Analysis Of The Potential For Cbl Inland Waterways As An Alternative Transport Logistics Using AHP

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Abstract. Economic growth in Indonesia gives effect to the development of the logistics industry in Indonesia. Logistics Business is a sector that has a fairly high growth rate, where increasingly improved growth requires effective and efficient logistical support. In 2018, the Government of West Java implement the Innovation Inland Waterways which aims to create a channel width of the sea into the mainland so that containers can be transported by water rather than through the toll-road to Tanjung Priok, and make Inland Waterways as an Alternative Transportation logistics, Central Government, also has made Inland Waterways Cikarang Bekasi Laut (CBL) as the National Strategic Projects, which is expected to reduce the current density on the land logistics from Cikarang Industrial Area to the Port of Tanjung Priok and aim to optimize the potential of the river as an alternative canal path of transport logistics. Where the volume of land transport logistics in Indonesia has reached nearly 90%, and with the construction of CBL Inland Waterways is expected to reduce costs with the integration of multimodal transport logistics. The purpose of this study was to find a potential that can be developed as Alternative Transportation Logistics and determines the priority level of that potential. Retrieval of data taken through a questionnaire distributed to experts in the field of logistics and related to the research being carried out. The result indicated that the Economic aspect was the top priority among the other potential to developed.

1. Introduction

In 2018, the Government of West Java, announced the construction of which has been announced by the Central Government which is Innovation Inland Waterways Cikarang Bekasi Laut which has been made as a National Strategic Project, which aims to create a canal so Containers can be transported by Water rather than by Land towards Tanjung Priok as an Alternative Logistics Transport, and expected to reduce the current density of logistics in the land or highway [1].

Modes of Transportation is one of the important tools in logistics such as to the distribution of goods from the point of origin to point of consumption. Setijadi mentions that Modes of transportation in Indonesia is dominated 90% by Land transport which is trucks. In 2016, around 70% the volume of Import-Export through the Port of Tanjung Priok from areas around Jakarta, West Java and Banten Province. Export volume comes from Bekasi by 32%, Karawang 29%, Purwakarta 8%, Bandung 6%, Tangerang 14%, Bogor 4%, Cilegon and Serang 8%. And the Import Destinations to Bekasi are 23%, Karawang 36%, Purwakarta 9%, Bandung 6%, Tangerang 14%, Bogor 4%, Cilegon and Serang 3% [2].
Figure 1. Distance and Map CBL Inland Waterway to Tanjung Priok and vice versa [4]. Jababeka Industrial Estate, West Java, is the largest manufacturing estate in Indonesia with an area of 5,600 ha[3] and there are 11 Industrial Area with more than 2,500 companies [4]. Both multinationals as well as small and medium enterprises (SMEs), Jababeka Industrial Estate, in particular, Cikarang Industrial Estate which has Cikarang Dry Port (CDP) and has an area of about 200 hectares that is easy to access using the highway and railway [5]. Distance from Cikarang and surrounding to the Port of Tanjung Priok through toll roads around 50-60 km [4], with the Volume of trucks going through the Toll-Road quite density per day and it is one of the causes of congestion, and with the high quite traffic congestion, as well as the often uncertainty of delivery, causes an increase in logistics costs [6]. However, it is only one cause, there are some other causes, such as, Weather. Unpredictable weather such as rain and even strong winds that make the delivery of goods becomes hampered and causing the delivery becomes ineffective. Then, the government policy that enforces the odd-even numbered systems is also one of the causes of the delivery of goods to the destination becomes ineffective [7].

According to CIA, 2010 on [8] The presence of waterways (rivers and canals) is an important precondition for inland waterway transport (IWT). Throughout the world, there are over 600,000 km of navigable waterway networks. But in the majority of IWT is underdeveloped [8]. Total Navigable length of Indonesia are over 21.579 km, and Inland Waterways represent a small % of overall transportation systems[8], In some countries Inland Waterways has been implementing and widely used to transport goods and people to travel long distances, such as on the largest networks in China, Russia, Brazil, Europe, several countries in the Americas, etc [4], [8]. European statistics show the use of Inland Waterways Transport as an alternative mode of transportation besides road or rail [9].

