Analysis of Seven International Indonesian Hub Ports Policy Development Impact on Shipping and Port Sector

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Abstract. The Indonesian government has just issued a policy plan of international hub port location, Integrated Port Network (IPN) to suppressing logistic cost. This study examines the IPN impact on shipping and port sectors by the total cost. The methods used in this research are set covering problem and cost comparison between transshipment in Singapore and directly shipped containers through the hub ports. As a result, IPN will be able to decrease the cost of logistics by 8%, which is the total cost of 9,220 billion Rp/year. The current ships used are 1,500–2,500 TEUs. Meanwhile, the largest ship size by the IPN concept is to 3,000TEUs and the smallest is 300TEUs, the greatest number of ships is on the Priok-Port of Singapore route as many as 14 units. On the port sector, not all designated ports are able to accommodate and serve the 2,000 TEU ships due to the facilities and port infrastructure. At least it costs Rp 1.183 trillion - Rp so that the concept of 7 hub ports can be implemented. After the implementation of IPN will cause a potential loss for both Tj Priok and Tj Perak. On the contrary, IPN will increase the potential throughput of the Kijing, Makassar, Bitung, and Sorong.

1. Introduction
Through Presidential Decree number 32/2011, Indonesia was targeted to become a developed country in 2025. With a per capita income target that will be achieved at 14,250 – 15,500 US dollars and gross domestic product (GDP) of 4 – 4.5 trillion US dollars. To realize this target, the Indonesian government began to strengthen national connectivity with the issuance of regulation number 26/2012. Connectivity can be interpreted as the interconnectedness between regions so that the delivery of goods goes effective and efficient [1]. In the regulation, it is said that there are two international hubs of Indonesia, namely Kuala Tanjung and Bitung, which serve as an international ship corridor and supported by major ports for domestic connectivity [2]. By connecting each region, the logistic cost of goods shipped from the place of origin to the destination will be decreasing. Thus, this policy will facilitate the owners of goods and increase their profits that will ultimately impact the increase in economic activity of the region.

The government has just issued a policy plan to develop the location of Indonesia's domestic-international hub of the Integrated Port Network (IPN) program to suppress the logistics costs of container ships [3]. As we know, up to 2019 as many as 85% of Indonesia's international containers or about 6.91 million TEUs are still being collected in the Port of Singapore. This makes the logistics cost of Indonesian international container is very high. So, with this policy, the Indonesian containers...
can be directly transmitted to the country of export destinations without being collected through the port of Singapore or vice versa in the future. The 7 designated hub ports are the port of Belawan or Kuala Tanjung, Tanjung Priok, Tanjung Perak, Kijing, Makassar, Bitung, and Sorong. However, making or planning an international hub is not the same as making a terminal for land transportation. The government needs to look at Indonesian maritime conditions and readiness, such as the demand and product offerings that will pass through international hubs, international ship traffic lanes (mainline carriers), national and international fleets, industrial support, and logistics activities inland areas, and so on. As a result, the development of Indonesia's international hub ports will shift Indonesia's current logistic and shipping distribution routes. Because the volume of export-import content that was previously only centered on 2 to 7 ports.

2. Overview

2.1. Indonesian Shipping Sector

Indonesian domestic container ship is dominated by ships with a size of 300 to 500 TEUs [4], which is as many as 78 units [4]. Meanwhile, the least number of ships is less than 200 TEUs and ships with a size of 801 to 1,000 TEUs. The total number of Indonesian domestic container fleet is 212 units. According to size and quantity, Indonesia's domestic container fleet has a different carrying capacity.

![Figure 1. Ship Size Contribution to Total Carrying Capacity](image1)

Ship with size 501-800 TEUs contributes around 31% of the total carrying capacity of domestic container ships. Despite the slightest number, the ship with a size of >1,000 TEUs contributes a substantial contribution, which is 22%. Meanwhile, the ship with a size of <200 TEUs only contributes 1% in the carrying capacity of the domestic container fleet.

![Figure 2. Capacity of The Seven Reviewed Hub Ports IPN Concept (TEUs/yr)](image2)
2.2. Indonesian Port Sector

The seven reviewed hub ports have different capacities. In 2019, the port with the largest capacity is Port of Tanjung Priok, which is 4.9 million-TEUs/year. Meanwhile, the Port of Sorong has a very low capacity because the equipment and facilities are not adequate. Port of Sorong has no cargo handling equipment for container ship and container yard.

