International Journal of ASRO
Volume 11, Number 04, pp. 61-68
Des 2020

THE IMPORTANCE AND UTILIZATION OF BIG DATA FOR INDONESIAN MARITIME INFORMATION

Zainul Hidayah.

Marine Science Study Program, Faculty of Agriculture, Trunojoyo University of Madura
Email: zainulhidayah@trunojoyo.ac.id

ABSTRACT

Sea transportation mode is still the favourite in the business world because of its high carrying capacity (capacity) and more competitive costs compared to other modes of transportation. As a country that has a vast marine area, Indonesia certainly has many problems related to its marine area. Indonesia faces various potential trans-national crimes that usually occur at sea such as illegal fishing, smuggling of goods, drugs and human, terrorism and piracy. Based on the complex conditions of the potential problems that arise in the maritime sector, all stakeholders and law enforcement officers at sea need integrated maritime information management to support their duties in maintaining security in Indonesia's waters. Therefore, it is hoped that the use big data of maritime information will be able to help stake holders involved in overcoming these problems.

Keywords : big data analysis, sea transportation, maritime information; Indonesian water

1. INTRODUCTION

Indonesia is the largest archipelagic country in the world with a coastline of more than 81,000 km consisting of 17,499 islands and a sea area of approximately 5.9 million km^2. This composition show means that 2/3 of Indonesia's territory is marine waters. Based on its astronomical location, Indonesia is located at a latitude of 6 ° N - 11 ° S and a longitude of 95 ° E - 141 ° E. With this position, Indonesia is located on the equator so that it has a tropical climate. According to its geographic location, Indonesia is flanked by two continents, namely Asia and Australia, and between two oceans, namely the Indian Ocean and the Pacific Ocean. This geographical location is strategic because these natural conditions also influence the life of the Indonesian people in shaping the maritime spirit of society. Based on astronomical and geographic conditions, Indonesian waters store natural resources, including the potential for marine energy derived from the energy of ocean currents, waves, tides, and winds. The condition of Indonesia's territory is both an opportunity and a challenge for this country.

According to Dong (2015), the marine transportation mode is still the favorite of the business world because of its high carrying capacity and competitive costs compared to other modes of transportation. Rodrigue (2013) compared the transport capacity between land, sea, and air transportation modes with truck capacity as a comparison standard. This comparison shows that the carrying capacity of sea transportation is much greater than other modes of transportation. Indonesia's maritime network is far more advanced than air, with nearly 90% of international trade conducted at sea (Dijk et al, 2015).

Due to business economic factors, Indonesian waters have become very congested by ship traffic. Moreover, of the 9 choke points owned by the world, four of them are in Indonesia as an international shipping route, namely the Malacca Strait, Makassar Strait, Sunda Strait, and Lombok Strait. Such conditions make the condition of Indonesian waters crowded with ships from Indonesia and other ships passing by. The density and activity of vessels crossing Indonesian waters can be seen in Figure 1 and Figure 2, which show the hectic activity of loading and unloading ships at Indonesian ports. In addition, Table 1 shows the intensity of visits by domestic and foreign ships to Indonesian ports.

