A paper presented at the 18th International Conference on Sustainable Development,
Montclair State University, New Jersey, USA, 13-14, December 2023.

Implementation of Ship Guidance Policy through Long Distance Digital in Indonesian Ports on the National Economy

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OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada.
ISSN 1923-6654 (print) ISSN 1923-6662 (online) www.oidaijsd.com
Also available at https://www.ssrn.com/index.cfm/en/oida-intl-journal-sustainable-dev/

Abstract: This research aims to determine and analyze: (i). Technological and innovation readiness in order to support the policy of implementing mandatory ship piloting; (ii). Implementation of mandatory pilotage and ship delay services at Indonesian Ports and what are the obstacles in implementing ship pilotage; (iii). Human resource readiness in implementing the mandatory ship piloting policy; (iv). The impact of the mandatory pilot policy on the smooth running of sea transportation modes for community transportation; (v). The impact of the mandatory pilot policy on the smooth flow of goods; and (vi). The impact of mandatory guidance policies on the macro economy, especially the role of investment in the maritime sector.

The approach used in this study was a qualitative approach which was carried out using Focus Group Discussions (FGD) which were then analyzed using the NVivo tool.

The results and conclusions of the research explain that: (i). The era of digitalization is a period when information is easily and quickly obtained and disseminated using digital technology. Meanwhile, digital technology is a technology that uses a computerized system connected to the internet. These two things always go hand in hand and have a mutual impact on society, especially service users (users); (ii). There are no good implementation practices (best practices) in other places, so the minimum requirements, implementation procedures for regulations, equipment (hardware and software), and reliable human resources are not yet available for comparison. So a comprehensive study is needed from various parties (academics, regulators, industry, ship owners, pilots, and pilotage operators) to ensure the reliability of digitized pilotage. There is also still no system or artificial intelligence technology that can replicate or replace how pilot officers behave, respond to situations that cannot be seen, felt, and respond directly to ship movements for the sake of shipping safety; (iii). The current education for pilot officers does not accommodate the digital pilot policy, especially in the readiness of the syllabus curriculum in the formation of pilot officers as well as increasing the qualifications of pilots. Likewise, VTS operators are not yet prepared regarding how to provide advice and direction regarding guidance. Challenges also lie with piloting supervisors as regulators in the field; (iv). The impact of policies can be both positive and negative. If the policy related to digital piloting is successful in its implementation without any obstacles, let alone incidents, it will, of course, have a very good impact on the smoothness of sea transportation modes, there will be no waiting time at the port due to waiting for the pilot's readiness, as well as ship maneuvering time that can become more efficient; (v). Because pilotage activities in the ship service performance structure are in waiting time and approach time where all goods are still on board, this creates an indirect impact received by shipping service users; and (vi). Implementation of this policy is a positive thing for investors. Investors see that Indonesia's maritime strength is already strong from both hardware and software sides. So far, they see that Indonesia has provided seafarers, provided shipyards, and built ships, while making and providing software has not been heard of by business actors, so having tools that help with guiding will give them the confidence to invest in the maritime sector.

Policy recommendations related to research include: (i). If the government implements a ship guidance policy via digital long distance, it should be measured as a whole by considering the multiplier impact through other sectors because the results of this study show that the implementation of this policy has a direct and indirect impact forward and backward on all sectors of the economy, not only sea transportation sector only; (ii). The government needs to resolve the obstacles to the implementation of ship guidance policies through digital distance in the field including implementation compliance for Compliant Ports through enforcement of ship guidance rules in the field with full commitment from all levels or stakeholders through synergy and through the active role of Kesyahbandaran as pilotage supervisor in regions, can build synergy, enforce ship piloting regulations, resolve human resource quality issues through education and training as well as outreach and quantity issues, simplify bureaucracy by re-evaluating existing SOPs, and use the latest technology such as surveillance cameras and digital information systems.

Keywords: Digitalization Guide, National Economy, Nvivo Analysis

Research Background

The digitalization era is a time when information is easily and quickly obtained and disseminated using digital technology. Digital technology is a technology that uses a computerized system connected to the internet. So digitalization is also known as a process of change that occurs from analog technology to digital technology. The current digital era has created a concentration/ focus on the media and has had a significant impact on people's lives, including the maritime community, especially in the scope of digitalization-based ship piloting sea transportation work.

