AI-Based Strategy in Building Competitive Advantage and Sustainability of Blue Economy Industry in North Sulawesi

Noviaty K. Darmasetiawan1,*, Andri Rianawati[2], Faizal S. Hadi[3], Juliani D. Trisnawati[4], Edmund Nathaniel[5], Dessy A. Christy[6]

[1, 2, 3, 4] *University of Surabaya, Indonesia*
[5] *Massey University, New Zealand*
[6] *Université Paris Crêteil, France*
[*]*Corresponding author. Email: noviatykds@staff.ubaya.ac.id*

ABSTRACT
North Sulawesi is one of Indonesia's strategic regions that has great potential in the blue economy sector, especially in fisheries, marine tourism, and marine energy. However, the challenges of sustainability and global competitiveness demand an innovative approach. This article examines the role of artificial intelligence (AI) as a strategy to strengthen the competitiveness and sustainability of the blue economy sector in North Sulawesi. Through a literature study approach and contextual analysis, it was found that AI is able to support efficient marine resource management, increase the productivity of the marine sector, and encourage digital transformation in the blue economy ecosystem.

Keywords: *Artificial Intelligence, Blue Economy, Competitive Advantage, Sustainability*

1. INTRODUCTION

Blue economy emphasizes the sustainable use of marine resources to support economic growth, job creation, and marine ecosystem preservation. North Sulawesi, with its rich marine biodiversity and strategic geographical location, is a potential area in the development of the national blue economy.

The potential of the blue economy sector in North Sulawesi is very large and strategic, supported by its geographical position in the heart of the world's coral triangle and directly bordering countries in the Asia-Pacific region. The following are the main potentials that stand out: (1) Fisheries and Aquaculture. Capture fisheries are one of the main sectors, especially in Manado Bay, Bitung, and the Sangihe-Talaud waters. The leading products produced by North Sulawesi are tuna, skipjack, mackerel, and demersal fish. Bitung is a national-scale fishing port that exports marine products to Japan, China, and Europe. In addition, aquaculture (marine and brackish water cultivation) is growing rapidly in Minahasa and Bolaang Mongondow. (2) Marine Tourism. Bunaken Marine Park is internationally renowned as a world-class diving destination with more than 300 types of coral reefs. The Sangihe, Lembeh, and Bangka regions also have marine ecotourism rich in biodiversity. Sustainable tourism potential: diving, snorkeling, dolphin watching, mangrove tourism, and traditional coasts. (3) Marine Transportation and Logistics. Bitung Port is the gateway for exports and imports in eastern Indonesia, and part of the sea toll program. Designated as a marine logistics hub to the Southern Philippines and the Pacific through the IMT-GT (Indonesia-Malaysia-Thailand Growth Triangle) and BIMP-EAGA collaborations. (4) Marine Renewable Energy. Huge potential in ocean current and wave energy, especially in the Sangihe-Talaud waters. Undersea geothermal energy (ocean thermal energy conversion/OTEC) has not been explored yet, but has future prospects. (5) Marine Conservation and Ecosystems. The coastal area of North Sulawesi is a hotspot for world marine biodiversity. There are several marine conservation areas (MPA), including the Bunaken Marine National Park and the Lembeh Coastal Conservation Area. It is a potential location for a blue carbon project through mangrove and seagrass restoration. In general, North Sulawesi prioritizes the concept of a blue economy and positions this sector for a promising future (Annur, 2024).

However, the level of utilization (development) of the marine economy is estimated to be only around 25% of its total potential [2]. There are various challenges that need to be responded to, including (1) limited data and digitalization of the marine sector, (2) illegal fishing activities (IUU fishing), (3) degradation of the marine environment due to coastal development and waste, (4) lack of local community involvement in technological innovation. However, various

challenges such as overfishing, ecosystem degradation, and technological inequality are obstacles to realizing the sustainability of this sector. Therefore, strategic technology-based innovation is needed, one of which is through the use of artificial intelligence (AI), to build sustainable competitive advantages (Chapsos I, Hamilton S, 2024).

