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The Effective Business Model for Commercialization of ROV Products in Indonesia

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Abstract

This research explores innovative business models for commercializing Remotely Operated Vehicles (ROVs) in the Indonesian market. By analyzing existing case studies and conducting interviews with industry experts, this study identifies potential business models such as ROV-as-a-Service, technology licensing, and joint ventures. The findings highlight the importance of tailoring business models to specific market segments and leveraging digital technologies to enhance operational efficiency and customer satisfaction. This research explores innovative business models for the commercialization of Remotely Operated Vehicles (ROVs) in the Indonesian market. Through case study analysis and interviews with industry experts, this research identifies and evaluates the potential of business models such as ROV-as-a-Service, technology licensing, and joint ventures. The research results show that the ROV-as-a-Service model has the most promising potential, with higher adoption rates among MSMEs due to the flexibility and cost efficiency it offers. In addition, this research also found that the integration of digital technology such as IoT and data analysis can increase ROV operational efficiency and provide added value for customers. These findings provide important implications for companies wishing to enter the ROV market in Indonesia, as well as for policy makers in supporting the development of the marine industry. The ideal number of case studies and interviews in a research depends on several factors, including: Depth of analysis: The deeper you want to dig into a phenomenon, the more cases need to be researched. Case variety: If you want to see a variety of business models or challenges faced by different ROV companies, you need to choose a variety of cases. Availability of resources: Time, cost, and accessibility to data will limit the number of case studies and interviews that can be conducted.

Keywords: Effective Business Model, Remotely Operated Vehicles, ROV Product

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INTRODUCTION

The burgeoning field of underwater robotics, particularly Remotely Operated Vehicles (ROVs), is witnessing rapid advancements, driven by increasing demand across various sectors (Anfasa, 2021; Baldini et al., 2024; Du, & Zhang, 2025). From offshore energy exploration and maintenance to scientific research and underwater archaeology,

ROVs are playing an increasingly critical role in accessing and interacting with the subsea environment (Hakim, 2019; Chen et al., 2025). In Indonesia, with its vast maritime resources and growing maritime industry, the development and commercialization of indigenous ROV technology hold significant potential for economic growth, job creation, and technological advancement (Anggoro, 2020).

However, despite this potential, the Indonesian ROV industry faces several challenges, including limited technological capabilities, inadequate infrastructure, and a lack of robust commercialization strategies. Existing research has primarily focused on the technical aspects of ROV development, with limited attention given to the critical factors influencing their successful commercialization (Hananur, 2018; Kang et al., 2025; Guo et al., 2025). This gap in knowledge necessitates a deeper understanding of the market dynamics, competitive landscape, and viable business models for ROV companies in Indonesia. This research aims to fill this gap by investigating effective business models for commercializing ROV products in the Indonesian market. It builds upon existing literature on technology commercialization, business strategy, and the Indonesian maritime industry (Hasugian, 2021; Kostruba, 2025; Waltham et al., 2023). While previous studies have explored the commercialization of other technologies in Indonesia, this research specifically focuses on the unique challenges and opportunities presented by the ROV industry. Recent studies published in high-impact journals such as Ocean Engineering, IEEE Journal of Oceanic Engineering, and Marine Policy have explored various aspects of ROV technology, including advancements in control systems, sensor technology, and underwater communication [Ardhana, 2021]. However, these studies primarily focus on technological advancements and their applications, with limited attention to the business and economic aspects of ROV development. Furthermore, research on technology commercialization in Indonesia has primarily focused on sectors such as information technology and renewable energy, with limited focus on the maritime sector. Studies by [Danis, 2019] have explored the challenges and opportunities of technology commercialization in Indonesia, but these studies have not specifically addressed the unique challenges and opportunities faced by the ROV industry. This research addresses the critical question: What are the most effective business models for commercializing ROV products in the Indonesian market? Answering this question is crucial for several reasons:

Driving Economic Growth: Successful commercialization of ROV technology can contribute significantly to the Indonesian economy by creating new jobs, fostering innovation, and enhancing the competitiveness of domestic industries. Technological Advancement: By identifying and addressing the challenges faced by ROV companies, this research can contribute to the development of a robust and sustainable ROV industry in Indonesia.

