implemented. The degree to which the aspects above are being protected and implemented will determine whether the terminal can be called spatially resilient or not.

3. Method

3.1 Climate change

Climate change is caused by global warming. Since the industrial revolution the amount of greenhouse gasses in the atmosphere have been increasing, the most important greenhouse gasses being carbon dioxide, methane and nitrous oxide (IPCC, 2014, p. 4). Because of this increase in greenhouse gasses, heat is trapped in the atmosphere, leading to global warming (Lallanilla, 2015). Global warming and the increase in temperature has effect on both environment and society. Warmer temperatures tend to change weather patterns resulting in climate change (IPCC, 2007). The effects of climate change differ from region to region based on their physical characteristics and longitude (Kahn, 2015).

3.2 Use of conceptual framework

In order to answer the main questions and sub questions, the conceptual framework is applied to the case. The left part of the conceptual framework will be used to determine the vulnerability of the port extension Terminal Teluk Lamong to the threats of climate change. The components that will be measured for this part are exposure and sensitivity. Because climate change takes place over a long period of time, a desk research will be carried out to see how the climate of Surabaya, and the surrounding areas, has changed over time.

The exposure of the port extension Terminal Teluk Lamong has been measured by doing research into the effects of climate change on this particular part of the island of Java; to be more precise: East-Java. In order to see how the sensitivity of the system is affected, parts of the information that have arisen from the previous component, namely exposure, is used. When it has become clear what the possible effects of climate change on Teluk Lamong are, it is possible to determine what the consequences of these effects are for the port and perhaps even how often they are likely to occur. For this part it is possible, and preferable, to interview employees of Pelindo III. During the interviews questions were asked about how employees currently experience the effects of climate change on the terminal, and what they think are the consequences for the port in the long run. By means of observation it was also possible to determine for example how intense precipitation affects the harbor. This is done for the effects of climate change which are most likely to occur in East-Java. The information that has been used for this consists of secondary data. Information and reports from the Badan Meteorologi, Klimatologi, Dan Geofisika (Indonesian equivalent of the KNMI) will be used to find information about weather patterns, and how they have changed.

In order to determine the vulnerability of the port expansion, the resilience has to be determined. The type of resilience on which this thesis focuses is spatial resilience. Therefore, resilience in the critical infrastructure and the protective surroundings has been researched. The aspects of which these factors consist are adaptability and adaptive capacity. In order to determine these, interviews have been conducted to learn how these concepts are applied in the port expansion. As mentioned earlier, the port expansion has been visited so that observations of the area could be made. During these visits it was also possible to make notion of any adaptive measures that lead to stronger resilience. Because

adaptability is influenced by the actors it is important to speak to these actors in order to determine this factor. Attempts to measure the adaptive capacity of the port is by reviewing the master plan of the port expansion failed because they are currently considered confidential. Maps of the height and sea level have been used to determine current levels and how they will be affected in the future. Another method which is used is interviewing employees whom were involved in the process of developing the port expansion. These employees were asked questions around the topic of spatial adaptation and resilience. Questions like which measures are being taken in order to increase the adaptive capacity of the expansion were asked to the employees of Pelindo III.

In order to determine how resilient, the port expansion is against the current and future threats of climate change (part of the main questions) the effect of the resilience on the vulnerability were determined. This was done by reviewing how the resilience of the port expansion reduces its vulnerability. So basically it can be seen as **impact – resilience = vulnerability.**

	Question:	**Method of information gathering:**	**Indicators:**
Main question	How spatially resilient is the port expansion Terminal Teluk Lamong against the current and future threats of climate change, and how could the spatial resilience of the port expansion be improved?	The answer to the main questions will be provided in the conclusion of the thesis. The different sub questions will all contribute to the answer of the main question.	
Sub question 1:	What is spatial resilience?	In order to answer this first sub questions literature will be reviewed. A brief history about the topic will be given and its application, relevance and importance for developments of today.	Not applicable, literature, desk research
Sub question 2:	What are the current, and future, impacts of climate change on the Surabaya (port) region?	For this sub question available literature on the impact of climate change will be looked for and used, for example IPCC assessments. After conducting meetings with lecturers at IT IS more documents that are commonly used in Indonesia on the impacts of climate change might be found and used.	Not applicable, literature, desk research
Sub question 3:	How do the effects of climate change affect the port expansion of Teluk Lamong?	The information that will be used to answer this sub questions will be gathered by interviewing different employees of Teluk Lamong terminal on the effects of climate change on the port and using secondary data from the BKMG, especially maps. Another method that will be used are observations. There will be moments when it is possible to access the actual terminal, under supervision and to make observations and take photographs.	- Climate change related events of which employees tell that already occurred or of which they think could happen in the near future, and their effects on the terminal - Climate change events which are seen while visiting the terminal - Effects literature suggests

			could happen in the future
Sub question 4:	How do the current plans for the expansions take climate change into account? What measures/strategies are being taken/applied to minimize the effects of climate change?	This sub question will be answered by reviewing the (partial) master plan of the Teluk Lamong terminal. In this plan there will be specifically searched for the reasons why certain choices are being made, for example why is the terminal built at its current height. Attention will also be paid to see if there are additional adaptation measures in place. When it is not possible to get the answers from the master plan additional questions will be asked during the interviews.	Adaptation measures in: - Energy: electricity, gas, oil. - Telecommunication and ICT: telephone connection, radio, broadcasting and internet - Transport: main roads, shipping routes, alternative routes - Sewerage system

Table 2.1 *List of questions, method(s) of information gathering and indicators*

3.3 Indicators

In order to measure the current state of resilience indicators were measured. The indicators will give meaning to the data. The indicators for resilience were be the following:

- Presence of spatial resilient measures in and in near proximity of the terminal
- Capacity of the spatial resilient measures
- Available alternatives for critical infrastructure (back-ups and system diversity)
- Incorporation in an overall spatial resilience or adaptation plan

The way of measuring them was as follows. Data will be gathered on all of the indicators, the way of collection can differ for every indicator. For every indicator one, two or all methods may be used, depending on how likely it is to gather the right amount of data to work with. When plans within the Terminal Teluk Lamong of these vital infrastructure elements into account, and protects them against the threats of climate change, they are being resilient. On the other hand, when they do not take the threats of climate change into account for their vital infrastructure they are not being resilient. In the final thesis there will be an explanation about how they do or do not take it into account, followed by whether this makes them resilient or not.

3.4 Quality control

Monitoring the quality of the research and the report is something which is very important. This aspect of the thesis is something which will be done entirely by myself. In order to assure the quality different aspects will always be taken into account:

- Use of sources which mention who the writer is, this way it is possible to check whether the person whom is being quoted can be considered an expert in this field of knowledge.
- Citation. All the data which is being used, or quotes from people, will all be cited in accordance with the APA norm.

- Use of data in an appropriate, and if necessary confidential, way. Data which is being retrieved from for example interviews will be processed in a correct way without mentioning the names of employees. If confidential data is being shared for the purpose of the research this confidentiality will be honored.
- Correct use of language and punctuation. In order to achieve this everything that will be written will be looked over multiple times. When everything is finished there will be one last check.

When it was not possible to acquire the necessary information for the report in the way as it was being expected, the method was changed to look for other ways to acquire it. An example of how this was done was by cross checking where the results of the interviews were compared with other sources, for example written sources or observations.

3.5 Type of research

This research is a qualitative research. The reason for this is the fact that this research will be an interpretation of the current situation. As mentioned earlier the methods for gathering data consisted of observations, interviews and literature reviews. All of these methods are characteristics of a qualitative research.

The research will be a case study. Data and information will be gathered from one specific case, Terminal Teluk Lamong which is part of the port of Surabaya. Terminal Teluk Lamong is a subsidiary company of Pelindo III. As a result, interviews were conducted with employees from both companies. Employees whom in their work have dealings that could be related to spatial resilience, climate adaptation or vulnerability to the effects of climate change are potentially interesting employees to interview. The interviews were conducted in an unstructured way. There was however a standard set of questions which was asked to all of the employees. After these questions were answered, additional follow up questions may have arisen. Because the interviews were unstructured there was the possibility to go down the road and gather data which one forehand was not thought of. The target amount of interviews was set at a minimum of five interviews. The interviews were semi structured. This means that there was a basic set of questions which was be asked to all the interviewees. However, because of the fact that the interviews were semi structured, when interviewees provided new insights or new information, additional questions towards this topic were asked.

4. Results

4.1 Terminal Teluk Lamong

Terminal Teluk Lamong is a subsidiary company of Pelindo III. Pelindo III is the port operator of 43 ports with 16 branches throughout 7 provinces in Indonesia (Pelindo III, 2015). Terminal Teluk Lamong is the first green port in Indonesia and it has been built to ease the operations in Tanjung Perak, which is the second largest port of Indonesia (Osman, 2015). Tanjung Perak has a capacity of 2.1 million twenty-foot equivalent unit (TEU). However, in 2013 the port handled 2.9 million TEU. The vision of Terminal Teluk Lamong is to secure a place within the top 5 terminal operators in the association of Southeast Asian Nations with environmental insight by 2020 (Putri, 2015).

Figure 4.1 *Terminal Teluk Lamong as of the 15th of March 2016*

Figure 4.2 Location of Terminal Teluk Lamong. Indicated with red is the Jalan Tambak Osowilangun, indicated with blue is the access road to the terminal and indicated with green is the on-site road.

The first construction phase of the terminal started in 2010 (Oxford Buisness Group, 2014, p. 81). The terminal has been operational since 2014, after completion of the first phase. It has a capacity of 1.6 million TEU and 10.3 million tons dry bulk (Osman, 2015). In total there are four different phases which should be finished by 2030. In appendix 1 till 4 the different phases, and what will be done during these phases can be seen. The terminal currently covers an area of about 39 acres of reclaimed land. Post 2030 a total of 386 acres will be reclaimed.

Terminal Teluk Lamong is located in between the cities of Surabaya and Gresik. It is closer to Gresik than it is to Surabaya. Currently the terminal is only accessible by road, namely the busy Jalan Tambak Osowilangun street. This street is indicated with red in figure 4.2. The Jalan Tambak Osowilangun is currently quite a bottleneck because of three reasons, the first reason being the large amounts of trucks that use this road. This often leads to traffic jams especially during rush hour. The second reason is the bad quality of the road that forces drivers to evade potholes in the road. The last reason is the fact that during the rainy season the road is regularly flooded because rain water virtually has nowhere to go.

4.2 Spatial resilience

4.2.1 Resilience

Various institutes and persons have given definitions to the word resilience. The word resilience can have different meanings in different contexts. Therefor it is necessary to clarify what is understood under both the terms spatial and resilience. To the term resilience the following definition has been given.

“The ability of a system to anticipate, absorb or accommodate, the effects of a hazardous event caused by climate change in a timely and efficient manner, including through ensuring the preservation of its essential basic structures and functions”.

This definition makes clear that resilience aims to minimize the negative effects of climate change to reduce potential harm.

4.2.2 Spatial resilience

As resilience has been defined it now has to be put in the context of spatial resilience. The word spatial in this context gives clarity on how the resilience is achieved. Spatial comes from the word space; it is composed out of all the different spatial elements which can be found on the terminal. Spatial resilience therefor is resilience that is achieved by building or adding spatial elements in such a way that the space is able to cope with the effects of climate change. Spatial resilience in the context of this research is therefore defined as:

“The ability of a system to anticipate, absorb or accommodate, the effects of a hazardous event caused by climate change in a timely and efficient manner, including through ensuring the preservation of its essential basic structures and functions as caused by its spatial elements”.

4.3 Climate change impact in Eastern-Java

In order to see how resilience affects the vulnerability of Terminal Teluk Lamong it is important to know against which effects of climate change the port has to be resilient. As the largest archipelago in the world, Indonesia is one of the countries that is most vulnerable to the effects of climate change. The largest threats of climate change to Indonesia are the increase in sea surface temperature, changes in the intensity and the pattern of rainfall and sea level rise (Badan Meteorologi, Klimatologi, Dan Geofisika, 2013).

4.3.1 Sea level rise

The first effect of climate change that will impact Indonesia is sea level rise. Figure 4.3 below shows the approximation of sea level rise in the Indonesian waters. The sea level of the Java Sea, near which Surabaya (red dot) is located, is currently rising with approximately 0.75 cm a year.

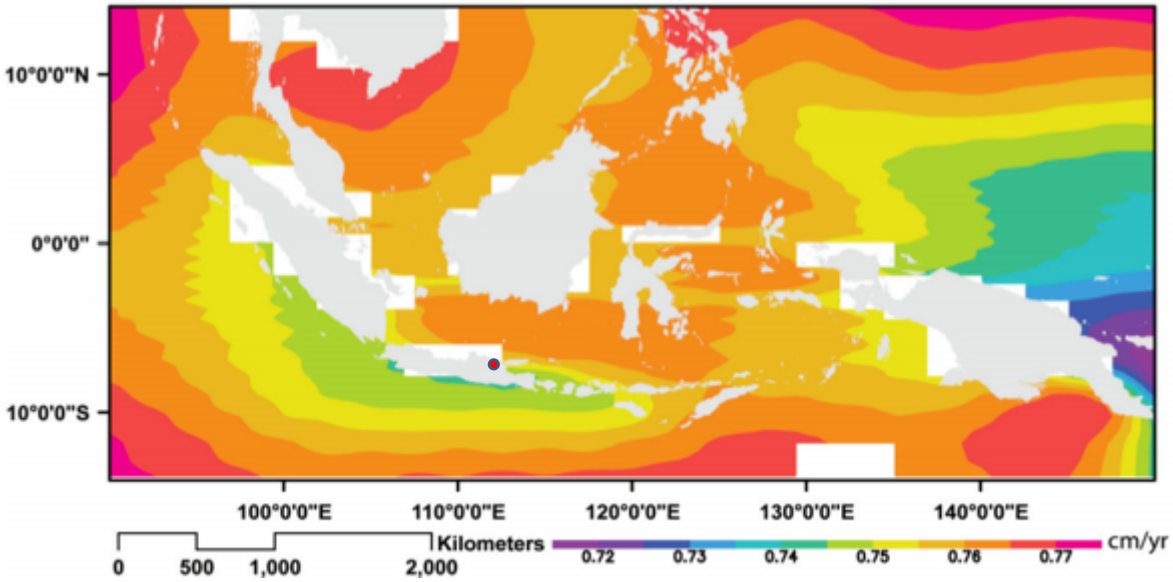

Figure 4.3 *Approximation of the amount of sea level rise in the Indonesian waters based on the scenario of IPCC SRESa1b, assuming CO2 concentration of 750ppm. Source: (Bappenas, 2010, p. 32)*

For Surabaya a subsidence level of 2.5 meter per century is expected (Bappenas, 2010, p. 61). This would mean that on average the soil is subsiding with 2.5 cm per year. Combined with a sea level rise of 0.75 cm this results in a relative sea level rise of 3.25 cm a year. The coastal zones in Surabaya are located at a height of 0-6 meters (Imaduddinaa & Subagyo, 2014). The zone closest to the sea is about 0-2 meter and moving land inwards it increases to about 6 meters.

4.3.2 Sea surface temperature increase

The second effect of climate change is the increase in sea surface temperature. The increase in sea surface temperature depends on the increase of air temperature. Right now the trend in sea surface temperature in Indonesia is an increase of about 0.020°C/year to 0.023°C/year (Bappenas, 2010, p. 25). For the sea around Surabaya the increase is estimated at around 0.021°C/year, as shown in figure 4.4.

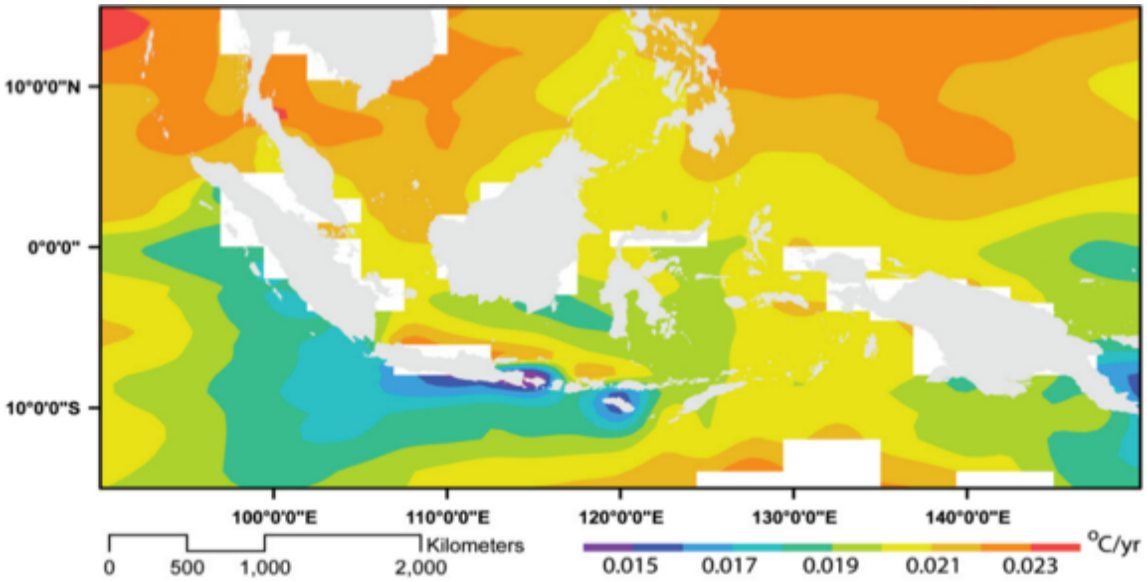

Figure 4.4 *The rate of sea surface temperature rise based on IPCC SRESa1b. Source: (Bappenas, 2010, p. 27)*

The sea surface temperature increase is a problem because it will accelerate the rate of sea level rise. When seawater gets warmer it expands, causing the sea level to rise. As a result of sea level rise current patterns can also change, causing a shift in weather patterns.

4.3.3 Increase in extreme weather events

A worldwide phenomenon as far as climate change is concerned is the increase of extreme weather events. Although Surabaya is not prone to cyclones and typhoons, it is likely that in the future they will be struck by storms more often and that these storms will be more powerful. An increase in extreme precipitation is also one of the consequences. Other extreme weather events are El Niño–Southern Oscillation followed by La Niña. El Niño is characterized by periods of drought while La Niña is characterized by periods of extreme rainfall. The transition period between the events causes drastic changes in sea water levels up to 20 cm. Aside from the rising sea levels; extreme climate conditions will also cause extreme weather that may lead to additional high waves (Bappenas, 2010, p. 42).

4.3.4 Changes in precipitation patterns

As a result of climate change it has become increasingly hard to predict weather patterns in Indonesia. The weather patterns seem to have changed over the past, as was pointed out during two of the interviews (appendix 7 &10). Both interviewees said that that it has become more difficult to predict when the wet season begins and when it will end. The wet season

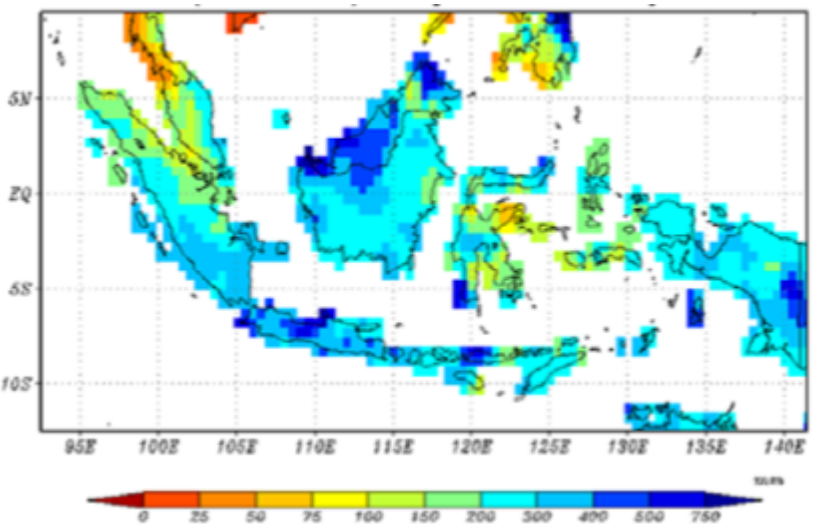

Figure 4.5 *Baseline (1961-1990) 30 year mean rainfall in January. Source (Badan Meteorologi, Klimatologi, Dan Geofisika, 2013, p. 5)*

used to last from October till March, however in recent year it has occurred that it lasted until April. Besides changes in the period in which the wet season will take place, there are also changes in the quantity of precipitation. Figure 4.5 shows the average amount of rainfall in January for the period 1961 till 1990, this is also the baseline amount. Figure 4.6 shows the average amount of rainfall in January for the period 1980 till 2010 minus the baseline. What can be seen on figure 4.6 is that the amount of rainfall in East-Java has increased with about 10 to 25 mm for month January.