One of the strategies for increasing competitive advantage and sustainability of the blue economy sector through the use of artificial intelligence (AI) is the use of Information Technology (IT), both internal IT and outsourcing IT with fisheries start-ups (Nurhikmayani R., Daryono B. S., Retnaningrum E., 2019). Currently, there are several fisheries start-ups available such as aruna, efishery, jalatech, fishlog, minapoli, banoo, and venambak (Blaber S. J. M., *et al.*, 2009). The fisheries IT is intended to make it easier for fishermen in terms of production, capital, networking, processing and marketing. The use of IT is expected to reduce costs, accelerate fisheries production and minimize the potential for fish harvest failure. In addition, the presence of technology in the fisheries sector can reduce transaction costs (Pedroza-Gutiérrez C., 2019). Therefore, in this study, the following problems are proposed: (1) What are the Potential and Challenges of the Blue Economy in North Sulawesi? (2) How is the Implementation of Artificial Intelligence (AI) strategies in creating competitive advantages and sustainability of the blue economy in North Sulawesi.

The aim of this research is to gain an overview of (1) the potential and challenges of the Blue Economy in North Sulawesi (2) the implementation of artificial intelligence (AI) strategies in creating competitive advantages and sustainability of the blue economy in North Sulawesi.

2. LITERATURE REVIEW

2.1. Blue Economy

The concept of the blue economy emphasizes economic growth that is in harmony with the sustainability of marine ecosystems (Wenhai L, *et al.*, 2019). The main sectors in the blue economy include fisheries, aquaculture, marine transportation, marine tourism, and marine-based renewable energy. Bari (2017), blue economy is defined as the separation of socio-economic activities from environmental degradation, with the aim of optimizing the benefits that can be obtained from marine resources. This concept emphasizes the use of the sea and its resources for sustainable economic development, by maintaining the welfare of society and the sustainability of the marine environment (Bari A., 2017)

2.2. Artificial Intelligence based Strategy in Industry

AI refers to systems that can mimic human intelligence in analyzing data, making decisions, and automating processes. In the marine context, AI is used in detecting fish migration patterns, predicting marine weather, optimizing port logistics, and data-based marketing. Alet (2024) identified four critical dimensions in integrating AI into business strategy: AI-focused strategy, customer understanding, effective interaction with customers, and effective AI implementation. These four dimensions are considered essential for the successful integration of AI into business strategy.

Samarasinghe and Medis (2020), proposed a conceptual model that focuses on the use of AI to increase competitive advantage through more efficient and effective human capital management in the Industry 4.0 era. Meanwhile, Shi, et al. (2024) proposed an AI strategy framework consisting of three layers: AI strategic competencies, AI use cases, and AI supporting actors. This approach differentiates AI strategies based on the size and orientation of the company, such as small and medium enterprises (SMEs), large technology companies, and traditional companies (Shi, Gebauer, & Javadi, 2024). In addition, Al-Surmi et al (2020), said that AI can assist in decision making, combining marketing strategies and information technology to improve operational performance. This model uses artificial neural networks (ANN) to explore the optimality of strategy combinations and shows superior performance compared to existing strategies.

2.3. Competitive and Sustainable Advantage

Competitive advantage in an industrial context means the ability to create higher value than competitors, while sustainability emphasizes the balance between economic growth, environmental sustainability (Appiah MK, *et al*., 2023) and social welfare (Bennett NJ., *et al.*, 2019)

Resource Based View (RBV) is an analytical approach that emphasizes increasing competitive advantage originating from the organization's strategic resources. Competitive advantage allows companies to obtain superior performance. The development of the RBV over the decades has made contributions to the fields of economics and strategic

management that either seek to refine the RBV concept or use it as a framework for addressing conceptual and empirical questions. Based on studies from J. Mahoney and J. Rajendran, in general the discussion of RBV can be viewed from three perspectives: First, a review based on the concept of strategic management which includes competitive advantage, including theories related to returns and performance in the field of strategy. Second, the RBV approach in economic organizations is related to positive agency theory, property rights, transaction cost economics and evolutionary economics. Third, the RBV approach is oriented towards industrial organization analysis (Rianawati A. *et al., 2024).*