Indonesian Logistics costs reached 24% of total gross domestic product (GDP) and the most expensive among in Southeast Asia that has been below 15% even 10%. And to reduce the cost of logistics, one of them requires sustainable infrastructure development and integrated, mainly, for multimodal transportation[10]. Actually, there are two modes of transportation to the Port of Tanjung Priok from Cikarang and vice versa, using the Land Transport which is Railways and Trucks. However, to increase the Tanjung Priok port connectivity, with make IWT as an alternative transport logistics, with the aims to will be a more modern and cost-effective mode of Alternative transport in the form of Inland Waterways by using barges[11]. Currently, Inland Waterways plays an important role in the inland connectivity of major seaports in Western Europe [12].

So, that condition raises a question: Do Inland Waterways have a Potential as an Alternative Logistics Transport in Indonesia?
2. Literature Review

2.1 Potential Transportation

Potential Transport, closely related to the concept of the choice of alternative transport options. Transport potential is a quantitative measure of the possibility of someone or logistics providers using a particular transportation alternative for a given trip [13].

Based on performance measurements by Ministerial Transportation Regulation Number 49 of 2005 about National Transportation System (SISTRANAS) consists of 14 indicator variables performances, namely Safety, Accessibility, Integration, Affordable Rates, Capacity, Regular, Smooth and Fast, On-Time, Efficient, Easy, Orderly, Safe, Comfortable, Low Pollution [14], According to (OECD, 1996 & NRTE, 1996) in the journal [15] there are three aspects of transportation, namely: Environment Aspects, Economic Aspects, Social Aspects. And in [16] the SISTRANAS indicators are grouped into three main indicators in that aspect.

Then the three main indicators and indicator variables SISTRANAS above based on transport performance made as a reference in determining the priority of potential that can be developed as an alternative Inland Waterways Transport Logistics.

2.2 National Logistics System (SISLOGNAS)

With the development of CBL Inland Waterways as An Alternative Transport Logistics, it is accordance with a Vision of Logistics Indonesia in 2025 on Presidential Regulations Number 26 of 2012 about National Logistics System Development (SISLOGNAS), Which the development of the National Logistics System consists of 6 main interrelated driving factors [17], namely such as figures 2 below:

![Figure 2. National Logistics System Driving Factors. [17]](image)

CBL Inland Waterways is one of a factor on National Logistics System which is in Transportation Infrastructure. The role and function of transportation infrastructure is to facilitate streamlining the movement of goods flows effectively and efficiently and in the context of realizing Indonesia as a maritime country, which has national economic security and sovereignty, and as a vehicle for unifying the nation within the framework of the Unitary State of the Republic of Indonesia (NKRI), Availability of adequate transportation infrastructure network is an important factor to realize local connectivity, national connectivity, and global connectivity [17].

2.3 Inland Waterways

According to Velsink H (2016) on Journal [4], Inland Waterway Transport (IWT) is commercial transportation that utilizes canals for moving commercial cargoes from major ports to hinterland and vice versa that connected by canals. IWT is defined as commercial transportation by ships that have not crossed the oceans.

Inland Waterway Transport (IWT) is Considered as a more environmentally friendly mode of transport Compared to highway trucking (see the PINE report by Buck Consultants International et al., 2004) [18].
Inland Transportation is transported through inland water such as rivers, canals, lakes, oceans, and so on [19].

Inland Waterway Transport (IWT) is an integral part of a comprehensive transport system of an area and the mode of transportation has many advantages; environmentally friendly, reliable, and cost-effective. After creating many bridges between countries and regions, IWT has contributed to the current economic development for centuries (INA, 2009) in the journal [20].

Therefore, we propose the hypothesize of proofing some weight criterion, which one is important, analyze with AHP which is Social Aspects, Economic Aspects, Environment Aspects.

3. Research Method
This paper applied the method Analytic Hierarchy Process (AHP) approach. AHP is one method that can be used to solve the problem of Decision Making Multi Attribute, namely by evaluating alternatives to a set of attributes or criteria, which each attribute is independent of each other [21]. The sampling technique used in this study is random sampling in 20 respondents who are experts in logistics and related to the research that is being done. The data used in this study are primary data through questionnaires distributed to each respondent at random. AHP was developed at the Wharton School of Business by Thomas Watson in the 1970s. In principle, AHP is a simplification of unstructured problems into parts more structured and organized in a hierarchy [22]. Graphically, the problem with AHP decision can be built as a multilevel diagram, starting with the target, then the first criteria, sub-criteria and finally an alternative. The structure of the AHP hierarchy can be seen in Figure 3 below:

![Figure 3. Structure Hierarchy AHP](image)

Steps in the AHP method:
1. Set targets, criteria and decision alternatives.
2. Set hierarchy to various criteria and decision alternatives.
3. Made a pair comparison matrix ratio based on each criterion and sub-criteria.