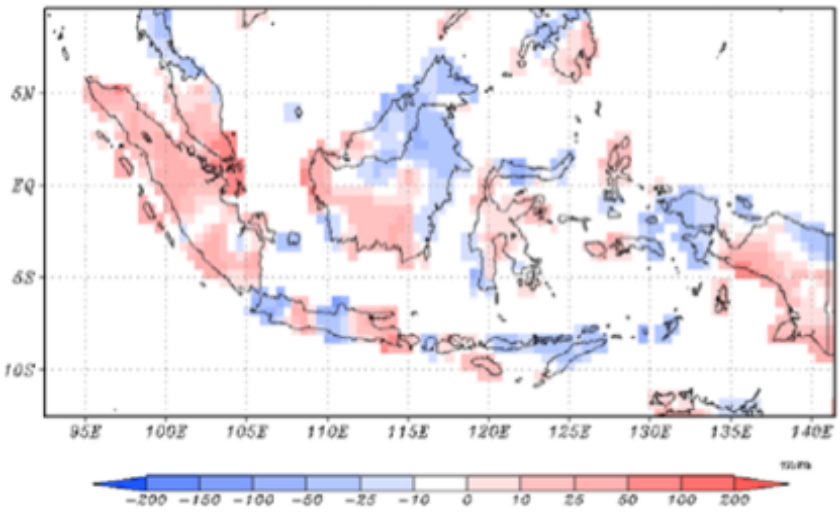

Figure 4.6 *Current (1980-2010) minus baseline rainfall in January. Source (Badan Meteorologi, Klimatologi, Dan Geofisika, 2013, p. 5)*

4.3.5 Changes in temperature

As a result of global warming the surface temperature in Indonesia has also been increasing. It is estimated that for the 20th century the temperature increase is not more than 1.0 °C. However, it is difficult to make an accurate estimation due to a lack of consistent data recordings in Indonesia (Badan Meteorologi, Klimatologi, Dan Geofisika, 2013, p. 5).

Based on data of the IPCC-AR4 models, it is predicted that during the period 2020 till 2050 the increase in temperature will be approximately 0.8 – 1°C relative to recent climatic periods (Badan Meteorologi, Klimatologi, Dan Geofisika, 2013, p. 6)

4.4 Effect of climate change on Terminal Teluk Lamong

All of the effects of climate change that have been mentioned previously can potentially affect Terminal Teluk Lamong in a negative way. To see how resilient the terminal is against these threats the next step is to see how these effects of climate change will influence the terminal.

4.4.1 Current effects.

Terminal Teluk Lamong is already suffering from some of the effects of climate change. As can be seen in appendix 5, the terminal is located in the Madura Strait (Selatan Madura). The only way to access the terminal by land is by using the road. On the 15th of April 2016 Surabaya was struck by intense rainfall. As a result of the rainfall and inadequate drainage, the Jalan Tambak Osowilangun road to the terminal was flooded. With this road being flooded it takes much more time to transport cargo on and off the terminal, resulting in a delay in terminal operations. How long the flooding last depends on the intensity of the precipitation event. In the case of this particular event it lasted until about three hours after the event stopped.

During heavy precipitation events it is hard for crane operator on the terminal to see the containers they on load and offload. When crane operators have limited visibility the operation has to be postponed and can only be resumed when there is good visibility. Another form of cargo that effected by precipitation is dry bulk. When it is being offloaded and it starts to rain the quality of the product, for example soya, is at risk. Therefor the operation has to be postponed immediately.

With climate change resulting in more frequent occurrences of intense precipitation, the operations on the terminal are likely to be postponed more often. The terminal will likely be indirectly affected because of their reliance on employees and infrastructure which are prone to flooding's. As a delta city Surabaya is located in low lying land. During the rainy season water easily remains within the city as a result of river overflow and heavy rainfall (Tantrin, 2010). As for now the delays in operation are not a tremendous problem. This is due to the fact that it is not a busy port. However, when in the future the terminal will develop and become larger, this could become a serious problem.

The effects of climate change of which employees at Terminal Teluk are most concerned about however, is the increase in storm frequency and intensity. When the wind speed in the terminal gets to high the operations have to be stopped. The reason for this is the fact that the cranes are very vulnerable to high wind speeds and can collapse as a result of it. According to Pelindo 3 employees whom were concerned with the development of Terminal Teluk Lamong, storm surges have never occurred in the old port Tanjung Perak. They explained that ever since the port was built by the Dutch it has never flooded and that the island of Madura serves as a natural storm surge barrier. The Madura Strait is well protected against wind generated waves, with an exception however when wind is coming from the East-Southeast (Asia Development Bank, 2004).

4.4.2 Future effects.

In the future it is likely that the previously described effects will occur more often and will be more severe. Other future effects of climate change that will affect the terminal consist of sea level rise and an increase of (sea) surface temperature.

The expected increase of surface temperature will only affect the terminal in the long term as a 0.8 – 1°C increase in temperature is expected for the period 2020 till 2050. When senior staff members were asked if they ever had to postpone operations because it was too hot for employees to work they laughed and said that this Indonesia. Employees here are used to the heat and are not affected by it (Appendix 6). An increase in surface temperature however also leads to an increase of air pollution (IPCC, 2007). Air pollution and an increase in hot days and nights have various kinds of health effects on the human body. There is no way to predict how this will influence workers on the terminal. However, it is likely that in the future workers will suffer from more health risks (United States Environmental Protection Agency, 2016).

When the (sea) surface temperature rises, evaporation increases. An increase in evaporation will result in an increase of water vapor. When water vapor condenses in the atmosphere it

releases heat that helps fuel storms (Riddick, 2013). When in the future the amount of water vapor increases, storms will develop more easily and they will be more powerful.

In the future it is likely that severe storms will develop more often and that they will increase in power. With more frequent and powerful storms the Jalan Tambak Osowilangun road to the terminal will also be flooded more often as the result of heavy precipitation. With storms occurring more often and being more powerful in the future, the terminal will likely have to stop its operations more often. This, combined with the fact that cargo cannot be transported as a result of flooding of the road, can result in delays.

As the sea surface temperature rises, the effect of thermal expansion on sea level rise will become bigger. Sea level rise is a threat to every coastal zone and Terminal Teluk Lamong is no exception. From the interviews it has become clear that the employees of the terminal are not worried with sea level rise yet (appendix 8,9 & 11). Sea level rise is of course a very slow process, and with a relative sea level rise of 3.25 cm/year there are no problems expected on the short term (until 2030). However, from a long- term perspective (post 2050), sea level rise can become a problem. In combination with an increase in storm frequency and severity, this can especially have a significant effect. An event like this combined with an increase in sea level will lead to more severe storm surges that affect both the terminal and the roads to the terminal. If something like this happens, the operations on the terminal will have to be postponed and there is a large chance that infrastructure on the terminal is damaged; the road to the terminal will be both severely damaged and flooded.

4.5 Adaptation measures

Now that resilience has been defined and the effects of climate change on the terminal are known, the adaptive measures need to be addressed. The adaptive measures result in adaptive capacity, which in its turn lead to resilience.

4.5.1 Energy

Currently Terminal Teluk Lamong is provided by energy from PLN, a state owned energy company. The terminal receives this energy from two cities: Surabaya in the South-East and Gresik in the North-West. This way, when there is a power outage in one of these cities, the terminal can still be supplied with energy from the other city. The power cables that run on the terminal site are located underneath the access road and on-site road. The on-site road runs all the way down to the wharf. The road is made of rigid pavement that is very watertight. When tested there was an infiltration of 2,5 cm (appendix 6) meaning that the cables that run underneath the roads are well protected against the infiltration of precipitation.

In the future a power plant will be built on the terminal site. This LNG power plant will be supplied with gas from Pertamina. The gas will be supplied to the terminal by means of a pipeline (appendix 6 & 7). When in the future the power plant fails, the terminal can switch back to energy from PLN at any moment. Both sources of energy are able to run alongside each other.

If a power outage occurs despite some of these measures there is a backup generator on the terminal. This backup generator is able to run one staging; for example operating a sea to shore crane. In such case the 6.6 megawatt generator is able to run for about 1 to 2 hours (appendix 8).

4.5.2 IT

The IT cables are located alongside the energy cables. Naturally, these cables enjoy the same protection. All IT equipment on the terminal is also certified with a minimum of IP-66. The second number of the two indicates how well it is protected against liquids. Six means: protected against temporary flooding's of water (The Engineering Toolbox , n.d.). On the terminal there are two large data centers. One is located in the office and the other is located in the workshop next to the container yard (see appendix 1). Both the data centers are located on the middle floor, meaning they are protected from flooding's.

4.5.3 Transport/terminal

The wharf of Terminal Teluk Lamong is built at a height of 5 meters compared to the low tide. The difference between high and low tide in the Strait of Madura is approximately 3 meters. This means that during high tide the wharf is still 2 meters above sea level. The road that runs to the wharf is built with an 1% incline (appendix 8). As a result rain will run of into the sea. For all the excess water there is a rain water sewerage which directs rain water straight into the sea.

Figure 4.7 *Anchorage point for the ship to shore crane*

On the wharf five ship to shore cranes are located. The cranes are equipped with an advanced breaking system and if necessary additional anchorage when the wind speed gets too high. Each of the cranes is being equipped with an anemometer to measure the wind speed. Crane operators have to follow a specific procedure when the wind reaches a potentially dangerous speed. When the wind moves at a minimum speed of 13 knots crane operators will get a warning from the anemometer. The crane operator then has to inform the vessel foreman who contacts the shift manager. The shift manager will then contact the crane operator and inform him to keep monitoring the wind speed. When the wind speed increases the crane will be moved to the anchorage area. A critical point here is a wind speed of 17 knots; at this speed the crane is not able to move in the opposite direction from where the wind is coming. At a wind speed of 20 knots the cranes are being anchored and the crane operator will leave the cranes, crane personnel is evacuated back to the offices

Currently there are plans to build a monorail connecting Terminal Teluk Lamong with Tanjung Perak. The monorail will have 5 stations where contained can be on- and off loaded. There are also plans to build a flyover. This flyover will connect the terminal directly with the toll road. Both measures will decrease the dependency of the terminal on the Jalan Tambak Osowilangun road and will decrease transportation time.

5. Discussion

In the previous chapter, the results of the research have been combined. These results will be used to get a specific answer for every sub question. In this chapter the answer to the sub questions will be repeated and a context will be provided so that the answers to the sub questions can be better interpreted.

5.1 Spatial resilience

5.1.1 Discussion

The IPCC defines resilience as the following:

"The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions". (IPCC, 2012).

The IPCC is known as the leading international body for the assessment of climate change (IPCC, n.d.). The definition that they provide states that it not only focuses on the systems itself but also on its components. However, focusing on its components is not realistic in the given time. Therefore, this aspect of the definition will not be taken into account. Furthermore, this definition of resilience ensures that a system, in this case Terminal Teluk Lamong, is able to react to, deal with, accommodate or recover from hazardous events. Ideally the system does not have to recover from a hazardous event because of its ability to react to, deal with and accommodate the event. If the system would need to recover from the event, it would mean that it (partially) failed. As a result, recovery from the event is considered as undesirable and will therefore not be taken into account. Another remark is that the definition of the IPCC does not go into detail about what caused these hazardous events. A hazardous event could also be a fire as a result of a gas leak or an oil spill. Therefore, it is important to point out that for the subject of spatial resilience against current and future threats of climate change, these hazardous events have to be triggered by either one or multiple effects of climate change.

What this definition makes clear is that the aim of resilience is to minimize the negative effects of climate change to a system. It does this by making the system able to react to these negative effects, to be able to absorb the negative effects and lastly, to accommodate them. This means that resilience is a way of adapting to the effects climate change rather than fighting its cause. The second part of the definition clarifies that after the system has been struck by one or multiple effects of climate change, it is still able to function in the same way it was functioning before the event.

Now that it is clear what resilience is the definition has to be placed in the context of spatial resilience. Spatial in its turn refers to all the different elements which are present in the particular space, in this case Terminal Teluk Lamong. It looks at the different spatial elements and whether these elements are built in a way to increase its resilience. However,

it also looks at additional spatial measures that might have been taken to contribute to an even larger extent.

5.1.2 Partial conclusion

As a result of what previously has been described, the type on resilience on which this research focuses, spatial resilience, can best be defined as:

"The ability of a system to anticipate, absorb or accommodate, the effects of a hazardous event caused by climate change in a timely and efficient manner, including through ensuring the preservation of its essential basic structures and functions as caused by its spatial elements".

5.2 Climate change impacts in Eastern-Java

5.2.1 Sea level rise/ sea surface temperature increase

Sea level rise is a threat to Eastern-Java for multiple reasons. The first of which are flooding's in the long-term. Most of the people on Java live in close proximity of the coast. When the sea level rises but no measures are being taken these people will have to find another place to live. Not all of Indonesia is affected by sea level rise in the same way, because the rate of sea level rise depends on the temperature. The sea level on the northern side of East-Java is currently rising with a rate of 0.75 cm/year. However, soil subsidence should also be taken into account and with a rate of 2,5 cm/year the relative sea level rise is set a 3,25 cm/year. It will take a while before the threat of flooding's, as a the result of sea level rise, will become a serious threat and people will actually have to move. Aside from flooding's, sea level rise also strengthens erosion. With a higher sea level, the water will be able to reach further inwards of the land. With sea level rise and erosion, the total wetland area in coastal zones will be reduced. When this happens, coastal ecosystems will be changed (Bappenas, 2010, p. 28). This also affects the people who live in these areas; some of them strongly depend on these ecosystems to provide for themselves and their families. Because sea level rise is strongly related to other effects of climate change it is hard to predict how it will develop in the future. For now the prediction for Indonesia for the year 2050 is a rise of sea level between 10 cm to 50 cm with an average of 25 cm to 30 cm (Bappenas, 2010, p. 30).

As mentioned, sea surface temperature is strongly correlated with sea level rise. As the temperature increases the sea water will become warmer. When the water gets warmer the thermal expansion of the water will increase, resulting in an increased rate of sea level rise. As a country that covers a very large area the increase in temperature is not evenly distributed. There are areas where the increase in temperature will be higher than others. As a result, the sea surface temperature will also differ and so does sea level rise. Differences in sea level rise can result in changes of current patterns, which can then possibly change the regional climate (Bappenas, 2010, p. 28). For now, these changes impose a significantly more serious threat to the livelihoods of the people compared to the rise of sea level.

5.2.2 Increase in extreme weather events

The increase in extreme weather events is a threat to people all over the world. However, changes in extreme weather events are especially devastating for developing and sub-

developed countries. As a sub-developed country Indonesia is prone to this threat both now and in the future. El Niño–Southern Oscillation (ENSO) and La Niña are extreme weather events that will intensify as a result of global warming (Cai et al., 2014). During the occurrence of ENSO, the wind that normally blows from East to West is weaker than usual or in some cases blows from West to East. As a result precipitation in Indonesia is reduced (L'Heureux, 2014). La Niña is the complete opposite; during this event there is extreme precipitation. The eastern wind is also supposed to transport water from the Eastern Pacific to the Western Pacific. However, when the wind weakens, or turns into the opposite direction, there is no supply of water. As a result, the sea level during El Niño will be depressed up to 20 cm below normal levels, during La Niña it will be elevated by 10 cm to 20 cm (Bappenas, 2010, p. 45).

As a result of global warming evaporation is increasing. At the same time climate change models suggests that precipitation events occur less often (The Climate Change Clearinghouse, n.d.). These fewer precipitation events however have to release the same amount of precipitation. This means that in the events to come there will be more precipitation, or an increase in intense precipitation.

5.2.3 Changes in precipitation patterns

When employees of Terminal Teluk Lamong were asked if they already suffer from some of the effects of climate change half of them said yes, and they all gave the same answer. The effects of climate change that they are experiencing are changes in precipitation patterns (appendix 8,9 & 11). Nowadays the wet season on Java last from October till March. One interviewee indicated that when he was young the wet season would start in September and lasted till February. The interviewees indicated that nowadays it is hard to predict when the wet season will start and when it will end.

5.2.4 Changes in temperature

The final notable effect of climate change on Eastern-Java is the expected increase of temperature. Because of a lack of data it is not possible to see how this effect has changed over recent years. Based on the IPCC-AR4 model the IPCC however have predicted an increase in temperature of about 0.8 – 1°C for the period 2020-2050 compared to recent periods.

As a result of the increase in temperature the sea surface temperature will also increase. When this happens the evaporation increases. An increase in evaporation will result in an increase of water vapor in the atmosphere. When water vapor condenses in the atmosphere it releases heat that helps fuel storms (Riddick, 2013). When in the future the amount of water vapor increases, storms will develop more easily and they will be more powerful as a result of this.

5.2.5 Partial conclusion

The effects of climate change that will impact Eastern-Java now and in the future are all strongly related to one another, meaning that one of the effects can cause and/or enhance another. At the very top of the list of causes is global warming. Global warming affects both the air temperature and sea surface temperature. These effects in their turn will initiate sea

level rise, the increase in extreme weather events and changes in weather patterns. The impact of climate change that is currently most predominant is the change in weather patterns, especially precipitation patterns. The inability to predict when the wet season starts can result in a serious threat to food security as it affects agriculture, both now and in the future. In the long run this will become even worse when the role of El Niño and La Niña becomes more dominant.

In the long run sea level rise poses another threat. With a relative sea level rise of approximately 3.25 cm/year it will take some time before this will actually impose a threat. However, since sea level rise is related with the temperature it can also be accelerated. With millions of people living in close proximity of the sea, and the increase in extreme weather events, the chance of being struck by floods that are the result of storm surges increases. When this would occur during a La Niña event this would especially increase the water level, by about 10 to 20 cm.

5.3 Effect of climate change on Terminal Teluk Lamong

5.3.1 Change in precipitation patterns

Aside from having an effect on East-Java, climate change will also affect the newly built Terminal Teluk Lamong. As mentioned before the effect of climate change which is most noticeable in East-Java is the increasingly unpredictable wet season. In the future there will be a decrease in precipitation events but the events will become more intense. For the terminal this will have both a positive and a negative effect. When crane operators are loading and unloading ships they have to be able to clearly see the containers which they are handling. In case this is not possible the unloading operation has to be stopped and can only be continued when the operator has a clear view again. As a result of intense precipitation it is possible that crane operators are not able to see clearly. With the increasingly bigger possibility of intense precipitation events the possibility that the operations have to be postponed during the rain increases. This will result in more frequent postponed operations. During extreme precipitation events which also last for a longer period the chance that the Jalan Tambak Osowilangun road to the terminal will be flooded will increase. Since this is currently the only road to the terminal by land the port very much depends on it. During any heavy and long precipitation event the road will flood. Because the condition of the road is also very bad, truck have to adjust their speed, causing traffic jams, or wait. On the other hand however, the change in precipitation patterns has a positive effect. Dry bulk is a good of which the quality is very important; rain will cause the quality of the product to deteriorate. When it starts to rain while unloading this cargo from a ship the operation has to be stopped immediately, it can only be continued when the rain has completely stopped. With less precipitation events in the future, the total amount of times that operations have to be stopped as a result of rain will be reduced.