As we know, sea transportation plays an important role in the flow of goods or as the community's choice of transportation mode. Sea transportation is a unified system, which consists of facilities and infrastructure, services, and transportation purposes with guaranteed safety and provides certainty and calm for actors so that the socio-economic activities of the community can be protected (Salim, 2004). This system is comprehensive, consisting of components that support each other and work together to integrate the system. If one of these components is damaged, the system will be damaged as well. (Miro, 2012). Sea transportation also has an impact on the economy of a country. There have been various previous studies that have discussed the relationship between a particular maritime sector in a country and its economy (see among others: Wang, et al (2021); Alharthi & Hanif (2020); Song & Mi, (2016); Osadume & Blessing (2020); Yusanto, 2019); Nalf et al., 2019); Prastyo, et al., 2022); Permata & Santoso, 2019); Oktafiansyah, 2022); and others).

Along with the development of time and the demands of community needs, the port manager needs to prepare facilities and infrastructure that are able to provide services according to predetermined standards. Therefore, it is important to establish cooperation with related agencies such as local governments in order to create synergies so that services from upstream to downstream can be carried out effectively and efficiently. Apart from that, there is a need to update technology-based, innovative, and competent human resource management (HR) in their field so that HR development becomes fundamental. So, technological developments or digitization must also be balanced by Port HR who have sufficient ability and knowledge in the field of shipping and ship safety regulations. Without having qualified human resources, it is impossible to implement ship regulations and their supervision properly. Many previous studies related to digitization and its relationship with HR have also been carried out, among others: Utami and Kusumawati (2020); Lukijanto, et al. (2022); and Claresta and Baldauf (2022).

The Strait of Malacca is the 3rd busiest in the world. There are lots of economic activities and also other activities such as commercial ships, and ships that are of importance to the country, such as warships, and others. The permit to carry out piloting activities has been running in this area. Permission for this was given to Pelindo and is still carried out physically (not digitally) and is still voluntary and not compulsory or obligatory. Mandatory pilot waters rules are set forth in the Minister of Transportation Regulation No. 57 of 2015 concerning Guiding and delaying ships, in the interests of shipping safety and security as well as smooth traffic at ports. Therefore, it is very important to continue to improve the quality and reliability of ship pilotage services (towage and pilotage) at the port. However, the current condition is that services, in the end-to-end process starting from planning order activities, dispatching, and executing pilotage services, are still carried out manually without any supporting applications so there is limited visibility of resources. As a new breakthrough effort, the ship piloting service business process has been switched to an online digital system, using SIPANDU (Port Ship Piloting Service Information System), which has been integrated with INAPORTNET at the Ministry of Transportation.

In carrying out ship piloting and towing there are several things that must be taken into account: (i). The limited number of piloting officers is not proportional to the number that must be traveled (guided) so that several ships are guided at one time; (ii). If one of the ships must be served in shifts, this will result in departures not being on time or waiting time; (iii). Sometimes the pilots don't write down the time of boarding the ship and the guide's end because usually the pilots are tired after carrying out the service (Human error). Since 1971 until now, the Ministry of Transportation, cq the Directorate General of Sea Transportation, has produced 1,769 Pilot Officers. Of this number, there are 1,086 Pandu workers whose certificates are still active. This number is of course still inadequate when compared to the existence of pilot waters that must be served. The number of Pilot Certificates from 1971 to February 2019 totaled 1,546 Certificates consisting of Number of Pilot Actively Participating in Pilot Certificate Endorsement is 909 Certificates, namely Piloting Level II 422 Certificate, Piloting Level I 533 Certificates, and Sea Piloting 28 Certificates.

Currently, based on variations in water characteristics and the level of difficulty of sailing, the Government has designated 155 water areas in Indonesia as guided waters, consisting of 32 Class I Compulsory Guided Waters areas, 31 Class II Compulsory Guided Waters areas, and 30 Class II Compulsory Guided Waters areas. Class III, as well as 62 water areas as Extraordinary Pandu Waters. In order to maintain the safety of the ship and its cargo when the ship enters the shipping channel towards the port pool to dock/dock at the pier, the captain needs an advisor, namely a guide. The presence of pilots will cut the waiting time. Waiting time is one of the factors that influences the operational performance of port services and shows whether transportation management at a port is good or not. The shorter the waiting time, the better the service and transportation management, and vice versa. This delay of ± 2 (two) hours can be said to be wasted (non-productive) time which must be accepted by the captain or ship's crew (Prasetia et al., 2021). The more time wasted, the greater the costs incurred by the ship, while the ship's engine must not be turned off (Tandung, et al., 2020).

