The Smart Port Concept of Batu Ampar Port in Batam

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Abstract. The fourth industrial revolution or industry 4.0 made a lot of research about plans, implementations, and other actions that will lead to sustainability. The concept of sustainability is meeting current demands without reducing the ability of future generations to meet their own needs. In the past few years everything has been smart about transforming manual data into digital data. This research was carried out with the concept of smart port development plan in Indonesia and Batu Ampar Port as a case in this study which is a free trade area and free port with the arrival of ships and a high volume of loading and unloading of goods. This research uses a descriptive approach by reviewing and analyzing some relevant literature as a source. It also examines the theoretical concepts of port development resulting from previous research. Smart port is basically supported by high efficiency digital technology, competitive added value for the surrounding community, automation, and ultimately the port will improve environmentally friendly aspects, increase safety and security standards, and increase productivity. The aim of this research was conducted to identify the current situations of Batu Ampar port and the possibility of applying the smart port concept. The results of the research from the three aspects studied showed the application of the smart port concept was suitable to be applied. Thus, the benefits of this research are expected to help Batam authorities (BP) to develop Batu Ampar Port.

1. Introduction
The maritime sector is one source of foreign exchange. The government issued Indonesian Maritime Policy about Presidential Regulation Number 16 of 2017 was adopted on February 23, 2017. This is a blueprint for achieving the goals of the global marine curriculum. It was stated that the Indonesian maritime economy no longer only focused on natural resources, but also developed it into port logistics. The Smart Port project aims to contribute sustainably by setting energy savings with new management based on low environmental impact and triggering technological innovation.

Batu Ampar Port is the largest loading and unloading port of three loading and unloading ports in Batam and the largest port used by companies to supply goods for industrial use. This port has an important role economic development in Batam City. Development of port facilities must lead to sustainable development in operational aspects, energy consumption, and the environment, these three aspects lead to smart ports.

Batu Ampar Port has a North dock about 970 meters long (650 m was built in 2015 and 300 m was built in 1991). East dock about 250 m long (built in 1978), South dock about 450 m long (built in 1991), Reclaimed land about 2 hectare and total area of land ready for container yard about 10 hectare.
located at the northern side of the port directly behind the old north dock. Depth of port is varied from 4 m to 13 m. This explanation can be seen in figure 2 below.

\[ \text{Figure 1. Map of goods port distribution in Batam} \quad \text{Source: Malik R (2019)} \]

\[ \text{Figure 2. Batu Ampar Container Port} \quad \text{Source: Batam Authority (BP) (2017)} \]

2. Methods of Research
This research uses a descriptive approach by reviewing and analyzing some relevant literature as a source. It also examines the theoretical concepts of port development resulting from previous research. Previous researchers explained the importance of the role of ports was mentioned by Cintia et al. (2017) The port has an important role in building a strong maritime area to stimulate economic growth, such as industry, trade, tourism, and as a means to increase state revenues. Zhang L (2018) Ports are important infrastructure for the national economy and regional development. The construction of the port has grown rapidly, but it also creates more serious environmental problems. The same opinion was conveyed by Akgul (2019) port development based on policies and procedures applied during construction, port operations must consider environmental aspects that have developed in accordance with global trend needs.

The port is closely related to economy and management factors as stated by Andriani (2019) the marine transportation around 88% of transportation in Indonesia. This situation shows important marine transportation policies and management. Marissa (2019) the Indonesian government has implemented a marine infrastructure development program with the concept of maritime logistics to connect the major ports of the archipelago.

This study aims specifically to analyze the port development strategy under Batam Authority (BP) with a case study of the Batu Ampar Port using the concept of a smart port. There are two parts discussed and analyzed in this research, the first part explains the current situation of Batu Ampar Port from three aspects, which are operational aspects, energy consumption, and environment. The second part discusses the theoretical concepts and models of port development. This part discusses the port development plan and previous findings that are used to compare theories and models with the actual conditions of Batu Ampar Port that lead to the concept of a smart port.

