Pre-Feasibility Study of Business Stream that Utilizing Automatic Identification System (AIS) Data

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Abstract. As maritime technology becomes more advance, it produces a large number of data with various information. The information could be obtained from the system which is transmitting data such as AIS (Automatic Integrated System), VTS (Vessel Traffic Services), IBS (Integrated Bridge System), LRIT (Long-Range Identification and Tracking), and so on. An integration of this data can produce useful form of information. It leads to an opportunity for parties whose can manage those information to become a new form of business. The idea is to manage data to become information which can support maritime stakeholders. This research proposes a process in developing various business models by integrating AIS data with other relevant data and then further evaluated using a Financial Analysis. This research is expected to be a reference in fulfilling the needs of maritime stakeholder and providing an overview of businesses which are feasible to be conducted.

1. Introduction
Maritime transport is the foundation of world wide trade, accounting for about 80% of all goods volume transported \cite{1}. Due to the size of the network that maritime logistics companies operate, they face large scale planning problems at the strategic, tactical and operational level \cite{2}. Making decisions regarding maritime logistics to ensure safety, minimize cost and improve productivity means taking into account a large number of parameters susceptible to change. This is further complicated by the limitations of ship-to-shore communication, which is why the maritime industry is traditionally not information intensive \cite{3}.

IMO (International Maritime Organization) through SOLAS Chapter V regulates the use of AIS to increase the level of security and safety at sea. The AIS system was originally designed for radar augmentation and vessel traffic services (VTS), but AIS data can be used to collect information about traffic in a given area \cite{4}, which can be exploited in research, i.e. AIS becomes a source of big data. All vessels over 300 GT (gross tonnage) are obliged to be equipped with an AIS transponder, transmitting the static data every 6 minutes, while the dynamic messages transmitted every 2-12 seconds, depending on the speed of ship. The content of static and dynamic data are shown on table 1. For more than a decade, researchers have increasingly used AIS data to analyse maritime traffic in a number of issues such as ship surveillance, tracking, security, collisions, shipping noise levels, and vessel emissions \cite{5}. Current AIS research fields are danger score, hazard navigation map, AIS for vessel inspection, and AIS form emission distribution and monitoring \cite{6}. AIS data integration in real-
time can be used as a basis for monitoring traffic analysis, estimates of air pollution, and vessel inspections in real time [7].

| **Table 1. Data Transmitted by AIS** |
|-------------------------------------|
| **Static Data**                     |
| MMSI Number                         |
| IMO Number                          |
| Name and Call Sign                  |
| Length and Beam                     |
| Type of Ship                        |
| Flagstate                           |
| DWT                                 |
| **Dynamic Data**                    |
| Navigation Status                   |
| Longitude and Latitude              |
| Destination and ETA                |
| Speed over Ground                   |
| Heading                             |

Many existing studies has done and resulting a longlist of AIS potential use. But, there is a gap between research with the implementation. This research propose an assessment of some suitable potential support which can help maritime actors in doing their operations, giving insight about several services can be offered as business streams.

2. Method

The following sub-sections explain how the research is performed through several steps as briefly explained below.

2.1. Literature Review

Literature review are done to give insight of several AIS potential support. The literature to be reviewed has to be an AIS-based research. Beside, the problem in which maritime stakeholder facing is a good opportunity for business. The literature review resulting a longlist of potential support which can help maritime actors in doing their operations.

2.2. Analytical Hierarchy Process

The Analytic Hierarchy Process (AHP) is a basic approach to decision making [8]. The AHP on this research is used to prioritize some potential supports, leads to some potential business ideas. Criteria for resulting the shortlist are technical aspect, investment, and benefits. Each criteria containing two sub-criteria. The sub-criteria on technical aspect consists of data complexity and technology, the investment involve of cost and time to realize the idea, while the benefits is contained of potential users and the regulation it fulfilled.

Data complexity is one of the challenges in producing information. The more complex of the data needed, the more difficult it is to be processed into information. Beside, application with a lower level of technology would be favourable instead of the one that requires a high-end technology.

In terms of investment, a smaller cost application is much more interesting. While time is defined as the duration that an application can be used and implemented. Shorter duration needed are always better than the longer one. Potential users describe the number of users that could utilize the applications. While regulation or policy that comply the application is one of the benefit obtained.
2.3. Pre-Feasibility Study
A preliminary feasibility study is a preliminary assessment of the practicality of a proposed plan or project. Modelled businesses plan are to be assessed using economic and financial analysis in which contained of IRR (Internal Rate of Return), PP (Payback Period), and NPV (Net Present Value), and have to comply with the standard to be given.