5.3.2 Extreme weather events

Another form of changed weather patterns is the increase in occurrence and intensity of extreme weather events. Employees who were interviewed mentioned the fact that right now high wind speeds are the biggest threat to terminal operations. When the wind speed becomes high, operations must be ceased. A high wind speed makes it impossible for crane

operators to pick up and off load containers in a proper way. When the wind is really extreme it can even cause cranes to collapse. Although the employees at Terminal Teluk Lamong did not mention the relation between the occurrence of high wind speed and climate change, they obviously are related. With extreme climate events occurring more often and becoming more intense operations have to be ceased more often. With an increase in the amount of storms, which brings along high wind speeds, the amount of storms that will cause operations to stop will increase. Both the occurrences of El Niño and La Niña have a positive and negative effect on the terminal. El Niño in Indonesia is characterized by a periods of droughts. Periods of droughts mean that port operation that have to be stopped as a result of precipitation will decrease. For example, unloading dry bulk (at little precipitation) or lack of visibility (at extreme precipitation); la Niña however is the complete opposite. During periods of which La Niña is active, operations have to be stopped more often. As for now it is not known if these two events balance each other out or if one is more predominant then the other.

5.3.3 Temperature increase/ sea level rise

The increase in temperature, expected to be 0.8 – 1°C for the period 2020 – 2050 in itself will not have a tremendous effect on the terminal. Employees who work outside on the terminal the entire day however are prone to health problems as a result of heat stress. As pointed out during the interviews Indonesians are used to high temperatures and can cope with it very well; this makes it hard to predict how they will respond to the increase of temperature. The increase in temperature will however directly affect the terminal in the long term. Most notably the fact that when temperature increases the sea level rises, what happens next is that current patterns change resulting in a change of weather conditions which has already been discussed. As mentioned in the previous chapter the sea level is rising with 0.75 cm a year while the soil is subsiding with 2.5 cm a year. As a result, the relative sea level rise is 3.25 cm a year. The problems that sea level rise will cause in relation to the accessibility of the terminal will be explained at the hand of figure 5.1.

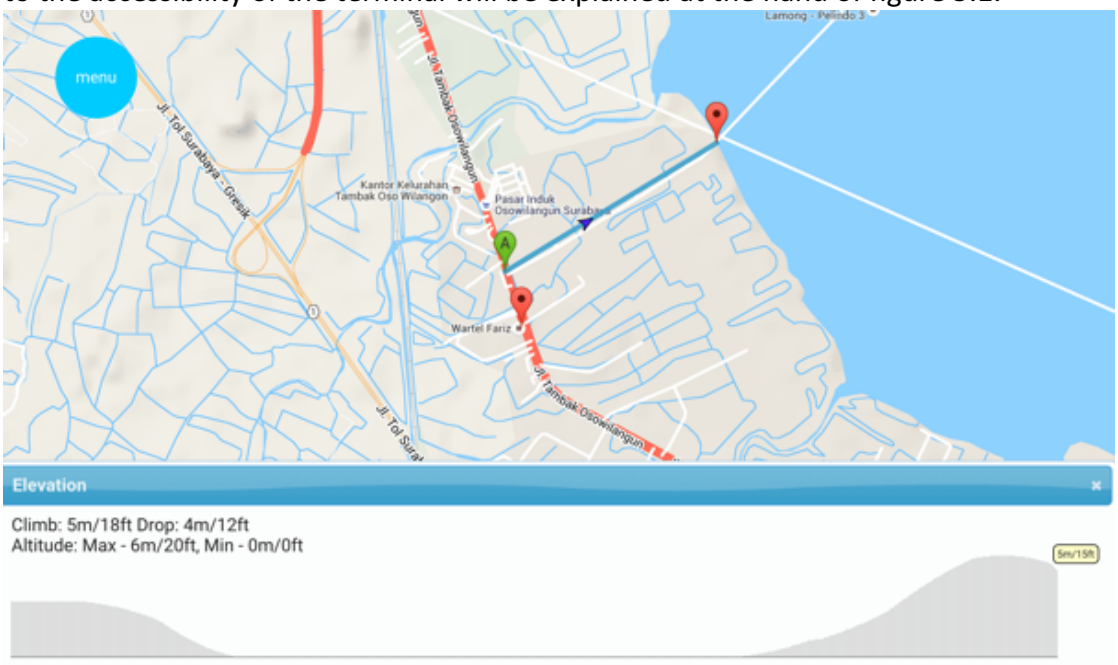

Figure 5.1 *Height profile of the Jalan Tambak Osowilangun road to the Terminal Teluk Lamong. Source: elevationmap.net*

Figure 5.1 shows the height profile of the access road all the way to the road to Terminal Teluk Lamong. The point which is indicated with an A is located at a height of approximately 3 meters; moving to the terminal the height decreases to 0 meters before it increases to about 5 meters at the very end. The road itself however is not located at 0 meters but the surrounding area is. With a relative sea level rise of 3.25 cm a year the relative sea level will increase with 110.5 cm in the year 2050 compared to now (2016). The effect of sea level rise on floods which are a direct result of sea level rise will depend on how stable and strong the right area is which is shown in figure 5.1. With sea level rise the sea will however push further into the river. As a result, the water level in the rivers will also increase. The rivers serve an important function of discharging large amounts of rain water since there is no adequate sewerage system. With higher water levels the rivers will not be able to discharge the same amount of water as they are now. This means that in the future, when there is an extreme precipitation event which has the same magnitude, it will take longer before all the water will be discharged. On the other hand, less extreme precipitation events will more easily flood the roads. This will increase delays both on and off the terminal. The second effect of sea level rise on the terminal is that with an increased sea level it becomes more prone to the effects of storm surges. With an increased sea level the waves of storm surges will be higher; with higher waves the terminal itself will become more vulnerable to these waves. Waves which extend the height of the wharf can negatively influence ongoing port operation and cause damage to infrastructure. The event of La Niña can also have an enormous impact on floodings in the future. During La Niña water levels will temporarily be increased by 10 to 20 cm. If during this period there is an extreme storm during the high tide water, levels and wave height can exceed normal levels by far. In the year 2100 an event like this can cause waves with a height between 6.5m and 7.5 meter (Bappenas, 2010, p. 61). In figure 5.2 you can see the flood depth in Surabaya when an event like this happens. If this will happen in the future the current height of the terminal will not suffice and there will be extensive damage to equipment and infrastructure. The same goes for the current road to the terminal and the newly proposed roads and railway.

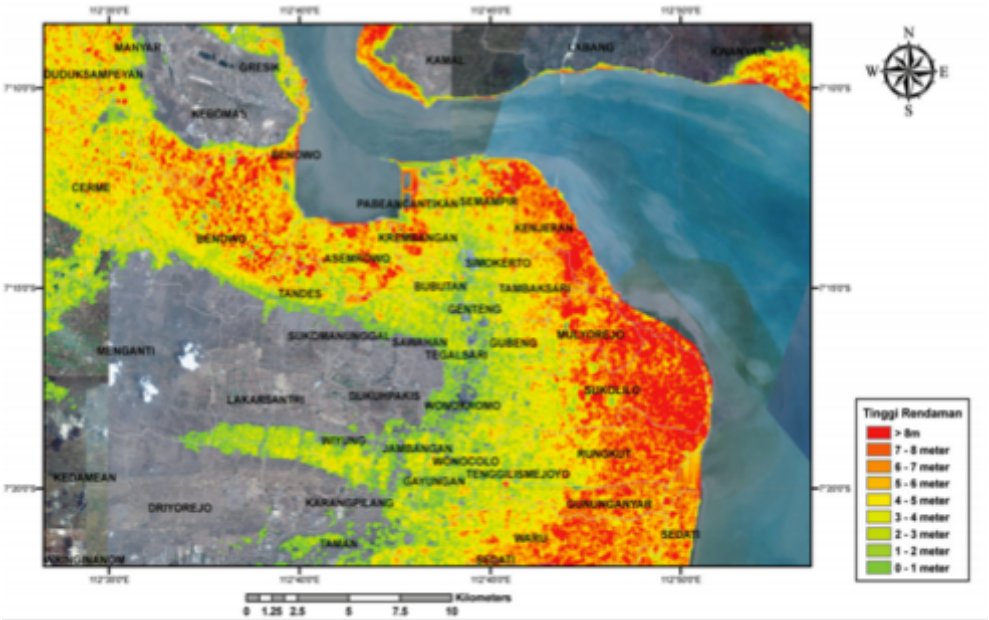

Figure 5.2 *Inundated area in Surabaya in year 2100 during extreme weather. Source: (Bappenas, 2010, p. 63)*

5.3.4 Partial conclusion

Terminal Teluk Lamong is sensitive to the effects of climate change both now and in the future. Right now the terminal already suffers from a changing precipitation pattern that will extend the duration of the wet season. As a result, the period of which the operations on the terminal might have to be postponed as a result of precipitation is extended. During heavy precipitation the terminal is also difficult to access because of the flooding of the Jalan Tambak Osowilangun. In the future the effects of climate change on the terminal will become more severe and cause the terminal even more problems. The one with the highest likelihood to strike the terminal, is that of the increase in storms and high wind speeds. This is also the effect of climate change of which the employees of the terminal are most concerned. The reason for this is the level of danger, as cranes can collapse and cause damage to equipment and infrastructure. It can also result in postponing operations because ship cannot be (un)loaded which on its turn leads to delays. In the future both the severity and occurrence of the previously mentioned effects of climate change will increase. Another long- term effect that is to affect the terminal is sea level rise. Terminal Teluk Lamong is very vulnerable to the rising sea level due to its location and its dependency on the Jalan Tambak Osowilangun road. The access road is also prone to sea level rise due to the fact that is located at a height of only 3 meters. Sea level rise in combination with La Niña, high tide and a storm can paralyze the port in the long-term.

5.4 Adaptation measures

In order to cope with the effects of climate change, measures are being taken to minimize nuisance. Not all these measures are taken with the idea to tackle the impacts of climate change. Some of them have become part of standard practices that at the same time reduce the impact of the effects of climate change.

5.4.1 Energy

The energy supply to Terminal Teluk Lamong is very important to continue operations. Machines like the stacking cranes and sea to shore cranes can only be operated when there is a constant supply of energy. Aside from this the terminal also relies on electricity for its IT systems and for electronically made transactions. As a result of the dependency on electricity a long lasting black out can disrupt the terminal operations. In order to ensure a constant energy supply, various measures are being taken. As for now the terminal is supplied with energy from state company PLN. The energy that is being used in the terminal comes from two sources, the city of Surabaya and the city of Gresik. Having two sources gives the terminal the advantage of having a back-up source when there is a power outage in one of the earlier mentioned cities. In the future the power station that is currently being build will supply the terminal with energy. When this power station is finished and fully operational it will use gas that is brought in by a pipeline. When there are problems with the power station the terminal can still use the energy from PLN. The energy from PLN and energy from the power station can be used alongside each other. When the measures described above fail to prevent a black out there are additional generators which in case of a power outage can continue the operation of either the sea to shore cranes or the stacking cranes. At test runs the generator have been running for a period of 1 to 2 hours. It is however unknown whether they are able to run for a longer period because this has not

been tested. The lampposts on the terminal are being supplied with energy by means of solar power.

The power cables that supply the cranes, office buildings and workshops with energy are located underneath the road. The road is paved with rigid pavement that is very watertight. Measurements have shown that during precipitation events there was an infiltration of 2.5 cm (appendix 6). The road on the terminal has also been built with a 1% incline so that precipitation can run off. According to an interview the cables themselves are already well protected because of the cable owner that provides well isolated plates and ducting.

Onsite renewable and low emission energy for a range of functions, to avoid risk associated with power disruption, the increased costs of energy and environmental legislative requirements (McEvoy & Mullett, 2013, p. 38). This is being mentioned as one of the adaptation actions in the document: *Enhancing the resilience of seaports to a changing climate: research synthesis and implications for policy and practice., 2013*, one of the few available reports on seaport resilience. Terminal Teluk Lamong does this by their power station which will soon be operational. The power station will be fueled by a liquid nitrogen gas (LNG). LNG is a liquid form of renewable natural gas (RNG) and is considered as renewable. As a result, the terminal will in future not fully depend on power from PLN. This will make them less prone to power disruption that are caused by external forces, such as problems at PLN or climate events that damage power lines elsewhere. Another report on resilient ports mentions the following: During super storm Sandy and Hurricanes Ike and Katrina, respondents identified damage to back-up generators that were stored in low-lying areas and the inability to utilize solar power during outages to the grid (Southworth, Hayes, McLeod, & Strauss-Wieder, 2014, p. 35). During the interviews it has become clear that the back-up generators in Terminal Teluk Lamong are also located on a ground level. As a result, they are prone to flooding's and damage caused by water during storms. Their only means of protection is the height at which the terminal is built.

5.4.2 IT

The IT infrastructure is another very important aspect for terminal operations. The IT on the terminal is responsible for operating most of the machines and equipment. It is especially important because a significant amount of the processes on the terminal are automated or will be automated in the future, for example self-driving trucks. This is also in line with the following: automation of logistic procedures is already being undertaken at some ports, and this process is expected to continue (McEvoy & Mullett, 2013, p. 38). It is mentioned as one of the adaptation opportunities, one that is already implemented at Terminal Teluk Lamong. IT cables to the office and the workshop have the same protection as the power cables since they are located next to the power cables. Other means of protecting IT infrastructure consist of the fact that all IT material is certified with at least IP-66, meaning it is dust free and protected against temporary flooding's of water. IP-66 it the minimum certification of IT materials meaning some have better protection than others. Currently there are data centers located on the terminal, one of which is in the office and the other one in the workshop. Currently there are plans to make two more data centers. According to the plan a data center in Jakarta will be created and the other one will be in the cloud, and therefor

always available. The current data centers are located in the middle of both buildings on the second floor, as a result they are not prone to flooding.

Currently there is no literature on how seaports should protect their IT infrastructure to threats caused by climate change. Because of the fact that most ports are prone to flooding it would however be sensible to have all IT material certified with IP-68. Meaning it is protected against long periods of immersion under pressure (The Engineering Toolbox , n.d.). Having data centers outside the terminal ensures the terminal to be able to call for data at any time, also when the two data centers on the terminal itself are not functioning.

5.4.3 Transport/ terminal

The difference between the high tide and the low tide around the terminal is 3 meters. During the low tide the difference between the sea level and the wharf is 5 meters. During high tide the difference is 2 meters. When interviewees were asked why this height was chosen they answered that this was in accordance with regulation from the ministry of transportation (appendix 6). They have rules which are called standardization of the port of Indonesia. The height of the terminal is in accordance with these standards. It however remains unknown if these standards take into account a rising sea level. This however seems unlikely since the maximum elevation is currently 2 meters from sea level. With sea level rise and the increase in storm occurrence and severity this height can soon easily be overtopped by waves. What was also striking is that Terminal Teluk Lamong has not been built with an idea for how long it will exist. When asked, employees indicated that they did not know and that maybe it would be 50 years or maybe 100. As mentioned before roads on the terminal have been built with an incline of 1% (appendix 8) so that they remain accessible during precipitation events. Water on the roads is able to run off into the sewerage and is discharged into the sea.

For the future, post 2030, the terminal has plans to build a fly-over. When this fly-over is finished trucks do not have to use the existing access road the terminal anymore. When using the fly over they can directly access the toll road to either Surabaya or Gresik. Another future plan is the monorail. The monorail will be a 10,5 km long track that connects Terminal Teluk Lamong with Tanjung Perak. There will be 5 stops where containers can be on- and of loaded. Having a better connection with existing infrastructure, and a new way of transportation will be a major advantage. Right now the terminal depends on the Jalan Tambak Osowilangun road. The road is prone to flooding's as a result of precipitation and is also very crowded with traffic, especially during rush hour. Having more than one route to transport cargo on and off the terminal will be of great benefit both during normal operations and evacuation. Something similar like this is also mentioned as an adaptation action. Encouraging model shift to improve resilience by introducing elements of redundancy in the supply system; that is, removing the reliance on either rail or road, but looking at a better incorporation of the two (McEvoy & Mullett, 2013, p. 38). Although the fly-over and the monorail are not planned to increase the resilience they do improve it when they will be finished in 2030. Another adaptation action is to extend gate hours of operations and coordinate with truck companies and railroads in advance of a disruption (if known event) to facilitate moving cargo off terminals (Southworth, Hayes, McLeod, & Strauss-Wieder, 2014, p. 37). This is one of the lesson learned aspects mentioned in: *Making*

U.S. Ports Resilient as Part of Extended Intermodal Supply Chains, which is partially applied. With the above mentioned plans, the terminal facilitates moving cargo off the terminal. When the plans are executed it can be done faster than it currently can. The monorail itself also is not prone to flooding's due to the fact that it is located above the ground. A disadvantage however is the fact that the monorail will be prone to strong gusts of wind.

Most of the adaptive measures that were mentioned during the interviews were related to what is considered to be the biggest threat to the terminal: high wind speeds and storms. Being a new port, the terminal has five ship to shore cranes located on the wharf. These cranes are equipped with a brake system, which is better than the ones in cranes in Tanjung Perak. During extremely high wind speeds the cranes can be moved to a special anchorage area where they will be anchored. In the document *Enhancing the resilience of seaports to a changing climate: research synthesis and implications for policy and practice., 2013,* the following is mentioned: as extreme weather events become more frequent, more targeted investments in technology that expands the operation boundaries of equipment. The new cranes are a good example of equipment that is adapted with these technological advances that extend the operation boundaries. Compared to the older cranes in Tanjung Perak the brake system of the new ones is better. Meaning that with higher wind speeds they can use the brake system to remain in the same position while (un)loading ships. The cranes are also equipped with anemometers. This way crane operators are able to monitor the wind and an alarm goes off when the wind reaches potentially dangerous speeds. When this happens terminal operations are being postponed or canceled. Depending on the wind speed the wharf is being evacuated and all employees meet up at the workshop.

The terminal is also equipped with a sewerage system. The sewerage system is for rainwater only, human waste is disposed of by means of septic tanks. Because of its location and the fact that roads are built with an incline, employees who were concerned with designing the terminal expect rain water to run off into the sea very quickly. Nonetheless the sewerage system has been built to discharge any excess water to sea.

5.4.4 Partial conclusion

Right now there is a wide range of measures available on Terminal Teluk Lamong to minimize the effects of climate change. However, most of these measures are not taken with the aim to minimize the effects of climate change but for other purposes. The only effect of climate change for which no measures were mentioned is heat. As has been mentioned before, heat is not considered a threat by Indonesians (appendix 6). This could be the result of the fact that virtually all the buildings in the country are equipped with air-conditioning and that there is always drinking water available. For employees this is likely to be normal, and therefore they didn't even mention it. Most that were interviewed could not mention any measures when they were being asked what kind of measures the terminal is currently taking concerning climate adaptation. The way of which the terminals resilience is being created is by robustness and redundancy; robustness because of the elevation at which the terminal is built and the way the cranes and roads are being built; redundancy because they have multiple energy sources, back-up servers and in the future, they will have multiple methods and roads to transport cargo on and off the terminal. The measures which are currently in place will suffice for now and the near future. However, to successfully

withstand and not be affected by the consequences of climate change in the long term, additional measures will be necessary, especially since sea level rise will impose a more serious threat.

5.5 Shortcomings

5.5.1 Attitude

With the measures which have been described above Terminal Teluk Lamong has been taken measures to protect itself from the effects of climate change. However most of these measures seem to be obvious for ports. The measures that have been taken are taken separately from each other and are not part of a resilience or adaptation plan. This was especially apparent from the interviews and the difficulty interviewees had when asked to mention measures which increase the resilience of the terminal. When during the interviews the interviewees were asked to mention any measures, they could not mention more than three, although according to their job one would expect that they are familiar with the subject and could mention more. The measures which they could mention were mostly related to their own department or section. Nonetheless, the measures that have been taken do increase the terminals resilience.

In general, there are some factors that have contributed to the lack of spatial resilience of Terminal Teluk Lamong. From the interviews it has become clear that most employees, both Pelindo 3 and Terminal Teluk Lamong, do their job based on experiences in previous jobs and events that occurred in the past. As a result, they have a very passive attitude towards new threats that have not occurred yet, for example climate change. Employees in general do not worry about sea based inundations because this has not happened in the past. On the other hand, events which have occurred, like high wind speeds, are one of their greatest concerns and there are both measures and procedures to minimize the effects of them on terminal operations.