To get a Consistency Ratio (CR), i.e. by comparing CI and RI we get a benchmark to determine the consistency level of a matrix, which is called the Consistency Ratio (CR). A comparison matrix is declared consistent if the CR value is not more than 0.10 (CR ≤ 0.10) [23].
Table 1. Average Random Consistency Index (R.I.) [22]

| N  | Random Index |
|----|--------------|
| 1  | 0.0          |
| 2  | 0.0          |
| 3  | 0.58         |
| 4  | 0.90         |
| 5  | 1.12         |
| 6  | 1.25         |
| 7  | 1.35         |
| 8  | 1.40         |
| 9  | 1.45         |
| 10 | 1.49         |

4. Result and Discussion

The data uses based on the results of questionnaires taken from experts in the field of logistics and related to the research being done, by criteria such as Social Aspects, Economic Aspects, and Environment Aspects, and Sub-criteria such as Safety, Accessibility, Affordable Rates, Capacity, Regular, Smoothly and Fast, On-Time, Integration, Efficient, Easy, Orderly, Safe, Comfortable, and Low Pollution.

The data processing of the AHP Method performed by determining the weight of each Criterion, Sub-criteria, and Alternatives were performed using a matrix of ratio comparisons. Weighting process and consistency test of the matrix of ratio comparisons, processed using Software Expert Choice v11.0. Based on the weighting process and consistency test in the Software, that the results obtained in this research indicate that each criterion and sub-criterion has different importance, and CR is not more than or equal to 0.10.

Analysis using AHP begins with a matrix table of ratio comparisons for all criteria and sub-criteria. 3 Criteria and 14 Sub-criteria potentials of Inland Waterways as an Alternative Logistics Transport that can be considered to be developed. Below are the results of weighting from a matrix table of ratio comparisons from Software Application.

Table 2. Weighting Criteria

| Criteria         | Weight |
|------------------|--------|
| A. Social Aspects| 0.248  |
| B. Economic Aspects| 0.521 |
| C. Environment Aspects| 0.231 |

CI = 0.03038, RI = 0.58, CR = 0.05238.

Table 3. Social Aspects Weighting

| Criteria     | Weight |
|--------------|--------|
| A1. Safety   | 0.273  |
| A2. Accessibility| 0.260 |
| A3. Affordable Rates| 0.183 |
| A4. Capacity | 0.140  |
| A5. Regular  | 0.145  |

CI = 0.01605, RI = 1.12, CR = 0.01433

Table 4. Economic Aspects Weighting

| Criteria         | Weight |
|------------------|--------|
| B1. Smooth and Fast| 0.180 |
| B2. On-time       | 0.269  |
| B3. Integration   | 0.119  |
Table 5. Environment Aspects Weighting

| Criteria                | Weight |
|-------------------------|--------|
| C1. Orderly             | 0.207  |
| C2. Safe                | 0.402  |
| C3. Comfortable         | 0.149  |
| C4. Low pollution       | 0.242  |

CI = 0.05274, RI = 1.12, CR = 0.04709

Table 6. Consistency Index Hierarchy (CIH)

| Criteria                     | X Weight | CI   | CIH  |
|------------------------------|----------|------|------|
| IW as an Alternative Logistics Transport | 1.000    | 0.030| 0.030|
| Social Aspects               | 0.248    | 0.016| 0.003|
| Economic Aspects             | 0.521    | 0.052| 0.027|
| Environment Aspects          | 0.231    | 0.029| 0.006|
| Total                        |          |      | 0.066|

Table 7. Random Index of Hierarchy (RIH)

| Criteria                     | X Weight | RI   | RIH  |
|------------------------------|----------|------|------|
| IW as an Alternative Logistics Transport | 1.000    | 0.580| 0.580|
| Social Aspects               | 0.248    | 1.120| 0.277|
| Economic Aspects             | 0.521    | 1.120| 0.583|
| Environment Aspects          | 0.231    | 0.900| 0.207|
| Total                        |          | 1.647|      |

After got CIH and RIH, and then it will know the Consistency Ratio Hierarchy (CRH) with calculations as follow:

\[
CRH = \frac{CIH}{RIH} = \frac{0.066}{1.647} = 0.040
\]
Consistency Ratio Hierarchy values by 0.040 and not more than $\Box$ 0.10. So, the Consistency Ratio Hierarchy it can be called Consistent because the CRH already Consistent and accordance with Consistency Ratio Requirements by [23].