Based on the explanation above, the limited fleet of pilot boats and tugs is the cause of less-than-optimal pilot services. (Widodo et al., 2019) so the gap in this research is that there is research space on the problems and obstacles to implementing digitalization guidance by describing the impact of digitalization on the National Economy. This dissertation also explains the role of new breakthrough efforts, namely the ship piloting service business process has been switched to an online digital system, using SIPANDU (Ship Piloting Services Information System at Ports), which has been integrated with INAPORTNET at the Ministry of Transportation. Utilization of this application system has been proven to provide added value to reliable services both qualitatively and quantitatively so that there is more focus on reducing logistics costs. As the latest breakthrough effort and to prevent abnormal conditions, it is necessary to change new business processes by abandoning manual ship piloting services by switching to an online digital system based on artificial intelligence.

Theoretical Basis

The Linkage of Economic Growth Theory with the Maritime Sector

The current maritime economic contribution to GDP is 6.4% and the future projection is 12.5% in 2045. The maritime development strategy contained in Indonesia's 2045 vision is: (i). The maritime economy continues to increase its contribution to 12.5% of GDP in 2045, through the development of efficient and effective sea connectivity, sustainable and competitive fisheries industrialization, and inclusive marine tourism; (ii). Improving maritime civilization by creating superior quality important human resources, maritime technological innovation, and a strong maritime culture based on maritime civilization; and (iii). Realizing Maritime Strength, by increasing defense capabilities, strong maritime security, and reliability in facing regional and global challenges.

Indonesia is one of five countries classified as an archipelagic state according to the United Nations Convention on the Law of the Sea (UNCLOS) in 1982. With its status as an archipelagic state, Indonesia has high marine potential, this is supported by Indonesia's vast sea area. amounting to 3.25 million km2 and 2.55 million km2 is the Exclusive Economic Zone. Apart from the vast sea, Indonesia is also supported by the number of ports spread throughout Indonesia. Based on the Ministry of Transportation (2020), there are 2,439 port names spread from Sumatra to Papua.

Digitalization Theory

Vessel Traffic Service Vessel traffic service (VTS) according to IMO is a shore-side system that ranges from providing simple information messages to vessels, such as the position of other traffic or warnings of meteorological hazards, to extensive traffic management within ports or waterways (IMO, 2020). This VTS can be useful for ship safety, namely by avoiding the risk of collisions between ships, grounding, and helping smooth ship movements so

that ship operations can be optimal. VTS, according to Mudiyanto & Febriana, (2021), works 24 hours a day and is equipped with VHF radio communication equipment, radar, and CCTV which can record and monitor ship traffic as well as violations or criminal acts such as smuggling, piracy, illegal transactions, and water pollution in water areas, especially waters around the port. The research results of Siswoyo, (2020), show that the implementation of this VTS system can help and reduce the risk of losses from ships so that ship traffic at the port can be monitored and performance can increase without forgetting the safety of the ship itself. Based on the discussion of digital technology developed by Indonesian Ports from the seaside, as stated above, the aim is to improve service performance from the ship side so that the waiting time for ships to be served is faster and more precise and costs can be reduced. Apart from that, the digital technology developed can streamline the operational costs of Indonesian Ports themselves so that services can be provided optimally and increase the competitiveness of Indonesian Ports. Suhartono, (2022), explained that apart from efficiency and effectiveness which are the result of digital development, we must not forget the safety factor of the ship itself so that ships stopping at Indonesian ports feel comfortable and safe and can increase sailing time.