Table 1. Indonesia’s Port Performance Time and Cargo Handling Productivity

| Name of Port | Port Performance Time (hour/ship) | C/H Productivity (B/C/H) |
|--------------|-----------------------------------|-------------------------|
|              | WT      | AT      | IT      | Total          |
| Belawan      | 2.44    | 1.72    | 3.46    | 6.62           |
| Kuala Tanjung| 2.62    | 0.80    | 1.10    | 4.52           |
| Tanjung Priok| 1.33    | 0.80    | 0.43    | 2.56           |
| Kijing       | 2.25    | 0.80    | 0.05    | 3.10           |
| Tanjung Perak| 2.86    | 0.80    | 1.18    | 4.84           |
| Makassar     | 0.92    | 0.80    | 0.68    | 2.40           |
| Bitung       | 0.96    | 0.80    | 0.49    | 2.25           |
| Sorong       | 1.03    | 0.80    | 4.79    | 6.62           |
| Pekanbaru    | 9.52    | 0.80    | 14.34   | 10.46          |
| Batam        | 1.39    | 1.00    | 0.00    | 2.39           |
| Pangkal Balam| 0.64    | 0.80    | 0.67    | 2.11           |
| Palmbang     | 6.27    | 0.80    | 0.13    | 7.20           |

Most of the ports in Indonesia have been operating 24 hours a day and 365 days a year [5]. Thus, uses such assumptions for this study. The duration of ship at the port is influenced by several port time components, i.e. ship service waiting time and cargo handling time. Port performance time consists of three namely waiting time (WT), approaching time (AT), and idle time (IT).

2.3. Container Flow and Movement

The number of Indonesian containers started to look steady with an increase since 2015. Whereas, the projection results of container continue to increase. The forecasting volume of the container is dominated by domestic containers (53%). In 2018, the total number of containers were 15,858,310 TEUs. In 2020, the volume of Indonesian containers reached 17,145,760.8 TEUs with amounted to 8,371,075 TEUs international containers. It is divided in 3,348,430 TEUs exports and 5,022,645 TEUs imports. The number of import containers is larger than exports in every region.

Table 2. Volume of Indonesia’s International Container in 2020 (TEUs)

| Region          | Volume  | Export | Import |
|-----------------|---------|--------|--------|
| Sumatera        | 806,537 | 322,615| 483,922|
| Jawa            | 7,131,779| 2,852,712| 4,279,068|
| Kalimantan      | 309,310 | 123,724| 185,586|
| Sulawesi        | 78,185  | 31,274 | 46,911 |
| Indonesia Timur | 45,265  | 18,106 | 27,159 |
| **Total Containers** | **8,371,075** | **3,348,430** | **5,022,645** |

2.4. Current Container Shipping Concept

The current pattern of international container delivery operation is the small ports that act as feeder ports that deliver containers to the main port. The feeder ports in this study are ports of Batam, Pekanbaru, Pangkal Balam, Panjang, Banten, Tanjung Emas, Balikpapan, Banjarmasin, Sampit, Benoa, Samarinda, Ambon, Merauke, and Jayapura. The main port of Indonesia is now 4, namely Port of Belawan, Tanjung Priok, Tanjung Perak, and Makassar. After the main port receives and collects the
containers from the area, the container of overseas destinations will be shipped through the international hubs such as Port of Singapore and Port of Tanjung Pelepas Malaysia.

2.5. Integrated Port Network (IPN) Concept

Integrated Port Network (IPN) is one of the government programs to equalize all related ports in terms of standards, facilities, and tariffs. The implementation of this program through infrastructure development and maritime connectivity. In line with these objectives, Indonesia needs to be directly involved in trading and turnover of world goods by establishing an international hub port that performs transshipment function of the domestic and international load on a wide scale. The Integrated Port Network Program will be balanced from the 7 ports that will serve as the main hub and all integrated into port, shipping, and industry aspects [3].

Based on a study conducted by the Ministry of National Development Planning (Bappenas) as a review of the proposal of this policy, by running the concept of IPN will be able to decrease the cost of logistics by 1.6% of the current condition. Also, the concept of IPN will be able to decrease the number of transshipment containers in the Port of Singapore and Port of Tanjung Pelepas. Thus, the country's income from the port sector can be felt.