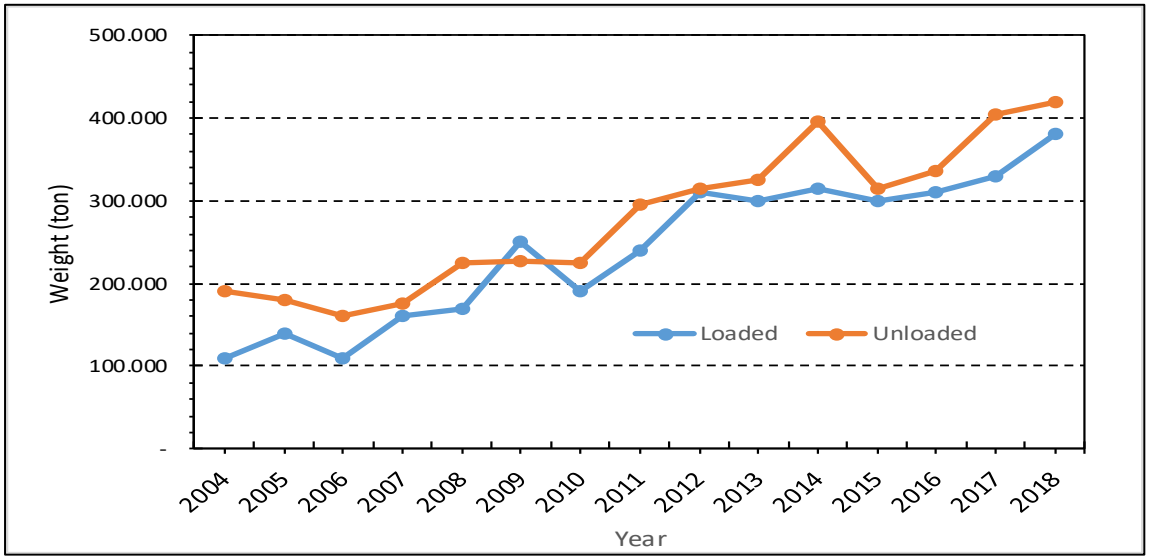

Figure 1. Domestic Shipping Loading and Unloading Statistics
at the Port of Indonesia 2004-2018 (000 tonnes)
(Source: Maritime Transportation Statistics Agency, 2018)

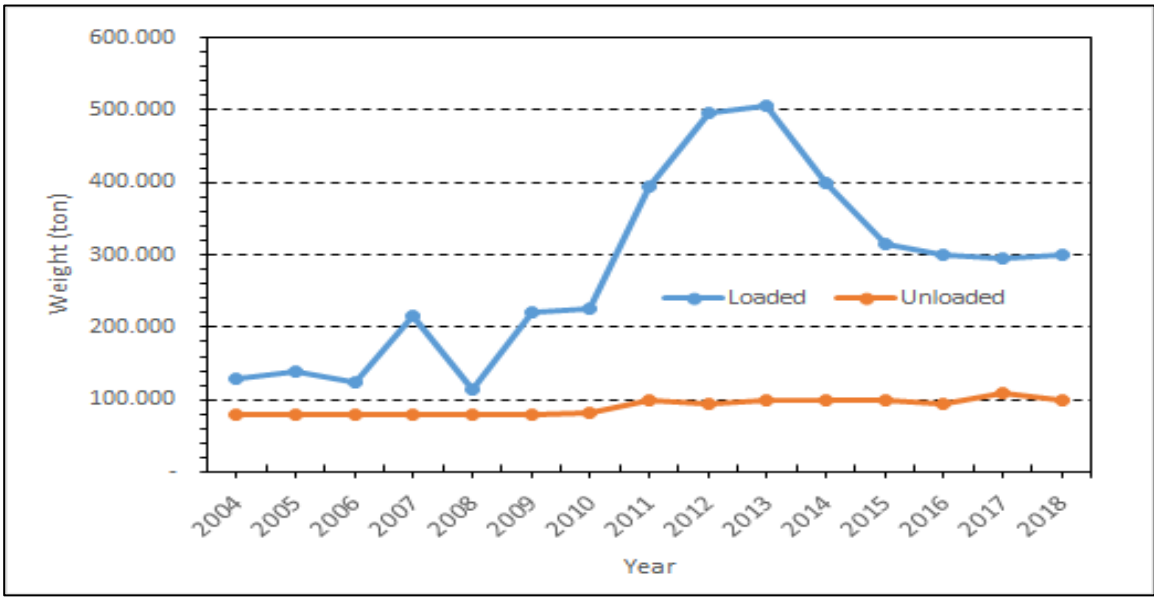

Figure 2. International Shipping Loading and Unloading Statistics
at the Port of Indonesia 2004-2018 (000 tonnes)
(Source: Maritime Transportation Statistics Agency, 2018)