From the above data, if the data are sorted, it will form priority potential which can be focused to be developed such as the table below:

Table 8. Results of the order of Criteria and Sub-criteria in accordance with priority weights

| Criteria          | Weight | Sub-criteria     | Weight |
|-------------------|--------|------------------|--------|
| B. Economic Aspects | 0.521  | B4. Efficient    | 0.316  |
|                   |        | B2. On-time      | 0.269  |
|                   |        | B1. Smooth and Fast | 0.180  |
|                   |        | B3. Integration  | 0.119  |
|                   |        | B5. Easy         | 0.116  |
| A. Social Aspects  | 0.248  | A1. Safety       | 0.273  |
|                   |        | A2. Accessibility | 0.260  |
|                   |        | A3. Affordable Rates | 0.183  |
|                   |        | A5. Regular      | 0.145  |
|                   |        | A4. Capacity     | 0.140  |
| C. Environment Aspects | 0.231 | C2. Safe         | 0.402  |
|                   |        | C4. Low pollution | 0.242  |
|                   |        | C1. Orderly      | 0.207  |
|                   |        | C3. Comfortable  | 0.149  |

5. Conclusion
From the results of the above data, it can be concluded:
1. Criteria with the first-highest weight value are the potential of Economic Aspects (B) with the highest Sub-Criteria Efficient.
2. Criteria with the second-highest weight value are the potential of the Social Aspects (A) with the highest Sub-criteria Safety.
3. Criteria with the third-highest weight value are the potential of Environment Aspects (C) with the highest Sub-criteria Safe.

Based on Table 8, it can be seen that the criteria of Economics Aspects are the first potential priority that can be considered for the development of Inland Waterways with a weight value by 0.521. While the third potential priority is Environment Aspects criteria with a weight value by 0.231. Then, the highest weight value of Sub-criteria on Criteria of Social Aspects are Safety by 0.273. Then, the highest weight value of Sub-criteria on Criteria of Economic Aspects are Efficient by 0.316, And lastly, the highest weight value of Sub-criteria on Criteria of Environment Aspects are Safe by 0.402.

Based on primary data processing, can be analyzed that Economics Aspects is a major potential to be developed and prioritized to be considered in making the Inland Waterways as an Alternative Logistics Transport. And in this research, authors only examined the potential that can be developed based on the performance of transportation as an input in the development of Inland Waterways Cikarang Bekasi Laut.

6. References
[1] Murtopo, “Inovasi Kanal Cikarang Ridwan Kamil Bisa Kurangi Aktivitas 4.000 Truk Kontainer di Jalan Tol,” 2018. [Online]. Available: https://wartakota.tribunnews.com/2018/09/29/inovasi-kanal-cikarang-ridwan-kamil-bisa-kurangi-aktivitas-4000-truk-kontainer-di-jalan-tol. [Accessed: 28-Jun-2019].

[2] I. Budhiman, “Angkutan Tanjung Priok: SCI: Kereta Lebih Cocok Ketimbang Kanal CBL,” 2018. [Online]. Available: https://surabaya.bisnis.com/read/20181015/450/849218/angkutan-tanjung-priok-sci-kereta-lebih-cocok-ketimbang-kanal-cbl. [Accessed: 16-May-2019].

[3] Jababeka & Co., Annual Report: Achieving The Vision. 2018.

[4] T. Achmadi, H. I. Nur, and L. R. Rahmadhon, “Analysis of Inland Waterway Transport for Container Shipping: Cikarang to Port of Tanjung Priok,” IOP Conf. Ser. Earth Environ. Sci., vol. 135, no. 1, 2018.

[5] B. Susantono, Transportasi dan Investasi: Tantangan dan Perspektif Multidimensi. Jakarta: Kompas, 2013.

[6] INSA, “Potensi Inland Waterways Sebagai Alternatif Angkutan Logistik,” 2018.