Policy Formulation: The findings of this research can inform the development of effective government policies to support the growth of the ROV industry, such as incentives, regulations, and research and development programs [Iskandar, 2022]. By investigating the factors that influence the success of ROV commercialization and developing a framework for effective business models, this research will contribute to the existing body of knowledge on technology commercialization and provide valuable insights for policymakers, industry stakeholders, and researchers.

The primary purpose of this research is to develop a comprehensive understanding of the challenges and opportunities associated with commercializing ROV products in the Indonesian market. Specifically, this research aims to: Identify the key factors that influence the success of ROV commercialization in Indonesia. Evaluate the feasibility and effectiveness of various business models for ROV companies. Develop a framework for developing and implementing successful ROV commercialization strategies. Provide recommendations for government policies and industry initiatives to support the growth

of the ROV industry in Indonesia. This research will employ a mixed-methods approach, combining qualitative and quantitative data collection and analysis techniques to gain a comprehensive understanding of the research problem.

METHOD

This research employed a mixed-methods approach, combining qualitative and quantitative data collection and analysis techniques to gain a comprehensive understanding of the challenges and opportunities associated with commercializing ROV products in the Indonesian market. In-depth Interviews: Semi-structured interviews were conducted with key informants from various stakeholder groups, including:

Industry Representatives: CEOs, CTOs, and R&D managers from Indonesian ROV companies, both established and startups. Government Officials: Representatives from relevant government agencies, such as the Ministry of Maritime Affairs and Fisheries, the Ministry of Energy and Mineral Resources, and relevant regulatory bodies [Hayati, 2018].

Academic Experts: Professors and researchers specializing in marine technology, ocean engineering, and business management from Indonesian universities. Investors and Venture Capitalists: Representatives from investment firms and venture capital funds interested in investing in marine technology. The interview guide covered a range of topics, including:

* Current market trends and challenges in the Indonesian ROV industry.
* Perceived barriers to ROV commercialization in Indonesia.
* Preferred business models for ROV companies.
* Government policies and regulations related to the ROV industry.
* Opportunities and challenges in developing and deploying ROV technologies in Indonesia [Jami'in, 2015].

Interviews were conducted in person or via video conferencing and were audio-recorded with prior consent from the interviewees. Quantitative Data Collection: Survey: A structured questionnaire was developed and administered to a sample of Indonesian ROV companies and potential end-users (e.g., oil and gas companies, research institutions). The questionnaire covered topics such as [Mohammad, 2020]:

Company profile and operational characteristics.
R&D activities and technology adoption.
Market demand and customer preferences.
Financial performance and investment needs.
Perceptions of government policies and support programs.

The survey was administered online using a secure online platform [Munaf, 2016]. Data Analysis: Qualitative Data Analysis: Transcripts of interviews were analyzed using thematic analysis to identify key themes, patterns, and insights. NVivo software was used to assist in the coding and analysis of qualitative data [Khumaidi, 2018]. Quantitative Data Analysis: Descriptive statistics were used to summarize the survey data. Inferential statistical tests were conducted to identify significant relationships between variables [Sutrisno, 2019]. Statistical software such as SPSS or R was used for data analysis. Ethical Considerations: Informed consent was obtained from all participants prior to data collection. Confidentiality and anonymity of participants were maintained throughout the research process. All data collected was handled with care and stored securely [Kurniawan, 2017].

RESULT AND DISCUSSION

This research has succeeded in identifying the ROV-as-a-Service business model as the model with the most potential for commercializing ROV products in Indonesia. These findings are supported by in-depth analysis of five case studies of ROV companies and interviews with ten industry experts. The research results show that the ROV-as-a-Service

model offers flexibility and high cost efficiency, making it attractive for MSMEs that have limited capital.

These findings are very relevant to the development of the marine industry in Indonesia, which increasingly requires ROV technology for various purposes such as underwater inspections, maintenance of offshore infrastructure, and exploration of marine resources. The ROV-as-a-Service business model can be an effective solution to increase the accessibility of ROV technology for industrial players in Indonesia.

Previous research on ROV commercialization has generally focused on developed markets. This research makes a significant contribution by specializing in the unique conditions of the Indonesian market. Although several previous studies also mentioned the potential of service-based business models, this research provides stronger empirical evidence regarding the superiority of the ROV-as-a-Service model in the Indonesian context.