Another aspect is the fact that as for now there have been no drills about how to act and what to do in case of an evacuation and other emergencies. There are procedures that employees have to follow. They learn these procedures during training on their first days on the job. When asked about drills, people reacted by telling that they do think this is useful and would increase the chance of a successful evacuation. They also told that perhaps in the future, when the terminal becomes bigger, drills will be conducted.

5.5.2 Regulation and policy

Besides the adaptation actions which have been mentioned previously, the document: *Enhancing the resilience of seaports to a changing climate: Research synthesis and implications for policy and practice., 2013,* also mentions some other important aspects. The most important aspects that have been neglected at Terminal Teluk Lamong will be mentioned below.

- Incremental growth of breakwater as sea conditions require: alternatively, whether breakwater needs to be reconfigured to deal with unpredictable swell conditions.

- Ensure climate changes are included in future design specifications, including accommodating future rainfall requirements into new building designs, incorporating sea level rise and storm surge into all port infrastructure elements.

The first of the two is considered an engineering solution whereas the second is a design and maintenance solution. Both solutions are however related. When climate change is included into the design specifications a possible measure could be breakwater. The employees whom were involved in the development of the terminal did not mention any specific climate change related standards or requirements. They indicated that the plans for the terminal are in line with the standardization of the port of Indonesia, which are from the ministry of transportation. It is however, unlikely that these standardizations take climate change into account because climate change related standards could not be mentioned.

5.5.3 Partial conclusion

The people whom were interviewed had a rather relaxed attitude towards the topic of climate change adaptation. Rather than act they tend to react and learn from experience instead of being pro-active. It is also unlikely that climate change adaptation is properly included in policies and regulation. In order to build spatial resilience against the effects of climate change, this is however very important.

6. Conclusion and recommendations

Located in the strait of Madura the port expansion Terminal Teluk Lamong is susceptible for the effects of climate change. With an average sea level rise of 0.75 cm/year, and a soil subsidence of 2.5 cm/year the relative sea level rise is approximately 3.25 cm/year. Another effect of climate change that will strike the port is the increase in extreme weather events. Heavy precipitation will occur more often as will El Niño and La Niña. The effects of climate change will strike the port differently and also the time span of when they will become a threat differs.

In the short term the terminal is sufficiently resilient against the threats of climate change. A big exception however is the Jalan Tambak Osowilangun, the road of which the terminal currently fully depends. During extreme precipitation the road is being flooded. The duration and the intensity of the event will determine the period for which the road will remain so. During these floods the terminal is hard to access from the cities of Surabaya and Gresik. This can potentially result in delays of terminal operations, especially when the terminal will get more crowded

In the long run the terminal will be prone to the effect the climate change. The increase in storm intensity poses a threat to terminal operations as they have to be postponed due to unsafe circumstances, especially high wind speeds. The combination of sea level rise in the long-term and extreme weather events like La Niña or a storm can result in wave heights that can easily overtop the current terminal. This can result in damage to the terminal and the postponing of operations.

For now, the terminal qualifies as a spatially resilient terminal. This is mostly the result of robustness and redundancy, both principles have been incorporated in the plans. Robustness is, amongst other things, the result of the height at which the terminal is built, the 1% incline of the on-site road and road materials and the anchorage points for the cranes in the wharf. Redundancy is applied through having several back-up servers in different locations, having different energy sources and in the future having a monorail and a new road. This way the terminal's dependency on the Jalan Tambak Osowilangun will decrease. It is however unlikely that the incorporations of these principals was aimed at increasing the terminals resilience against the threats of climate change.

When compared to other European ports or terminals, Terminal Teluk Lamong may not qualify as a spatially resilient terminal. However, it is important to keep in mind the Indonesian context. The countries aim for economic growth currently outweighs preparing vital infrastructure for the effects climate change, this is not so different from other Western ports. When compared to Tanjung Perak, the port of Surabaya which has been built by The Dutch during colonial times, Terminal Teluk Lamong is significantly better prepared for the effects of climate change and therefor more resilient. Building the terminal this way is already a step into the right direction for a country like Indonesia.

In order to prepare the terminal for climate change in the long run, employees of Terminal Teluk Lamong and Pelindo 3 should move away from there learning from experience based

attitude. In order to successfully prepare the terminal for the effects of climate change, a pro-active attitude towards the topic of climate change is required. With a pro-active attitude damage to the terminal and the cancelation of terminal operations can be avoided in the future.

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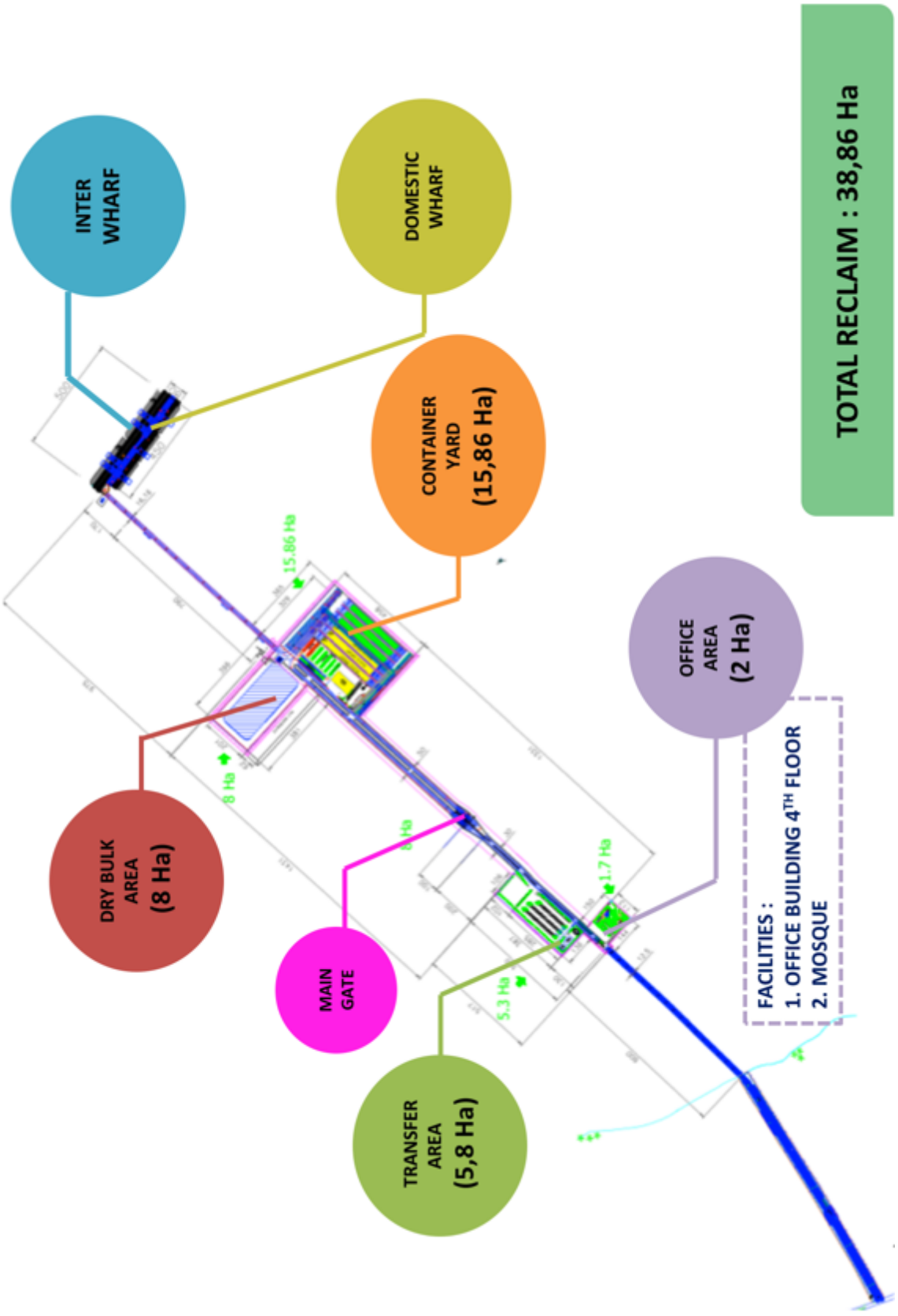
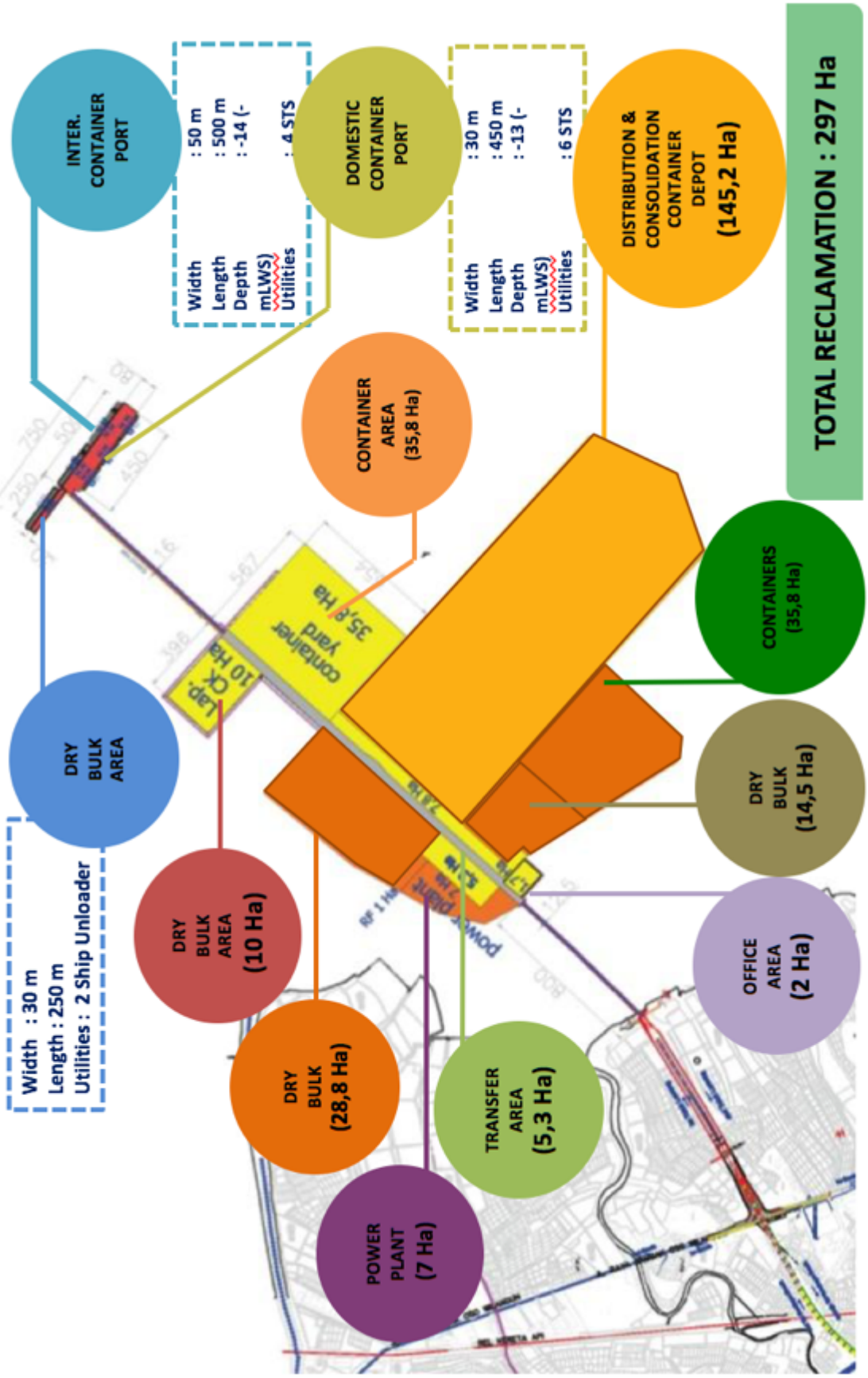
Appendices

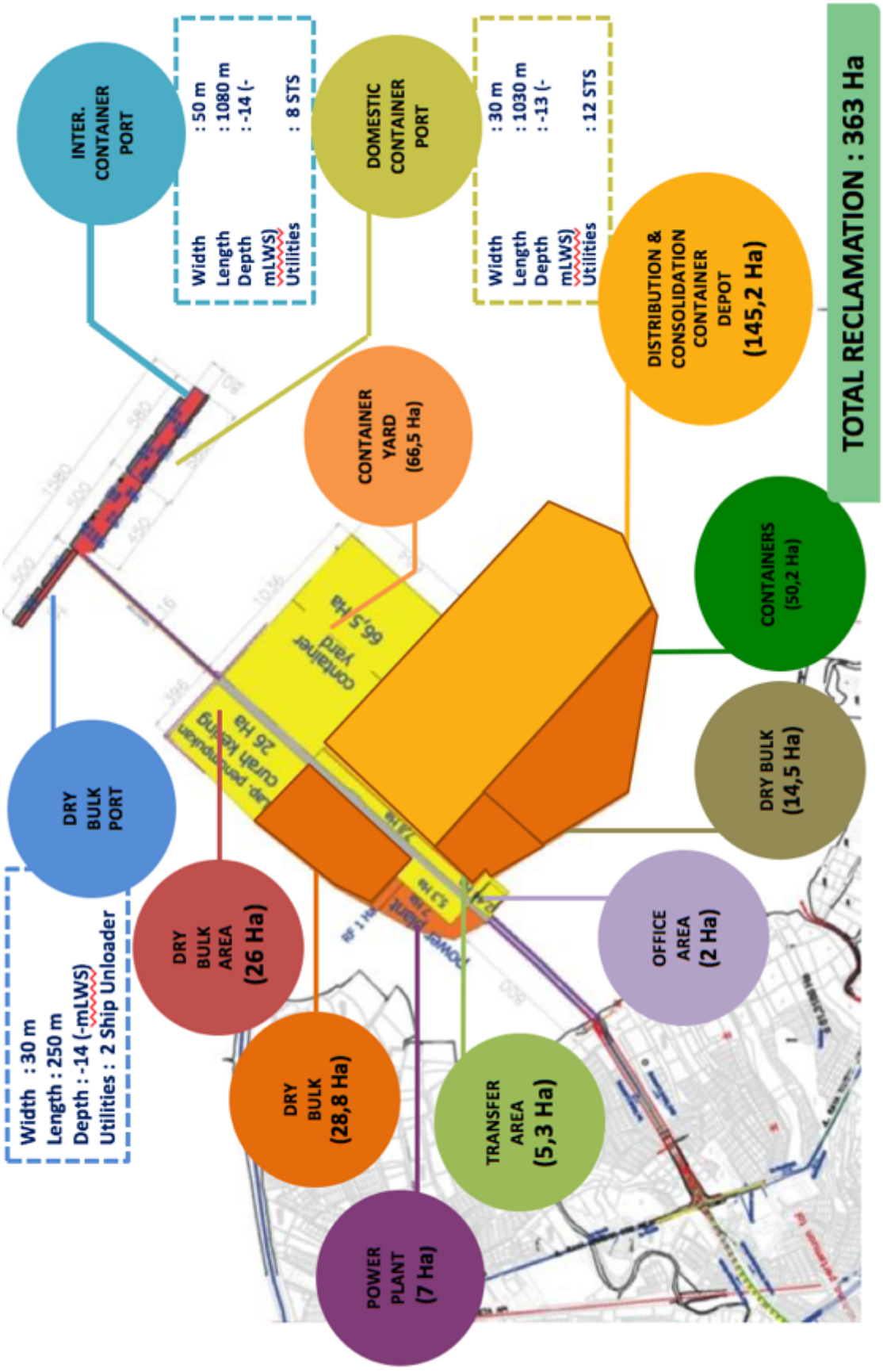
Appendix 1. Map of the current terminal



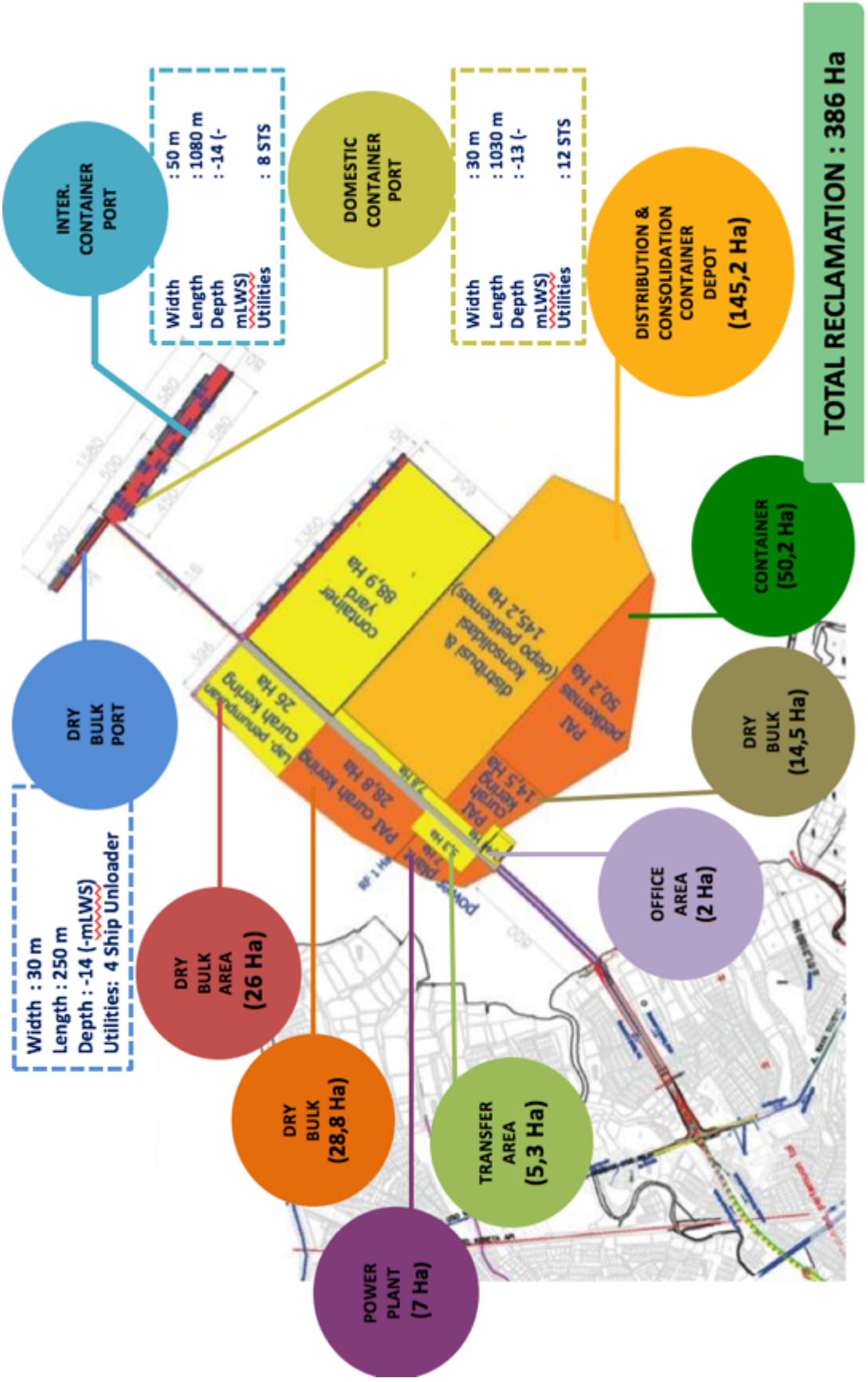
Appendix 2. Map of the terminal in phase 2