Laws and Regulations Relating to Ship Guiding

The application of e-pilotage to the implementation of remote pilotage has complied with all existing regulations; both international regulations and domestic regulations. Regarding international regulations, among others, following the 1982 United Nations Convention on the Law of the Sea (UNCLOS); International Convention on Safety of Life at Sea (SOLAS) 1974; IMO Conventions and Codes; then SOLAS Chapter IV 1974, Radio Communication; SOLAS Chapter V 1974, Safety of Navigation; Navtex Manual; and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidelines and Recommendation. Meanwhile, domestic regulations start with Law Number 17 of 2008, Government Regulation Number 5 of 2010 concerning Navigation, Minister of Transportation Regulation Number PM 18 of 2022 concerning Automatic Identification Systems for Ships Carrying Out Activities in Indonesian Territory, and Regulations of the Minister of Transportation Number 4 of 2023 concerning Shipping Telecommunication Operations and Ship Traffic Management Services in Indonesian Waters.

The government has also established mandatory piloting of waters as outlined in Minister of Transportation Regulation No. 57 of 2015 concerning Guiding and Towing Ships, in the interests of shipping safety and security as well as smooth traffic at ports. Because it is related to the smoothness, security, and safety of the ship being guided is the main thing in the implementation of ship piloting, because the consequences that can result from negligence in ship piloting activities can affect the smoothness of ship traffic in the port, even on the waters and the environment. Article 1 (4), states that a pilot is a sailor who has expertise in the field of nautics and has fulfilled the requirements to carry out ship piloting. Guide personnel will assist the captain in providing advice, information, and instructions to the captain regarding the condition of local waters, which means that the ship's responsibility remains entirely with the captain. Pilot personnel also have a very important role in creating a level of safety for ships entering and exiting a port, as well as facilitating national logistics distribution. Ship piloting services are the first and last service provided to ships that will stop at a port. Therefore, it is very important to continue to improve the quality of service.

Research Methods

This research uses a qualitative approach with primary data sources. Primary data was obtained through presentations from informants/relevant agencies through Focus Group Discussions (FGD). In carrying out an FGD, there are several things that must be considered in selecting participants, namely: (i). Who has info; (ii). Able to tell; (iii). Engage directly; (iv). Willing & ready; (v). Consciously involved; and (vi). Credible (Carey, 1994; Dick, 1996; Sena & Fairdian, 2014; McLafferty, 2004; Streubert & Carpenter, 2003; Raco, 2010). The FGD method has a high level of difficulty and the influence of a moderator or interviewer also greatly determines the final results of data collection (Lambert & Loiselle, 2008; Lehouux, et al., 2006; Steubert & Carpenter, 2011; and Leung, et al., 2005). Furthermore, from an implementation perspective, the FGD method requires a conducive environment for optimal interaction between discussion participants (Lambert & Loiselle, 2008). Therefore, for credibility reasons, in this study, there were 6 (six) informants who represented the perspectives of stakeholders. The following is a profile of some related data, as follows:

Table 1. Informant Profile Adjusted to FGD

No	Informant	Occupation	Agency	Category
1	Dr. Umar Aris, SH., MH., MM.	Principal Policy Analyst	Ministry of Transportation	Regulators
2	Capt. Budi Mantoro, M.Si. M. Mar.	Navigation Director	Directorate General of Sea Transportation	
3	Capt. Barto	Head of Harbormaster	Belawan Port	Operators
4	Capt. Al-Abrar	Senior Manager Region 1	PT. Pelindo Jasa Maritim	
5	Pasoroan Herman Harianja	President	Indonesian Maritime Pilots Association	Association
6	Capt. Zainal Hasibuan	Head	Indonesian National Shipowener's Association (INAPA)	

Source: Author (2023)

Furthermore, the existing data will be analyzed using NVivo software, which is a qualitative data analysis software developed by Qualitative Solution and Research (QSR) International. According to QRS International (2013), the hierarchy analysis in NVIVO aims to see coding patterns and compare the amount of coding activity at each node (Bandur, 2019), so that researchers can carry out further investigations of nodes with a certain hierarchy. Furthermore, the comparison diagram in this case wants to see whether there are similar nodes in each case. Furthermore, the matrix code is used to identify the offense for each particular item (QRS International, 2013), where the matrix code is used in this study to see the relationship between each existing node. Furthermore is project mapping, where in this case a concise mapping of the problems will be carried out through existing sub-nodes.