The RBV principle as a theory of competitive advantage states that sustainable competitive advantage requires companies to obtain economic rents or returns. Furthermore, it will focus on how the company gains and maintains excellence. It also answers the question of what must be done with resources to be competitive. Resource characteristics that have advantages can be obtained if the resource has unique value, is difficult to imitate and is difficult to obtain substitute goods. The RBV is a choice of strategies that will be carried out to develop and maximize returns. The main contribution of the resource-based view of the firm is the theory of competitive advantage. The basic logic is to start with the assumption that the desired outcome of managerial efforts in a company is sustainable competitive advantage. Achieving sustainable competitive advantage allows companies to obtain 'economic rent' or above average returns. This focuses attention on how companies achieve and maintain excellence. The RBV argues that maintaining competitive advantage lies in the ownership of certain key resources, namely resources that have characteristics such as value, barriers to duplication. Advantage can be obtained if the company effectively optimizes these resources. RBV emphasizes strategic choices, optimizing resources. Penrose also states that resources are not only physical but can also be non-physical (Rugman & Verbeke, 2002). In other words, the services produced by resources are a function of the resources used, in the sense that the same resource is used for the same purpose ((Rianawati A. *et al., 2024).*

3. RESEARCH METHODS

This research entails a focus on the topic of AI-Based Strategy in Building Competitive Advantage and Sustainability of Blue Economy Industry in North Sulawesi. The research used qualitative descriptive method. It is used phenomenological approach, a qualitative research, where the researcher knows the position at the time of data collection in the field and becomes the data interpreter (Moleong, 2011), to analyze this topic through the experience, opinions, thoughts, and feelings of several parties as stakeholders in the blue economy sector of Bitung City, North Sulawesi, consisting of the Mayor of Bitung City, Maritime Affairs and Fisheries Service, Ministry of Tourism and Marine Tourism in Bitung City, Actors Capture Fisheries Businesses and Exporters, Capture Fisheries SMEs Business Actors, Academic Professors in the field of Maritime Affairs and Fisheries, who have implemented resources and strategic management in blue economy. The sampling technique used in this research was snowball and purposive sampling, that is, sampling technique from the data source with a certain consideration. It is said to be snowball sampling because initially only one key person was known as an informant, then the informant invited several other stakeholders who were deemed capable of completing the required information (Sugiyono 2013).

Data collection techniques for a qualitative method used in-depth interviews and focus group discussion. Data analysis techniques for the qualitative method using (1) data reduction, data collected from the field in the form of results in-depth interview and observation, recorded in detail and thorough, then summarized, selected key points, focus on the things that are important and sought the theme and the pattern. After that, (2) displaying data after the data was reduced, then the next step was to perform the presentation of data. The presentation was done in the form of a brief description, making the chart, the relationship between categories, the flowchart in this study using narrative text. And the last step was (3) drawing conclusion/ verification is the withdrawal of conclusions and verification (according to Miles & Huberman instead of Sugiyono 2013).

Descriptive data sources come from primary data and secondary data from scientific articles, policy reports, and relevant secondary data regarding the application of AI in the blue economy sector, especially in coastal areas of Indonesia.

4. DISCUSSION

4.1. Potential and Challenges of Blue Economy in North Sulawesi

North Sulawesi has a very large blue economy potential, which if managed strategically and sustainably, can be the main driver of regional economic growth. Some of the leading sectors that are relied upon include: (a) Capture fisheries and aquaculture: The waters of North Sulawesi are rich in marine biodiversity, making the fisheries sector the backbone of the regional economy. This region has great potential in the development of marine aquaculture (mariculture) such as grouper, tuna, and seaweed. (b) Marine tourism: The beauty of the underwater world such as in the Bunaken Marine Park makes North Sulawesi a world tourist destination. Marine ecotourism is a great opportunity to improve the local

economy while preserving the environment. (c) Marine transportation and marine export ports: The strategic geographical position supports the development of marine logistics routes and export ports, which play an important role in the global value chain of marine commodities. However, there are several major challenges that can hinder this potential if not addressed: (a) Limited marine and ecosystem data makes planning and management less effective. (b) Uneven distribution of human resources skills, especially among fishermen and small and medium business actors, is an obstacle to technology adoption. (c) Limited access to digital technologies, including internet infrastructure and modern devices, widens the digital divide between coastal and urban areas.