In the 1982 Convention on the Law of the Sea (UNCLOS, 1982), some rules stipulate that a country can carry out cross-border activities peacefully in certain territorial waters in other countries. In the 1982 Convention on the Law of the Sea, Article 19 paragraph (1) explains the meaning of cross-peace, namely: “Transition is peaceful as long as it does not harm the peace, order or security of the coast. Country. Such passage shall be made under the provisions of this convention and other rules of international law. This article affirms that every ship of the coastal state has the right or not to cross the territorial sea of another country as long as it does not prejudice the peace, order, or security of the coastal state. With this regulation, Indonesia as a coastal country must be able to guarantee the security and safety of foreign shipping in its activities of carrying out crossings peacefully.

As a maritime country and with large sea area, of course, Indonesia has many problems related to its territorial waters. Indonesia faces various potential trans-national crimes that commonly occur at sea such as illegal fishing, smuggling of goods, drug smuggling, human trafficking, terrorism, and piracy.

Table 1. Domestic and Foreign Ship Visit Statistics Data at Indonesia's Ports 2017-2018

No	Province	Ports	Unit		GT (000)	
			2017	2018	2017	2018
1	Aceh	Lhokseumawe	450	397	3.400	3.492
2	North Sumatera	Belawan	3.539	3.780	24.458	22.488
3	West Sumatera	Teluk Bayur	2.024	1.781	12.562	12.434
4	Riau	Dumai	4.240	4.980	32.999	39.346
		Pekanbaru	20.047	25.808	14.349	15.610
5	South Sumatera	Palembang	3.790	4.142	6.727	8.019
6	Lampung	Panjang	2.393	4.990	25.229	36.683
7	Riau Islands	Tanjung Pinang	19.360	20.962	3.799	3.694
		Batam	82.167	71.629	28.570	31.318
8	DKI Jakarta	Tanjung Priok	14.256	15.284	140.604	160.558
9	Central Java	Tanjung Emas	5.316	3.917	33.473	28.953
10	East Java	Tanjung Perak	12.622	12.627	94.309	103.503
11	Banten	Banten	9.423	9.501	60.465	61.493
12	Bali	Benoa	4.093	2.428	5.291	6.021
13	East Nusa Tenggara	Tenau	1.882	1.967	3.279	3.243
14	West Kalimantan	Pontianak	2.026	2.199	4.766	5.761
15	South Kalimantan	Banjarmasin	23.168	20.957	90.705	89.804
16	East Kalimantan	Balikpapan	5.100	5.377	44.333	42.060
		Samarinda	12.650	13.871	48.080	66.750
17	North Sulawesi	Bitung	2.990	2.888	13.579	10.642
18	South Sulawesi	Makasar	5.390	5.088	33.927	34.232
19	Maluku	Ambon	3.534	3.323	13.569	17.124
20	West Papua	Sorong	1.649	1.259	9.491	5.464
21	Papua	Jayapura	634	486	5.524	4.432
		Biak	897	684	2.998	2.743
Total			**243.640**	**240.325**	**756.486**	**815.867**

Source: Maritime Transportation Statistics Agency, 2018

To monitor this vast marine area against criminal activities, Indonesia has seven law enforcement agencies that have a marine patrol task force. These law enforcement agencies include the Indonesian Navy (TNI-AL), Police-Directorate of Marine Police; Ministry of Transportation-Directorate General of Sea Transportation; Marine and Fisheries Ministry; Ministry of Finance-Director General of Customs and Excise; Maritime Security Agency, and the Task Force to Eradicate Illegal Fishing. The seven law enforcers routinely conduct security patrols at sea in a sectoral manner under their respective authorities. Based on the complex conditions and potential problems that arise in the maritime sector, all stakeholders and law enforcement officers at sea need maritime information management to support their duties in maintaining the security of Indonesia's marine areas.