2.6. Ship Operations

Distance is one of the most important aspects of calculating transportation costs. The distance is measured from the point of origin to the destination point. The distance between these ports will affect the length of sailing time, ship frequency, fuel requirements, and the ship's transportation capacity in a year. Based on the regression by the comparison ship, there are several different size alternative ships used in this study which are also adjusted to the availability of the fleet in real conditions.

| Origin (i) | PKB  | BAT  | PBL  | PLM  | PIG  | JAM  | BaNT | TJE  | BJM  | SPT  | BEN  | SAM  | BLK  | AMB  | MRU  | JYP  |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| BLW        | 288  | 330  | 299  | 679  | 1,103| 608  | 1,177| 1,271| 1,430| 1,301| 1,858| 1,730| 1,715| 2,879| 3,420| 3,442|
| TPR        | 770  | 591  | 405  | 457  | 214  | 456  | 254  | 210  | 614  | 526  | 845  | 900  | 886  | 2,068| 2,408| 2,737|
| KJG        | 402  | 392  | 378  | 394  | 682  | 725  | 461  | 593  | 456  | 924  | 896  | 881  | 2,063| 2,899| 2,713|
| TPE        | 1,032| 1,016| 719  | 700  | 516  | 881  | 692  | 284  | 353  | 346  | 453  | 615  | 600  | 1,782| 2,720| 2,451|
| MKS        | 1,380| 1,874| 1,540| 1,534| 1,435| 1,739| 1,763| 1,382| 328  | 485  | 459  | 616  | 340  | 551  | 1,489| 1,220|
| BIT        | 1,995| 1,235| 1,031| 1,013| 1,084| 1,100| 1,052| 562  | 450  | 471  | 476  | 357  | 587  | 761  | 1,779| 2,010|
| SRG        | 2,150| 2,327| 2,007| 2,001| 2,144| 2,324| 2,348| 1,667| 1,577| 1,695| 1,623| 1,201| 1,216| 494  | 1,224| 718  |

*Figure 3. Integrated Port Network Concept*
In addition to sea distance, alternative ships are one of the basic data to count transport costs. Based on the regression by the comparison ship, there are several different size alternative ships used in this study which are also adjusted to the availability of the fleet in real conditions.

**Table 4. Main Dimensions of Alternative Ships**

| Alternative Ships (TEUs) | Ship 1 | Ship 2 | Ship 3 | Ship 4 | Ship 5 | Ship 6 | Ship 7 | Ship 8 |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Capacity TEUs           | 300    | 500    | 800    | 1,000  | 1,500  | 2,000  | 2,500  | 3,000  |
| LOA m                   | 155    | 160    | 167    | 171    | 183    | 195    | 206    | 218    |
| LPP m                   | 145    | 150    | 157    | 161    | 172    | 184    | 195    | 206    |
| B m                     | 23     | 24     | 24     | 25     | 26     | 28     | 29     | 30     |
| H m                     | 13     | 13     | 14     | 14     | 15     | 16     | 17     | 17     |
| T m                     | 9      | 9      | 10     | 10     | 11     | 12     | 12     | 13     |
| GT                      | 3.672  | 5.919  | 9.291  | 11.538 | 17.157 | 22.776 | 28.395 | 34.014 |
| V௖ Knot                | 12     | 12     | 12     | 14     | 15     | 17     | 17     | 18     |
| AE HP                   | 2,239  | 2,674  | 3,326  | 3,762  | 4,849  | 5,937  | 7,024  | 8,112  |
| AE kW                   | 1,670  | 1,995  | 2,482  | 2,806  | 3,617  | 4,429  | 5,240  | 6,052  |
| ME HP                   | 9,263  | 10,721 | 13,456 | 15,279 | 19,836 | 24,394 | 28,951 | 33,508 |
| ME kW                   | 6,910  | 7,998  | 10,038 | 11,398 | 14,798 | 18,198 | 21,597 | 24,997 |
| SFOC AE ton/hari        | 13     | 16     | 20     | 22     | 28     | 35     | 41     | 48     |
| SFOC ME ton/hari        | 54     | 63     | 79     | 90     | 116    | 143    | 170    | 197    |
| TCH Jt-Rp/hari          | 84     | 89     | 97     | 102    | 115    | 129    | 142    | 155    |

3. **Methodology**

The first step is identifying the problems. The main problem in this study is the change of maritime concept in Indonesia, which resulted from the 2 locations of international to 7 points. The hypothesis at this step is the need for the size of the ship that will be used to serve every point will vary widely considering demand at each point differently. Whereas Indonesia has a lot of old ships and the size is not big. Also, it takes a very high cost to build and develop multiple ports with the same standard. Divides the required data into 2 parts, i.e. supply-side data and demand-side data. The supply-side data consist of port facility, port capacity, tariff, port operation, container fleet, container ship main size, ship capacity, ship operation, and point of origin and container cruise purpose, so on. Meanwhile, demand-side data consists of the number of Indonesia's international containers, Indonesia's import countries, and Indonesia's export destinations. Then, it calculates the capacity of 7 hub ports. Moreover, it calculates the distribution of potential demand for each port hub.