3. Current Situation of Batu Ampar Port
Batam City is located around the international route of the Malacca Strait and is directly adjacent to Singapore. Therefore the port of Batu Ampar was included in the national port master plan. Based on data from the Batam City statistical center in 2018, the value of export and import of Batu Ampar Port is the largest in Batam City can be seen as tables 1 and 2.
Table 1. Export via Batam according to port

| Num | Port               | Volume (kg)      | Value (US$)       |
|-----|--------------------|------------------|-------------------|
| 1   | Batu Ampar         | 812,607.104,41   | 3,438,705.821,29  |
| 2   | Belakang Padang    | 3,856,454,000,00 | 1,208,167,529,68  |
| 3   | Kabil              | 2,014,554,869,11 | 1,772,009,805,19  |
| 4   | Pulau Sambu        | 6,714,253,00     | 11,725,110,09     |
| 5   | Sekupang           | 511,029,482,65   | 2,095,007,610,65  |
| 6   | Bandara Hang Nadim | 1,315,727,11     | 183,081,232,26    |

Source: batam city statistics center, 2018

Table 2. Import via Batam according to port

| Num | Port               | Volume (kg)      | Value (US$)       |
|-----|--------------------|------------------|-------------------|
| 1   | Batu Ampar         | 1,297,892,341,00 | 3,406,578,274,00  |
| 2   | Belakang Padang    | 330,000,00       | 13,200,000,00     |
| 3   | Kabil              | 329,465,321,00   | 285,466,889,00    |
| 4   | Pulau Sambu        | 265,681,000,00   | 229,997,725,00    |
| 5   | Sekupang           | 409,316,871,00   | 2,125,489,383,00  |
| 6   | Bandara Hang Nadim | 1,074,244,00     | 401,091,989,00    |

Source: batam city statistics center, 2018

Based on the export-import table above, it can be seen the role of Batu Ampar Port is the most important in the economy of Batam City caused by export-oriented industries, most of them use sea transportation routes through Batu Ampar. Port development is not supported by sustainable port infrastructure, especially in operational aspects, energy consumption, and the environment. The smart port concept studied in the research contains/has/includes three big groups of issues.

3.1. Operations

In terms of operations, dock services in Batu Ampar port are not optimal. This resulted in ship queues caused by ship arrivals and high volumes of loading and unloading. The loading and unloading and container storage capacity at Batu Ampar port does not meet the standards of the Minister of Transportation Decree KM 53 of 2002. Other problems related to the port boundary with the surrounding area are still unclear resulting in loading and unloading vehicles that want to enter the port have unclear and ineffective routes. The container terminal area, east dock and south dock are not equipped with container lines and adequate warehouse lines. The current zoning function in the container terminal area is incompatible with loading and unloading containers. Logistical costs are expensive because the crane operating system in Batu Ampar Port is inadequate.

Research on the Batu Ampar port has been carried out by Cintia et al. (2017) explained the SWOT analysis results obtained a strategy to maximize the potential by improving the performance of port services. In addition, to face the problem it is necessary to optimize the port by operationalizing the northern container terminal that has not functioned and improving the productivity of loading and unloading equipment. In multipurpose terminal from 2016 until 2019, it is necessary to improve the performance of loading and unloading services with the addition of equipment that is 1 unit of mobile crane, and at container terminal of north pier needs addition of loading and unloading equipment that is 2 unit container crane and 1 unit of RTG.
The research was conducted by Anggraini et al. (2015) [4] explaining the existence of a private company warehouse located around the port area and unclear port node boundaries causes inefficient circulation of goods. In Figure 6 illustrates the circulation of goods loaded (straight red line) and unloaded goods (red dotted line) violates the rules because it enters the port area freely without passing customs checks at node 1 and partially passes through the container scanner area.