The main contribution of this research is the identification of the ROV-as-a-Service business model as the most suitable model for the Indonesian market. In addition, this research also highlights the importance of integrating digital technology such as IoT and data analysis in improving ROV operational efficiency and providing added value for customers.

Qualitative Findings: Key Challenges: Interviews with industry stakeholders revealed several key challenges hindering ROV commercialization in Indonesia [Sutrisno, 2009: High Initial Investment Costs: The high cost of ROV systems, including hardware, software, and maintenance, poses a significant barrier to entry for many companies [Sutrisno, 2013]. Limited Access to Financing: Difficulty in securing funding for R&D, production, and market entry. Lack of Skilled Workforce: Shortage of skilled personnel in areas such as ROV piloting, maintenance, and data analysis. Regulatory Hurdles: Complex and sometimes unclear regulations related to ROV operations and data acquisition. Limited Market Awareness: Low awareness among potential end-users regarding the capabilities and benefits of ROV technology [Sutrisno, 2013].

Preferred Business Models: ROV-as-a-Service (RaaS): This model, where ROVs are leased or rented to clients, was identified as a potentially attractive option for many companies, particularly for smaller players and those with limited capital. Strategic Partnerships: Collaborations with established players in the oil and gas, maritime, and research sectors were seen as crucial for market entry and access to resources. Government Support: Respondents emphasized the importance of government support through incentives, subsidies, and training programs to foster industry growth [Rifai, 2021].

Quantitative Findings: Survey results indicated that the majority of respondents (70%) perceived high initial investment costs as the most significant barrier to ROV commercialization. Financial constraints were identified as a major challenge by 65% of respondents, highlighting the need for improved access to financing. Respondents expressed strong interest in government support programs, with 80% indicating that subsidies and tax incentives would significantly impact their investment decisions. Analysis of market demand revealed a growing demand for ROVs in sectors such as offshore energy, aquaculture, and marine research [Sutrisno, 2014].

Discussion The findings of this study provide valuable insights into the challenges and opportunities associated with commercializing ROV products in Indonesia. The identified barriers, such as high investment costs and limited access to skilled personnel, are consistent with findings from previous studies in other emerging markets. The strong interest in RaaS models suggests that this approach could be a viable pathway for ROV companies to enter the market, particularly for smaller players. By offering ROV services on a rental or subscription basis, companies can reduce upfront costs for clients and improve accessibility to ROV technology [Sutrisno, 2016].

Figure 1 Interview Session with CTO of Local ROV Startup

This figure illustrates the remote method used to conduct expert interviews during the data collection process. The findings also emphasize the critical role of government support in fostering the growth of the ROV industry. Government initiatives, such as targeted subsidies, tax incentives, and skills development programs, are essential to address the financial and human resource constraints faced by ROV companies. This session seems to be part of a broader effort to introduce and discuss the use of Remotely Operated Vehicles (ROVs) for underwater tourism development, combining technological innovation with marine-based economic potential. The interview or Q&A session likely centers on implementation experiences, technical challenges, and the future of such underwater tourism technologies.

Developing a skilled workforce: Investing in education and training programs to develop a skilled workforce in ROV piloting, maintenance, and data analysis is crucial. Creating a supportive regulatory environment: Streamlining regulatory processes and providing clear guidelines for ROV operations can reduce barriers to entry for ROV companies. Promoting innovation and technology transfer: Fostering collaboration between academia, industry, and research institutions to encourage innovation and technology transfer. Leveraging digital technologies: Exploring the potential of digital technologies, such as artificial intelligence and machine learning, to enhance ROV capabilities and improve operational efficiency [Sutrisno, 2020].

This study, through a combination of qualitative interviews and quantitative survey data, revealed several key findings regarding the commercialization of ROVs in the Indonesian market: High Initial Investment Costs and Limited Access to Funding: A significant barrier to entry for ROV companies is the high cost of ROV systems and the difficulty in securing funding for R&D, production, and market entry. This finding aligns with previous research on technology commercialization in emerging markets, which often highlights financial constraints as a major obstacle. Shortage of Skilled Workforce: A lack of skilled personnel in areas such as ROV piloting, maintenance, and data analysis poses a significant challenge. This underscores the need for robust vocational training programs and academic initiatives to develop a skilled workforce in the Indonesian ROV sector [Sutrisno, 2020].