2. SOURCES AND TYPES OF MARITIME INFORMATION

Digital information technology continues to develop, especially to address the needs of the maritime sector. This is one of the main keys to effectiveness and efficiency in the management of the maritime sector. Several government agencies have duties and functions as providers of maritime information. Besides, information on Indonesian waters can also be obtained from various international institutions, both government and private. These international institutions such as International Maritime Organization (IMO), International Maritime Bureau (IMB), Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP). Other maritime information can also come from private services such as Automatic

Identification System (AIS) and Maritime Mobile Service Identity (MMSI).

The maritime information required for navigation, fisheries and sea transportation is of various types. This information is useful for all stakeholders engaged in the marine sector in carrying out their activities, for example determining navigation, routes, safety, port location, loading and unloading times, and so on. In the context of advances in information technology related to maritime affairs, the availability of data and information is very important, especially in terms of quality, quantity, availability, and speed of access. This is very relevant to the concept of Big Data Integration in the maritime sector. As for the types of information that have a significant influence in the maritime context in general, namely:

- Climate and weather information
- Fishing ground area
- Oil and gas potential information
- Information on Hydro-Oceanography (currents, tides, velocities, wave heights, sedimentation etc.)
- Information on commercial and shipping vessels
- Port information and facilities
- Tourism information
- Information on potential crime at sea (*illegal logging, illegal fishing* etc)
- Information on the potential of encroachment on territorial boundaries
- Information on potential accidents at sea
- Information on pollution at sea
- Information on *disaster*/natural disasters

3. A CONCEPTUAL APPROACH OF BIG DATA

A group of data is categorized as "Big Data" not only because of its size. According to Gartner (2012), big data is data with high volume, high speed, and high variation of information. In general, according to Chen et.al (2014) and Jou (2014) big data can be defined as a collection of data that is very large (volume), fast-changing / growing (velocity), comes in various forms/formats (variety), and has a certain value (value), provided that it comes from an accurate source (veracity). The main thing that distinguishes big data from conventional data sets lies in the management mechanism (Toba, 2015). Several characteristics differentiate Big Data from other systems (Zaman, et.al, 2017). Big Data systems have a very large volume of data, which usually exceeds ordinary servers in general and this data will continue to grow every day. Data sizes can reach more than