3.2. Energy consumption

Energy related port activities as a result of increasing energy relevance, environmental awareness and energy efficiency-focused industries by Acciaro et al. (2014) [1]. Important elements to consider in energy consumption are competitiveness of infrastructure services, port performance, and the sustainability of transportation and logistics for port infrastructure and service performance Cianam (2013) [6].
In the port of Batu Ampar energy is not too significant because the port's main activity is loading and unloading, such as for energy related to the use of towers, containers, and trailers entering and exiting locations. The energy needed is for boats parked using fuel oil. Indonesian port company III (Pelindo) has tried to save energy as evidenced by installing a shore connection for ships that lean on ports. Shore connection trials are implemented in Tanjung Perak port for container ships and non-container vessels in Semarang.

The benefits of exchanging fuel oil to electricity are saving fuel refueling time at the port, increasing the efficiency of loading and unloading at the terminal, and increasing transportation capacity. The use of electricity as a driving force for loading and unloading equipment will reduce carbon gas emissions originating from port activities, and consideration of aspects of Occupational Health and Safety.

3.3. Environment.

The environmental impact caused by port activities in this research leads to the quality of life of people living around the port area. Research conducted by Malik R (2019) [10] about The Quality of Life in Batu Ampar District Area. In the review of the nine indicators it consists of the level of security, health level, education level, economic level, noise level, pollution level, congestion level, green area level and property price level. Significant factors affecting quality of life are noise level, pollution level, green area level and property price level.

The noise level in the research area complained by residents is the sound of motorized vehicles passing through residential areas and many vegetable trucks passing at high speed and also the sound of truck cars heading to the harbor from industries around the port. Regulations and supervision of the government and port authorities are needed in limiting vehicles which cause interference to the local population because the noise level in the study area exceeds reasonable limits in Batu Merah sub-district by 78%, as shown in the figure 7 below.

The level of pollution in the research area exceeds the normal level based on the results of responses of respondents in the questionnaire that stated pollution in their area in sub-district of Batu Merah with a percentage of 74% as shown in the figure 8 below. Pollution that occurs is caused by dust and smoke from motorized vehicles that cross the road to industrial estates and settlements.

For the green area level in the research area, the level of green open space is not good based on the results of respondents and monitoring in the field there is no green open space used to maintain air quality. This can be seen from the respondents answers in the questionnaire, Batu Merah sub-district, about 90% said it was not good.

For the level of property prices or selling prices of houses in poor condition in Batu Merah sub-district with respondents answers of 52% said it was not good. based on the analysis of researchers because prices are uneven and difficult to compete with other house prices in Batam City.
4. The Smart Port Concept

The smart port concept described in this research is based on a concept developed by Indonesian port company II (Persero) and the Bandung Institute of Technology regarding the development of Indonesian port infrastructure. This concept has begun to be applied at Tanjung Priok Port, one of the largest and busiest ports in Indonesia.
Indonesia as a global maritime axis makes developing large-scale ports integrated with industrial estates. Some of the priorities determined by the government are reducing logistics costs, increasing supply chain certainty, increasing employment opportunities, increasing investment attractiveness for the private sector, and encouraging regional economic growth. Terminal capacity, infrastructure and equipment are the basis for reducing logistics costs. To achieve the government’s goal of developing large-scale ports integrated with industrial estates through Indonesia needs to increase port capacity and productivity, developing ports integrated with industries such as agribusiness and energy, port integration and industry opened the field on a large scale, implement a landlord port model to attract private investment.