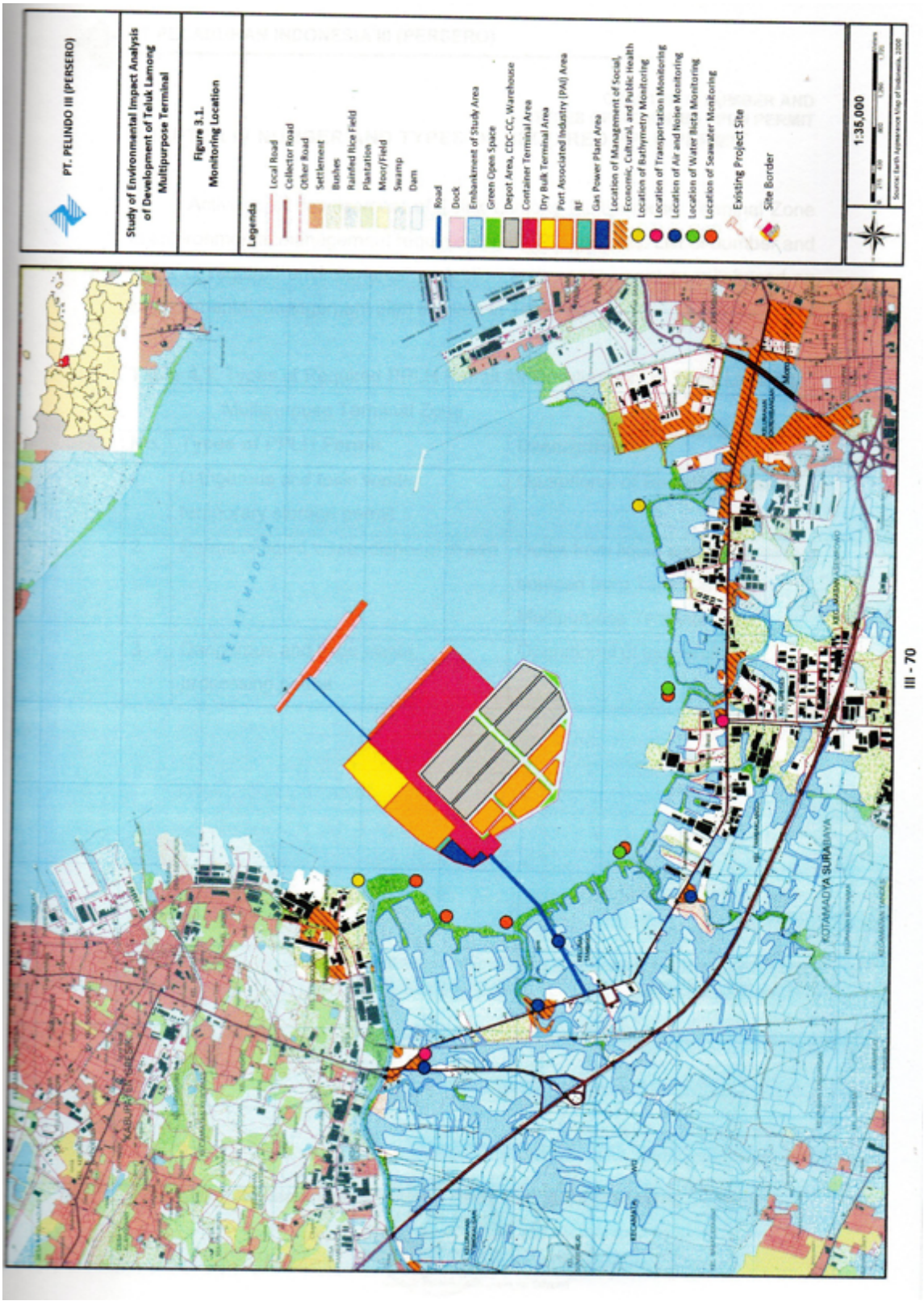
Appendix 3. Map of the terminal in phase 3



Appendix 4. Map of the terminal in phase 4



Appendix 5. Study of environmental impact analysis of development Teluk Lamong Multipurpose Terminal.



Appendix 6: Transcription of the meeting at Pelindo 3 in Tanjung Perak on the 1st of April 2016.

Important: the interviews have been conducted with Indonesian employees of both Pelindo 3 and Terminal Teluk Lamong. The interviews have been transcribed in the exact way that the interviews were held. Therefor things like a verb, word order or time might seem odd in a certain sentence, this is however the exact way that the interview was conducted.

Meeting with Mr. Faruq, Mr. Edo, civil engineers and Ms. Mahyndrana Putri, planning department.

Joshua: so in accordance it was 0,5 meter because it was with regulation right?
Mr. Faruq: yeah.
Joshua: and these are regulations from the government
Mr. Faruq: from the ministry of transportation, standardization of the port of Indonesia.
Joshua: as a result, there were like safety measures there and they have to be taken into account and they are mostly related to the height with for example sea level rise.
Mr. Faruq: yeah
Joshua: and then besides the sea level rise were there also for other aspect so for example for storms that there are like wave breakers in place because I've seen like the stones and the grasses.
Mr. Faruq: we learn about for example the storms we learn from our terminals, that already exist and where storms already occurred and accidents happened. We make the system with more anchorage and breaks. It is 20 meters or 25 meters we have an anchor breaks for storm.
Joshua: and they are located like below or?
Mr. Faruq: yes we have like a hole to anchor the equipment in
Joshua: are you also familiar with the word resilience.
Mr. Faruq/Mr. Edo: yes
Joshua: how is this, resilience, being incorporated in the the terminal Teluk Lamong, so like the ability to protect itself and bounce back so that it cans still function both during and after an extreme weather event so for example a flood, that it is still able to operate.
Mr. **Faruq**: I think in Indonesia a certain more than like your country if the flood here of course we will stop the operation and after it we take all of the equipment to a safer spot. Because the elevation is too high 2 meter at the highest tide.
Joshua: this is also what they told me that for as long as the Tanjung Perak port exists they have never experienced a flood.
Ms. Mahyndrana: yes we learn of the accidents before like in the exiting port in Tanjung Perak, and there it never happened.
Mr. **Faruq**: so that it a flood from the sea
Ms. Mahyndrana: but it is a different case in Semarang because here the soil is very stable, but Semarang the soil is very soft
Joshua: so they have to do with soil subsidence.
Mr. Edo: there they also have soil that is below the sea level, it is quite different from here.
Joshua: so here it will never happen because of the stable soil and soil type?
Mr. Edo: yes

Joshua: and then for example has it ever happened in Tanjung Perak that for example the rain was so heavy that you couldn't operate? Because of extreme rainfall?
Mr. Edo: oh, if the crane from TPS is going down because of a storm, not because of the rain, and because of the wind. The wind had a speed of 40 knots.
Joshua: does this happen often?
Mr. Faruq: no
Joshua: like how many times did it happen?
Mr. Faruq: we will make the equipment stop, with the break system, in TPS so the new equipment in TTL, from august this year with the new system.
Joshua: could you say that this has also been done because of climate change, you know there is a higher probability of extreme weather events and an increase in their duration and strength.
Mr. Faruq/Mr. Edo: yes
Joshua: so then like the physical resilience that will consist out of the anchor breaks?
Mr. Edo: Yes, like they have the anchorage break system.
Mr. Faruq: in the crane there is hole, when some storm comes, the equipment has some anchorage that they can put through the hole so it can anchorage itself.
Joshua: and were there more safety standards and norms, because you told me about the height, were there more safety standards, I don't know about Indonesian regulation, that were also applied in TTL?
Mr. **Faruq**: ooh safety standards,
Joshua: or just the height? Like materials
Mr. **Faruq**: the standard of the material is let's say, with the, concrete. We use the water tight concrete with the minimum strength is 35 Pascal. Or 400 kilogram per square centimeter, so it is quite water tight the concrete. The rain falls in the concrete will be safe corrosion, and we have been tested in the lab that the infiltration is only 2.5 centimeter with the tense back. That means very very water tight.
Mr. **Edo**: so we follow the regulation for the structures and for the operation we follow the regulation from I think our experience, for example the wind storm and speed of the wind. If the speed of wind or storm is
Mr. Faruq: 40
Mr. Edo: we have to stop the operation at TTL at 40 knots, around 80 km/h. so we have some kind of panic button that need to be pushed and then everything stops.
Mahyndrana: so all of the operators of the equipment have to stop and have to go down to the office until the storm is less.
Mr. Faruq: so we put an alarm during the storm to give the information to the operators. But it is very rare
Joshua: do you remember the last time that it has actually happened? Or how often it happened?
Ms. Mahyndrana: Teluk Lamong actually in the rainy period. Because in Indonesia, you know the tropical, they have a rainy and dry season. Maybe in the wet season but. It has happened but I think it is in December of last year.
Joshua: so yes, do you also have like the right tools to forecast for example, high waves and heavy storms?
Mr. Faruq: we get the information from the organization metrologi klimatologi Indonesia. Yes we accept like a letter like that.
Joshua: and then when they see there are like hard winds or high waves they warn you?

Mr. **Edo**: yes
Joshua: is that the the only warning system or are there more warning systems, maybe for different subjects?
Mr. Faruq: we plan about that maybe the warning system in Teluk Lamong, Karanajn, that is located in front of our channel it is about 20 miles from the Teluk Lamong. But the problem is that sometimes the connection is bad so, we have to improve about the warning system.
Joshua: this is also a warning system about the wind?
Mr. Faruq: yes, this is also about the wind
Mr. Faruq: but we don't worry about the waves because there is Madura Island that is protecting us, like a breakwater.
Joshua: so that is your storm surge barrier?
Mr. **Edo**: Yes
Mr. Faruq: we don't worry about the waves.
Joshua: And tsunamis they only happen on the other side of Jawa?
Mr. Edo: because the problem in the south of Jawa, earthquake and tsunami is different from here.
Joshua: so yeah there are like plans and procedures, so for example for the wind.
Mr. Faruq: yes, the operation of the terminal Teluk Lamong has to the condition
Ms. **Mahyndrana**: I told you that the equipment in the terminal Teluk Lamong still needs the operator. So that all the operators go down when a storm comes.
Mr. **Edo**: the terminal Teluk Lamong write us something like the standard operations, like the standard operations in terminal Teluk Lamong. You want to see the standard operations?
Joshua: yes, that would be very helpful about the procedures.
Mr. **Edo**: but they ware written in Bahasa, but maybe Nana can help you.
Mr. Faruq: maybe that's something you want to know?
Joshua: yeah that might be very helpful.
Joshua: and for example the power and electricity is also very important for the terminal, I think that I have seen that the power for all of the machines is underground. Can you maybe tell something about that? Because when you built electricity lines it is also prone to winds.
Mr. Faruq: So as we know about the electricity cable system, we put it underground, because it is not only about the anckaching.
Mr. Edo. We put the line of the cable below the surface because we want to be concerned with the safety if we put the cables on the surface it will have some conflicts with the operation.
Joshua: So for operations because they can't see past them?
Mr. Faruq: but we still about the regulation about the safety with the electricity we are still oke if we put the cables below the surface.
Joshua: and for example is there also the electricity is now from the state owned company, but in the future you will generate your own power?
Mr. Edo: Yes PLN,
Joshua: so when the power plant fails will it still be possible to get energy from somewhere else?
Mr. Faruq: we have a contingency plan, because we have a plan for using the pipe from the land and for the future we can also use the LNG which will be brought to the terminal by ship. So we have extra storage for the LNG as well.

Joshua: so the contingency plan is also that when the onsite power plant fails you can also go back and use the energy which is being provided to you know by PLN.
Mr. Edo: yes
Mr. Faruq: yes
Mr. Edo: yes, we can use it parallel and it is being synchronized with the energy from PLN
Joshua: you mentioned that you don't really worry about floods, but is there like an acceptance to floods, like we can handle a flood which is this high, or we can cope with a certain amount of flood damage?
Joshua: oke I have seen the different phases of terminal Teluk Lamong, has is also been designed in a way that the most important and vital aspect are being well protected? For example, the container storage and the control room, can you maybe elaborate on that?
Mr. Faruq: it is the same, we have the protection from lets say a storm, it is the same system.
Mr. Edo: because it is the same vendor from the Koenig crane.
Mr. Faruq: we worry more about the moral hazards, so they have to make the all the time to check the weather.
Joshua: and also has it ever occurred that it might be too hot to work for people, because of the temperature in outside, because this is also one the effects of climate change. Has this ever occurred?
Mr. Edo: too hot, too hot? Haha we Indonesian are used to the heat, so that is not a problem for us.
Joshua: are there maybe other contingency plans that you could relate to the port still being operational after a certain climate change event or anything? Because we talked about the plan for storms. Are there any others maybe? I can't think of any more because we talked about the storms, floods, power, so is there maybe any other that you could think of?
Mr. Faruq: I think that the power source, because now we have to sources for the power. One from PLN and the other one is from terminal Teluk Lamong. So if one these power sources fails, the other can serve as a back up. So that is the redundancy system here.
Joshua: so that you have two sources?
Mr. Faruq. Yes.
Joshua: are there like enough facilities, because you mentioned when there is a storm the drainage and the containers go down. Are there enough facilities to get them down quickly enough? Because the time when I visited the terminal it wasn't that busy at the warf.
Mr. Edo: yes it is enough
Mr. faruq: I think that when something happens to a crane we will call the other crane to lift it up. Because this one is very very light compared to the other crane.
Mr. Edo: Just some information for you, this year, we have a plan a master plan of the contingency plan but we start maybe in June so the time when you go back to Holland we will start. All the risk of the operation of the management something like that, is being put in there.
Joshua: and also I saw like the sewage system, has it also been designed with a certain, because you have quite some rainfall so there is allot of rain, has it been designed in a way that it is able to discharged enough of this rain? Are there like standards that it has to be able to discharge this amount of water within a certain time? Can you maybe tell something about that.
Mr. Faruq: we expect that the water will run fast of terminal Teluk Lamong.

Joshua: but there is also like sewerage? Where does this go to? Where does the water that the sewage collects go to?
Mr. Faruq: this time we actually still use the existing facilities located in Surabaya, so far from Teluk Lamong, but for the next we have the plan to built the reception facilities.
Mr. Edo: starting from 2017 all the materials, and after the reclamation.
Joshua: and in Indonesia the sewage because we know where the toilets go to and then you also have where the rain goes to, is it the same system or separated.
Mr. Edo: we have sceptic tanks so these systems are not connected.
Mr. Faruq: we use the bio system for the sceptic tank.
Mr. Edo: we have the waste for toilets and we use it for washing hands and the urinal the water is going to the one system to the sceptic tank. But if you use in the mosque for the pray the water is going to the sea.
Joshua: and the rainwater is it also going to the sea?
Ms. Mahyndrana: yes, the toilets and the rain is a different one.
Mr. Faruq: different in the yard we use the separated system, we have a concrete that the water cannot infiltrate. And then we use the drainage system so get the water away.
Joshua: Oke thank you that were all my questions.
Mr. Faruq: I think it is very interesting to ask your questions about the climate change to open our minds. Because in Indonesia is more stable weather because it is in the tropical. Very different from your country.

Appendix 7: Transcription of the meeting at Terminal Teluk on the 21st of April 2016

Meeting with Mr. Ghufron Khafid, shift manager.

Joshua: What is you name? and how long have you been working here?
Mr. Ghufron Khafid: my name is Ghufron Khafid, I have been working here for 2 Year
Joshua: What is your job here at Terminal Teluk Lamong? What are you responsible for?
Mr. Ghufron Khafid: I'm a shift manager. Coordinate all/every parts operational of the wharf, land side and sea side operations, controlling all to ensure all planning and operations.
Joshua: Could je describe your day to day activities here at Terminal Teluk Lamong? So a normal working day for you what does It consist of?
Mr. Ghufron Khafid: I have the supervision for the yard and for the boats they control the ships and the main activists for operation of the terminal. Loading and discharging focus on vessels and ships. So I just control all operational and I ensure that the operation can go on. Also communication with the port authority they can discuss it with me. I also communicate with the vessels. Actually all the foreman or supervisor can talk to me, I also manage them.
Joshua: and you are also in the control room?
Mr. Ghufron Khafid: yes I'm always in the control room on the top floor.
Joshua: Are you familiar with climate change?
Mr. Ghufron Khafid: no not really, maybe you can explain more about it?
Joshua: yeah sure, climate change you know because of the greenhouse gas emission, so carbon dioxide. Because there is allot of industry and then it gets warmer because of their emission and because of this we face certain problems. In the Netherlands for example we have a relative increase in sea level rise, so we have to protect our country against climate change. Indonesia faces different problems, for example the rain season will change and when it rains the rain will be more intense. So for example I heard that last Friday the main road to Terminal Teluk Lamong was flooded.
Joshua: You didn't know climate change but now since I explained it could you maybe mention some of the effect of climate change?
Mr. Ghufron Khafid: the weather like it will become more hot and all the staff and workers inside here will feel that. But at least with our green port idea we will try to reduce the emission. So I think it helps to reduce to keep the warmth. But our terminal only contributes a few. And at least will not help much, but at least it's a start. For example, we don't use the diesel but electricity for the crane and the terminal is highly automatized. Other ports still use the conventional energy.
Joshua: How do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Mr. Ghufron Khafid: the effect at least from the weather first will be sometimes we, is that we can't predict the weather. Now we can predict with the rainy season and the dry season. But now sometimes the very extreme weather it means like wind, the effect is that sometimes it affects the operations of the vessel. Because it is very dangerous and certainly with the wind and the rain it will stop the operation. If connected with the issues that will affect all that we cannot predict it anymore.
Joshua: so because you are the shift manager it is important for your job right? That when it rains and when there is hard storm, so you have a lot to do with those topics.

Mr. Ghufron Khafid: yes we have some persons who when the wind reach some limit speed we have to stop and park the vehicle. Because sometimes it happened it the other port. TPS, where I worked previously. Almost every year some accident happens with very fast wind. Sometimes collapse the cranes. Which is very dangerous.
Joshua: So how does Terminal Teluk Lamong prepare itself for what you just mentioned maybe the rain or the winds?
Mr. Ghufron Khafid: well actually the terminal not only connect, we design for the multi-purpose. First for the …. If only small rain or not hard wind it is oke, we can still continue the operation if the operator can still see the view. But in some certain limit for the wind we have to stop. We very depend on the weather if little rain falls we have to stop for the dry bulk. So to prepare for that first we have to communicate our vessel foreman have to monitor the weather. Still some cloud we have to stop, like that. Especially the dry bulk
Joshua: because otherwise the quality of the dry bulk will be in jeopardy?
Mr. Ghufron Khafid: yes that is for the physically controlling but the other side for the system our engineering our IT guys prepare the system for the wind speed. We have the wind speed in knots. Certain limit we have to stop the activity is like. Is like from the control room from the STS, sea to shore, they have the wind meter. The operator can see the wind speed on the top. They have better information for the wind.
Joshua: so now I have some questions about do you for example get training about what to do when such weather events happen. So for example when a storm occurs or heavy rain. Do you train or how do you prepare yourself?
Mr. Ghufron Khafid: actually the training is not yet in here. Activity stop we have the procedure. But focusing on the operational until now there is not yet any formal training about how to manage the heavy rain. The activity regarding the operational. But the procedure state that we have to follow the procedure for heavy wind. When it reaches the limit and then we have to stop. I think it is good to know the formal training and procedure about how the influence and the effect. Existing we just know by experience from the previous terminals.
Joshua: because maybe before you worked here you worked in Tanjung Perak?
Mr. Ghufron Khafid: yes
Joshua: and there have you experienced it that you have to shut down the operation because of storm or wind speed.
Mr. Ghufron Khafid: no
Joshua: oke, so as far as you are concerned, you have been working here now for 2 years and it has never happened that you had to shut down.
Mr. Ghufron Khafid: at least not a real shut down, we just stop for a few minutes. Because the wind, it is like to strong. But not until really extreme wind and we have to evacuate. At least for these 2 years.
Joshua: so how does the information about that you have to shut down reach you? Because you just mentioned that in the cranes they have like wind meters, but are there also like for example, you work together with weather information that says when a storm is coming?
Mr. Ghufron Khafid: in here we still not kept that information. Supposedly the terminal can connect with some metrology information that they have to give, because in my previous terminal they every day they give the information for the weather. But now in here is still not yet. So we just depend on the procedure when we see the raining and the wind is fast. We have to stop at that time. But we do not have the guidance from the forecast.