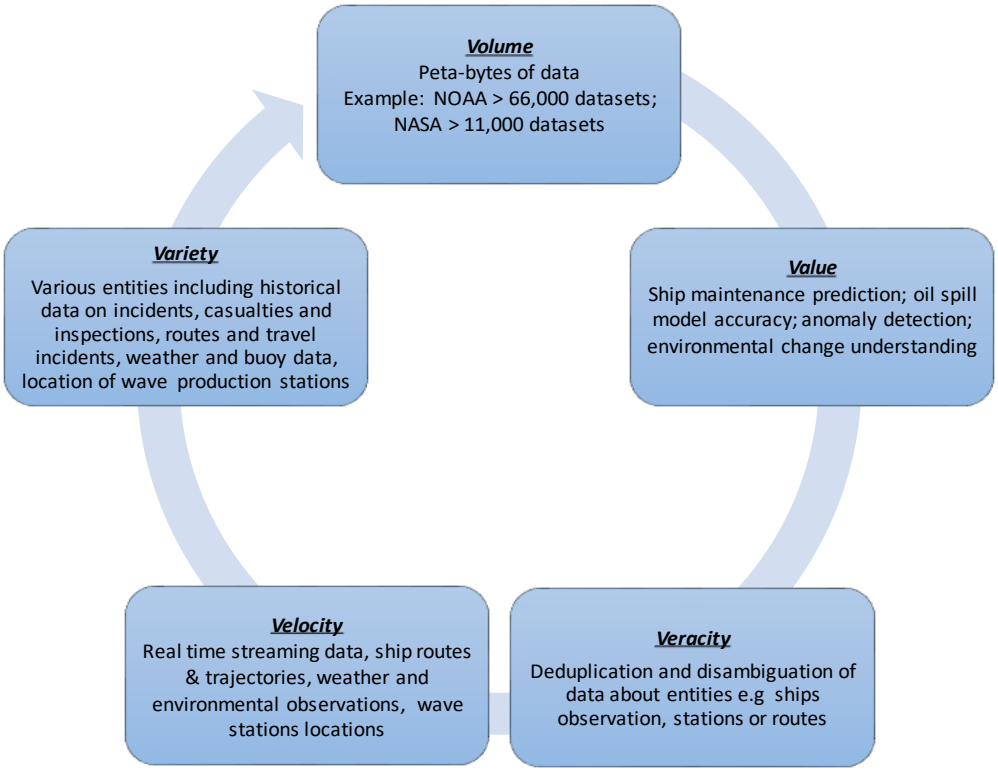

Figure 3. Big Data : Maritime Dimension Concept (Lytra, 2017)

100 TB and are usually stored on external infrastructure (not maintained).

Besides, Big Data also has various kinds of data (variety), with very diverse data formats and types, so it requires a special process to be able to process it. Big Data must also be able to process its data in a very fast time (velocity) so that data can be useful not only because of the information it produces but also because of the speed required to process it into that information. The next characteristic of Big Data is the correctness of the data (veracity). To ensure that information is useful and reliable, the data sources or the providers is need to be carefully inspected. Therefore, the validity of the data must be considered. Furthermore, the five characteristics of big data value, which means that big data is very valuable (Maryanto, 2017). The 5V concept of big data dimensions especially in the maritime sector is shown in Figure 3 above.

Several types of data related to the maritime sector that adequately fulfill the characteristics of Big Data include:

a. Ship Platform Data

Platform data data is basicaly data of the form of ship, hardware or software that supports ship operations. In principle, paltform data can be in the form of ship technical data, ship capabilities, and supporting software owned by the ship. With this data, it will provide information to stakeholders who need it to secure the water area and ensure the safety of the ship itself.

b. Weather Data

Weather information for shipping is very much needed in the shipping world, whether it is when it is about to sail, dock or when making a voyage. In general, information about the weather elements needed for a voyage is rain, wind conditions, visibility, and wave height. Weather information needed for a ship trip includes rain intensity, direction, and speed, wave height both average wave height and highest wave height, tropical storm information, and visibility. Bad weather is very feared in the shipping world because of the result it causes, namely the occurrence of various accidents in the middle of the sea which will eventually cause many casualties. Therefore, weather data is very important in the maritime world.

c. Traffic Condition Data

Dense shipping traffic conditions have the risk of causing accidents at sea. The flow in and out of ships is faced with a situation of a narrow shipping channel, of course, the potential for ship collision accidents. Therefore, data regarding shipping traffic conditions is very important to determine the density of shipping traffic so that interested parties can regulate existing shipping traffic. Several applications of the application of Big Data Analytics in the maritime sector currently have integrated the three variables above and have been applied in real terms in the field, but their utilization is still partial and has not been integrated nationally with other maritime data which has a significant effect.

d. National Integrated Ships Monitoring Tool

Currently, many vessels do not have permits to enter Indonesian territory and are engaged in illegal fishing. The contributing factor is due to the absence of an information and communication technology system that can monitor the presence of vessels carrying out illegal fishing. This is overcome by the existence of the Intelligent Maritime Transportation System (IMTS) which can track the whereabouts of illegal vessels.

e. Automatic Identification System

Based on 2009 data, there were 293 accidents in Indonesian seas, and some of them were related to existing facilities and underwater pipelines. The International Maritime Organization (IMO) states an obligation to use Automation Identification System (AIS) which functions as an automatic tracking system to avoid ship collisions.

4. BIG DATA INTEGRATION

The management of diverse data in a very large amount requires an effective way to process it. Especially if the generated information is needed to assist decision making for policymakers. It takes a fast and precise way to be able to process data into information. In implementing Big Data purposes, 4 important elements become challenges, namely data, technology, processes, and human resources (Aryasa, 2015).