3. Result and Discussion
In this section, this paper proposes some AIS-based application and it features based on literature review. An assessment is done using AHP method to give insight about the rating of application. The results are explained below.

3.1. Clustering Potential Support
Based on literature review, various potential support could be clustered according to various factors. This research proposed 7 application-based clusters and its features. The clusters and its bodies could be seen in table 2 to table 8 below.

| Early Warning System | Pipeline | Cable | Platform | TSS Area | Conservation Area | Buoy | Grounding |
|----------------------|----------|-------|----------|----------|-------------------|------|-----------|

The Early Warning System (EWS) has function to increase safety at sea. Vessel near marine infrastructure such as pipeline, cable, buoy, and offshore platform in which potential causing accidents will be warned, giving awareness for the operator to avoid the accident. Collisions between ships could also avoided by giving warnings which projected routes intersecting at the same time. In addition, this system can provide warnings to ships that are near conservation areas or have the potential to pass through them. Examples of other benefits are warnings for ships that have the potential to grounding.
Table 3. Shipping Efficiency

| Shipping Efficiency                  |
|-------------------------------------|
|                                    |
| Route Optimization                  |
| Forecast Port Delay                 |
| Analysed Traffic Between Ports      |
| Tug Performance                     |
| Port Performance                    |

Shipping efficiency can be improved by selecting the optimum routes. These features considering distance, time, speed, engine performance and fuel consumption, ship traffic density at sea and can forecast delays at ports, leads to shipping efficiency by slowing ship speed which lowering the fuel consumption. The tugging and port performance also could be assessed due to the fee it charges.

Table 4. Monitoring

| Monitoring & Security               |
|-------------------------------------|
| Vessel Movement Monitoring          |
| Vessel Traffic Monitoring           |
| Ship Engine Performance             |
| Emission Monitoring                 |
| Illegal Fishing                     |
| Transhipment                        |

Monitoring & security is an application to monitor the movement and condition/status of equipment on board using existing sensors. Engine performance could be monitored, which is possible to monitor the fuel consumption. Ship movement and traffic visualization can be done in real-time. To enhance the security and reduce illegal acts at sea, it could detect indications of illegal acts. Illegal fishing and transhipment can also be detected from their positions and or their suspicious behaviour.

Table 5. Fisheries

| Fisheries                           |
|-------------------------------------|
| Product Traceability                |
| Fish Finder                         |
| Ship-to-ship Fishing Location Sharing|
| Tracking Fishing Area               |

Fisheries is a feature that has a function in the field of fisheries. Ships connected to the system can sharing the locations which are rich in marine resources. Searching of fishing area could be done by tracking the movement of other fishing vessels. In addition, fish can also be tracked related to the location and time it captured. So, it can help the government to map and control the potential of maritime resources.

Table 6. Marine Accident & Impact

| Marine Accident & Impact            |
|-------------------------------------|
| Oil Spill/Discharge Trajectories    |
| Analysed Oil Spill/Discharge Impact |
| Identify Origin of Pollution        |
| Data Saving Cloud for Simulation & Investigation |

The trajectories of oil spills at sea can be projected by considering the conditions such as wave and tides. Then, it also can make an assessment of oil spill impact to the environment. In addition, simulation of ship movements in the past can also be done so that it can help in terms of investigation. The origin of pollution like oil discharge could be identified based on vessel movement data.
Table 7. SAR and Patrol

| SAR & Patrol               |
|----------------------------|
| Distribution of Vessel Debris from Marine Accident |
| SAR & Patrol Coordination  |
| Live-report of SAR & Patrol Operation              |
| Autonomous Patrol           |

Search operations depend a lot on the location and current condition of the ship when an accident occurs. The distribution simulation of vessel debris from marine accident could help search and rescue operations. SAR and sea patrol operations could be coordinated through this tools. The goal is that the operation could be optimally dispersed or not gather on an area. In addition, the process and results of the operation could be updated as a live-reports. Sea patrol could be done autonomously.

Table 8. Administration and Inspection

| Administration & Inspection       |
|-----------------------------------|
| Inspection Priority               |
| Documents Checking                |
| Clearance Publishing              |
| Tax audit                         |

Marine administration is an applicable tools related to administration. Its function is to provide ship documents data and their expiration date, so that checking and port clearance could be issued online. Thus, it can improve time efficiency. Ship logbook and cargo manifest are stored and updated in real-time. Existing data could be used for audit and investigation purposes.