Joshua: is that something that, because this is just phase 1, do you think that like when phase 4 is completed that you get that information? Will it change in the future because the terminal will become bigger?
Mr. Ghufron Khafid: yes of course, in the end it will be there because it is very important to know the forecast.
Joshua: and you also mentioned that you have the procedure about what to do so is it clearly state who has to do what? Is there a clear task division?
Mr. Ghufron Khafid: yes because for example the vessel foreman they have to communicate with the operator which then indicates how the wind speed is, because he knows exactly, and then the alarm signal, everyone on the wharf side can be…
Joshua: ooh you hear it, it is like a siren?
Mr. Ghufron Khafid: siren yes, and just information our crane, because it is quite new technology which means the konecranes equipment they have the breakfast better then my previous terminal. I don't really understand the equipment very good but the break system is very good, better then the old cranes. And the old cranes, in the previous terminal, when the crane still walking the wind blows to them with the speed maximum 18 knots, they can move. Even if the breaks are on they still move. Here they can't because better system.
Joshua: because I also heard that there is like an anchorage system. Is this additional safety or is this always?
Mr. Ghufron Khafid: this is basic on the equipment set. Means that the set of equipment of course they have the break and anchorage system they have to be at the right spot so that they can use the anchorage systems. I think this is helpful at least when wind comes at least stop and anchorage.
Joshua: so when the information reaches you that you have to shut down the operations how long does it take before the operation actually stops?
Mr. Ghufron Khafid: actually because existing in the phase 1 is still not much not big, not yet. So now at least in 5 minute, yes. So at least to get back to the control. Meaning that if some wind and stop must be, we can still control. But the operator on the cabin of the STS they have to going down and evacuate by cars that needs some time. That's only the operator, but to evacuate the operator going down is if really extreme winds, but if sometimes for the last 2 years not really extreme winds, this is for when wind is 20 knots.
Joshua: so maybe then he just shuts down. He breaks but he can stay up?
Mr. Ghufron Khafid: yes
Joshua: could je maybe like explain the whole like procedure to me like now you get information, what do you do in you job as a shift manager?
Mr. Ghufron Khafid: I will check the weather, of course the operator cranes inform first because the weather on the top can see better and more clearly, they will inform to us and I will inform give the order to all that we have to stop operation and evacuate. We will keep monitor the wind. If the wind is more then 20, have to go down. But less then they can wait. So I have to order to all that if more then 20 they have to inform the operator to vessel foreman supervisor and to me and I say: oke, this is not safe we have to return and all evacuate and anchor the cranes. And evacuate to the office on the wharf, the small office.
Joshua: so whenever there is an evacuation everybody ahs to go to that office?
Mr. Ghufron Khafid: Yes
Joshua: oke, but as you mentioned there haven't been any trainings yet? Maybe this is something for the future.

Mr. Ghufron Khafid: uhm, training like drill, not yet. But at least they know exactly how to follow the procedure.
Joshua: because everyone is familiar with the procedure?
Mr. Ghufron Khafid: yes. But I think drill is important because it is like emergency like fire must be recorded every year. Like something to do drill or training a real training we don't do yet.
Joshua: So how do the people know then know what they have to do or where they have to go is it something that you tell them at that moment? If there is no training or is there something like they tell the first time when they are at the job that whenever something bad happens you need to evacuate?
Mr. Ghufron Khafid: previously we took the training because as you know that our staff our operational team is quite new. Really the fresh graduate from the study meanwhile some our people we got here from the old terminal means that based on our experience we can train. So previously we have only training theory like class, inform to them how to manage the emergency procedure something like that. And after by the procedure we said to them and based on the experience of the last two years at least not until the very heavy wind but at least some activities they have to stop. So like the theory and the procedure they can understand well.
Joshua: and, do you also know something about the power supply here? Because you said like the sea to shore they use energy and the cranes in the dockyard they also use energy. I'm not sure if this is also something you are familiar with but ill just ask you and then we'll see. So, how is the whole terminal supplied with energy?
Mr. Ghufron Khafid: existing our energy supplied by the government the PLN. Fully from the PLN then the power plant is not operational yet. But now we have the supply from the government with subsidy. We have to pick up two from the other cities Gresik and Surabaya. The government give us power supply back up to city. Means that when Gresik is no energy, we get from Surabaya.
Joshua: So you always have the energy from one city even when the power fails from the other?
Mr. Ghufron Khafid: it helps us because we very depend on the electricity because crane operational depend on them but in the future when our power plant is active and operate we can use this energy for our operational. And the government as a pick-up (back up)
Joshua: because you can still like for example when that power plant fails, the one on the terminal, you can still use the energy from PLN?
Mr. Ghufron Khafid: Yes of course
Joshua: because this is a gas turbine, and how do you know like how is it going to be supplied with gas? Is it going to be ships that bring the gas? Or trucks?
Mr. Ghufron Khafid: by pipe as far as I know.
Joshua: is there also, has it ever happened that the power goes down in this terminal?
Mr. Ghufron Khafid: yes, but in the first time that we operate, in the first year. Sometimes the power shuts down we stop the operation.
Joshua: because you cannot run the operation without electricity
Mr. Ghufron Khafid: yes,
Joshua: do you know how often it has happened?
Mr. Ghufron Khafid: not much, 2 or 3 times in the first year. And that it not because of the PLN. Sometimes, I think it is, issues because our operations, sometimes we do something and then black out. The fault is because of us not PLN. Because I talk to the head in Gresik.

Joshua: and when it happened, the black out, how long does it take before the energy is back up again?
Mr. Ghufron Khafid: actually different from the electricity, they have a very quick response. Less then 3 hours, but the other issue is not only electricity itself. Because beside electricity we have the system IT system. when there is a black out also all our system fail, electricity is up very quickly but the system must be set up again, restart. And it takes allot of time.
Joshua: because in the container yard everything is automatic so then you cannot do anything.
Mr. Ghufron Khafid: yes, we very depend on the system. I think the IT system, of course they plan to pick up (back-up) to do something. But at least sometimes cannot pick up all. If 1 or 2 hours will not be enough.
Joshua: so the it is also very important as you mentioned, because you communicate you have like walkie talkies. Can you still communicate with the operator in an STS when there is a power outage?
Mr. Ghufron Khafid: previously when there is not energy we cannot all of. But more recently it has been very good the pick up, they will pick up the main server for communicate. So the communication still up still live live so we can help by the sign for the pick up.
Joshua: and also the IT is it also your responsibility or is there someone who is the head of IT?
Mr. Ghufron Khafid: yes, they have, we are focusing on operation terminal the supporting from IT they have at least from every they have 24 hours help desk and the issues they can quickly help.
Joshua: so they are not here and you can call?
Mr. Ghufron Khafid: they are here for the helpdesk
Joshua: oke, and did you ever had any problems with IT that were not caused by a power outage? So maybe a problem from it itself.
Mr. Ghufron Khafid: yes, sometimes we have 2 or 3 times that the system can stop the operation. Some issues that I don't know how but perhaps the issues related with the what is it called…back up system or something. Not much happen otherwise in the last 2 years we stop. But we had the issues with the IT itself the main issue is the main electricity which influences the systems. When the electricity is down it takes time.
Joshua: so it takes longer for the IT systems to be up again that for the power?
Mr. Ghufron Khafid: Yes
Joshua: and you also told me about that when it is raining you also have to shut down the operation and that is because of the sight of the operators, that they can't see clearly or is it also because there is too much water on the road so that they can't drive?
Mr. Ghufron Khafid: it is because they can see because of the weather from the clouds. But from behind the view we cannot work. Because of the rain we only see from the sky but during the night it is dark.
Joshua: oke, and is there anything like a sewerage system on the terminal? Something you know of? That they can like, ill look it up on google translate, it is no problem.
Mr. Ghufron Khafid: ooh sewerage
Joshua: is there any or how do you try to get rid of the water on the terminal?
Mr. Ghufron Khafid: ooh water management system?
Joshua: yes, but from the rainwater, do you know anything about that?

Mr. Ghufron Khafid: not really because if some raining the water itself it goes into the sea. We not manage for that.
Joshua: uhm oke thank you that were my questions.
Mr. Ghufron Khafid: oke, of course you focus on how the control system and operation we are as I told you very automated and very depend on the system we still concern about the business contingency plan for whole operations. Because the operational is very depended on electricity and the system.
Joshua: you would say that those are most important components here?
Mr. Ghufron Khafid: Yes, the other thing is the of course weather, but weather everyone understand means that if the the operation stops during the heavy weather the vessel side they understand. With the condition to stop operation because when we stop operation they will be delay time for them. But it affected all their schedule of course. For the training it is oke. But for the other two, they will influence big. Those are two of the issues for which this terminal will have to find a solution. I have the experience from the previous terminal meaning we have the procedure for ICT.
Joshua: but here is it also possible to operate the terminal manually?
Mr. Ghufron Khafid: we do not think about that because of course already seen our we really depend on the automation system if all stop we still cannot know how to manual operation. Because from the previous terminal every single move was being tracked and written down. But here with the automatic we still think about how the wind influence the operation to beginning in that issues that the biggest issues here.
Joshua: and do you like meet up with other people to talk about these issues and see if there is any way to talk about these issues and come up with solutions?
Mr. Ghufron Khafid: still not yet because we still focusing on the operation. At least the IT change the focus on how the server, to ensure the IT. They have the other back-up server. We have 2 servers actually main server and back up server with a different location but if this 2 down they still have the other back up. And the other from the electricity the management has think about the power plant. But that's how the control of the plant but sometimes it happens to systems. Because even tough they have allot back up server if some issues we cannot predict it will be mess for the operational. But still in the first phase is not big. Stop 4 hours they can understand.
Joshua: I also have another question because the power, the cables, how are they supplied with energy are the cables in the road under the surface?
Mr. Ghufron Khafid: yes, under.
Joshua: so they are quite safe located for storms.
Mr. Ghufron Khafid: yes, it is dangerous when they are above ground
Joshua: so mostly the energy and the IT cause the most problems now. But because you are still small you can manage and customers can understand. But in the future you'll have to try and find a solution for this.
Mr. Ghufron Khafid: yes.
Joshua: oke, that is it, ill stop the recording, thank you very much for your time and answers.

Appendix 8: Transcription of the second meeting at Terminal Teluk on the 21st of April 2016.

Meeting with Mr. Mohamad Fahrurrozi, responsible for electrical and infrastructure.

Joshua: What is you name? and how long have you been working here?
Mr. Mohamad Fahrurrozi: Mohamad Fahrurrozi, 1 year.
Joshua: and before this did you work in another port?
Mr. Mohamad Fahrurrozi: another port in Makassar, Makassar port.
Joshua: What is your job here at TTL? What are you responsible for?
Mr. Mohamad Fahrurrozi: my job in electrical and infrastructure.
Joshua: so you are responsible for all the buildings having electricity the equipment the STS that they have electricity?
Mr. Mohamad Fahrurrozi: electricity is the power. But automation maybe the STS like operate is not my section.
Joshua: so what, could you explain your section?
Mr. Mohamad Fahrurrozi: my section is infrastructure like wharf, yes, road, building and revetment and drainage.
Joshua: and all related to the electrical?
Mr. Mohamad Fahrurrozi: electrical like substation in TTL power.
Joshua: so on a normal day what do you do? could je describe your day to day activities here at Terminal Teluk Lamong?
Mr. Mohamad Fahrurrozi: For activity we supporting operation terminal like we add facilities like uuh…specific plates and add another electrician about the for building for electrician installation and for other.
Joshua: so I just told you about climate change. The changing environment. Are you familiar with climate change?
Mr. Mohamad Fahrurrozi: maybe a little.
Joshua: but have you heard of this before?
Mr. Mohamad Fahrurrozi: in here I have not. I don't know, the change of climate in Surabaya because I live long time in Makassar.
Joshua: do you know some of the effects of climate change
Mr. Mohamad Fahrurrozi: what?
Joshua: do you know the effects, the consequences of climate change?
Mr. Mohamad Fahrurrozi: yes of course.
Joshua: How do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Mr. Mohamad Fahrurrozi: now and in the future? Oke, climate change can change maybe in wharf maybe in elevation of water, maybe climate change can up from natural maybe usually the tidal is 3 meters but maybe with climate change we can 3,5 or 4 meter so we can,
Joshua: like sea level rise
Mr. Mohamad Fahrurrozi: Yes, sea level water level can change the wharf because the ship to wharf it gets higher. Can the ship is very very difficult to get close.
Joshua: In your job do you have any thing to do with climate change as far as you are concerned?

Mr. Mohamad Fahrurrozi: in here is not major in climate change because I think the elevation of wharf is a… the design for meters like 1,5 until 2 meter from high level spring design. Top is 2 meter oke so I think climate change in here is not effect, not big effect for my wharf.
Joshua: Do you think climate change will affect your job in the future in a different way then It does now?
Mr. Mohamad Fahrurrozi: now, oke, I think sedimentation from like this is many river. Maybe this will get sedimentation from river in here, the effect is flood in here. And the effect to the city in here, around here.
Joshua: oke, so not for the terminal itself but for the surrounding cities?
Mr. Mohamad Fahrurrozi: yes, but the social effect in Indonesia is very very high like that. Maybe is not minor but the social effect in Indonesia is very high maybe you can see in Indonesian people ya?
Joshua: Do you know any examples of how TTL is preparing itself for climate change and the effects? For example, you already mentioned the height of the wharf, do you maybe have some more examples of how they prepare itself? Because here they are really concerned with the storms you know for the operations, so heavy winds or heavy rainfall or sea level rise. Do you know of any examples of how TTL is trying to minimize the effect of those things?
Mr. Mohamad Fahrurrozi: the effect to my…?
Joshua: can you mention any examples of this?
Mr. Mohamad Fahrurrozi: first we, plant my plan tree in here now is not bigger still small around the terminal on road and then.
Joshua: any why exactly do you plant the tree? So that it holds the surface
Mr. Mohamad Fahrurrozi: not the surface, if we plant the tree the climate change we can not big change. Because global warming we can reduce first. Second at the like that, we can storm anchor if the wind speed wind I wharf. When you go to wharf you can see the storm anchor in wharf. So when the high speed we can storm anchor to the wharf for the stability of equipment or STS. In here the high speed wind.
Joshua: does it happen often the high speed wind?
Mr. Mohamad Fahrurrozi: 15 knot maybe, I don't know the specific. You can get the true data ICT maybe.
Joshua: so in your job you don't have anything to do with shutting down the operations when the wind speed gets to high.
Mr. Mohamad Fahrurrozi: I'm sorry I don't understand
Joshua: your job is about infrastructure so your job is not about warning people and stopping the operations when there is a storm?
Mr. Mohamad Fahrurrozi: ooh yes, not for me but for another section. Maybe you can ask other people.
Joshua: oke then ill ask you some questions about the power supply because that is you job right?
Mr. Mohamad Fahrurrozi: of, course yes.
Joshua: so how is the whole terminal being supplied with energy?
Mr. Mohamad Fahrurrozi: the power we use the PLN power. 16 megawatts, in the future we can use the power plant with the generator in here with the gas engine, power plant, in another future maybe develop another people developing to STS and the other equipment

we use electrical we use the power plant. The power plant will have 6.6 megawatt in the first staging. But we will develop until 200 megawatts.
Joshua: and this is at then end of phase 4?
Mr. Mohamad Fahrurrozi: yes, another developing in the future
Joshua: and from the PLN they just use conventional oil right?
Mr. Mohamad Fahrurrozi: PLN power from water and coal, from PLN.
Joshua: and in the future you will use the gas?
Mr. Mohamad Fahrurrozi: yes
Joshua: and how does the gas get here in the future?
Mr. Mohamad Fahrurrozi: yes gas from PERTAMINA entry with the pipe from road to this installation is ready until this power plant. From there transfer to move the generator supply to all the installation
Joshua: and the pipe is it in the sea or is it in the bridge, the pipe for the gas
Mr. Mohamad Fahrurrozi: the pipe from road until this under soil, until the bridge is up and installation beside the bridge. And another entry until power plant.
Joshua: so has it ever occurred that there is a black out, so that there is no power available.
Mr. Mohamad Fahrurrozi: first is when under construction terminal Teluk Lamong, because not good installation. Now it is oke.
Joshua: what would you do in case of a power outage? Do you have a procedure or back-up generator?
Mr. Mohamad Fahrurrozi: back-up generator we have, the generator we use when the power from PLN is black out and the generator we can use in the operational for 1 staging. For example, STS is 1, STC is 2. We can continue operation in yard.
Joshua: and how long can you continue the operation? Is there like a time, like 1 hour or maybe 2 hours?
Mr. Mohamad Fahrurrozi: I have a try 1 until 2 hours but it's the try maybe if long time is oke too, because the power is 6.6 megawatt.
Joshua: and are the cables like the power cables to for example the STS and the cranes, where are they located?
Mr. Mohamad Fahrurrozi: located under the road
Joshua: so you would say that they are being well protected?
Mr. Mohamad Fahrurrozi: well protected because first from the cable owners is good isolation second the plates and the cable ducting.
Joshua: and if there was a power outage how long does it take to restore the energy?
Mr. Mohamad Fahrurrozi: the black out is the time? Maybe is 1 hours until 4 hours because it depends on the PLN because when the black out we must call the PLN. The people from PLN, they move the power it depends on PLN. Because the speed from PLN is oke
Joshua: because I also heard that the terminal is being supplied with power from Gresik and power from Surabaya, so when the power from one fails, you can always use the other.
Mr. Mohamad Fahrurrozi: oh yes, two sources from Gresik and Surabaya.
Joshua: and the generator you told me about the back up generators are they located up high or are they located on the ground?
Mr. Mohamad Fahrurrozi: on the ground,
Joshua: so if there would be a flood or something maybe from waves, if there is a storm are they protected?
Mr. Mohamad Fahrurrozi: oke first the elevation, the elevation is the same as the wharf. I think the wharf is not flood. The elevation is oke from wave. And another is here in building.

Joshua: oke so you think there is enough protection?
Mr. Mohamad Fahrurrozi: yes,
Joshua: so do you know the elevation; do you know why they chose the height that they chose. So why did they pick the height that the terminal is built on?
Mr. Mohamad Fahrurrozi: oke, main elevation in the wharf is 5 meters and the tide is, low water spring till high water spring is 3 meters. So different from high level water to elevation wharf is 2 meters the road in here is 4.7 meter.
Joshua: so that is high enough?
Mr. Mohamad Fahrurrozi: yes, I think this is high enough for the climate change. 2-meter level will maybe change in 100 years.
Joshua: have there ever been any other problems that you face or had to deal with that with infrastructure that are related to climate change
Mr. Mohamad Fahrurrozi: maybe the design. The design is very superior you cannot model of the infrastructure because of maybe the speed wind. Maybe the high speed like that is not major but is very important to improve. Like the design.
Joshua: what is currently being done by the terminal to cope with the effects of climate change like what you mentioned the anchor system. could you think of any other measures?
Mr. Mohamad Fahrurrozi: maybe when the high speed wind we usually stop operation. We communication to operator wind speed is high so you must be stop to all activity. All activity that do height, is open and we close.
Joshua: so they stop the operation until it is safe again with the wind speed to continue
Mr. Mohamad Fahrurrozi: yes, if the wind speed is oke, they start again.
Joshua: do you think that what is being done now for climate change by the terminal Teluk Lamong is enough for the terminal to be safe form climate change?
Mr. Mohamad Fahrurrozi: in the future maybe we can use the water from toilet and another, and we recycle again to water like water we supply to sea so now I use the water from other supply. Maybe later we can use the water from the sea or recycle the water.
Joshua: and I also heard that the road over there (to the terminal), last Friday it was flooded because of the rain?
Mr. Mohamad Fahrurrozi: yes because the drainage over there is not good. I look high water spring and rain is….
Joshua: so a combination of the rainfall and the high water level?
Mr. Mohamad Fahrurrozi: and not good drainage to
Joshua: so who is responsible for that road? Do you know?
Mr. Mohamad Fahrurrozi: maybe the city because this road is province road of Jawa province.
Joshua: and are there any plans to tackle the drainage problems of the road? Do you know about that, do you maybe work together to build a new road or to come up with an alternative?
Mr. Mohamad Fahrurrozi: I think that my opinion, I think first the drainage like the big drainage is very very good. But I know that the municipality of Surabaya underground is big drainage, from Dutch, which is not use. I think it is very important to can move water from city to bypass to city. But now the infrastructure like not many good because of the drainage. So when there is heavy rain, in Indonesia is very high intensity rain, so it is not good for road to sea.
Joshua: but there are not plans to improve drainage? Do you know about that?