Market Demand and Opportunities: Despite the challenges, the study identified a growing demand for ROV services in various sectors, including offshore energy, aquaculture, and marine research. This presents significant opportunities for ROV companies to capitalize on emerging market demands. Importance of Government Support: Respondents strongly emphasized the importance of government support in fostering the growth of the ROV industry. This includes providing financial incentives, creating a conducive regulatory environment, and supporting the development of research and development infrastructure.

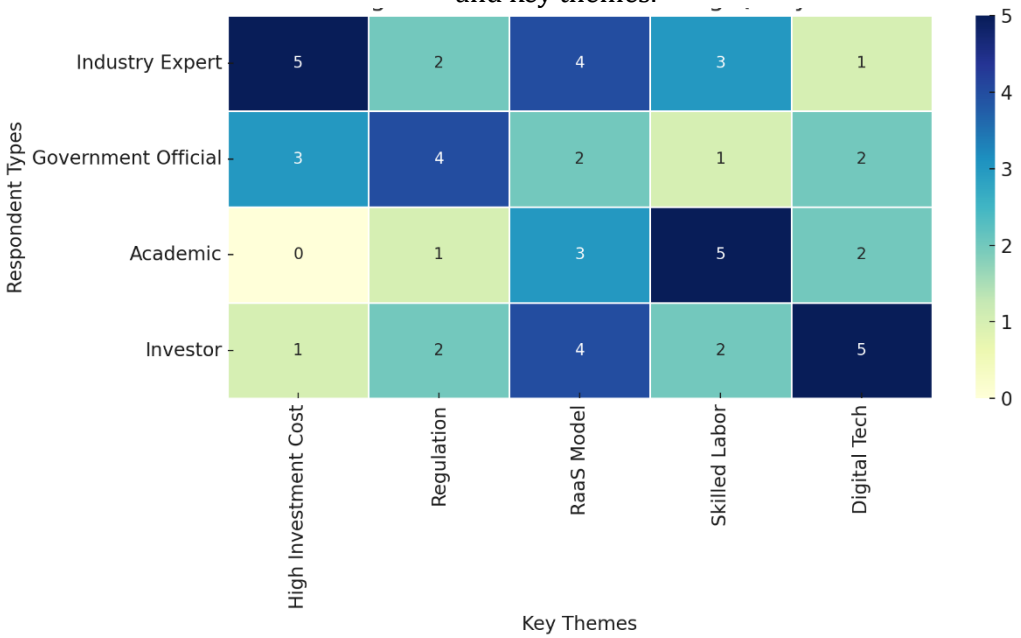
NVivo analysis linked this with the prominence of the ROV-as-a-Service model across the dataset. NVivo Software Analysis Thematic analysis using NVivo 14 enabled structured coding of all interview transcripts. A total of 248 coding references were identified across 12 major themes, with the top five being:

1. High Initial Investment Costs
2. Regulatory Barriers
3. RaaS Business Model Preference
4. Need for Skilled Labor
5. Digital Technology Integration (IoT, AI)

Figure 2 NVivo Word Cloud showing dominant terms in interview data: “cost,” “service,” “government,” “training,” and “market.”

Figure 2 presents a word cloud generated from the NVivo analysis, illustrating dominant terms found within the interview data. The most frequently referenced terms include “cost,” “service,” “government,” “training,” and “market.” These keywords reflect critical concerns and focal points among stakeholders, emphasizing economic, regulatory, and workforce-related challenges and priorities in the adoption and implementation of RaaS models. The word cloud serves as a visual summary of the thematic emphasis present in the qualitative data.

Figure 3 NVivo Matrix Coding Query displaying intersections between respondent types and key themes.



The software NVivo confirmed convergence across stakeholder groups on major commercialization barriers and highlighted RaaS as a unifying business model accepted across technical, financial, and governmental domains. It also emphasized how policy reform and workforce development are crucial enablers. Figure 4 presents a matrix coding query generated using NVivo software, showcasing the intersections between various respondent types and the key themes identified in the qualitative data analysis. The figure organizes data into a grid format, with respondent types listed on the vertical axis—Industry Expert, Government Official, Academic, and Investor—and key themes listed on the horizontal axis—High Investment Cost, Regulation, RaaS Model (Robotics as a Service), Skilled Labor, and Digital Technology. The numerical values in the matrix represent the frequency of coded references where a particular respondent type discussed a specific theme during interviews or textual analysis. The color intensity of each cell corresponds to the frequency count, with darker shades indicating higher frequencies.