3.2. Application Rating

The data processed using the Expert Choice software. With the aim of selecting an AIS-based application idea, the final results of the assessment can be seen in Figure 2 and Figure 3.

![Figure 2. Relative Weight of Criteria and Subcriteria](image)
The result shows that the criteria with the biggest relative weight is the benefit criteria, with the relative weight of 0.736. The sub-criteria that has the greatest relative weight is the potential user with a weight of 0.486.

The assessment shows that the value of the largest in sequence is the early warning system, shipping efficiency, monitoring & security, administration & inspection, marine accident & impact, fisheries, and SAR & patrol in the last position. Hence, the early warning system will be brought to a preliminary feasibility study.

3.3. Financial Analysis
The financial analysis conducted to evaluate the feasibility of a project. To do the financial analysis, some assumptions are required. The cost structure of the project can be seen in table 9 below, divided into 2 (two) category. The capital expenditure (CAPEX) are the cost needed to make an asset operable, while the operation expenditure (OPEX) are the cost to operate the asset.

| Description                                         | Value       |
|-----------------------------------------------------|-------------|
| Remote Based Station                                | IDR 140,150,000.00 |
| Main Based Station                                  | IDR 395,300,000.00 |
| Monitoring Station                                 | IDR 137,350,000.00 |
| Software Developer and Installation Service         | IDR 978,000,000.00 |
| **Total**                                           | IDR 1,650,800,000.00 |

| Description                                         | Value       |
|-----------------------------------------------------|-------------|
| Maintenance                                         | IDR 297,144,000.00 |
| Building, Internet, and Electricity                 | IDR 228,000,000.00 |
| Operator                                            | IDR 180,000,000.00 |
| **Total (Yearly)**                                  | IDR 705,144,000.00 |

The remote based station has the function to receive the radio signal of ship movement data, then convert and send it to the main based station server by the internet. The server will process the data becoming an information which then could be shown in the monitoring station. A dangerous condition would be noticed by the operator, whose will warn the ship to take an action to avoid accident.
The early warning system could be a very useful tool to protect offshore infrastructure and provide safety. To get those benefits, this service could be offered by a various price per month. The scenario could be seen in figure 4 and table 10 below.

![Present Value Graph](image)

**Figure 4. Present Value Graph**

**Table 10. Scenario**

| Price/Month | Year 3 | Year 4 | Year 5 | Payback Period (Year) |
|-------------|--------|--------|--------|-----------------------|
|             | IRR    | NPV (IDR) | IRR    | NPV (IDR) | IRR    | NPV (IDR) |           |
| 100M        | 9%     | 359,220,220 | 26%    | 1,504,790,242 | 35%    | 2,776,059,266 | 2,7 |
| 110M        | 21%    | 899,220,220 | 39%    | 2,404,790,242 | 48%    | 4,126,059,266 | 2,3 |
| 120M        | 33%    | 1,439,220,220 | 50%    | 3,304,790,242 | 59%    | 5,476,059,266 | 2,0 |

Figure 4 shows the present value of the early warning system provider, while the table 10 shows the financial evaluation. From the taken price scenario, the graph shows exponential line, indicating an increased profits every year. The first price scenario (100 M/month) took about 2.7 years to get the break even point, while the second scenario (110 M/month) took 2.3 years, and the last scenario (120 M/month) took 2 years. The minimum acceptable IRR for one particular company could be 15% while for others could be 20% or 25%. With this condition, the most acceptable condition is the second scenario for a 3 years project, followed by the first scenario for a 4 years project.

**4. Conclusion**

There are many advantages obtained by combining AIS data with other relevant datas. This research proposes 7 application ideas and brought them into an assessment. From the assessment, it can be concluded that there is a tendency towards the benefits offered from the application. Especially, how the application can be utilize by a number of users. Hence, it put the early warning system to the top position.

An early warning system service could be best offered on a 3 years duration with the service price of IDR 110 Million per month, with an IRR of 21% and a positive NPV, reach the break even point in
about 2.3 years. The second best service are offered to IDR 100 Million per month service over 4 years with an IRR of 26% and positive NPV, taking 2.7 years for it payback period.

However, one of the main challenges is to develop software or application which could be commercialized to support maritime stakeholders and improve their performance. This research could be a reference to do so.

5. References

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