4.2. Implementation of Artificial Intelligence (AI) Strategy in Creating Competitive Advantage and Sustainability of Blue Economy in North Sulawesi

AI Strategy Can Drive Excellence and Sustainability. The application of artificial intelligence (AI) is a key strategy in addressing the above challenges and creating competitive advantages and sustainability of the blue economy in North Sulawesi. This strategy can be applied in various sectors as follows: (a) AI for Fisheries Resource Management. Efficient and sustainable fisheries management requires accurate data and an adaptive monitoring system. AI technology can be used for: detecting fish populations through satellite image analysis and drone monitoring, so that fishermen can identify potential fishing locations, predicting fish migration patterns and fishing seasons with machine learning based on historical data and environmental factors, to avoid overfishing and support the sustainability of fish stocks, and automating logistics and cold chains, from transporting catches to distributing them to markets, to maintain product quality and reduce waste. (b) AI in Aquaculture, namely the marine cultivation sector can increase productivity through: real-time monitoring of water quality and fish health with IoT sensors integrated with AI, enabling early detection of changes in environmental conditions. An automatic feeding system that adjusts fish nutritional needs precisely, reduces waste and accelerates growth. Early detection of disease through analysis of fish behavior and health, helps reduce the risk of economic losses due to outbreaks. (c) AI in Marine Tourism is aimed at increasing the appeal of marine tourism and intelligent destination management, AI can be applied in: Personalizing tourist experiences through digital preference and behavior analysis, so that tourism promotions and services are more targeted. The use of virtual reality (VR) and AI-based chatbots for interactive destination promotion, increasing engagement of potential tourists before visiting. Predicting the impact of tourism on the environment, helping destination managers in making data-based policies to maintain the carrying capacity of the ecosystem. (d) AI in Marine Environmental Protection. Marine conservation is an important element in a sustainable blue economy. AI technology can support these efforts through: Automatic identification and mapping of marine debris, enabling more targeted and efficient clean-up actions. Detecting coral reef damage using computer vision from underwater imagery, accelerating the monitoring and intervention process. Predicting the impact of climate change on marine ecosystems with predictive AI models, which can be the basis for long-term mitigation and adaptation.

5. CONCLUSION AND RECOMMENDATIONS

From the results of the research conducted, it can be concluded that artificial intelligence is a strategic instrument to encourage competitive advantage and sustainability in the development of the blue economy in North Sulawesi. However, its success is highly dependent on the readiness of digital infrastructure, adaptive regulations, and active participation from local stakeholders.

Meanwhile, the recommendations that can be given are: (1) increased investment in coastal digital infrastructure is needed, (2) Strengthening the AI-based marine innovation ecosystem is very necessary; (3) For further research, this research is a preparation of a blue economy roadmap, especially related to digitalization and AI, and is an initiation of a pilot project in the fisheries and marine tourism sectors.

REFERENCES

All You Need to Know About Resource-Based View n.d. https://strategicmanagementinsight.com/tools/resource-based-view/ (accessed March 23, 2024).

Annur CM. Indonesia Punya 16 Ribu Pulau, Sebagian Besar Ada di Timur 2022. https://databoks.katadata.co.id/datapublish/2022/02/27/indonesia-punya-16- ribu-pulau-sebagian-besar-ada-di-timur (accessed March 23, 2024).

Appiah MK, Ameko E, Asiamah TA, Duker RQ. Blue economy investment and sustainability of Ghana's territorial waters: an application of structural equation modelling. International Journal of Sustainable Engineering 2023:1–15. https://doi.org/10.1080/19397038.2023.2195422.