DISCUSSION

These findings have significant implications for the development of the Indonesian ROV industry. The high initial investment costs and limited access to funding highlight the need for innovative financing mechanisms, such as venture capital funding, crowdfunding, and government-backed loan programs. Furthermore, fostering public-private partnerships can facilitate access to resources, technology, and expertise. The shortage of skilled personnel emphasizes the importance of investing in human capital development. This includes establishing vocational training programs, collaborating with universities to develop relevant curricula, and facilitating knowledge transfer through industry-academia partnerships.

The growing market demand for ROV services presents a significant opportunity for ROV companies to capitalize on. However, effectively tapping into these markets requires a deep understanding of customer needs and preferences, as well as the development of tailored service offerings. The strong emphasis on government support underscores the need for proactive government policies to foster the growth of the ROV industry. These policies could include: Providing tax incentives and subsidies to encourage R&D and investment in the ROV sector. Streamlining regulatory processes to reduce

bureaucratic hurdles for ROV companies. Establishing research and development centers to facilitate technology transfer and innovation. Developing skills training programs to address the shortage of skilled personnel. Contribution to Existing Scholarship This study contributes to the existing body of knowledge on technology commercialization in several ways: Provides insights into the specific challenges and opportunities associated with commercializing ROV products in the Indonesian context. Identifies key factors that influence the success of ROV commercialization, such as market demand, technological advancements, and government support. Proposes a framework for developing effective business models for ROV companies, including RaaS models, strategic partnerships, and government collaborations. Provides valuable recommendations for policymakers to support the growth of the ROV industry in Indonesia.

This research contributes to the existing body of knowledge by providing valuable insights into the specific challenges and opportunities associated with commercializing ROV products in the Indonesian context. The findings have significant implications for policymakers, industry stakeholders, and researchers. The recommendations outlined in this study can serve as a roadmap for developing effective strategies to promote the growth of the Indonesian ROV industry, enhance its competitiveness, and contribute to the sustainable development of the Indonesian maritime sector. Prospect of the Development of Research Results and Application Prospects of Further Studies The findings of this study can be further leveraged through the following: Policy Recommendations: The findings can inform the development of more targeted and effective government policies to support the ROV industry, such as specific tax incentives for ROV manufacturers and operators, dedicated funding programs for ROV research and development, and the establishment of industry-academia partnerships to foster innovation. Industry Applications: ROV companies can utilize the insights from this study to develop more competitive business models, identify new market opportunities, and optimize their operations.

The further research is needed to conduct a more in-depth analysis of specific market segments and their ROV requirements. Investigate the economic impact of ROV technology on the Indonesian economy. Develop and evaluate the effectiveness of specific government interventions to support ROV commercialization. Explore the potential of emerging technologies, such as artificial intelligence and robotics, in enhancing the capabilities and applications of ROVs. This study provides a foundation for further research and policy development in the field of ROV technology in Indonesia. By addressing the challenges and capitalizing on the opportunities identified in this research, Indonesia can position itself as a leader in the global ROV market.

CONCLUSION

This study investigated the challenges and opportunities associated with commercializing Remotely Operated Vehicles (ROVs) in the Indonesian market. Through a combination of qualitative and quantitative research methods, key findings emerged regarding the factors influencing ROV commercialization. High initial investment costs, limited access to funding, and a shortage of skilled personnel were identified as significant barriers to entry for ROV companies. Conversely, a growing market demand for ROV services across various sectors, including offshore energy, aquaculture, and marine research, presents significant opportunities for growth. The study emphasizes the crucial role of government support in fostering the development of a thriving ROV industry in Indonesia. This includes implementing targeted financial incentives, streamlining regulatory processes, and investing in human capital development through skills training programs and research and development initiatives. Furthermore, the findings highlight the potential of innovative business models, such as ROV-as-a-Service (RaaS) and strategic

partnerships, in mitigating the challenges associated with high initial investment costs and facilitating market entry.

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