Analysis of Result and Discussion

Description of Research Objects

Work accidents that have become safety fatalities in the Indonesian maritime sector in the last three years include work accidents that befell pilots, namely the breaking of guide ladder ropes during the implementation of pilotage services. The incident was recorded at KM. Tatamilau on 26 October 2017 at Merauke Harbor, Dumai Harbor on 19 December 2017, Balikpapan Harbor on 19 December 2017 until Pandu Class 37 Hendi Wandiantoni died, MV. Amartha Jaya I on December 22 2017 at Karang Jamuang, East Java. The Director General of Sea Transportation, Ministry of Transportation of the Republic of Indonesia, responded to work accidents that befell pilots while carrying out piloting services by issuing Circular Letter No. PP.30/12/20/DP-17 dated 19 December 2018 concerning Standardization of Guide Stairs. The circular instructs Harbormasters, Port Authorities, Harbormasters and Port Authorities and Port Management Units as pilotage supervisors, to: supervise the technical implementation of pilotage safety in waters where pilotage is carried out, report to the Director General of Sea Transportation regarding pilotage problems and obstacles along with suggestions for solving them. shipping safety and security, and ensuring the availability of pilot ladders on each ship that will be provided pilotage services in accordance with the applicable provisions as attached in this circular letter. Based on these considerations, port operational performance is a reflection of the results of port performance in providing services within a certain period of time.

Port operational performance will depend on ship visits at the port. The quantity and quality of ship visits are also influenced by pilotage services to and from ports. The rules regarding pilotage have been stipulated in the International Convention for the Safety of Life at Sea 1974 (SOLAS 1974), Minister of Transportation Regulation No. 57 of 2015 concerning Guidance and Delay of Ships and Regulation of the Minister of Transportation of the Republic of Indonesia No. PM 93 of 2017 concerning Ship Guidance Auxiliary Facilities and Infrastructure. Because of the importance of pilotage in supporting port activities, it is necessary to conduct research on the implementation of safety regulations for pilots at ports. The government has determined pilot mandatory waters as outlined in the Minister of Transportation Regulation No. 57 of 2015 concerning Guiding and Towing Ships, in the interests of shipping safety and security as well as smooth traffic at ports. Because it is related to the smoothness, security, and safety of the guided ship, it is the main thing in the implementation of ship piloting, because the

consequences that can result from negligence in ship piloting activities can affect the smoothness of ship traffic in the port, even on the waters and the environment.

Result of *Focus Group Discussion* (FGD)

As explained in the previous chapter, in this research, informants were divided into 3, namely: Regulators, Operators, and Associations.

a. Regulators

There are 2 relevant informants namely: Informant 1, Dr. Umar Aris, SH., MH., MM, and Informant 2, Capt. Budi Mantoro, M.Sc. M. Mar. In his presentation, informant 1 alluded to the impact of guiding on the economic aspect. The following is the statement in question: "What I understand is that ship piloting is a tool or system to condition the ship to be safe in sailing both departing from and going to the port so that piloting is needed. "The issue of pilotage activities has an impact on the economy, for example, it is one of the business sectors of BUP. Basically, according to existing laws and regulations, it is the government's right and the government's right in accordance with shipping laws."

Based on the quote above, it can be seen that the economic impact of ship piloting activities, one of which, comes from the Port Business Entity (BUP) which will provide PNBP to the state. Furthermore, the informant also mentioned the need for the availability of human resources in carrying out pilotage activities, that the technological aspect is able to make a significant contribution to ship pilotage activities and also has implications for increasing shipping security and safety, as well as the importance of synergy between stakeholders. The presentation by Informant 2 alluded to existing regulations. Informant 2 also touched on technological aspects related to ship piloting (E-Pilotage) which aims to provide an evaluation in preparing facilities and infrastructure in implementing sea piloting policies. Furthermore, the informant also touched on the HR aspect as a supporter of digital piloting activities.

b. Operators

There are also two informants, namely Informant 3, Capt. Barto and Informant 4, Capt. Al-Abrar. Informant 3's presentation touched on the geographical situation of Indonesia. Furthermore, Informant 3 also touched on the role of the technological investment required in relation to ship piloting activities. The recommended investment is not only targeted at the technological aspect, but also at the port infrastructure aspect. Furthermore, the informant also indicated that there were obstacles in the technological aspect (SIPANDU) that would have an impact on shipping activities that were less than optimal. The informant also implicitly mentioned the impact of piloting activities on Indonesia's competitiveness as a maritime country.