According to Emyana (2016), the source of Big Data, information can be structured and unstructured data. Structured data has predefined data types, formats, and structures. Data can be transactional data, OLAP data, traditional RDBMS, CSV files, simple spreadsheets. Meanwhile, unstructured data is textual data with an erratic format or does not have an inherent structure, so it requires more efforts, tools, and time to make it. This data is generated by internet applications, such as URL log data, social media, email, blogs, video, audio, and semantic data. Information processing that comes from big data can be done using paid or open source software. In general, Big Data architecture consists of data acquisition, data pre-processing, data curation, data storage, and data usage.

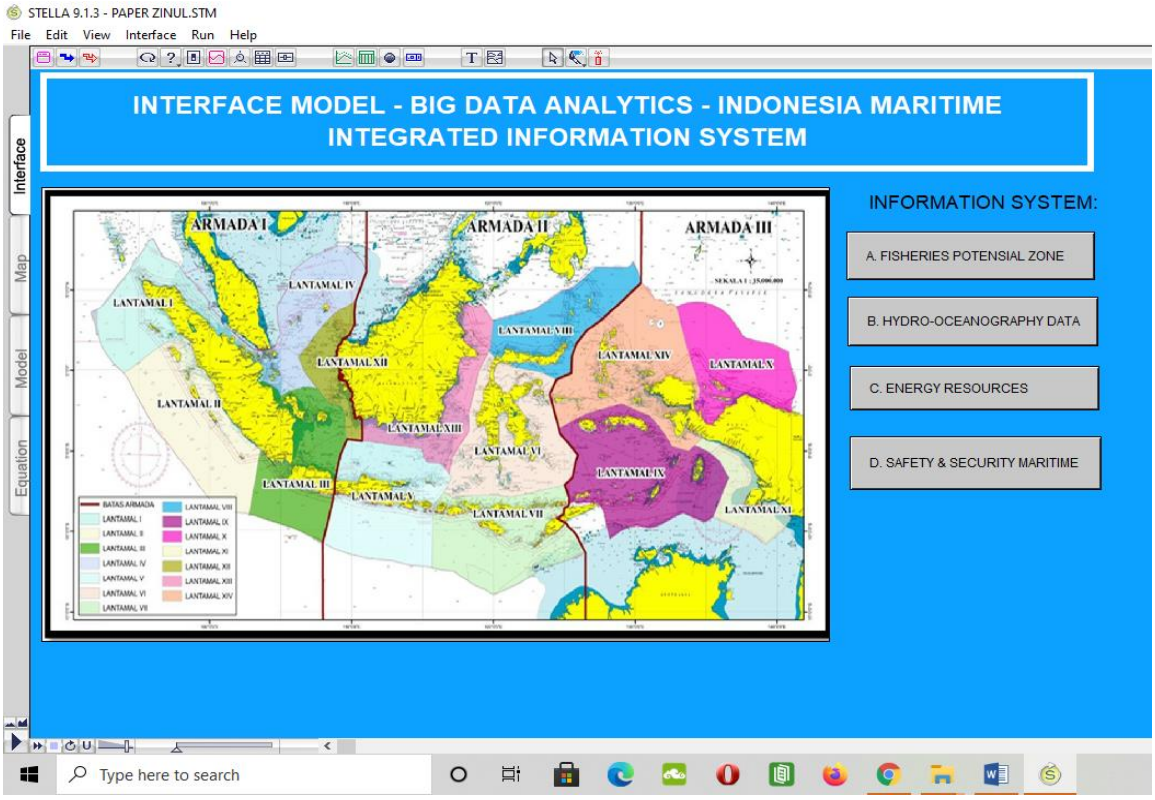

Figure 4. Example of Big Data Integration Interface : Author's Concept

The integration of Big Data between government agencies related to the marine sector can have a significant positive impact. By sharing various maritime information, government officials can support each other in carrying out their duties to maintain security and safety in Indonesia's marine areas. Data integration concepts that can be carried out include shared algorithms, interfaces for all detection systems used by all government agencies, and synchronization of information and communication systems for maritime stakeholders (Mirovic et al, 2018).