Calculates export container shipping cost based on current shipping pattern, with transshipment in Port of Singapore. The shipping is port to port. The ship departs from the feeder port to the main port (Priok, Perak, Belawan, or Makassar) using a domestic ship. From the main port, the ship will sail to Port of Singapore for transshipment. The containers are transported using the mother ship from Port of Singapore to the destination country. After we know transport costs to the destination country, then divide it by the amount of cargo transported will be obtained the unit cost. The concept of cost calculation at this step is not very different from the current conditions cost calculation. Only, authors make a zoning area for every hub to know the coverage area of each port hub against the feeder. A basic selection of coverage area is the closest distance and demand amount. So, the container of the feeder Benoa does not need to transfer goods to the port of Tanjung Priok to export, simply through the port of Tanjung Perak. The output from this step-in addition to the unit cost is the route ship size and number of required ships.

After knowing the current cost and cost of IPN concept, we compare both costs to figure out what is the impact on shipping. Whether the IPN concept can decrease the logistic cost and how significant the amount of. The feasibility of developing investment 7 designated ports as international hub ports. Correspond to the government plan to equate the standard and facilities of 7 port hubs. It is important
to consider that building only a port infrastructure requires a high cost. Also, the government should be aware of the potential ships and goods entering the hub port. IPN concept will change the market share of the port operating today. So, it is necessary to know the market share and the potential of the load transfer from one port to another. The analysis was conducted on 2 sectors, shipping, and port sector. Analysis of the shipping sector includes the change of total cost, unit cost, ship size, number of ships needed, route changes. While the analysis on the port sector includes the potential for additional costs because there are some investments to develop international hub ports, the number of shifting containers, and market share every hub.

4. Result

4.1. Analysis on Shipping Sector

By comparing the shipping cost of the current condition and when the IPN concept is applied, we know how the impact of this policy on the shipping sector. Three aspects become comparison criteria, namely the total cost, total unit cost, and the size of the ship. If viewed from the aspect of the total cost, then obtained the result that the concept of Integrated Port Network can lower the cost of logistics by 7%, which is the total cost of the current condition of 9,922 billion-Rupiah/year, while the total cost of the Integrated Port Network concept of 9,220 billion-Rupiah/year.

![Figure 4. Total Cost Comparison Between Existing Condition and IPN Concept](image)

**Table 5. Comparison of Existing and IPN Unit Cost**

| Route (Origin-Destination) | Existing Distance (nm) | IPN Distance (nm) | Distance Difference (nm) | Existing Unit Cost (Rp/TEU.nm) | IPN Unit Cost (Rp/TEU.nm) |
|----------------------------|------------------------|------------------|--------------------------|-------------------------------|--------------------------|
| Batam                      | 2.924                  | 2.794            | 130                      | 3.910                         | 4.467                    |
| Pekanbaru                  | 2.882                  | 2.752            | 130                      | 3.945                         | 4.571                    |
| Pangkalbalam               | 2.893                  | 2.763            | 130                      | 4.235                         | 4.543                    |
| Panjang                    | 2.900                  | 2.631            | 359                      | 4.614                         | 4.354                    |
| Banjarmasin                | 3.030                  | 2.671            | 359                      | 4.430                         | 4.312                    |
| Tanjung Emas               | 2.986                  | 2.627            | 359                      | 4.631                         | 4.411                    |
| Jambi                      | 3.649                  | 2.130            | 1.519                    | 4.116                         | 3.472                    |
| Pakembang                  | 3.668                  | 2.149            | 1.519                    | 4.066                         | 3.393                    |
| Banjarmasin                | 3.459                  | 2.927            | 532                      | 3.630                         | 4.504                    |
| Sampit                     | 3.352                  | 2.820            | 532                      | 3.711                         | 4.633                    |
| Balikpapan                 | 3.773                  | 3.152            | 621                      | 3.556                         | 4.525                    |
| Samarinda                  | 3.785                  | 3.164            | 621                      | 3.580                         | 4.550                    |
| Amboy                     | 9.649                  | 7.064            | 2.585                    | 1.474                         | 7.032                    |
| Merauke                    | 6.477                  | 3.593            | 2.884                    | 2.698                         | 12.577                   |
| Jayapura                   | 5.911                  | 3.087            | 2.884                    | 2.418                         | 13.586                   |
Figure 5. Unit Cost Comparison Between Current Conditions and IPN Concept