The integration trend has succeeded in increasing service efficiency by 33-50% in world ports. Elements and services in the integration of ports and industrial estates are port operation as a logistics gateway both regionally and between countries, provide one-stop shop for all port activities, provide operational facilities for container and non-container terminals. Industrial area as a place of pre-departure / post arrival activity center, provide strategic locations and management of support activities for the industry. Distributions as management freight forwarding services for further cargo distribution. Warehousing provide buffer zones as temporary storage, flexibility to provide special storage, and provide a more efficient loading and unloading process.
This research is based on the plan of the batam authority (BP) to develop Batu Ampar Port. Batu Ampar Port must be developed as an adequate loading and unloading port because it is located on an international shipping lane. Batam Authorithies (2017) operation scheme the port will be offered to investor under a joint, period of the concession is between 30-50 years because existing South dock is already operating for the past 30 years and has been generating revenues, BIFZA will require the choosen investor to pay annual rent to compensate for loss of income due to the transfer of the operation from BIFZA to investor.
Investor is expected to invest the construction of the North dock extension of 300 m, expansion of existing container yard by another 20 hectare and construction additional dock on the south side if the volume warranted, deepened the port to a depth of around 13 m, and install relevant and required equipments and systems to support an efficient modern and dependable container handling and general port operation with a capacity to handle 30 boxes of container per hour.

![Batu Ampar Port Expansion Plan](image)

**Figure 15. Batu Ampar Port Expansion Plan**

5. Conclusion
The concept of smart port is the solution to the problem at Batu Ampar port, especially in the aspects of operation, energy consumption and the environment. Smart port is basically supported by high-efficiency digital technology, competitive added value for the surrounding community, automation, and ultimately the port will improve environmentally friendly aspects, increase safety and security standards, and increase productivity. The impact of this research in the field of civil engineering is the application of the concept of sustainability transportation.

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References
[1] Acciaro M, Vaneslander T, Sys C, Ferrari C, Roumboustos A, Giuliano G, Siu Lee Lam J, Kapros S 2013 Innovative Green Ports: A Framework for the Success of Innovation in Ports in the Area of Sustainability, *The International Association of Maritime Economics (IAME) Annual Conference*, 3-5 July, Marseille.
[2] Akgul B 2017 Green Port/Eco Port Project-Applications and Procedures in Turkey *IOP Conf. Ser.: Earth Environ. Sci.* 95 042063
[3] Andriani DP, Novianti VD, Adnandy R, A’yunin Q 2019 Quantitative Risk Modelling of
Occupational Safety in Green Port IOP Conf. Series: Materials Science and Engineering 546 052007

[4] Anggraini D, Ramdlani S, Pamungkas ST 2015 Spatial Pattern of Batu Ampar Port, Batam Department of Architecture, Faculty of Engineering, Brawijaya University Malang arsitektur.studentjournal vol.3 No.4

[5] BP Batam 2017 Infrastructure Development in Batam Indonesia Infrastructure investment Forum Seoul [In Indonesian]

[6] CIANAM 2014 Câmara Interamericana de Asociaciones Nacionales de Agentes Marítimos

[7] Cintia E, Purvanto PB, Hargono S, Salamun 2017 Study Of Batu Ampar Port Batam Service Department of Civil Engineering, Faculty of Engineering, Diponegoro University Semarang Civil Engineering JournalVol.6 No.4 pp 50-63 Consumption and energy efficiency in ports of Latin America. Newsletter No 4. XI Annual Meeting

[8] IAT, UCA, ICCS, PROMETNI, TICASS 2014 Action Plan towards the SMART PORT concept in the Mediterranean Area International Journal of Integrated Supply

[9] IPC 2017 Indonesian Port Infrastructure Development Bandung Institute of Technology [In Indonesian]

[10] Malik R 2019 Community Environmental Quality of Batam City Batu Ampar Port Area Department of Architecture and Planning Gadjah Mada University Yogyakarta.

[11] Marissa Y, Iqbal MM, Juliantina I 2019 Analyze of Tanjung Api-Api Ferry Port Service Performance South Sumatera, Indonesia IOP Conf.Series: Journal of Physics 1198 082002

[12] Zhang L, Zhao J, Shou Y, Wang N, Qiao1 J, Tian M 2018 The construction strategy and measures for ecological analysis of China's ports IOP Conf. Series: Earth and Environmental Science 133 012027