Furthermore, the presentation made by Informant 4 touched on regulations related to piloting activities. Informant 4 also mentioned the economic potential of shipping activities in the Malacca Strait, so that ship piloting activities are needed as well as obstacles to piloting activities in the Malacca Strait which has dense shipping activity. These obstacles target the availability of ship piloting services and existing human resources, so in this case the role of digitalization is needed to run activities smoothly.

c. Associations

There were two informants involved, namely Informant 5, Pasoroan Herman Harianja, and Informant 6, Capt. Zainal Hasibuan. The presentation by Informant 5 alluded to the types of ship piloting activities, the potential of the maritime sector for the economy, the role of a Pilot Officer (HR), and also the technology used to support ship piloting activities. Just like the previous informant, electronic ship piloting cannot replace the role of a pilot officer in carrying out ship piloting activities, so the presence of human resources is still needed in addition to the use of technology. Furthermore, the presentation made by Informant 6 alluded to the history of the emergence of ship-guiding activities, the reasons for conducting ship piloting, and the characteristics of Indonesia which are different from Finland, where technology dominates ship-guidance activities compared to human power. This is different from the condition in Indonesia which will experience a demographic bonus, so ship piloting activities in Indonesia still require a human touch (HR).

From the presentation tabulation above, the following is an aggregate coding hierarchy to see which nodes are the most dominant of all informants. The node system is divided into 4 (four) which refer to the formulation or research objectives that have been developed previously, namely: (i). Obstacles & Challenges in Implementing Compulsory Guidance Policy – Nodes 1 System; and (ii). Implementation of Mandatory Ship Piloting-Nodes System 2 policy. In addition, it will also show nodes with the highest hierarchy in the other node system, this is intended to explore other nodes outside the node system that has been built. In aggregate, there are at least 15 nodes with the highest

hierarchy. The following table describes the number of references in aggregate (including sub-nodes, if any) from each of these nodes, as follows:

Table 2. Aggregate Hierarchy Nodes Reference

No.	Nodes	Ref.	Files Coded	Max. Value	Share
1	Availability of Human Resources	6	6	6	100%
2	Availability of Facilities and Infrastructure	5	5	6	83%
3	Human Resource Competency	5	5	6	83%
4	Ship Guide Regulations	5	5	6	83%
5	Digital Pilotage > Sailing Safety	5	5	6	83%
6	Regulatory Transformation	4	4	6	66%
7	Digital Pilotage + Physical Pilotage > Shipping Safety	4	4	6	66%
8	Guide Ship > Macro Effects	4	4	6	66%
9	Pilote Exemption	3	3	6	50%
10	Digital Pilotage	3	3	6	50%
11	Stakeholder Synergy	3	3	6	50%
12	Ship Guide > PNBP	3	3	6	50%
13	Pilot Exemption > HR Availability	2	2	6	50%
14	Bureaucratic Ease	2	2	6	50%
15	Availability of E-Pilotage Regulations	2	2	6	33%
16	Technology Development > HR Synchronization	2	2	6	33%
17	Operational Standards	2	2	6	33%
18	Technology Readiness	2	2	6	33%
19	Ship Pilot Definition	2	2	6	33%
20	VTS Coverage > Logistics Costs	2	2	6	33%

Source: Processed Data (2023)

These results show that the 20 nodes above have the largest contribution to the overall hierarchy, both in terms of number of references and data sources (transcripts). This indicates that overall (3 categories of informants), both implicitly and explicitly, agree regarding the need for the availability of human resources related to. In addition, the “HR Availability” nodes have the highest resource value (6) with a total contribution of 100%.

Furthermore, it will be shown about the hierarchy of the Nodes1 System (Barriers & Challenges of Ship Guiding Policy). In the Nodes 1 System, "HR Availability" is the node with the highest number of references, namely 6 with a total contribution of 100%. Furthermore, the nodes "Availability of Facilities & Infrastructure and HR Competency nodes", respectively, have a number of references of 5, with a contribution of 83% each. Furthermore, are the Regulatory Transformation nodes with a total of 4 references with a contribution of 66%. These results mean that, in the context of obstacles and challenges in ship piloting policies, issues regarding the availability of human resources, facilities and infrastructure, and competence were most frequently mentioned by all informants.

Furthermore, the hierarchy of the Nodes 2 System (Implementation of Ship Guidance Policy) will be shown. In the Nodes 2 System, "Digital Pilotage > Shipping Safety" is the node with the highest number of references, namely 5 with a contribution of 83%. Furthermore, the other nodes (Digital Pilotage + Physical Pilotage > Sailing Safety, and Vessel Guiding > Macro Effects), respectively, have a reference count of 4, contributing 66% each. These results mean that, in the implementation context, electronic ship piloting activities will have an impact on shipping safety and also the macroeconomy.

Furthermore, the hierarchy of the Other Nodes System will be shown (things touched on outside the research objectives). In the Other Nodes System, "Ship Pilot Regulations" is the node with the highest number of references, namely 5 with a contribution of 83%. Furthermore, the other nodes (Potential of the Indonesian Maritime Sector, and Definition of Ship Pilots), respectively, have a number of references of 2 with a contribution of 33% each. These results mean that, beyond the stated research objectives, the informants touched predominantly on ship activity regulations and the potential of the Indonesian maritime sector.

Furthermore, there will be a comparative analysis between Regulators and Operators, Regulators and Associations, and Operators and Associations. This section is the second stage in coding analysis which is based on nodes or coding that was created previously in first cycle coding. The results illustrate the similarities in things mentioned by each informant (category). These similarities are displayed in the nodes located in the middle of the informant's case. The result can be drawn on a concept mapping as seen in the following figure.

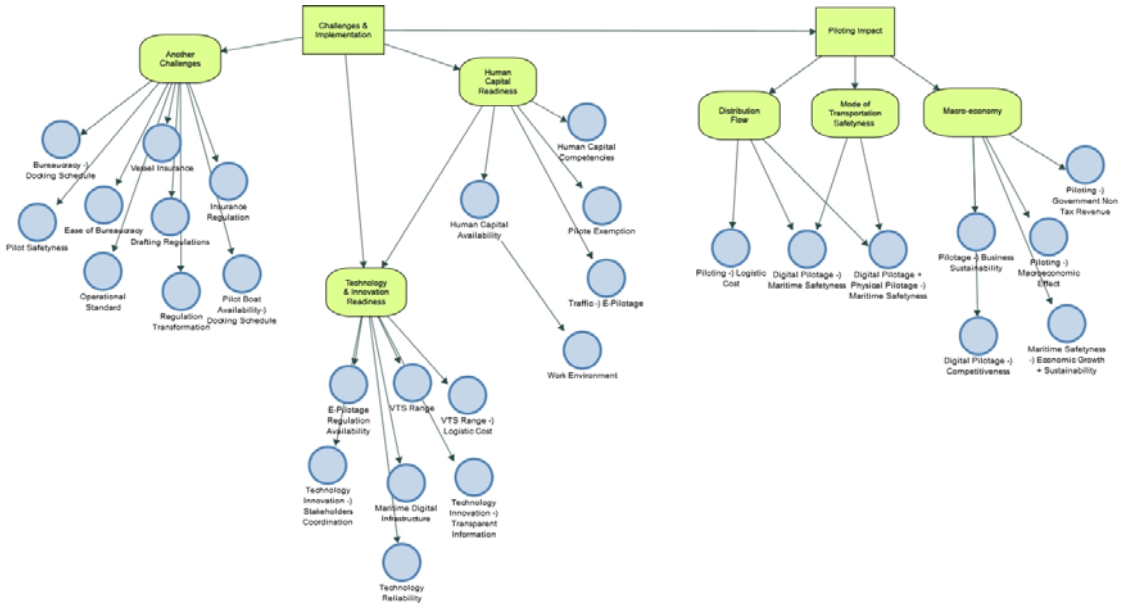

Figure 1. Concept Meta
Source: data processed

Based on the figure above, it can be seen that: (i). Obstacles and implementation are mapped in terms of technology & innovation, HR readiness, and other obstacles. On the technological aspect, it is necessary to have regulations regarding E-Pilotage, innovations that will have an impact on the openness and fluency of information, technology reliability, to digital facilities and infrastructure (VTS). The increase in the availability of facilities and infrastructure is considered capable of having an impact on logistics costs. In the Human Resources aspect, the level of competency, work environment, as well as matters regarding the availability of Pandu's human resources are mapped. It can be seen that the “HR Availability” nodes have a connection with Traffic > E-Pilotage. This is related to the use of digital technology in mandatory guiding activities which have a limited number of human resources. Furthermore, other obstacles are also mapped, such as regulations, bureaucracy, operationalization, and guide safety; (ii). Some of the impacts of mandatory piloting are also mapped, namely on: Aspects of the smooth flow of goods, modes of transportation, and the macroeconomy. The smooth flow of goods by means of transportation has connections at the same nodes, which is related to shipping safety. Apart from that, specifically in the flow of goods, the impact that will be felt is related to logistics costs. On the macro aspect, mandatory piloting activities have several effects, namely PNBP, competitiveness (impacting capital inflows), BUP business continuity, economic growth, and also sustainability; and (iii). When viewed as a whole, the obstacles mapped will have an impact on mandatory ship piloting activities. The impact of these activities will also target logistics, transportation modes, and the macroeconomy.

Conclusions and Policy Recommendations

Conclusions

Based on the results and analysis described previously, several conclusions can be drawn regarding this research, as follows:

a. The results of the coding processing show that the theme of this research is related to the economy (foreign direct investment) related to the implementation of long-distance digital ship piloting policies at Indonesian ports.

b. Qualitatively, the readiness of technology and innovation to support the mandatory ship piloting policy is not yet optimal. This can be seen from the VTS Affordability > Logistics Costs nodes where one of the informants mentioned the need to increase the role of VTS so that it does not cause long waiting times for ships while waiting for guides which will have an impact on logistics costs.

c. There are several obstacles found in the implementation of ship piloting activities which are predominantly mentioned by informants, such as: (i). Availability of human resources; (ii). HR Competency; and (iii). Availability of facilities and infrastructure. The availability of human resources is an aspect alluded to by all informants with a total contribution of 100%. This means that all the informants involved mentioned the problem of the availability of pilot human resources. The limitations of existing human resources will be resolved through the implementation of electronic ship piloting (Digital Pilotage), but this does not eliminate the role of HR (Pilot Officers) in operations.

d. The readiness of ship piloting human resources is considered not optimal, this is evidenced by the lack of pilot human resources compared to the amount of existing shipping traffic so the role of technology is needed to cover these deficiencies.

e. The mandatory pilot policy will have an impact on the smooth running of sea transportation modes. This is proven by the existence of the Ship Guide > Logistics Costs node. By implementing an electronic and physical ship piloting system, it will have an impact on the accuracy of ship schedules, which will have an impact on the efficiency of logistics costs.

f. Mandatory guidance policies will have an impact on the macro economy. This is shown by the existence of several nodes such as "Ship Pilot > PNBP", "Ship Pilot > Macro Effects", "Ship Pilot > BUP Business Sustainability". The addition of electronic ship piloting activities will increase revenues for the state in the form of PNBP through services provided by Port Business Entities (BUP). This will also have an impact on the sustainability of BUP's business in the future.

5.2. Policy Recommendations

a. The relationship between aspects of Technology and the maritime transportation sector is shown in the results of mapping the Maritime Technology keyword network which contains nodes such as Digital Transformation, Disruptive Technology, Innovation, Maritime Operations, Shipping Documents, Shipping Industry, Standardization, Standard, Business Opportunities, digital innovation, digital technologies, logistics centers, Maritime Supply Chain, Blockchain, Blockchain-Based Maritime Supply Chain, Implementation Challenges, and Operations Management. This indicates that digital transformation studies in the maritime sector have been carried out before and the two are interrelated. The relationship between technological aspects and sea/maritime transportation from 31 articles is also related to the maritime industry supply chain (Maritime Supply Chain).

b. The relationship between aspects of Human Resources (HR) and the maritime transportation sector is shown in the results of mapping the Maritime Innovation keyword network which contains nodes such as Collaborative Innovation, Human Capital, Maritime Industry, The Adriatic Region, and University. This indicates that studies regarding Human Resources in the maritime sector have been carried out before and the two are interrelated. As for the relationship between the 11 selected articles, one of them is related to the role of university institutions and innovation collaboration. Based on a previous study, universities/universities play a significant role in HR transformation through their collaborative role, but there are still limitations in the availability of research development.

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