Mr. Mohamad Fahrurrozi: yes I think, government not want to, because you can look at road. And the soil in here is not good, the soil here is clay so the high compression and the settlement is not good for the road and drainage not good to. I don't know maybe the government have not money I don't know
Joshua: but in the future they have the plan to built the flyover, do you think that will solve the problem? Because then the trucks are able to enter and leave the port?
Mr. Mohamad Fahrurrozi: yes, not all of them. The flyover can register traffic jam at the street. The trucking when to fly over and to toll can reduce the population trucking on the road. You can see the street is now at 5 pm is very very jammed.
Joshua: has it ever happened that the Bay of Madura, that it was blocked that ships could not enter the Bay of Madura
Mr. Mohamad Fahrurrozi: I'm sorry I don't understand
Joshua: uhm, so this is like the Bay of Madura, we are here, and has it ever happened that the ships could not enter the bay from here or here because the waterways were blocked?
Mr. Mohamad Fahrurrozi: What do you mean?
Joshua: had it ever happened that it was being blocked and that ships could not dock?
Mr. Mohamad Fahrurrozi: the depth you mean? In the dredging this channel until the 400 meters and Pelindo maintenance this channel.
Joshua: so if there are problems with the depth they are being solved by Pelindo
Mr. Mohamad Fahrurrozi: Yes because the depth in here is maximum 13 meters, it is oke
Joshua: oke, and is there a sewerage system? is it here?
Mr. Mohamad Fahrurrozi: Yes, but not good now, because the improve my system in here because the system like from restaurant and canteen, collected one place, in a sceptic tank and is some spillage.
Joshua: and is the sewerage system also for rainwater or just water that is being used in these buildings?
Mr. Mohamad Fahrurrozi: just the building, the volume is little now, in the future maybe bigger.
Joshua: and the road do you know did they use like a material so that when the rainfalls the water can get away that it not remains on the surface? Can you maybe tell something about that?
Mr. Mohamad Fahrurrozi: yes, the choice of main road is concrete, rigid pavement, if then the rain fall not absorb to the soil. But the road is built with incline so then from the road to drainage and from drainage to sea.
Joshua: and those drainage systems are located near the road? So like the rain falls and it goes into the drainage and then into the sea?
Mr. Mohamad Fahrurrozi: maybe in sea container yard, we make the inclination to 1% to the water can to drainage.
Joshua: oke that is it, thank you for you time,
Mr. Mohamad Fahrurrozi: I'm sorry for my English.
Joshua: ooh that's not problem, we were able to understand each other.

Appendix 9: Transcription of the meeting at Terminal Teluk on the 28th of April 2016

Meeting with Mr. Hadi Saputro, shift manager.

Joshua: What is you name? and how long have you been working here?
Mr. Hadi Saputro: Hadi Saputro, 2 years
Joshua: also really from the beginning of the terminal right?
Mr. Hadi Saputro: yes
Joshua: What is your job here at TTL? What are you responsible for?
Mr. Hadi Saputro: I'm shift manager; my responsibilities start from (….?) until the wharf. I make sure all man is suitable with the job. I must give people with the right job with the right position.
Joshua: so like the right people at the right place?
Mr. Hadi Saputro: Yes, I make sure many people is enough for working for all location.
Joshua: Could je describe your day to day activities here at Terminal Teluk Lamong?
Mr. Hadi Saputro: yeah, first time I must briefing all of crew ya, before they start working and I'm divide of operator how many people working in one STS today. And then how many vessels must pertain I must plan every day.
Joshua: so that is something you must do before you day starts you must plan everything and then you like in the briefing you tell them
Mr. Hadi Saputro: also maybe any information from the office about any accident or any new. Next week and next month what is the schedule of the office we must tell also in.
Joshua: so like keep them up to date about what is going on are you familiar with climate change?
Mr. Hadi Saputro: I just listened but I don't know too much about the climate.
Joshua: oke, because it is like it is getting warmer, here you have like a constant temperature but in my country there is really a difference between summer and winter, and this is getting bigger but also some of the effects are for example that storms they will occur more often and that they will be heavier and more intense. And for example sea level rise, those kind of things. How do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Mr. Hadi Saputro: Here is very seldom if there is like a sea level rise but the always accident is coming from the strong wind is almost every accident.
Joshua: and does it happen often the strong winds?
Mr. Hadi Saputro: maybe in month start of September till April maybe.
Joshua: so that is during the rainy season?
Mr. Hadi Saputro: raining season yes.
Joshua: and did you work at TPS before you came to work here?
Mr. Hadi Saputro: no TPS just training there.
Joshua: In your job, you just said like the storms so you have some dealings with climate change as far as you are concerned? Because if it starts like the storms something is your responsibility. And how do you think in the future will become more storms do you think you have to deal with it more often in the future?
Mr. Hadi Saputro: Yes, we must have a storm warning I think so. Now we only have on the anemometer, this is wind speed.
Joshua: ooh yes, this is the one in the STS. So you don't get warning from, you have like the weather institute?

Mr. Hadi Saputro: usually we have, we can watching from the PMG. PMG always send message from the warning maybe today rainy season and have warning maybe also. We can go to the information of the PMG.
Joshua: maybe you know like before like today there will be a storm, and then you can measure up in the STS the wind speed.
Joshua: Do you have any examples of how Terminal Teluk Lamong is preparing itself for climate change and its effect? Because of course the anemometers they are some example, and I think because you most relate it with storms maybe you can think of ways you try do deal with storms or try to ensure the safety during a storm.
Mr. Hadi Saputro: yeah exactly all equipment like cc, STS limitation of looking. When the wind start 13 knots per second the STS will get warning and when start 17 the STS can not be put in another position. When wind is coming from here we cannot go to there and wind already 17 and then 20 we cannot move anything so when 13 I'm prepared and contact all crew, I'm all supervisor in wharf I inform: please stand by. Because maybe the wind will be more strong, so stand by to go to the anchor area but we still looking but we must looking for the nearest anchor area.
Joshua: and then you try to move it to the anchor area and to anchor the STS?
Mr. Hadi Saputro: yes, when the wind is more increasing we moving to the anchor area.
Joshua: and in the anchor area how does it work? like you anchorage the STS. And is it just the normal break or is it something…
Mr. Hadi Saputro: and also put down the anchor
Joshua: and this can only be down in these areas?
Mr. Hadi Saputro: yes, but everything will be stopped. But if we don't have channel to looking for the anchor area we can direct anchor anywhere, this is no problem for safety.
Joshua: and you just mentioned what you need to do when they say there is a storm coming. But do you also like train for this. Like what to do who is responsible for what and you have like a training for what to do when a storm occurs?
Mr. Hadi Saputro: ooh yeah, usually when the storm occur we only see by visual. Normally the cloud very dark and then we will start small monitor. We just monitor first and then I call to the safety officer to monitor the wind speed exactly from the like PMT and then when the safety officer informs: oke, the wind like will be more increase so we stand by, prepare standby, so I inform to yard to queue and also to brigade our standby.
Joshua: and how many times can you do you know has this occurred that you had to stop the operation
Mr. Hadi Saputro: for preparation at least 15 minute we prepare for anything. But only less then 5 minutes we must stop.
Joshua: has it already happened this year that you had to stop
Mr. Hadi Saputro: uh, yeah, I have but the wind is not too strong only 17 I'm inform to our director oke, now in quay is very strong wind try to prepare for storm.
Joshua: and do you also, does everybody know what to do in case of a storm?
Mr. Hadi Saputro: Yes everybody knows because sometime I'm not in quay and in office they call me inform about how the situation in there and they already know what to do.
Joshua: like with the trainings do you also practice it when there is not storm so that everybody knows what to do?
Mr. Hadi Saputro: for the drill?
Joshua: yes, like drill
Mr. Hadi Saputro: we never conduct the drill

Joshua: do you think that I might happen in the future that you start doing a drill?
Mr. Hadi Saputro: I think so that QHSC department have plan about that but the concept now is that normal accident like crash like fire an other but about the storm I don't know, still maybe in the future we make a plan.
Joshua: because this is just phase 1 of the terminal so maybe when it becomes larger.
Mr. Hadi Saputro: yeah
Joshua: is there like a clear task division about who has to do what when you shut down the operation?
Mr. Hadi Saputro: yeah shift manager on duty like me, because maybe if the time like that we cannot call our manager. But in the night at 1 o clock not many people here we must make decision here.
Joshua: and then you tell everybody what to do or do they all know?
Mr. Hadi Saputro: yes, I tell to all already using the communication, the walk ie talkie, we inform to all channel for prepare abort. Maybe people stop working.
Joshua: so you just open up to all channels and tell them that they have to stop, and then everybody stops and you have to gather at the office?
Mr. Hadi Saputro: yes
Joshua: and yeah you just told me, 15 or 5 minutes.
Mr. Hadi Saputro: yes, preparing and then preparing for action.
Joshua: and do you also about the power supply of the terminal?
Mr. Hadi Saputro: yes
Joshua: because how is the terminal being supplied with power, with energy.
Mr. Hadi Saputro: we have FR department, facility readiness department, they are responsible for the power supply in Terminal Teluk Lamong.
Joshua: ooh oke, so then maybe I should ask them, and do you also have to do with the infrastructure like the roads, or is this also the, facility and readiness.
Mr. Hadi Saputro: yes they are also reasonable about that, now in the near the bridge ya, around the ST area, the road is very dangerous for operation. When the truck coming so this is like not flat and like a hole in there. So I inform the facility readiness to make investigation and then prepare for repair.
Joshua: so yeah you're not responsible but if you notice that something is wrong you just inform them about if they can maybe fix this?
Mr. Hadi Saputro: yes
Joshua: do you know if there are ever any problems with rainfall when there is like a storm but not so much the wind speed but the rainfall that you have to stop?
Mr. Hadi Saputro: yes, because the rain so heavy rain, rain is operator cannot looking so clearly in the container yard, so it danger like blind, so must be stopped also when heavy rain but only the reason if the operator can still clear looking to container it is oke.
Joshua: but as soon as it becomes to much and he can't see anymore you also have to stop the operation?
Mr. Hadi Saputro: yes, but this is especially for container yard. The dry bulk is very sensitive with the rain.
Joshua: because it is mostly like soya beans right? So it will...
Mr. Hadi Saputro: hahaha yeah, so otherwise is not good for quality
Joshua: do you think that you know like that they provide you with enough information that you can like handle adequately take the right decisions as a shift manager for when there is like a storm or when you have to stop the operations?

Mr. Hadi Saputro: what do you mean?
Joshua: do you think you get enough information so that you can make good decisions?
Mr. Hadi Saputro: yes, I think so,
Joshua: just based on the PG and the computers, oke, and are the people in the cranes in the STS are they responsible, because they see the wind speed on their monitors right? So do they also have to make the decision to for example go down and to leave the STS?
Mr. Hadi Saputro: no no, he only gives information about that, information to vessel foreman and foreman to wharf supervisor and they inform to me.
Joshua: could you maybe explain more about how the information stream goes like he informs the vessel foreman and what is the procedure for like say someone noticing the wind speed gets to high, how does it reach everyone? Not with the walkie talkie but all the different functions involved. Can you maybe tell a bit more about that?
Mr. Hadi Saputro: for the first time usually operator STS always looking for the monitor, in the monitor also have indicator how many speeds the wind. And then when the wind speeds reach 13 he informs the vessel foreman. And vessel foreman: oke, directly inform to me. And I say to the vessel foreman, oke we are just watching the winds. Inform the operator STS to keep watch the monitor. If the wind increase to much we will try to looking for safe area.
Joshua: and the vessel foreman is not someone from TTL? But that someone who's on the boat?
Mr. Hadi Saputro: yes, on the bridge
Joshua: because for them they want to do everything as soon as possible so they can leave again right?
Mr. Hadi Saputro: yes
Joshua: do you maybe, maybe not, in the responsibility within your job but do you have any other ideas about how TTL prepares itself for climate change? It doesn't have to be your responsibility but can you think of something the terminal does in general?
Mr. Hadi Saputro: I mean like the Teluk Lamong must give more information about the CCTV camera and also maybe we have, I mean, joint venture, with the PMG station. Sometimes when the storm comes from the Philippines, is always many typhoon in there, sometime the wind also in here. So we must also have joint venture with the PMG for maybe, periodically send a message about the weather more far away.
Joshua: oke because now you only look locally to the weather and not all the way what's happening in the Philippines.
Mr. Hadi Saputro: and for maybe give more additional about the CCTV, but sometime you know yesterday, we kept accident from the Brazilian vessel struck our dock.
Joshua: because he didn't stop? So he hit the wharf?
Mr. Hadi Saputro: yes, but we don't have supervision in there so the bars is directly running,
Joshua: like the parts in the wharf
Mr. Hadi Saputro: and then he go
Joshua: and you haven't heard from them
Mr. Hadi Saputro: luckily we have some project, project I mean some people in the, but not terminal Teluk Lamong, they inform to us, so we know about that. I mean if we have CCTV for record the accident we can, I mean like detect and then we can record the accident and then we can catch the person.
Joshua: and also maybe you can analyze it and see what went wrong, what can you do to prevent it in the future. Does it happen more often accident?

Mr. Hadi Saputro: we only 1 time we have an accident; another accident maybe is vessel burping but maybe too much tension from the tuck boat. But we can see directly because many people in here.
Joshua: I see, it what just because at the time there was no one there. And for example fires, because you have a fire department, has this occurred
Mr. Hadi Saputro: yes, I think so, because the first time here we must have the fire installation and must periodically test it. Drill and test for any accident, we can already ready for the fire I think now TTL is not enough about the fire hydrant, I think this is one of the not good condition. Because yesterday we kept a fire we only use the truck.
Joshua: so in the future…
Mr. Hadi Saputro: warn the fire hydrant in location maybe with the 200 meters we must have.
Joshua: because now there was nowhere from where they could get the water
Mr. Hadi Saputro: yes
Joshua: oke, lets see. Do you have any knowledge about the height of the wharf, looking at it from sea level? Do you maybe know something about that?
Mr. Hadi Saputro: im not sure because this is also the facility readiness responsibility.
Joshua: oke, well thank you very much that was it. I don't have any other questions.

Appendix 10: Transcription of the second meeting at Terminal Teluk on the 28th of April 2016,

Meeting with Mr. Pegwai, IT, process business and governance section head.

Joshua: What is you name? and how long have you been working here?
Mr. Pegwai: Mr Pegwai, terminal Teluk Lamong maybe 2 years 8 year and at Pelindo 3, 8 years.
Joshua: so when the terminal opened you were moved from Pelindo 3 to Terminal Teluk Lamong, or do you consider yourself still to be at Pelindo, because first at TPS maybe.
Translator: Mr. Pegwai is still in Pelindo 3 but Pelindo 3 put him here, this is Pelindo 3 employee. He is singed to Terminal Teluk Lamong. So he is the Pelindo 3 employee singed to Terminal Teluk Lamong to support the operation in here. But it is not we can say that he is not for a long time maybe. So just for maybe 2 or 3 years.
Mr. Pegwai: I don't know but I'm not leaving.
Joshua: What is your job here at TTL? What are you responsible for?
Mr. Pegwai: I'm in position in IT, process business and governance section head.
Joshua: so what does this mean? What are you responsible for?
Mr. Pegwai: I'm responsible for……, English is not good ya
Joshua: that's no problem
Translator: so he's working here, his job is to design the business plan in here based on ICT system. so ICT development for the terminal Teluk Lamong.
Joshua: so is it also like the IT processes around the communication with the STS.
Mr. Pegwai: yes, and I think governance the ethic of governance in Terminal Teluk Lamong all around Terminal Teluk Lamong but ICT is under control from me.
Joshua: so like all the internet how the people communicate?
Mr. Pegwai: yes
Translator: almost all of the procedures in Terminal Teluk Lamong we just based belongs to here. He takes the responsibility.
Joshua: Could je describe like a normal day for you, could you describe a normal day like today what are your task and jobs?
Mr. Pegwai: job here today, my job is
Translator: he takes responsibility to make sure that the project is with the good done
Mr. Pegwai: one: I'm planning project, number three: contract,
Translator: make sure that the contract is, so what happened in this type of the project it is still according to contract. So that the work of the project is same as the contract.
Joshua: oke and is it being executed by an outside firm.
Translator: yes, and every job that did by the third party he checks it.
Mr. Pegwai: it is contract, in ICT.
Translator: he did the system procedure
Joshua: and are you familiar with climate change?
Translator: so he says that he thinks about the climate change so like, when he was child and he as been in here now he thinks that the climate has already changed. But in part of the process he doesn't think about it. He tells us that the example of the climate change that he thinks it's the rainy season in here has changed. So when he was child,
Mr. Pegwai: ooh sorry rain is September to January or February.

Translator: so when he was child the rainy season was from September to January or February. But it is not, has already changed. So we cannot predict it when will be the rain season. So we can predict when he was child when is the rain season but now is unpredictable.
Joshua: and how do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Translator: so he thinks that the effect is the rising of the water level in here and then about the…. As you know, we are in here of in front river, you can see there is river over there and then he said that it is maybe happen in the future that the material from the river is came to here. And then as you know that we plan to make the reclamation area in here so it will affect the water around the river and the seabed is getting shallow, around the river. So he thinks that that's the effect of the climate change in here.
Joshua: In your view in your job do you have any dealings with climate change as far as you are concerned?
Translator: it is on the effect the positive effect or the negative effect, both of them. He says the climate change. So he thinks that his job is not have it will never effect at the negative side so… his job is to make the new system in here, such as the paperless system. So it maybe a positive effect to the climate change, given the prevention of logging of the Kalimantan. As you know that Kalimantan is allot of logging there. So the paperless system will effect but it is not massive effect, but it's a little bit. He is trying to walk on the positive side for the climate change.
Joshua: Do you have any examples of how Terminal Teluk Lamong is preparing itself for climate change and it is effect? Could you mention any?
Mr. Pegwai: all the process here in terminal Teluk Lamong create in smoke or,
Translator: sorry could you maybe explain about your question? I have the idea of pat Pegawi but I have to know if it is correct.
Joshua: for me it is like how does Terminal Teluk Lamong prepare itself for climate change you already said that the rainy season it has become unpredictable so what does Terminal Teluk Lamong do to prepare itself for climate change or maybe try to do something against the effects?
Translator: so he says the existing of the ecosystem in here as we can see that the river area, it is not shallow area. And then he thinks that to maintain the river he need to dredging to make the dredging around the, but it is only at the area at the area that is not shallow. So we are not changing the ecosystem we are not trying dredging in another area there is only dredging at the end of the river. And terminal Teluk Lamong is designed by Jayca and they are already by make a research about the design about the Terminal Teluk Lamong to make sure that the design I not changing the ecosystem massive. But we know that the existing Terminal Teluk Lamong it is changing the system but is not a massive change to the ecosystem. They are already making a research. Jayca is from Japan.
Joshua: How is this spelled?
Translator: J A Y C A. So pat Pegawi said that if we want to know is the ecosystem in here already broken or not we can see that in morning in here you can see that there are allot of white bird around here. It is not changing from when terminal Teluk Lamong wasn't existing here and compared to now. Compared to nowadays they are not changing.
Joshua: alright and now I have the questions that are related to the IT infrastructure, do you also know something about the power supply? The energy supplied how the whole terminal is being supplied with energy, does he know something about that as well?