[7] D. A. Putra, “JNE Ungkap Tiga Faktor Pemicu Keterlambatan Pengiriman Barang,” 2018. [Online]. Available: https://www.merdeka.com/uang/jne-ungkap-tiga-faktor-pemicu-keterlambatan-pengiriman-barang.html. [Accessed: 28-Jun-2019].

[8] B. Wiegmans and R. Konings, Inland Waterway Transport: Challenges and Prospects. Routledge, 2016.

[9] Eurostat Statistics Explained, “Modal Split of Inland Freight Transport, EU-28, 2012-2017 (% Share in Tonne-Kilometres),” Market Observation Inland Navigation In Europe, 2017. [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php/Freight_transport_statistics_-_modal_split. [Accessed: 04-Jul-2019].

[10] D. Prabowo, “Biaya Logistik Indonesia Masih Mahal,” 2019. [Online]. Available: https://properti.kompas.com/read/2019/02/27/230149621/biaya-logistik-indonesia-masih-mahal. [Accessed: 28-Jun-2019].

[11] Y. Supriyanto, “Pelindo II Diminta Segera Bangun Cikarang-Bekasi Laut Inland Waterways,” Bisnis.com, 2017. [Online]. Available: https://ekonomi.bisnis.com/read/20170428/98/649051/pelindo-ii-diminta-segera-bangun-cikarang-bekasi-laut-inland-waterways. [Accessed: 26-May-2019].

[12] A. Caris, S. Limbourg, C. Macharis, T. van Lier, and M. Cools, “Integration of Inland Waterway Transport in The Intermodal Supply Chain: A Taxonomy of Research Challenges,” J. Transp. Geogr., vol. 41, pp. 126–136, 2014.

[13] B. Ranković Plazinić and J. Jović, “Mobility and Transport Potential of Elderly in Differently Accessible Rural Areas,” J. Transp. Geogr., vol. 68, no. October 2017, pp. 169–180, 2018.

[14] Kementerian Perhubungan, Nomor : KM.49 Tahun 2005 Tentang Sistem Transportasi Nasional ( SISTRANAS ). 2005.

[15] N. Brotodewo, “Penilaian Indikator Transportasi Berkelanjutan Pada Kawasan Metropolitan Di Indonesia,” J. Perenc. Wil. dan Kota, vol. 21, no. 3, pp. 165–182, 2010.

[16] W. P. Humang, “Kinerja Jaringan Transportasi Jalan Akses dari Hinterland ke Pelabuhan Tanjung Ringgit Kota Palopo,” War. Penelit. Perhub., vol. 30, no. 1, p. 35, 2018.

[17] Peraturan Presiden Republik Indonesia, No. 26 Tahun 2012 Tentang Cetak Biru Pengembangan Sistem Logistik Nasional. 2012.

[18] J. Wang and J. Y. Li, “Inland Waterway Transport in the Pearl River Basin, China,” Espac. Geogr., vol. 41, no. 3, pp. 196–209, 2012.

[19] H. Gunawan, Pengantar Transportasi dan Logistik, 1st ed. Jakarta: Raja Grafindo Persada, 2014.

[20] J. Li and T. E. Notteboom, “The Development of The Inland Waterway Transport System in Flanders (Belgium): An Institutional Analysis,” Pap. 5th ALRT Conf., 2012.

[21] S. Kusumadewi, S. Hartati, and H. Wardoyo, R, Fuzzy Multi-Attribute Decision Making. Yogyakarta: Graha Ilmu, 2006.
[22] S. Sidjabat, “Work Motivation Assessment of Conventional Ojek And Online Ojek in Jakarta City Through AHP,” GROSTLOG 2018 Adv. Transp. Logist. Res., vol. 1, pp. 13–24, 2018.
[23] T. L. Saaty and L. G. Vargas, Models, Methods, Concepts & Applications of the Analytic Hierarchy Process. International Series in Operations Research & Management Science., 2nd ed. New York: Springer, 2001.
[24] D. Rimantho, F. Fathurohman, B. Cahyadi, and S. Sodikun, “Pemilihan Supplier Rubber Parts Dengan Metode Analytical Hierarchy Process Di PT.XYZ,” J. Rekayasa Sist. Ind., vol. 6, no. 2, p. 93, 2017.