a. Shared Algorithm

The algorithm is a special method that consists of a series of steps that are arranged and written mathematically to solve a problem with the help of a computer. Collaborative use of big data requires algorithms that can easily integrate data obtained from various sources to produce the required information. The need for the application of this shared algorithm aims to bridge the authorities, responsibilities, and interests of stakeholders so that maritime activities can run in an integrated and sustainable manner without causing overlapping policies or conflicting regulations.

b. Integration of Detection Systems

Data exchange between stakeholders is crucial for the integrity of data information. Therefore, the suitability of the interface of all detection systems owned by government agencies needs to be developed in the maritime sector. Other government sectors that have used this system include e-government which is implemented under the coordination of the Ministry of Communication and Information Technology. The management of data integration and exchange has been implemented by the relevant ministries, which is useful for bridging data exchange between government agencies even though they have different databases, applications, and operating systems. The application can function as GSB (Government Service Bus) and Web-API (Application Programming Interface).

GSB is a system that manages information integration and data exchange between government agencies. GSB is able to synergize information from several Web-API (Application Programming Interface). Web-API can be viewed as a medium for Information Systems Interoperability. Looking at from the success of e-government in other sectors, it opens up ideas about the application of interfaces between maritime stakeholders, which is possible for the success of the maritime sector's Big Data integration (Nita and Mihaelescu, 2017).

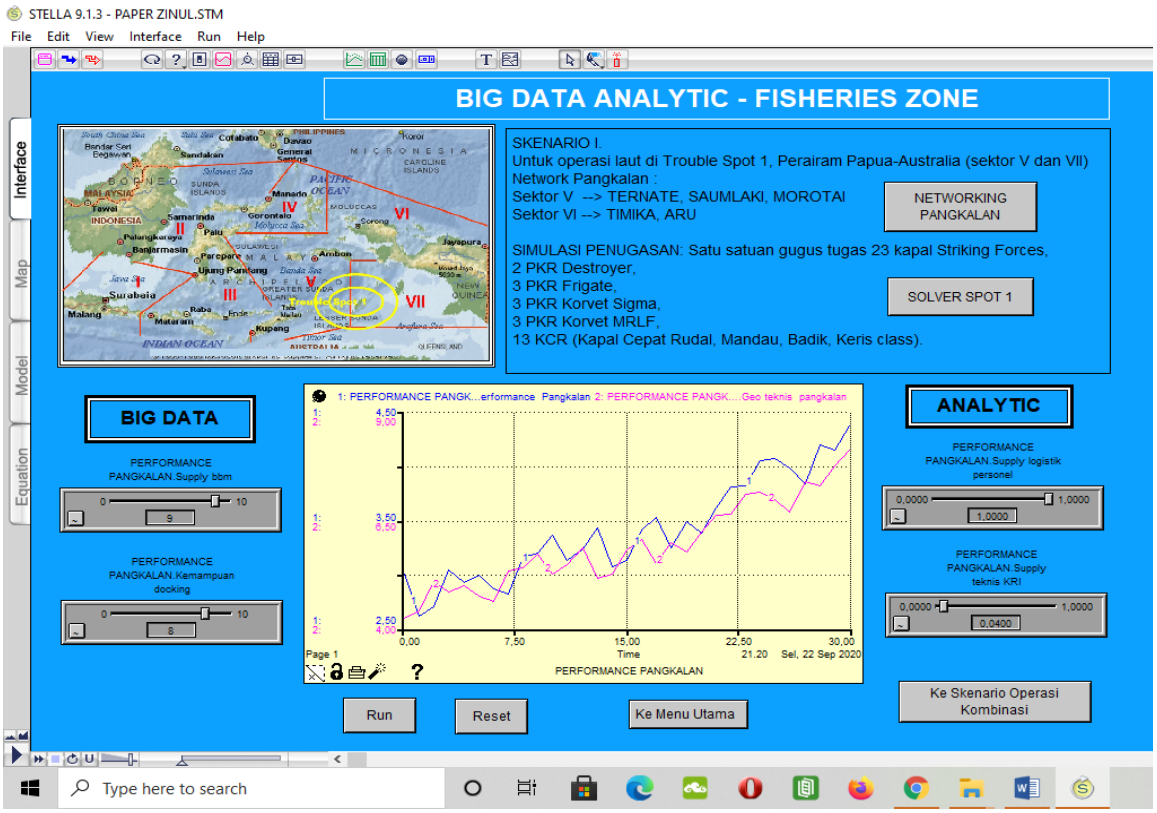

Figure 5. Example of Big Data Simulation to Determine Fishing Ground

c. Synchronization of Communication Systems.

Furthermore, another system that needs to be developed is integration in communication systems. With integration of the communication system includes channels, frequencies, and communication lines, it is possible to establish more advance cooperation so that the integrity of Big Data can be supported to create a fully function monitoring system of Indonesia's maritime area.

5. CONCLUSIONS

Based this study, the following conclusions are obtained :

a. The use of Big Data, especially in the maritime sector, is an urgent need that should be implemented in the near future. The rapid development of information technology and the fast interoperability of the use of Big Data will provide benefits for making decisions correctly and accurately.
b. The use of Big Data analysis for the Maritime sector can support Indonesia's vision as a World Maritime Axis because it will create maritime security, maintain sea transportation security, increase economic growth, create maritime connectivity between its components, increase bilateral cooperation and maritime diplomacy
c. Synergy and collaboration between government agencies, the private sector both from within and outside the country in the use of Big Data must always be maintained. The nature of Big Data that covers a wide area makes its use not limited to territorial areas only, but includes regions

ACKNOWLEDGEMENT

The author greatly acknowledge the support from Defense University Maritime Science Study Program for providing the necessary resources to carry out this research work. The authors are also grateful to Indonesian Naval Technology College, STTAL Surabaya and the anonymous reviewers and journal editorial board for their many insightful comments, which have significantly improved this article.

REFERENCES

Alamsyah, A. (2015). (Big) Data Analytics for Economics, Business and Management: A Social Network Approach. In Big Data Workshop of Aptika and IKP Research and Development Center, May 19 2015.

Aptika and IKP Research and Development Center.

Aryasa, K. (2015). Big Data: Challenges and Opportunities. In Big Data Workshop of Aptika and IKP Research and Development Center, May 19 2015. Aptika and IKP Research and Development Center.

Dijk, C. Mheen, P. & Bloem, M. (2015). Indonesia Maritime Hotspot. Maritime by Holland, Amsterdam

Dong, J.X., Lee, C.Y & Song, D.P (2015). Joint service capacity planning and dynamic container routing in shipping network with uncertain demands, *Transportation Research.* 78 (1).404-421 pp.

Emyana, R.E.S. (2016) Implementation of Big Data Technology In Government Institutions In Indonesia. *Journal of Post and Informatics Research*. 6 (2).113-116 pp.

Lytra, I., Vidal, M.E., Orlandi, F & Attard, J. (2017). A Big Data Architecture for Managing Oceans of Data and Maritime Applications. Proceeding of the International Conference on Engineering Technology and Innovation (ICE/ITMC).

Maryanto, B. (2017). The use of Big Data in various sector. *Media Informatika*. 16 (2). 107-113 pp.

Mirovic, M., Milicevic, M & Obradovic, I. 2018. Big Data in the maritime industry. *Nase More*. 65 (1). 56-62 pp.

Nita, S.L & Mihaelescu, M.I. 2017. Importance of Big Data in maritime transport. Mircea cel Batran Naval Academy Scientific Bulletin. 20 (1). 485-489 pp.

Toba, H. (2015). Big Data : Towards the next evolution in information era. Key note speaker paper. SeTiSI Maranatha University, Bandung.

Zaman, I., Pazouki, K., Norman, R., Younessi, S & Coleman, S. (2017). Challenges and opportunities of Big Data analytics for upcoming regulations and future transformations of the shipping industry. *Proceedia Engineering* 194. 537-544.