The figure above shows that in general, the unit cost of the international container shipping on current conditions is more equitable than the IPN concept. The unit cost while IPN concept had to implement via direct call route caused the inequality of unit cost in some areas. Like the areas of Samarinda, Ambon, Merauke, and Jayapura that have a low demand for international containers than other ports. So, the unit cost of the shipping is very high. There are differences in ship size requirements for each port. However, it can be seen the demand pattern of the international ship size of the current condition tends not to differ considerably. The average size of the ship is in the numbers 2,000 to 2,500 TEUs. The smallest ship size is 1,500 TEUs, while the largest ship size is 3,000 TEUs. Unlike the size of the ship's needs when the IPN concept is applied inequality. The largest size ship is 3,000 TEUs, while the smallest size ship is 150 TEUs.

Figure 6. Ship Size Comparison Between Current Conditions and IPN Concept

4.2. Analysis on Port Sector

The implementation of the Integrated Port Network (IPN) concept will have some impacts on the port sector in Indonesia. The analysis is carried out from the supply and demand side. Both in terms of the throughput of each port and the costs to be incurred to improve the port facilities. Based on the calculations of the supply side, there are 4 among the 7 prospective ports Hub Indonesia requires a total investment fee of 1,182 billion-Rupiah so that the concept of IPN can be implemented. The port that requires the largest investment cost is Port of Sorong around 722 billion-Rupiah. Moreover, the
hub port development project can only or may be done at Bitung Port and Belawan. This is because both ports have enough potential demand than the port of Makassar and Sorong. So, it will instead increase the logistic cost and draw the price of the goods.

![Figure 7. Port Development Cost due to Implementing IPN Concept](image)

On the demand side, the expanding hub port location will be able to shift the several containers to a new hub port such as Kijing, Bitung, and Sorong. Thus, the throughput of the three ports may increase. On the other side, now Kijing Port is the hinterland of Tanjung Priok port. Therefore, the charge of international containers that will and/or from the Kijing will stop at the port of Tanjung Priok. Meanwhile, Tanjung Perak Port handles international freight from and/or to Port of Makassar, Bitung, and Sorong. When the concept of IPN is applied, the port of Tanjung Priok will lose 3% of the container of its total throughput and the port of Tanjung Perak will lose 6% of the containers of its total throughput.

![Figure 8. Potential Load (Container) Changes at Seven Hub Ports After IPN is Applied](image)

![Figure 9. Market Share of Seven Hub Ports After IPN Implementing](image)
5. Conclusions

The current Indonesian shipping conditions indicate that Indonesia's container volume increased +7% annually. The movement is still dominated by domestic containers of 53% and international containers around 47%. The highest container volume is in Java Island amounting to 11.32 million-TEUs or equivalent to 69% total container throughput Indonesia. Then, Indonesia's container ship is mostly 501-800 TEUs by 31%. The total capacity of the Indonesia container fleet is 110,220 TEUs/year. Meanwhile, the seven-candidate of hub ports do not have the same standards. Port of Tanjung Priok has the highest capacity, it is about 4.9 million-TEUs/year. Whereas the smallest capacity in Port of Sorong is 0.075 million-TEUs/year.

The impact that will be seen in the shipping sector is Integrated Port Network will reduce total logistics cost by 7%, which currently amounted to 9,922 billion-Rupiah/year to be RP 9,220 billion-Rupiah/year. But, the direct call concept on Integrated Port Network makes total unit cost higher than the current condition, which is Rp 99,963/TEU.nm and Rp 57,748/TEU.nm for current conditions. Then, the largest international ship size requirement for the Integrated Port Network concept is 3,000 TEUs, while the smallest ship size is 300 TEUs. In the current condition, the size of the ship tends to be evenly between 2,000 to 2,500 TEUs.

The impact of IPN concept on the port sector also shows things that are not much different from the shipping sector, Indonesia still needs to improve this sector. The good thing is, Integrated Port Network Concept will flatten 7 hub port market shares and reduce market share imbalances. The concept will add market share port Belawan by 16%, Port of Kijing 22%, Makassar port 16%, Bitung port 3%, and Sorong 9%. However, it will reduce the market share of Tanjung Priok Port 3% and Tanjung Perak 6%. But, as I say before It needs the development of facilities on Port of Belawan, Kijing, Bitung, and Sorong. The total investment cost is 1,183 billion-Rupiah so that the concept of 7 Hub ports can be implemented. Furthermore, development on the Port of Kijing and Sorong can’t be done because based on feasibility analysis, the value of the return of both interest rates respectively amounted to -8.7% and 0.1% (under the target return interest rate, which is 10%).

References

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