Mr. Pegwai: no, this is not my type.
Joshua: oke, no problem I thought that maybe because energy for you is really important
Joshua: So how is this terminal being provided with IT infrastructure? Like the cables, where are they? Can you tell something about that?
Translator: could you explain more about the question?
Joshua: it is just like how is the IT infrastructure on the terminal connected with other IT infrastructure near the road and to the cities?
Translator: so you want pat Pegwai explain to you about the infrastructure of the IT in the Terminal Teluk Lamong?
Joshua: yes so for example the internet in here, is it wireless or is it a cable?
Translator: So there are two type of the network in here which is using fiber optic cable and then the other one is using the wireless network. And the fiber optic cable use for infrastructure that is not moving such as the building. And the wireless network use for the moving object such as CTT, you know they are moving, but they are connected to the network using wireless. So if you want to check at the site, start from here to the key it is covered by wireless network. We already check whenever we are standing in here even if af the key in the seawall we always have the wireless network. So you can say that all of the area of Terminal Teluk Lamong is covered by wireless network for the moving objects.
Joshua: So then the cable that gets to the building is it underneath the ground. and, so because I have interviewed people before and they said that the effect of climate change with which they are mostly concerned are storms.
Translator: storms.
Joshua: yes, with the high wind speed. So then cables underneath the ground are quite safe. Are there any means of how they try to protect the IT infrastructure?
Translator: you mean protect from what?
Joshua: especially the threats of climate change, so flooding maybe because of rain, flooding from storms.
Mr. Pegwai: we check wind speed. This my program for monitoring wind speed in here.
Translator: so, IT in here using wind speed checker, so to detect when storm, when are the storms coming and we already connect it to the BMKG, you can check what is BMKG, it is government metrology and climatology, so we can check it when is the storms coming. And then we can use the wind speed detector, so when the wind speeds tells us the storm is coming then all equipment in here, especially for the IT is already certified IP66 minimum. IP 66 is the certification means that all the equipment, IT equipment, is waterproof and impact proof. So even if it is hard raining or maybe there are earthquake the data is safe.
Joshua: and the IP-66 it is called? And it is being checked by like an outside form?
Translator: who can give certification of IP-66? So it means, it is not like an ISO, so he said that if pat Pegawai is going to buy the equipment of IT he makes sure the equipment is already IP-66 certified so it is not, were not hiring the other firm from outside to check the standardization like that. It is different with ISO.
Joshua: so you basically check if the equipment is IP-66 certified and then you buy it?
Mr. Pegwai: yes
Joshua: and higher is always better?
Mr. Pegwai: yes, maybe you can try to find this IP-66 in this equipment
Joshua: oke, yes I will try to google it so I can learn more about it.
Translator: you can not about the IP-66 if you can check

Joshua: yeah I can look it up on the internet and then I can check, so are you also responsible for the communication around the whole terminal. So let's say from the office to people anywhere else. Is that your responsibility?
Translator: So you mean communication internal Terminal Teluk Lamong?
Joshua: yes, but I mean with IT, so not like communication by, you know either mail or cellphones or walkie talkies, anything like that.
Mr. Pegwai: communication in, maybe email for communication for data, phone for talking in around to operation, radio tracking. It is all digital, so all of talk in radio can to save in server.
Joshua: so everything is being recorded?
Mr. Pegwai: yes, in server
Joshua: And in case of an emergency the employees are also being informed by their radio's?
Translator: so there is a system, they make a system that can turn on the sirens. So they can turn on and turn off the siren just by the system. and it is connected to the quay safety. So even if it is not every people in here have the access, some have the responsibility they have the access. to turn on the warning.
Joshua: oke and then they will hear the sirens and then they'll know what is going on.
Translator: and then we say the public address, if you go up to the site, some part of this area have a big speaker so ICT can inform the other people around here. Even if they are not key, in the sea way or in the main office. They can inform every people in here. They can see the big speaker on the outside of the building.
Joshua: Oke, and has the IT-infrastructure on this terminal ever failed? Maybe because of a power outage like a black-out? Or I don't know any other errors, have it ever happened?
Translator: so you mean like?
Joshua: like that there was nog communication possible like maybe.
Translator: so your questions is how if the power is down?
Joshua: yeah, what happens then?
Mr. Pegwai: planning, if the power supply our energy electricity is down from PLN. I'm ready to number one is general server, we have general server
Translator: we have general server to if the electricity is black out
Mr. Pegwai: and then is pick up is UPS,
Translator: and then they have UPS, UPS is sub station three. So the first time is using the generator and is the generator is built we use the UPS.
Mr. Pegwai: and one more maybe LNG
Translator: as you can see that we are going to turn on the power plant. Maybe it it related to the energy. And then we have the back up data in here. Data back-up in here is two. We have two place in Indonesia, now two and we plan to make
Mr. Pegwai: maybe one beside cloud all data center,
Translator: oke, for now we have two data server in here two back up all of the data of the Terminal Teluk Lamong, which is in here in the main building, and the other one is in the workshop, so we have two data center. And then we plan to make a system, a new system, using cloud system, so all data in here back-up to cloud. And the other one is another data center not in here maybe we can use data center in Jakarta or another place in Indonesia. But it is still a plan.
Joshua: so the IT infrastructure has never failed here on the terminal?
Translator: no never failed

Joshua: Do you think the IT infrastructure on this terminal is vulnerable to the effects of climate change?
Translator: vulnerable, could you explain more vulnerable?
Joshua: ill use google translate to translate it.
Translator: no, no, no I can translate it myself with my phone, synonym maybe?
Joshua: prone maybe
Translator: So you mean that, could explain reply your question? I get vulnerable the meaning, but the question is?
Joshua: do you think that the IT infrastructure on the terminal is vulnerable to the effects of climate change? You already mentioned that you try to protect it with the IP-66 but maybe in the future when climate change becomes worse that it becomes, that the infrastructure becomes more vulnerable?
Translator: he said that yes, it may be vulnerable if the climate change is getting worse. So he said that we don't have any in here but if the climate change in the future. Yeah we have many in here. But if the climate change is getting worse in here.
Joshua: you just mentioned the two back up generator but could you mention any other measures that are being taken to make sure that the IT infrastructure is always being able to run.
Translator: despite of electricity?
Joshua: yes, despite of electricity
Translator: so he talks about the data security but he can't tell you all the detail because it is confidential. But he said that we already have the firewall for the internet access. So the data for transaction in here is safe.
Joshua: and do you also, because hacking for example is not a physical treat, do you also prepare for more physical threats? Are the servers for example located in safe places? That they are being located on places that are not prone to flood?
Translator: so you mean that in the infrastructure?
Joshua: yes, for the IT infrastructure.
Translator: oke, he said that, the server room in here and in the workshop tower, located in the middle of the building. So if the water level in here is rising like a flood it is safe, but if the heat of the sun is very extreme it is safe. But it is not maybe not extreme protection for the climate change. But we are trying to make it safe.
Joshua: well that actually is the first time that the aspect of it becoming hotter is being mentioned. So that's.
Translator: but just like I said before like we try to make a better center, so if there is a problem in here, lets say if the building is being destroyed the data is safe.
Joshua: and then my last question, is there like a contingency plan, so like a plan
Translator: contingency for what?
Joshua: for like when the communication fails, for some reason?
Mr. Pegwai: if our ICT fail, all ICT fail, maybe can do manual transaction. And this is maybe just.
Translator: so let's say the infrastructure in here fail, is totally down, so we use the manual system for a while while the IT team is trying to make the IT fix, the problem fix, we use the manual system. for temporary needs. But after that were staring it up.
Joshua: oke, that was it, those were my questions, thank you very much for your answers.

Appendix 11: Transcription of the meeting at Terminal Teluk on the 2nd of May 2016

Meeting with Ms. Faranita Dwi Hapsari, supporting facilities readiness in technic department.

Joshua: What is you name? and how long have you been working here?
Ms. Faranita Dwi Hapsari: my name is Faranita Dwi Hapsari I work here for about 2 years
Joshua: What is your job here at Terminal Teluk Lamong? What are you responsible for?
Ms. Faranita Dwi Hapsari: I'm workings as a supporting facilities readiness in technic department. Because my basic is about architecture. I used to study architect. So I help here for civil team about the the infrastructure especially like building, built something like that and connecting it with aesthetic something like that, and the design of the building something like that. But because our concern now is Terminal Teluk Lamong is green port so I want to connect it with green architecture which I already studied in my school, in ITS, I'm architect in ITS, study architect.
Joshua: so then your like responsible for the aesthetics of the buildings?
Ms. Faranita Dwi Hapsari: yes, but connect it the of course sustainability. Ill try to use the principal of green architecture ill try it even if from the simple thing. But ill try it one by one. Because if we do it into a big, maybe everybody cannot accept it. So I just try what I can do from small thing I hope it will give a big thing in the future.
Joshua: so like a stepping stone, and then in the future it will get bigger and bigger?
Ms. Faranita Dwi Hapsari: yes, because Terminal Teluk Lamong is still developing right
Joshua: yes exactly, and then infrastructure it is mostly like the building? Or are there also other facilities you could say?
Ms. Faranita Dwi Hapsari: about the facility especially about the building. We use for the act of our responsibility to the climate something like that we use, you already know it, we use ACP aluminum composite panel. Because it is about the corrosive, what is that?
Joshua: yeah I know what you mean.
Ms. Faranita Dwi Hapsari: yeah something like that so we use ACP and mostly we use glass. Because it will not contact with corrosion, it will survive I mean. We use material like that but, in the during these 3 years I see, it is oke. We use glass ACP mostly our building use this material, but were not talking about the reusable and recyclable material something like this. Like concrete when we don't use this building again you have to broke off this building and you water the material, even you can use something like steel. Even you built it when you're not using again you can still use the material for the next project.
Joshua: Could je describe your day to day activities like when you go to work what does a normal day at work for you look like?
Ms. Faranita Dwi Hapsari: mostly I work on the outside. Out there because we have to see what happens in the terminal maybe especially about infrastructure. Because my job is about infrastructure. To analyze for preventive action, preventive maintenance right, something like that. But mostly in outdoor, indoor maybe draw or discuss something making arrangement of cost about materials. But mostly I work in the outside.
Joshua: so you look about the current state of about a building and you see if it needs maintenance and then you make a plan r something?
Ms. Faranita Dwi Hapsari: yes, to make a plan maybe to repair there is a broke of something make a repair.
Joshua: and are you familiar with climate change?

Ms. Faranita Dwi Hapsari: familiar but what kind of climate change you want to know?
Joshua: no this is just climate change in general.
Ms. Faranita Dwi Hapsari: ooh in general oke. I thought that it has a decrease ya, about the, I mean what kind of climate change? Global warming something like that?
Joshua: yeah sure
Ms. Faranita Dwi Hapsari: it decreases ya, it already decreases. I mean bad environment something like that but in every country now has something like campaign to about sustainability.
Joshua: so that they are really trying to fight it to reduce it? Oke. And do you also know some of the effects of climate change. So like because of climate change what kind of impact can it have on the world. Can you maybe tell something about that? Do you know something about that?
Ms. Faranita Dwi Hapsari: about the climate change…
Joshua: so for example what I mentioned like sea level rise, increases in temperature, increase in storm duration and intensity.
Ms. Faranita Dwi Hapsari: yes of course sea leveling it will connect about the climate change. And then maybe, why is that. Especially in this terminal Teluk Lamong or for global?
Joshua: for the terminal, or in Surabaya is fine
Ms. Faranita Dwi Hapsari: getting hot in Surabaya, getting hot and hotter, I think you will feel it already.
Joshua: yes I'm not used to the heat so for me it is even worse.
Ms. Faranita Dwi Hapsari: have you got more black from your sun skin? Like tanning
Joshua: yeah definitely
Ms. Faranita Dwi Hapsari: only know about that
Joshua: How do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Ms. Faranita Dwi Hapsari: pardon me?
Joshua: How do you think climate change will effect the Terminal Teluk Lamong now and in the future?
Ms. Faranita Dwi Hapsari: of course it will effect ya, especially now from the start of we built this Terminal Teluk Lamong, what I know is about the design. About the infrastructure is caution to the climate change, I give you an example. Yeah of course it will give an effect for our port right, because we have an image like green port. So we are different from another port. If we concern about the climate change and we can give a solution maybe about the port business, the port crane, about the port building, about the port infrastructure, and everything that support the port and connect it with climate change. It will give the, I mean, give the something different with another port, something like that.
Joshua: and in your job do you have any dealings with climate change as far as you are concerned? Because you just mentioned like the green architecture
Ms. Faranita Dwi Hapsari: ya I have a deal, something like that. But what I said before I start it from the small thing. I already built the sub shelter bus, I said sub shelter, because there is a big main shelter and a sub shelter. And I already applied it to small shelter bus in the inside of the terminal. Like you seeing photo cell so you're not give an effort to turn off or turn on the light. It will off and on automatically because we use a sensor and we use material steel and glass. Because it will can use for another project, maybe if the building has to broke out.

Joshua: Do you think that climate change will affect your job in the future? So that maybe in the future you will have to more green architecture or maybe less? What do you think will it affect your job?
Ms. Faranita Dwi Hapsari: effect of my job is, for now, I try my best to to prove that green architecture it will have use for the port in the future. I will try a little form my department or maybe if I can show it to another department for the Terminal Teluk Lamong in the future I will use the green architecture. Because in my team I'm from architect and I have two friends which is from civil, they just civil engineer, they already just know if you want to built something you use some like iron and this material what you see now. But I tell them even beside we built the building we have to concern about what the building benefit in the future, connect it to the sustainability. I show them this is the principal of green architecture maybe from my partner team there is an electrical man too and there is installation man too. Concerned about water, I told them about green architecture. Like how you can use this principal like conserving energy like use it for electrical, and about working with climate. There is a principal from green architecture you can use it for your building, how you can build or design your building stable with the climate. Like here in Surabaya it is very hot, what kind of material you can use. It will comfortable but it will still save, small thing about it, more detail. But for me it will give a benefit in the future. Even if rom the small thing
Joshua: so you look maybe what kind of color that it likes reflect sunlight's, so that it is cooler inside, and maybe materials that you need less energy for air-conditioning. Things like that?
Ms. Faranita Dwi Hapsari: Yeah that's true
Joshua: Do you have any examples of how TTL is preparing itself for climate change and it is effect? And especially the effects of climate change. So how can you for example in your job keep the effects of climate change, like sea level rise or an increase in temperature, how does this effect your job? Do you also try to take that into account for example? Another example is the height of the wharf; it is two meter so that when there are waves they do not overtop the the roads.
Ms. Faranita Dwi Hapsari: but based on my job maybe I can not tell, I cannot give you the best answer because I'm not basic civil right. Because of the leveling of the sea it is about the civil construction. But what I can tell you there is the moving of the climate change, for Terminal Teluk Lamong we already built the like, what is that, this is the birth. Benteng what is that?
Joshua: ill translate it
Ms. Faranita Dwi Hapsari: ooh yaa, Google translate. Ooh do you know what it means?
Joshua: yes
Ms. Faranita Dwi Hapsari: we already built it in the bridge to birth, the place of the cranes.
Joshua: ooh yes, I see
Ms. Faranita Dwi Hapsari: what I know of the descend of our crane, as you can see to the respect for the, because the wind in Terminal Teluk Lamong is very strong, we already have 91 knots in here, it is very strong. And the design of the crane is connect with what happened in this. What climate happened in this terminal.
Joshua: So for example the wind speed?
Ms. Faranita Dwi Hapsari: yes the wind speed
Joshua: oke, so maybe this is not really about your, because your mostly about the buildings but have there been any problems related to infrastructure, which where maybe caused by the effects of climate change. So for example I know that two or three weeks ago the main

road over there was flooded because of the rain. But are there also things like on the terminal itself that affected the infrastructure because of the effects of climate change, and did you have any problems with this?
Ms. Faranita Dwi Hapsari: I didn't get what do you mean?
Joshua: for example, have there ever been any floodings on the terminal it self because of heavy rainfall?
Ms. Faranita Dwi Hapsari: ooh no no no, we never have any flooding's. We never have, maybe because the drainage system is already, has already think about that. Or as you can see the level of our Terminal Teluk Lamong is higher then the main road.
Joshua: oke so those are like, but those are also things you did because of climate change. So you have no effect of the sea level rise and also when it rains you are still able to continue the operations.
Ms. Faranita Dwi Hapsari: yes, like that
Joshua: so you just mentioned the drainage system, do you know anything more about it or just that it is here on the terminal
Ms. Faranita Dwi Hapsari: what do you mean?
Joshua: do you know anything about the drainage system could you maybe tell something about it like the capacity? It is no problem if you can't, but if you do…
Ms. Faranita Dwi Hapsari: what I know the general drainage system right. You make more a drainage system in the roads. It is general but for what I know for drainage system is maybe for port.
Joshua: do you know where does the water that enters the drainage system goes to?
Ms. Faranita Dwi Hapsari: yes, into the sea. We move it to the sea, but before we move it but depend on where the water from. I mean if the water from like the rain, we can directly throw it to the sea. But if from the like the waste, we make an oil trap, if you see sceptic tank is for human waste. And if for water waste we already built the oil trap. So we decrease the effect to the environment. So the water which is thrown to the sea is already cleaned.
Joshua: so there is no problem?
Ms. Faranita Dwi Hapsari: were not broke the ecosystem to the sea
Joshua: and you mentioned something what was it? The general drainage system and the height of the wharf.
Ms. Faranita Dwi Hapsari: the height?
Joshua: the height of which the wharf is built it is also something that you mentioned right? So like the height that it doesn't have any effect from waves or from storms?
Ms. Faranita Dwi Hapsari: ooh yes something like that
Joshua: do you think that what is is currently being done to tackle the effects of climate change that it is sufficient?
Ms. Faranita Dwi Hapsari: sufficient? What is sufficient?
Joshua: uhm, sufficient,
Ms. Faranita Dwi Hapsari: I already heard but I forgot, what is in Bahasa, ooh is it enough.
Joshua: is what is currently being done enough
Ms. Faranita Dwi Hapsari: what we have done now
Joshua: is it enough to fight the effects of climate change, so sea level rise, storms. Do you think they take this into account while making decisions and doing things?
Ms. Faranita Dwi Hapsari: I think we already have now is, for now it is enough, but we don't know for in the future right. So maybe we can analyze or to perfection for now. Maybe it like citation for us like

Joshua: and see if it is enough, so analyze it for the future and see if it is enough?
Ms. Faranita Dwi Hapsari: you do it alone? You do you thesis alone?
Joshua: yes
Ms. Faranita Dwi Hapsari: ooh I thought, that maybe you are in a team
Joshua: no different subject, because my friend is looking more into sustainability. Oke those were all of my questions.
Ms. Faranita Dwi Hapsari: do you already know about the…. I don't know I translate.
Joshua: ooh the tide
Ms. Faranita Dwi Hapsari: yes, the tide of the sea, we for the safe from the birth to the, what is that, the tide to the sea, we have a safety space about two meters. So you already know about this?
Joshua: yes but maybe if you can explain
Ms. Faranita Dwi Hapsari: oke yes,
Joshua: when the tide is on it is highest there is still 2meters
Ms. Faranita Dwi Hapsari: yes, we still have two meters for our safety. I think about the level sea I already know about that
Joshua: and this is really something that they took into account maybe because of sea level rise? So if there is like a storm so that the waves they don't come on the wharf?
Ms. Faranita Dwi Hapsari: yes, so you what is that, so you need a bit (bathymetry?)
Joshua: sorry what?
Ms. Faranita Dwi Hapsari: bathymetry is about the wharf
Joshua: my research is not really about the numbers and really specific materials, it is more about the general principles that they try to apply. So for example the height of the wharf is a good one. But it is hard to find out why and how they did it and with whom they decided this. Because most of the people here they just work here and they were not involved with the development of the terminal, so that's kind of difficult.
Ms. Faranita Dwi Hapsari: so you just the general one, what people can do,
Joshua: yeah what they do and what is being done I just try to conduct as many interviews to tell them to me and then I can work it out. Because there are like some general principles of resilience and then ill check the general principles and what they are doing here. And then if they match or don't match I can say like oke, good job, or maybe in the future you should do more.
Ms. Faranita Dwi Hapsari: so for the result you give a score something like that?
Joshua: yes, it is not like a score but it is written.
Ms. Faranita Dwi Hapsari: just to compare
Joshua: yes, it is quantitative so not qualitative. So it is not about the numbers more about the explanations, how and why those kind o things.
Ms. Faranita Dwi Hapsari: but during this interview you said about climate change is about rain and about the sea level and the storms. I think you will discuss it more deeply I mean.
Joshua: yeah but the thing is like not everybody knows about that. Because the main infrastructure at which I was looking are like telecommunication and IT, so I interviews a department head from IT, and also someone from infrastructure. Because for example the roads they are being built at a certain height. So when there is waves and rainfall the water can get away. Like what you said about the drainage is also a measure that you can incorporate for the climate change. So maybe it is not like all there but when you think of it, this is also a way to deal and cope with it. And these are like the things I need to find out.
Ms. Faranita Dwi Hapsari: ooh yes I see.