Bappenas. (2022). Rencana Aksi Ekonomi Biru Indonesia 2022–2045. Kementerian PPN/Bappenas.

Bennett NJ, Cisneros-Montemayor AM, Blythe J, Silver JJ, Singh G, Andrews N, et al. Towards a sustainable and equitable blue economy. Nat Sustain 2019;2:991–3.

Blaber S. J. M., Dichmont C. M., White W., Buckworth R, Sadiyah L., Iskandar B., *et al*. Elasmobranchs in southern Indonesian fisheries: The fisheries, the status of the stocks and management options. Rev Fish Biol Fish 2009;19:367–91. https://doi.org/10.1007/S11160-009-9110-9/METRICS.

Chahal H, Gupta M, Bhan N, Cheng TCE. Operations management research grounded in the resource-based view: A meta-analysis. Int J Prod Econ 2020;230:107805.

Chapsos I, Hamilton S. (2024), Illegal fishing and fisheries crime as a transnational organized crime in Indonesia. Trends Organ Crime 2019;22:255–73. https://doi.org/10.1007/S12117-018-9329-8/METRICS.

FAO. (2020). The State of World Fisheries and Aquaculture 2020. Food and Agriculture Organization of the United Nations.

Iyengar K, Sweeney JR, Montealegre R. Information Technology Use as a Learning Mechanism. Mis Quarterly 2015;39:615–42.

Jin Y, Vonderembse M, Ragu-Nathan TS, Smith JT. Exploring relationships among IT-enabled sharing capability, supply chain flexibility, and competitive performance. Int J Prod Econ 2014;153:24–34.

Morgan NA, Slotegraaf RJ, Vorhies DW. Linking marketing capabilities with profit growth. International Journal of Research in Marketing 2009;26:284–93.

Nurhikmayani R., Daryono B. S., Retnaningrum E. Isolation and molecular identification of antimicrobial-producing Lactic Acid Bacteria from chao, South Sulawesi (Indonesia) fermented fish product. Biodiversitas 2019;20:1063–8.

Pedroza-Gutiérrez C. Seafood Supply Chain Structure of the Fishing Industry of Yucatan, Mexico. Viability and Sustainability of Small-Scale Fisheries in Latin America and The Caribbean, vol. 19, Springer, Cham; 2019, p. 353–78. https://doi.org/10.1007/978-3-319-76078-0_15.

Putra, I. M. (2023). Teknologi dan Inovasi dalam Ekonomi Biru Indonesia. Jurnal Ekonomi Kelautan, 12(2), 45-56.

Rianawati A, Darmasetiawan NK, Hadi FS, Oktavianus J, Utama CA. Enhancement of Indonesia's blue economy sector through innovation and competitive advantage based on Resource-Based View theory. Problems and Perspectives in Management. 2024 May 3;22(2):165-81.

Rianawati A, Darmasetiawan NK, Hadi FS, Joshua O. Peningkatan Akuakultur Di Wilayah Jawa Timur Melalui Strategi Inovasi Dengan Pendekatan Matriks TOWS. Management Studies and Entrepreneurship Journal (MSEJ). 2024 Jan 30;5(1):1518- 31.

Sardana D, Terziovski M, Gupta N. The impact of strategic alignment and responsiveness to market on manufacturing firm's performance. Int J Prod Econ 2016;177:131–8.

Sugiyono, D. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D*.

Sun H, Hong C. The alignment between manufacturing and business strategies: its influence on business performance. Technovation 2002;22:699– 705.

Terziovski M. Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. Strategic Management Journal 2010;31:892–902.

UNESCO. (2021). Artificial Intelligence in Ocean Science and Management. United Nations Educational, Scientific and Cultural Organization.

Wenhai L, Cusack C, Baker M, Tao W, Mingbao C, Paige K, *et al*. Successful blue economy examples with an emphasis on international perspectives. Front Mar Sci 2019;6:261.

Wernerfelt B. A resource-based view of the firm. Strategic Management Journal 1984;5:171–80.

What is the Blue Economy? n.d. https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy (accessed March 23, 2024).

World Bank. (2017). The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries.